Biology 2012 (Outside Delhi) SET I

Time allowed : 3 hours **Maximum marks : 70**

SECTION–A

1. **Why is banana considered a good example of parthenocarpy ?** [1]

   Answer : Banana is considered a good example of parthenocarpy because formation of fruit in banana occurs without fertilization (parthenocarpy), *i.e.*, there is no formation of seeds.

2. **State two different roles of spleen in the human body.** [1]

   Answer : The role of spleen in the human body is that the spleen is the secondary lymphoid organ that produces lymphocytes and the red pulp of spleen removes the old or damaged red blood cells from the body.

3. **A garden pea plant produced axial white flowers. Another of the same species produced terminal violet flowers. Identify the dominant traits.** [1]

   Answer : The dominant traits are : Axial, violet flower.

4. **Why is it desirable to use unleaded petrol in vehicles fitted with catalytic converters ?** [1]

   Answer : It is desirable to use unleaded petrol in vehicles fitted with catalytic converters because lead in petrol inactivates the catalysts which converts harmful pollutants (CO, unburnt hydrocarbons, nitric oxide) to lesser harmful pollutants (CO_2, H_2O, N_2).

5. **Where is acrosome present in humans ? Write its function.** [1]

   Answer : The anterior portion of the sperm head in human beings is covered by a cap-like structure called acrosome.

   Function of Acrosome :

   Acrosome is filled with hydrolytic enzyme-Hyaluronidase that aids in the entry of sperm into the ovum.

6. Write the name of the following : [1]

(a) The most common species of bees suitable for apiculture

(b) An improved breed of chicken

Answer : (a) *Apis indica* is the most common species of bees for apiculture.

(b) Leghorn is an improved breed of chicken.

7. Comment on the similarity between the wing of a cockroach and the wing of a bird. What do you infer from the above, with reference to evolution ? [1]

Answer : The wing of a cockroach and the wing of a bird are not similar anatomically i.e., not similar in structure but similar in function. Thus we infer that these organs are analogous which has resulted in convergent evolution.

8. Mention the role of cyanobacteria as a biofertiliser. [1]

Answer : The role of cyanobacteria as a biofertiliser :

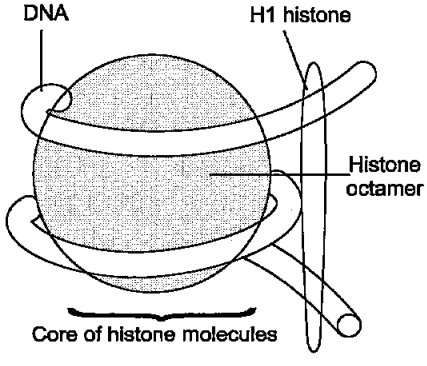
Cyanobacteria (*Anabaena and Nostoc*) are free-living in the root nodules of leguminous plants and they fix atmospheric nitrogen. They act as a biofertilizers especially in paddy fields.

SECTION–B

9. (a) Draw a neat labelled diagram of a nucleosome. [2]

(b) Mention what enables histones to acquire a positive charge.

Answer : (a)



(b) Depends on the abundance of basic amino acid residues of lysines and arginines with charged side chain.

10. State one advantage and one disadvantage of cleistogamy. [2]

Answer : Advantage of cleistogamy : Self-pollination is assured, seed production is also assured in the absence of pollinators.

Disadvantage of cleistogamy : In cleistogamous flowers due to self-pollination least variations are observed.

11. (a) Where do the signals for parturition originate from in humans ? [2]

(b) Why is it important to feed the newborn babies on colostrum ?

Answer : (a) The signals for parturition in humans originate from the fully developed foetus and the placenta which include mild uterine contraction.

(b) The colostrum or first milk is important to feed the new born babies because it contains antibodies (IgA), to provide passive immunity to the baby.

12. (a) A recombinant vector with a gene of interest inserted within the gene of α-galactosidase enzyme, is introduced into a bacterium. Explain the method that would help in selection of recombinant colonies from non-recombinant ones.

(b) Why is this method of selection referred to as "insertional inactivation" ? [2]

Answer : (a) Bacteria is grown in a medium with chromogenic substrate, blue coloured colonies with no recombinations and colonies with no blue colour shows presence of recombinants. Chromogenic substrate is used to identify recombinants and non-recombinants

(b) Gene for the enzyme is inactivated by insertion which is referred to as insertional inactivation.

13. Explain brood parasitism with the help of an example. [2]

Answer : Brood parasitism involves the use of host individuals of the same or different species to raise the young of the brood parasite. This relieves the parasitic parent from the investment of raising young or building nests, producing offspring etc.

E.g. : The cowbird family in North America is a brood parasite (because they are not capable of building a nest) while most brood parasites have eggs that mimic the hosts eggs, the cowbird is again different.

14. Give reasons for the following : [2]

(a) The human testes are located outside the abdominal cavity.

(b) Some organisms like honey-bees are called parthenogenetic animals.

Answer: (a) To maintain the temperature (2-2.5°C) lower than the normal internal body temperature, which is essential for spermatogenesis.

(b) The phenomenon of development of female gamete directly into an individual without fertilization is called parthenogenesis. Example: The drones/males develop from unfertilised eggs of honey bees.

15. Name the plant source of *ganja*. How does it affect the body of the abuser ? [2]

Answer : Plant source : *Cannabis sativa*/hemp plant.

Effect : It damages cardiovascular system of the body.

OR

Name the two special types of lymphocytes in humans. How do they differ in their roles in immune response ?

Answer : B lymphocytes, T lymphocytes.

B-cells produce pathogen specific antibodies called humoral immune response.

T-cells help the B-cells to produce antibodies and are responsible for direct cell mediated immunity.

16. (a) Mention the cause and the body system affected by ADA deficiency in humans.

(b) Name the vector used for transferring ADA-DNA into the recipient cells in humans. Name the recipient cells. [2]

Answer : (a) The body system affected by ADA deficiency in humans is immune system. ADA deficiency is caused due to lack of the gene coding for adenosine deaminase.

(b) A retroviral vector is used to transfer ADA-DNA into recipient cells. The recipient cells are lymphocytes.

17. How did Ahmed Khan, plastic sacks manufacturer from Bangalore, solve the ever - increasing problem of accumulating plastic waste ? [2]

Answer : Ahmed Khan, a plastic sacks manufacturer solves the ever increasing problem of accumulation of waste. Polyblend fine powder of recycled modified plastic can be used to lay roads that will increase the road life. When blended with bitumen, it enhances the bitumen's water repellent properties and increases the life of road.

18. Name the bacterium that causes typhoid. Mention two diagnostic symptoms. How is this disease transmitted to others ? [2]

Answer : Bacterium: *Salmonella typhi.*

Diagnostic Symptom: Constipation, stomach pain, headache, weakness, loss of appetite, high fever.

The disease is transmitted through contaminated food and water.

SECTION–C

19. (a) Explain the phenomena of multiple allelism and co-dominance taking ABO blood group as an example. [3]

(b) What is the phenotype of the following :

(i) I^Ai (ii) ii

Answer : Multiple allelism : (a) In humans, the ABO blood groups are controlled by a gene called gene 'I'. It has three alleles, I^A, I^B and *i*, hence, referred to as multiple allelism.

Co-dominance : If I^A and I^B both are present in an individual, and they both are expressed because of the phenomenon of co-dominance.

(b) **(i)** Phenotype of $I^A i$: A blood group.

(ii) Phenotype of *ii* : O blood group.

20. How does industrial melanism support Darwin's theory of Natural Selection ? Explain. [3]

Answer : In England, before industrial revolution the environment was unpolluted. The white-winged moths were more and lichens on the barks of trees were pale. The white-winged moths could easily camouflage, while the darkwinged were spotted out by the birds for food. Hence, they could not survive. After industrial revolution the lichens became dark (due to soot deposit). This favoured the dark-winged moths while the white-winged were picked by birds. The population of the former which was naturally selected increased.

21. (a) What is the programme called that is involved in improving success rate of production of desired hybrid and herd size of cattle ? [3]

(b) Explain the method used for carrying this programme for cows.

Answer : (a) Multiple ovulation embryo transfer Technology/MOET is used for improving success rate of production of desired hybrid and herd size of cattle.

(b) Methods used for carrying this programme for cows :

1. The cow is administered with FSH to induce follicular maturation and superovulation to produce 6 to 8 eggs.

2. The animal is either mated with an elite bull or artificially inseminated.

3. The fertilised eggs 8-32 cells stage are recovered non-surgically and transferred to surrogate mother where they develop into an improved variety.

22. Explain the function of each of the following: [3]

(a) Coleorhiza (b) Umbilical cord

(c) Germ pores

Answer : The function of each of the following:

(a) Coleorhiza : Protects the radical of (monocot) embryo.

(b) Umbilical cord : Transports nutrients and respiratory gases and metabolic wastes to and from mother and foetus.

(c) Germ pores : Allow germination of pollen grains and formation of pollen tube.

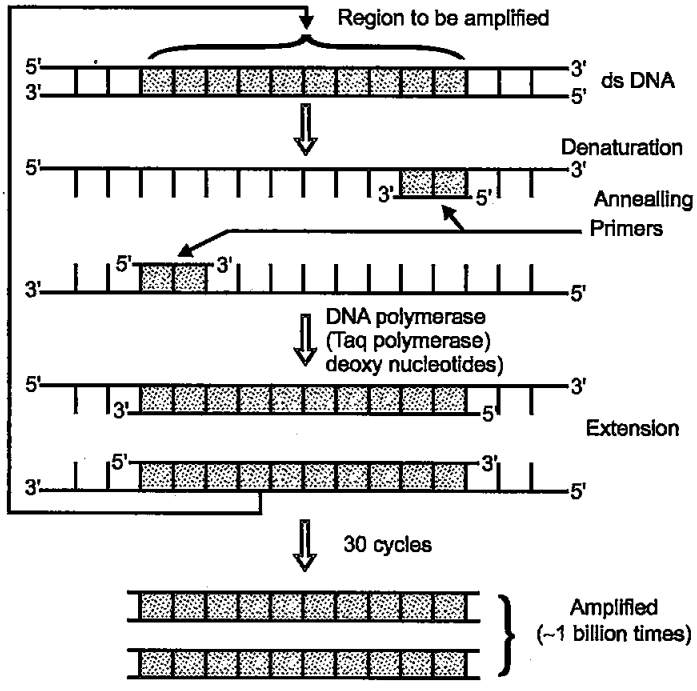
23. How is the amplification of a gene sample of interest carried out using Polymerase Chain Reaction (PCR) ? [3]

Answer : Polymerase chain reaction (PCR) is a method in which the desired gene is synthesised *in vitro* in following steps :

1. Denaturation : The double-stranded DNA is denatured by applying high temperature of 95°C for 15 seconds. Each separated single stranded strand now acts as template for DNA synthesis.

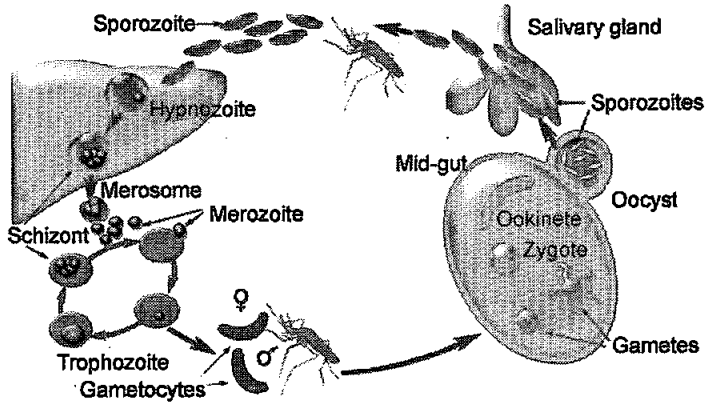
2. Annealing : Two sets of primers are added which anneal to the 3′ end of each separated strand. Primers act as initiators of replication.

3. Extension : DNA polymerase extends the primers by adding nucleotides complementary to the template provided in the reaction. A thermostable DNA polymerase (*Taq* polymerase) is used in the reaction which can tolerate the high temperature of the reaction. All these steps are repeated many times to obtain several copies of desired DNA.



24. Trace the life-cycle of malarial parasite in the human body when bitten by an infected female *Anopheles*. [3]

Answer : Plasmodium requires two hosts to complete its life cycle. When female Anopheles mosquito bites a healthy person, sporozoite of Plasmodium gets into human blood through the bite of female Anopheles mosquito. The parasites multiply in liver cells and finally burst in liver cells and release in blood, then they get into red blood cells, where they further multiply asexually and burst in RBCs also and released toxic substance haemozoin (associated with fever and chills). After a while they change into gametocytes, which are picked up by the mosquitoes and the entire cycle occurs again.



Life cycle of Malaria Parasite in Human Body.

25. List the salient features of double helix structure of DNA. [3]

Answer : The salient features of Double Helix structure of DNA :

1. It is made up of two polynucleotide chains where backbone is sugar phosphate constituted and bases project inside.
2. There is complementary base pairing between the two strands of DNA. The amount of adenine is equal to thymine and the amount of guanine is equal to cytosine.
3. The two strands are coiled in right-handed fashion and are anti-parallel in orientation. One chain has a 5′→3′ polarity while the other has 3′→5′ polarity.
4. The diameter of the strand is always constant due to pairing of purine and pyrimidine, *i.e.*, adenine is complementary to thymine while guanine is complementary to cytosine.
5. The distance between the base pairs in a helix is 0.34 nm and a complete turn contains approximately ten base pairs. The pitch of the helix is 3.4 nm and the two strands are right-handed coiled.

OR

How are the structural genes activated in the lac operon in *E. coli* ?

Answer : The structural genes activated in the lac operon in *E. coli* in the following manner :

Lactose consists of the genes lac z, y and a. Lactose acts as the inducer that binds with repressor protein and frees the operator gene. RNA polymerase freely moves over the structural genes, transcribing lac mRNA, which in turn produces the enzymes responsible for the digestion of lactose.

26. Alien species are highly invasive and are a threat to indigenous species. Substantiate this statement with any three examples. [3]

Answer : The three examples of the above statement are :

1. Nile perch introduced into Lake Victoria in East Africa led to the extinction of Cichlid fish.
2. Invasive plants like *Parthenium /Lantana / Eichhornia* caused environmental damage and posed a threat to indigenous species.
3. Introduction of African catfish (*Clarias gariepinus*) to aquaculture is a threat to indigenous Indian catfishes.

27. (a) Tobacco plants are damaged severely when infested with *Meloidegyne incognitia*. Name and explain the strategy that is adopted to stop this infestation. [3]

(b) Name the vector used for introducing the nematode specific gene in tobacco plant.

Answer : (a) The infestation was prevented by strategy which was based on RNA interference or RNAi or gene silencing. During this process nematode specific gene is introduced into host plant (using Agrobacterium) which produces dsRNA. This specific mRNA of the nematode silenced and parasite dies.

(b) *Agrobacterium tumifaciens* vector is used for introducing the nematode specific gene in tobacco plant.

SECTION–D

28. (a) Taking one example each of habitat loss and fragmentation, explain how are the two responsible for biodiversity loss.

(b) Explain two different ways of biodiversity conservation. [5]

Answer : (a) Habitat loss and fragmentation are responsible for biodiversity loss are :

1. **Habitat loss :** The Amazon rainforest (called the "lungs of the planet") is being cut and cleared for cultivation of soya beans and for conversion into grasslands for raising beef cattle.
2. **Fragmentation :** When large-sized habitats are broken or fragmented due to human settlements, building of roads, digging of canals, etc., the population of animals requiring large territories and some animals with migratory habitats declines.

(b) The two different ways of biodiversity conservation are :

1. *Ex situ*
2. *In situ* conservation.

1. Ex situ conservation : In this conservation threatened organisms are taken out from the natural habitat and placed in special setting with care and protected, *e.g.*, zoological park, botanical garden, wild safari.

2. In situ conservation : In this conservation threatened organisms are conserved in their natural habitat, *e.g.*, national parks, biosphere reserves.

OR

(a) What depletes ozone in the stratosphere? How does this affect human life? [5]

(b) Explain biomagnification of DDT in an aquatic food chain. How does it affect the bird population ?

Answer : (a) Chlorofluorocarbons (CFCs) released from the refrigerators, air conditioners deplete ozone in the stratosphere. Ozone acts as a shield and protects the earth from the harmful UV rays of the sun.

Effect on Human life : Chlorofluorocarbons depletes ozone layer causing UV rays to reach to earth which damages DNA causing mutation, skin cancer, inflammation of cornea, cataract, aging of skin, snow blindness.

(b) If DDT leaches from the agricultural field, it gets into the water body (the concentration is 0.0003 ppm) and enters the food chain :

Zooplanktons (0.04 ppm) → Small fish (0.05 ppm) → Large fish (2 ppm) → Any fish eating bird (5 ppm). Concentration of DDT increases along the food chain, reaching a high level in the top carnivore bird.

Effect on Bird population : DDT concentration disturbs Ca^{2+} metabolism, egg shells become thin, premature breaking results in the decline in bird population.

29. The following is the illustration of the sequence of ovarian events "a" to "i" in a human female :

(a) Identify the figure that illustrates corpus luteum and name the pituitary hormone that influences its formation.

(b) Specify the endocrine function of corpus luteum. How does it influence the uterus ? Why is it essential ? [5]

(c) What is the difference between "d" and "e" ?

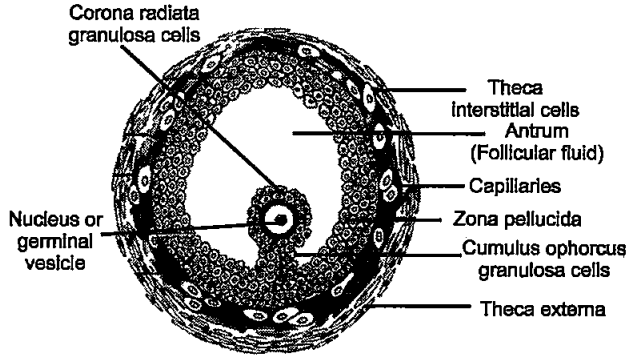
(d) Draw a neat labelled sketch of Graafian follicle.

Answer : (a) Corpus luteum is illustrated by 'g' and the hormone influencing its formation is luteinising hormone (LH).

(b) Corpus luteum produces the hormone progesterone, which causes proliferation of the endometrium which gets highly vascularised. It is essential for the implantation of the fertilized ovum and maintains the same during pregnancy.

(c) "d" is the developing tertiary follicle. "e" is the Graafian follicle.

(d)



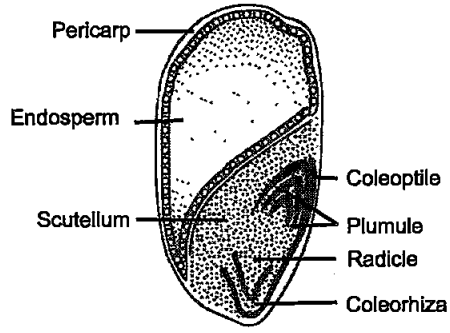
OR

(a) Why is fertilisation in an angiosperm referred to as double fertilisation ? Mention the ploidy of the cells involved.

(b) Draw a neat labelled sketch of L.S. of an endospermous monocot seed.

Answer : (a) Fertilisation of haploid egg cell by one haploid male gamete to form diploid zygote is called syngamy. Fertilisation of two (diploid) polar nuclei by the other haploid male gamete to form triploid primary endosperm nucleus is called triple fusion.

(b) L. S. of an endospermic monocot seed.



30. Describe Frederick Griffith's experiment on *Streptococcus pneumoniae*. Discuss the conclusion he arrived at. **[5]**

Answer : Frederick Griffith's experiment Transforming Principle conducted by him in 1928.

1. Frederick Griffith (1928) conducted experiments with *Streptococcus pneumonia* (bacterium causing pneumonia).
2. He observed two strains of this bacterium—one forming smooth shiny colonies (S-type) with capsule, while other forming rough colonies (R-type) without capsule.
3. When live S-type cells were injected into mice, they died due to pneumonia.
4. When live R-type cells were injected into mice, they survived and he arrived at this conclusion.
5. When heat-killed S-type cells were injected into mice, they survived and there were no symptoms of pnuemonia.
6. When heat-killed S-type cells were mixed with live R-type cells and injected into mice, they died due to unexpected symptoms of pneumonia.
7. He concluded that heat-killed S-type bacteria caused a transformation of the R-type bacteria into S-type bacteria but he was not able to understand the cause of this bacterial transformation.

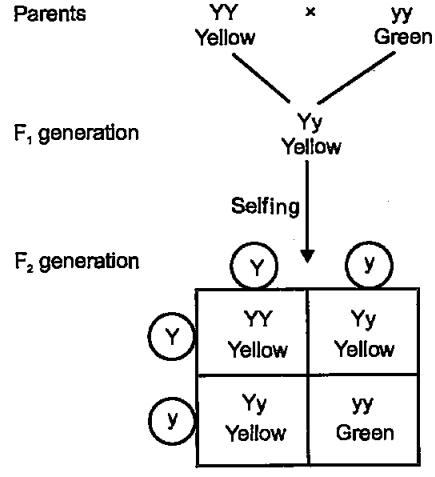
OR

(a) Explain a monohybrid cross taking seed coat colour as a trait in *Pisum sativum*. Work out the cross up to F_2 generation.

(b) State the laws of inheritance that can be derived from such a cross.

(c) How is the phenotypic ratio of F_2 generation different in a dihybrid cross ?

Answer : (a) A monohybrid cross taking seed coat colour as a trait in *Pisum sativum*. for *e.g.*, if pea plant with yellow seed coat is crossed with pea plant having green seed coat then in the F_1 generation all the plants have yellow seeds.



F_2 Phenotypic ratio = 3 : 1

F_2 Genotypic ratio = 1 : 2 : 1

The law of inheritance can be derived from such a cross :

(b) 1. Law of Dominance : Factor occurs in pairs. In a contrasting pair of factors one member of the pair dominates (dominant) the other (recessive).

2. Law of Segregation : Factors or allele of pair segregate from each other such that gamete receives only one of the two factors. Paired condition is restored at the time of zygote formation.

(c) Phenotypic ratio of F_2 generation in monohybrid cross is 3 : 1 whereas in a dihybrid cross the phenotypic ratio is 9 : 3 : 3 : 1.

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Biology 2012 (Outside Delhi) SET II

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous set.

SECTION–A

1. How do the pollen grains of *Vallisneria* protect themselves ? [1]

Answer : The pollen grains of *Vallisneria* have mucilaginous covering to prevent them from getting wet.

2. Name the respective pattern of inheritance where F_1 phenotype : [1]

(a) does not resemble either of the two parents and is in between the two.

(b) resembles only one of the two parents.

Answer : (a) The respective pattern of inheritance where F_1 phenotype not resembles either of the two parents and is in between the two known as Incomplete dominance.

(b) resembles only one of the two parents Law of Dominance.

5. How is the entry of only one sperm and not many ensured into an ovum during fertilisation in humans ? [1]

Answer : During fertilisation in humans : At the sperm head there is an enzyme to dissolve the follicles of ovum and facilitate entry of the sperm nucleus for fertilisation and helps the sperm to enter into the cytoplasm of the ovum.

7. State the significance of *Coelacanth* in evolution. [1]

Answer : It is an ancestor of amphibians. The latest analysis shows that the genes of modern coelacanths can themselves be considered living fossils.

SECTION–B

12. Name the source organism that possesses Taq polymerase. What is so special about the function of this enzyme ? [2]

Answer : *Thermus aquaticus.*

The enzyme can tolerate high temperature and is thermostable. It does not get denatured during PCR at high temperature.

13. State one advantage and one disadvantage of cleistogamy. [2]

Answer : Advantage : Cleistogamy flowers produce assured seeds set even in the absence of pollinators to increase genetic variations.

Disadvantage : The disadvantage of Cleistogamy is the offspring produced have limited genetic diversity.

15. Name the source of cyclosporin-A. How does this bioactive molecule function in our body ? [2]

Answer : The source of cyclosporin-A *Trichoderma polysporum.*

Bioactive molecule function in our body : It is used as an immuno-suppressant agent in organ transplant patient.

OR

(a) Name the group of viruses responsible for causing AIDS in humans. Why are these viruses so named ?

(b) List any two ways of transmission of HIV infection in humans, other than sexual contact.

Answer : (a) The group of viruses responsible for causing AIDS in humans is Retrovirus. These are named so because they (have RNA genome) have reverse transcriptase enzyme which carries on the processes RNA → DNA → RNA.

(b) 1. Transfusion of infected blood.

2. Sharing infected syringes and needles.

3. Children born to HIV mother through placenta.

17. Name any two organisms that are responsible for ringworms in humans. Mention two diagnostic symptoms. Name the specific parts of the human body where these organisms thrive and explain why. [2]

Answer : *Microsporum* and *Trichophyton* are two organisms that are responsible for ringworms in humans.

Symptoms : Dry and scaly lesion on skin, nails, scalp, intense itching.

These thrive in body groin, between toes, thrive better in heat, moisture, perspiration.

SECTION–C

19. Differentiate between perisperm and endosperm giving one example of each. [3]

Answer :

S. No.	Perisperm	Endosperm
(i)	It is persistent nucellus.	Endosperm is the tissue formed after double fertilization and it provides nourishment to the embryo.
(ii)	It is diploid in nature.	It is triploid in nature.
(iii)	Example : black pepper, beet.	Example: maize, rice, wheat, castor.
(iv)	It is a part that belongs to seed.	It contains reserve food meterials.
(v)	It is usually dry.	It is usually in fluid form.

25. (a) List any three ways of measuring population density of a habitat. [3]

(b) Mention the essential information that can be obtained by studying the population density of an organism.

Answer : (a) There are different ways of measuring population density of a habitat which are as follows :

1. Quadrat method : This method involves the use of square of particular dimensions to measure number of organisms.

2. Direct observation : This method is used for counting of organism.

3. Indirect method : This method is used for the number of fish caught per trap and it gives the measure of their total density in a given water body.

(b) The population density of an organism provides us the status of habitat, whether competition for survival exists or not, whether population is increasing or declining, natality, mortality, emigration, immigration.

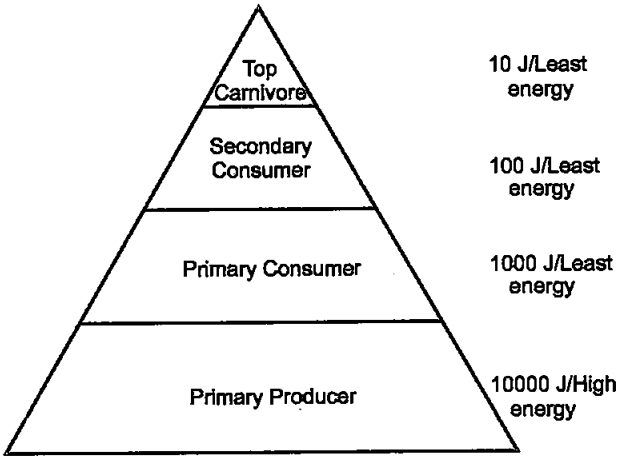
SECTION–D

28. (a) Explain the significance of ecological pyramids with the help of an example. [5]

(b) Why are the pyramids referred to as 'upright' or 'inverted' ?

Answer : (a) Ecological pyramid expresses the relationship between the organisms at different trophic levels with reference to their number, energy and biomass.

E.g., Pyramid of energy



(b) Upright Pyramid : In this pyramid producers are more in number and in biomass than the herbivores, and herbivores are more in number and biomass than the carnivores. The Pyramid of energy is always upright as only 10% energy is transferred from one trophic level to the next.

Inverted pyramid : It shows less number or biomass of producers when compared to primary consumers. For *e.g.*, large number of insects feeding on a big tree gives inverted pyramid of number.

OR

(a) Explain giving reasons why the tourists visiting Rohtang Pass or Mansarovar are advised to resume normal 'active life' only after a few days of reaching there.

(b) It is impossible to find small animals in the polar regions. Give reasons.

Answer : (a) The tourists visiting Rohtang Pass or Mansarovar are advised to resume normal 'active life' only after a few days of reaching there because initially the person suffers from altitude sickness, nausea, fatigue and heart palpitation because of low oxygen availability and low atmospheric pressure. Gradually the body increases RBC production, decreasing binding capacity of Hb and increases the breathing rate to get acclimatised.

(b) Small animals are rarely found in polar regions because small birds have larger surface area relative to their volume, so they lose heat much faster, spend more energy to generate body heat. They have to expand much energy to generate body heat through metabolism.

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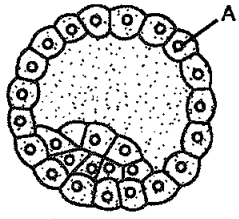
Biology 2012 (Outside Delhi) SET III

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous sets.

SECTION–A

1. Identify the figure given below and the part labelled "A". [1]



Answer : The figure is of blastula / blastocyst.
A—Trophoblast.

2. How do interferons protect us ? [1]

Answer : Interferons protect uninfected cells from further viral infections, by creating cytokine barriers.

3. Name the interaction between a whale and the barnacles growing on its back. [1]

Answer : Commensalism is the interaction between a whale and the barnacles growing on its back.

7. In a dihybrid cross, when would the proportion of parental gene combinations be much higher than non-parental types, as experimentally shown by Morgan and his group ? [1]

Answer : According to Morgan and his group when the genes are present on a same chromosome or incomplete linkage is present then the proportion of parental gene combinations will be much higher than non-parental types.

SECTION–B

12. Name the cells that act as HIV factory in humans when infected by HIV. Explain the events that occur in the infected cell. [2]

Answer : Macrophages/Helper T-cells act as HIV factory in humans.

The events that occur in the infected cell :

1. HIV attached to CD-4 cell with GP-120 to CD-4 protein.
2. Reverse transcription by reverse transcriptase enzyme.
3. Its DNA attached with host cell DNA.
4. Multiplication of HIV.
5. Lysis of infected cell.

15. Name and explain the two types of immune responses in humans. [2]

Answer : The two types of immunity are active immunity and passive immunity.

Active immunity : Immunity developed in the host body due to production of antibodies in response to antigens which are of low intensity and produce memory cells.

Passive immunity : When readymade antibodies are directly given to protect the body against foreign agents which is of very high intensity.

16. How does the study of different parts of a flower help in identifying in wind as its pollinating agent ? [2]

Answer : Pollination in which wind distributes the pollens is called anemophily.

Wind pollinated flowers have light and non-sticky pollen grains, well exposed stamens to disperse pollen easily, large and often feathery stigma for easy trapping of pollen, single ovule in each ovary, numerous flowers packed into an inflorescence.

SECTION–C

22. Explain how do the following act as contraceptives :

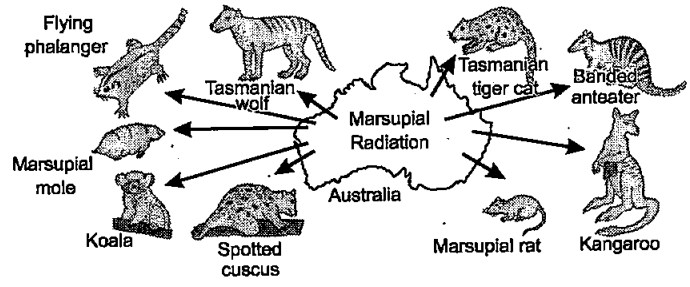
(a) CuT (b) "Saheli" [3]

Answer : (a) CuT release Cu ions when inserted into the uterus which suppress sperm motility, lowers the fertilising capacity of sperms. These devices are inserted by doctors as experts in the uterus through vagina.

(b) Oral contraceptive for the females contains a non-steroidal preparation. It is once a week pill

with very few side effects and high contraceptive value inhibits ovulation, implantation, as well as alters the quality of cervical mucus to prevent or retard the entry of sperms.

26. Name and explain the evolutionary concept represented in the illustration given below : [3]



Answer : The illustration represents adaptive radiation or divergent evolution.

It is the example of adaptive radiation in placental animals of Australia.

1. A variety of placental mammals have evolved which appear similar to a corresponding marsupial.
2. When more than one adaptive radiation appears to have occurred in an isolated geographical area, and two or more groups of unrelated animals come to resemble each other for similar mode of life or habitat, it is called convergent evolution.

OR

(a) Why is it that the father never passes on the gene for haemophilia to his sons? Explain.

(b) State the functions of the following in a prokaryote :

(i) tRNA (ii) rRNA

Answer : (a) The father never passes on the gene for haemophilia to his sons because haemophilia is a sex-linked recessive disease and the defective gene is present on X chromosome only and not on Y chromosome.

(b) Function of t-RNA in prokaryotes :

(i) tRNA reads the genetic codes, carries amino acids to the site of protein synthesis and acts as an adaptor molecule.

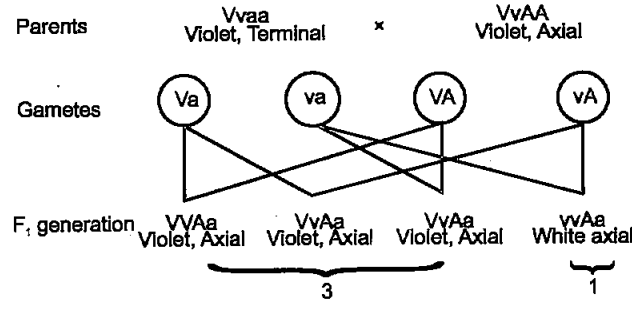
(ii) rRNA plays structural and catalytic role during translation.

SECTION–D

30. (a) A garden pea plant bearing terminal, violet flowers, when crossed with another pea plant bearing axial, violet flowers, produced axial, violet flower and axial, white flowers in the ratio of 3 : 1. Work out the cross showing the genotypes of the parent pea plants and their progeny.

(b) Name and state the law that can be derived from this cross and not from a monohybrid cross. [5]

Answer : (a)



(b) This cross is based on Law of Independent Assortment. This law states that when two pairs of traits are combined in a hybrid, segregation of one pair of characters is independent of the other pair of character.

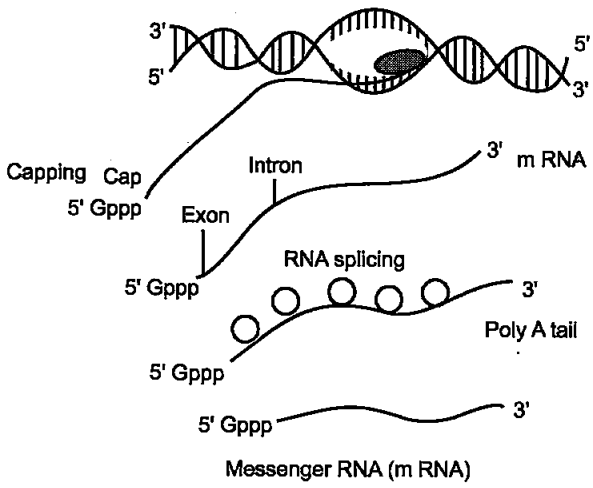
OR

(a) Describe the process of synthesis of fully functional mRNA in a eukaryotic cell.

(b) How is this process of mRNA synthesis different from that in prokaryotes ?

Answer : (a) The process of synthesis of fully functional mRNA in a eukaryoic cell.

1. The primary transcrips are non-functional, containing both the coding region, exon, and non-coding region, intron, in RNA and are called heterogenous RNA or hnRNA.
2. The hnRNA undergoes two additional processes called capping and tailing.
3. In capping, an unusual nucleotide, methyl guanosine triphosphate, is added to the 5'-end of hnRNA.
4. In tailing, adenylate residues (about 200-300) are added at 3'-end in a template independent manner.
5. Now the hnRNA undergoes a process where the introns are removed and exons are joined to form mRNA by the process called splicing.



Process of Transcription in Eukaryotes

(b) In prokaryotes, there is a single DNA-dependent RNA polymerase that catalyses transcription of all types of RNA in bacteria. In bacteria, mRNA does not require any processing as it does not have any introns.

●●

Biology 2012 (Delhi) SET I

Time allowed : 3 hours **Maximum marks : 70**

SECTION–A

1. **Mention the unique flowering phenomenon exhibited by *Strobilanthus kunthiana* (neelakuranji).** [1]

   Answer : The unique flowering phenomenon exhibited by *Strobilanthus kunthiana* (neelakuranji) is that it flowers once in 12 years.

2. **How does smoking tobacco in human lead to oxygen deficiency in their body ?** [1]

   Answer : Smoking tobacco leads to oxygen deficiency in human body because smoking increases carbon monoxide (CO) content in blood. The greater affinity of CO to haemoglobin/CO forms a stable bond with haemoglobin. Presence of CO does not allows oxygen to bind with haemoglobin and reduces the concentration of haem-bound oxygen. This causes oxygen deficiency in the body.

3. **A garden pea plant (A) produced inflated yellow pod, and another plant (B) of the same species produced constricted green pods. Identify the dominant traits.** [1]

   Answer : The trait to produce inflated yellow seeds is dominant over the trait producing constricted green seeds.

4. **Why is *Eichhornia crassipes* nicknamed as "Terror of Bengal" ?** [1]

   Answer : It grows at an alarming rate and spreads on the surface of the water body, causes oxygen depletion leading to death of aquatic life of fishes and other aquatic organisms.

5. **Write the location and function of the sertoli cells in humans.** [1]

   Answer : Location of Sertoli cells : In the testis **Function of Sertoli cells :** Provide nutrition to the developing sperm cells.

6. **Name the following :**

   (a) The semi-dwarf variety of wheat is high-yielding and disease-resistant.

   (b) Any one inter-specific hybrid mammal. [1]

   Answer : (a) Sonalika and Kalyan Sona are the semi-dwarf.

   (b) Mule/Hinny/Liger/Tigon.

7. **Write the similarity between the wing of a butterfly and the wing of a bat. What do you infer from the above with reference to evolution ?** [1]

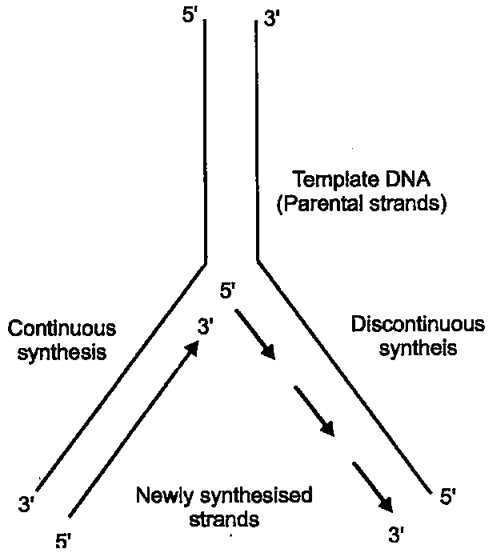
   Answer : Analogous organs, as their origin is not the same but they perform similar functions. From the above reference we can infer the evolutionary relationship between organisms and it shows the convergent evolution.

8. **Write what do phytophagous insects feed on.** [1]

   Answer : As the name suggests phytophagous insects feed on plants or Plant sap.

SECTION–B

9. Draw a neat labelled sketch of a replicating fork of DNA. [2]



Replicating fork of DNA

10. Where is sporopollenin present in plants ? State its significance with reference to its chemical nature. [2]

Answer : Present in exine, of pollen or pollen grain. Sporopollenin is the most resistant organic polymer hence protects the pollen or gamete and provides protection to pollen from unfavorable conditions.

11. (a) Highlight the role of thymus as a lymphoid organ.

(b) Name the cells that are released from the above mentioned gland. Mention how they help in immunity. [2]

Answer : (a) Immature lymphocyte differentiates into mature lymphocyte in thymus. T-cells produced in the bone marrow get matured in the thymus and are released from here and migrate to secondary lymphoid organs.

(b) The cells are released from the thymus gland and are known as T-lymphocyte. These T-cells help B-cells to produce antibodies and take part in immunity.

12. Explain the work carried out by Cohen and Boyer that contributed immensely in biotechnology. [2]

Answer : Stanley Cohen and Herbert Boyer constructed the first artificial recombinant DNA. They isolated the antibiotic resistant gene, from the plasmid of a bacterium that was resistant to the antibiotic drug , and then linked this gene with the plasmid of *Salmonella typhimurium*, construction of artificial recombinant DNA molecule.

13. Why do clownfish and sea anemone pair up ? What is this relationship called ? [2]

Answer : Clownfish lives in tentacles of sea anemone and gets protection from its predators by moving around the stinging tentacles of the sea anemone.

The sea anemone is neither helped or harmed by the interaction with the fish, this relationship is called commensalism.

14. (a) State the difference between meiocyte and gamete with respect to chromosome number.

(b) Why is a whiptail lizard referred to as parthenogenetic ? [2]

Answer : (a) Meiocyte - diploid (2n)

Gamete – haploid (n)

(b) Whiptail lizard is referred as parthenogenetic because it is a female and gives rise to new female reptile without fertilization and female gamete undergoes development to form new organism from unfertilised egg.

15. Name the plant source of the drug popularly called "smack". How does it affect the body of the abuser ? [2]

Answer : Plant source of smack: *Papaver somniferum (Poppy)* which is a stronger analgesic than morphine.

Effect of smack on the body of abuser: It reduces heart beat and increases blood sugar and it is a depressant which slows down body function.

OR

Why is *Rhizobium* categorized as a 'symbiotic bacterium' ? How does it act as a biofertiliser ?

Answer : *Rhizobium*, a symbiotic bacteria, which lives in the root nodule of leguminous plants, fixes atmospheric nitrogen into organic forms to be used by plants. It is a biofertilizer as it is a living organism that enriches nutrient content of the plant. Bacterium gets food and shelter from the plant.

16. (a) State the role of DNA ligase in biotechnology.

(b) What happens when *Meloidegyne incognitia* consumes cells with RNAi gene ? [2]

Answer : Role of DNA ligase in biotechnology :

(a) Joining of DNA fragment is done by DNA ligase, linking of Okazaki fragments or discontinous synthesis fragments and linking of desired gene with plasmid to form recombinant DNA.

(b) If *Meloidegyne incognitia* consumes cells with RNAi gene so specific mRNA of the nematode is silenced and prevents the translation of mRNA. Thus causes death of parasites.

17. Some organisms suspend their metabolic activities to survive in unfavourable conditions. Explain with the help of any four examples. [2]

Answer : Some examples with their unfavourable conditions under which they suspend their metabolic activities :

1. Polar bear - hibernation during winter
2. Snails or fishes - Aestivation during summer
3. Species of zooplankton – diapauses
4. Higher plants, spores of bacteria or fungi– become dormant and form cyst as in case of amoeba

18. (a) Name the Protozoan parasite that causes amoebic dysentery in humans.

(b) Mention two diagnostic symptoms of the disease. [2]

(c) How is this disease transmitted to others?

Answer : (a) The Protozoan parasite that causes amoebic dysentery in humans is *Entamoeba histolytica.*

(b) Symptoms : Constipation, abdominal pain, stools with mucus and blood clot.

(c) This disease is transmitted to others by fecally contaminated food and water.

SECTION–C

19. It is established that RNA is the first genetic material. Explain giving three reasons. [3]

Answer : Reason for RNA being the first genetic material :

1. Processes like metabolism, translation, splicing evolved around RNA.
2. RNA is reactive and catalyses reaction and in some virus it is the hereditary material.
3. It is unstable and hence would have mutated to lead to evolution.

OR

(a) Name the enzyme responsible for the transcription of tRNA and the amino acid the initiator tRNA gets linked with.

(b) Explain the role of initiator tRNA in initiation of protein synthesis.

Answer : (a) Enzyme responsible for the transcription of tRNA: RNA polymerase in prokaryotes and RNA polymerase III in eukaryotes.

The amino acid the initiator tRNA gets linked with Formyl methionine in prokaryotes and methionine in eukaryotes.

(b) The role of initiator tRNA is initiation of protein synthesis.

1. This tRNA combines with amino acid methionine in presence of amino acyl-tRNA synthetic enzymes resulting in the formation of charged tRNA.

2. The mRNA attaches to smaller subunit of ribosome and charged initiator tRNA. After that tRNA joins the initiator codon and signals the start of translation.

3. The initiator tRNA functions on the ability of anticodon sequence mutants of initiator tRNA to initiate protein synthesis. The anticodon UAC recognizes the mRNA AUG codon and binds by forming complementary base pairs, leaves the amino acid, initiating the protein synthesis.

20. State the theory of Biogenesis. How does Miller's experiment support this theory ? [3]

Answer : Theory of Biogenesis : The first form of life could have come from pre-existing, non-living organic molecules (e.g, RNA, protein etc.) proposed by Oparin and Haldane. This theory suggests that origin of life is first abiogenesis and biogenesis later.

21. Name the two different categories of microbes naturally occurring in sewage water. Explain their role in cleaning sewage water into usable water. [3]

Answer : Different categories of microbes naturally occurring in sewage water, are aerobic and anaerobic bacteria, fungi, filamentous fungi.

Role in cleaning sewage water into Potable water :

1. The primary effluent is passed into large aeration tanks where it is constantly agitated.
2. This allows abundant growth of aerobic microbes like bacteria and filamentous fungi.

3. The growth of these microbes reduces BOD of effluents. Once the BOD is reduced significantly, then the effluent is passed into settling tanks where the bacterial flocs are allowed to sediment.
4. This sediment is called activated sludge. A small part of activated sludge is again introduced into large tanks called anaerobic sludge digesters.
5. Here anaerobic bacteria digests the bacteria and fungi in the sludge.
6. This digestion produces methane, H_2S and CO_2 gas. These gases forms the biogas.
7. The effluent from secondary treatment is then released into natural water bodies.

22. Write the function of each one of the following: [3]

(a) (Oviducal) Fimbriae (b) Coleoptile

(c) Oxytocin

Answer : (a) (Oviducal) Fimbriae : Collection of ovum released by ovary.

(b) Coleoptile : Protects the plumule of the monocot embryo.

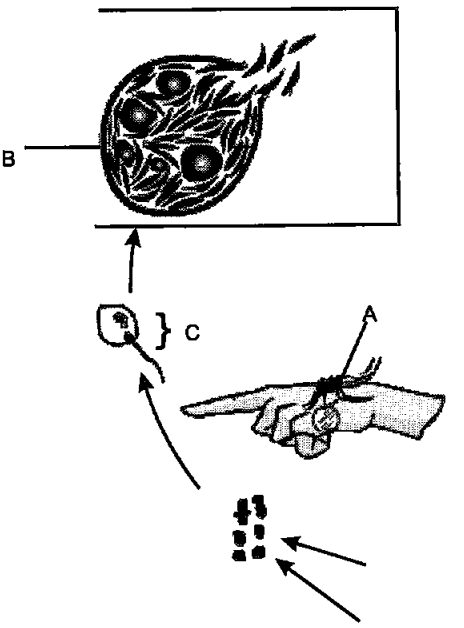
(c) Oxytocin : Causes uterine contraction for parturition (child birth) and also promotes milk ejection.

23. Name the genes responsible for making Bt cotton plants resistant to bollworm attack. How do such plants attain resistance against bollworm attacks ? Explain. [3]

Answer : The Bt toxin is encoded by the *cry* gene, *cry*IAC and *cry*IIAb, which produces protein crystals during a particular phase of their growth. This toxin provides resistance to plants against lepidopteran, coleoptern and dipterans pests.

Bt cotton, is the variety of cotton in which the gene from the bacterium that encodes for the toxin is incorporated. When bollworm bites the cotton fruits, it consumes the toxic insecticidal protein. The protoxin gets activated by the alkaline pH of the gut of the insect and binds to the surface of the midgut epithelium of the insects and causes swelling and cell lysis, which eventually leads to the death of the insects.

24. Study a part of the life cycle of malarial parasite given below. Answer the questions that follow : [3]



(a) Mention the roles of 'A' in the life cycle of the malarial parasite.

(b) Name the event 'C' and the organ where this event occurs.

(c) Identify the organ 'B' and name the cells being released from it.

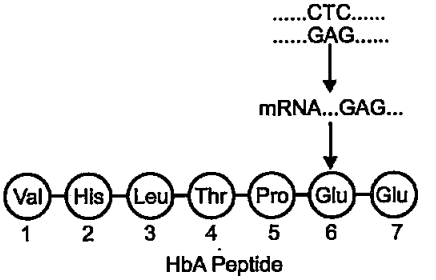
Answer :

(a) A represents the female mosquito. Gametocytes of Plasmodium enter the mosquito when it bites an infected person and takes the malaria parasite along with the blood meal.

(b) C is the fertilization stage and it takes place in the intestine of the mosquito.

(c) B is the salivary gland of the female anopheles mosquito and the sporozoites escape out of the mosquito's salivary gland.

25. Given below is the representation of amino acid composition not the relevant translated portion of β-chain of haemoglobin, related to the shape of human red blood cells. [3]



(a) Is this representation indicating a normal human or a sufferer from certain related genetic disease ? Give reason in support of your answer.

(b) What difference would be noticed in the phenotype of the normal and the sufferer related to this gene ?

(c) Who are likely to suffer more from the defect related to the gene represented- the males, the females or both males and females equally ? And why ?

Answer : (a) Yes, this representation is indicating a normal human. Normal person mRNA contains GAG codon which codes for glutamic acid, at the 6^{th} position.

(b) In a sufferer who exhibits sickle cell trait, the codon GAG is replaced by GUG in the mRNA. Hence, during translation of the defective mRNA, Glutamic acid is replaced by Valine at the 6th position of Beta globin chain of the haemoglobin.

(c) Both the males and females suffer equally because sickle cell anaemia is not a sex linked disease. It is an autosomal recessive disease and sickle shaped RBC will cause equal deficiency of oxygen in both males and females.

26. By the end of 2002 the public transport of Delhi switched over to a new fuel. Name the fuel. Why is this fuel considered better? Explain. **[3]**

Answer : Delhi Government switched to CNG (Compressed Natural Gas). Delhi had been categorized as the fourth most polluted city of the world in a list of 41 cities. Burning of fossil fuels has added to the pollution of air in Delhi. CNG is considered better due to the following reasons :

1. CNG is a clean fuel that produces very little unburnt particles and thus it is considered as eco-friendly.
2. CNG burns most efficiently, unlike petrol or diesel, in the automobiles and very little of it is left unburnt.
3. Moreover, CNG is cheaper than petrol or diesel.

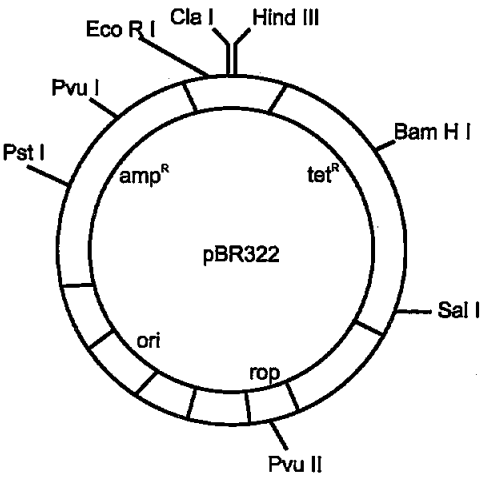
27. Draw a schematic sketch of pBR 322 plasmid and label the following in it :

(a) Any two restriction sites.

(b) Ori and rop genes.

(c) An antibiotic resistant gene.

Answer : (a) Sketch of pBR 322 plasmid : **[3]**



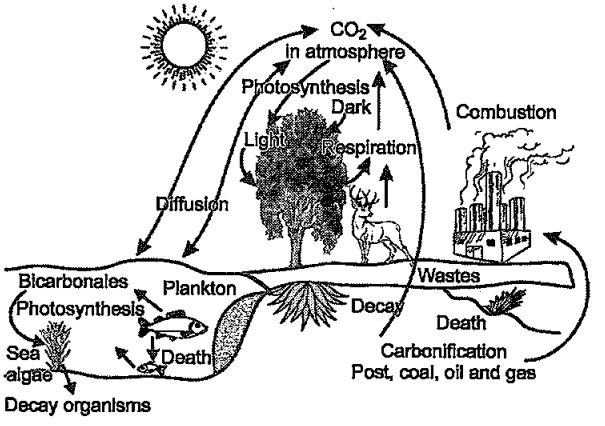
(b) The Restriction sites mentioned in the figure are Hind III, EcoR I, Bam HI, Sal I, Pvu II, Pst I, Cla I and Antibiotic resistant.

(c) genes: amp^R and tet^R

SECTION–D

28. Explain the carbon cycle with the help of a simplified model. **[5]**

Answer : Key process involved in carbon cycle is photosynthesis and respiration.



1. In photosynthesis, carbon-dioxide and water produces carbohydrates and oxygen while respiration oxidizes food to give carbon-dioxide and water.

2. 71% carbon is found dissolved in oceans. In rock it gets stored as calcium carbonate.

3. Carbon can either be liberated to atmosphere through respiration or can be passed to animal when being eaten or remains in plant even after death.

4. A considerable amount of CO_2 is fixed annually by process of photosynthesis.

5. Excess of carbondioxide can cause global warming.

OR

Explain how does :

(a) A primary succession start on a bare rock and reach a climax community ?

(b) The algal bloom eventually choke the water body in an industrial area ?

Answer : (a) 1. The species of organisms that first invade a bare area are called pioneer species (lichens).

2. Lichens secrete acids which dissolve rocks, thereby leading to weathering and soil formation.

3. Next seral stage will be bryophytes which can hold in the small amount of soil.

4. Bryophytes are then succeeded by grasses.

5. They are succeeded by bigger plants, and ultimately, an entire forest gets established. This remains stable as long as the environment remains unchanged.

(b) Effluent from industries contains large amount of nutrients. This causes excessive growth of free-floating algae causing algal bloom. Later, the decomposition of these algae depletes the supply of oxygen, leading to the death of other aquatic animals life thus choking the water body. This ageing process of a lake caused due to nutrient enrichment is called Eutrophication.

29. The following is the illustration of the sequence of ovarian events (a – i) in a human female.

[5]

(i) Identify the figure that illustrates ovulation and mention the stage of oogenesis it represents.

(ii) Name the ovarian hormone and the pituitary hormone that have caused the above mentioned event.

(iii) Explain the changes that occur in the uterus simultaneously in anticipation.

(iv) Write the difference between 'c' and 'h'.

(v) Draw a labelled sketch of the structure of a human ovum prior to fertilization.

Answer :

(i) Figure 'f' illustrates stage of ovulation.

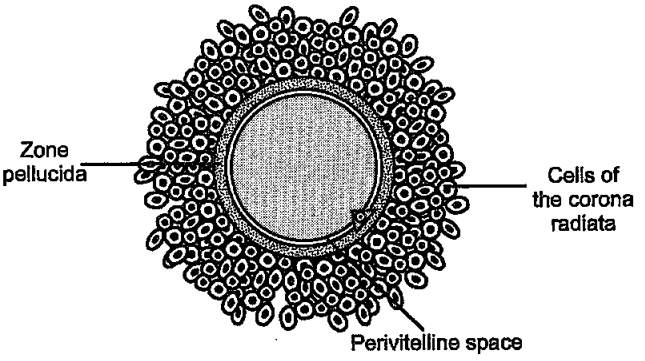
(ii) Ovarian hormone = estrogen

Pituitary hormone = Luetenizing hormone

(iii) Endometrium lining gets thickened and highly vascularised, high regeneration anticipating implantation of the fertilized ovum.

(iv) 'c' is developing Graafian follicle while 'h' is regressing corpus luteum.

(v) Labeled diagram of the human ovum prior to fertilization.



Human ovum prior to fertilization

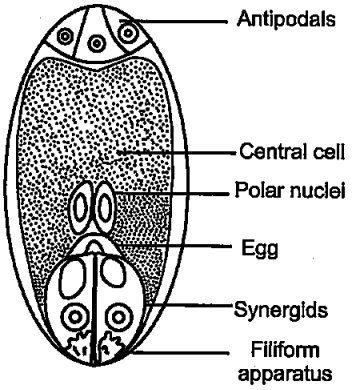
OR

How does the megaspore mother cell develop into 7-celled, 8 nucleate embryo sac in an angiosperm ? Draw a labelled diagram of a mature embryo sac.

Answer : The megaspore mother cell undergoes mitosis to form one functional and viable megaspore. The functional megaspore divides mitotically to produce two nuclei which migrate to opposite poles, forming a 2-nucleate embryo sac.

1. Further mitotic divisions lead to the formation of 4-nucleate stage followed by 8-nucleate stage of the embryo sac.
2. Among the eight nuclei, six are enclosed by cell walls and organised into cells, while the remaining two nuclei (called polar nuclei) are situated above the egg apparatus in a large central cell.
3. Out of the six cells, three are grouped at the micropylar end, and constitute the egg apparatus made up of two synergids and one egg cell.
4. The other three cells are located at the chalazal end, and are called antipodals. Thus, a typical angiosperm embryo sac after

maturity is 8-nucleated and 7-celled.



30. What is the inheritance pattern observed in the size of starch grains and seed shape of *Pisum sativum*? Work out the monohybrid cross showing the above traits. How does this pattern of inheritance deviate from that of Mendelian law of dominance? [5]

Answer : In pea plants (*Pisum sativum*) a single gene controls the expression of a number of traits, namely starch syntheis and size of starch grains. This phenomenon is called pleiotropy and genes are called pleiotropic genes. It has two alleles B and b. BB homozygotes produced large starch grains as compared to that produced by bb homozygotes. The cross involved is

P generation BB × bb

F_1 generation Bb × Bb

F_2 generation

	B	b
B	BB	Bb
b	bB	bb

Ratio : Large : Intermediate : wrinkled

1 : 2 : 1

Deviation from Mendel's law of dominance : If starch grain size is considered as the phenotype, the trait of size of starch grain shows incomplete dominance. Hence in heterozygous condition the starch grains are of intermediate size.

The trait of seed shape follows Law of Dominance and the hybrid will show only dominant trait.

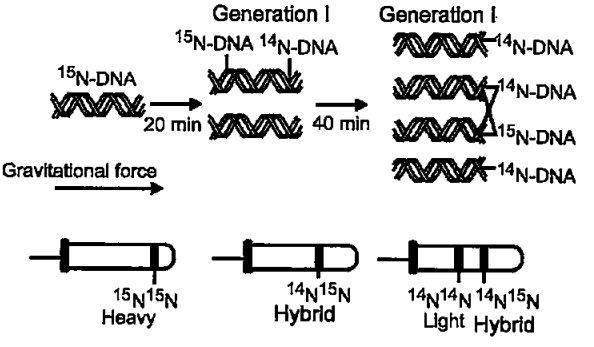
OR

State the aim and describe Messelson and Stahl's experiment.

Answer : Messelson and Stahl in 1958 aimed at proving that the DNA replicates in a semi-conservative fashion. The semi-conservative DNA replication suggests that after the completion of replication, each DNA molecule will have one parental and one newly-synthesised strand.

Experiment done by Messlson and Stahl :

1. They grew colonies of *E.Coli* for several generations on a culture medium having NH_4Cl with heavy isotope of Nitrogen, 15N.
2. This heavy isotope got incorporated in Nitrogen containing compounds, like DNA.
3. When the whole DNA was found to contain heavy isotope of N_2, the bacteria were shifted to culture medium having normal nitrogen, 14N.
4. After 20 minutes, 1st generation of *E. Coli* was obtained. Its DNA was isolated and tested for presence of heavy DNA and normal DNA. This was done for several generations.
5. To test the presence of type of isotope, the isolated DNA was added to tubes having CsCl. The tubes were provided with centrifugal force for many hours, till the DNA lies at a fixed position in the tube.
6. DNA of I generation, having completely heavy isotope was heaviest.
7. When *E. Coli* was shifted to normal N_2 containing culture, the DNA of its I generation was slightly less dense than its parental material.
8. In the 2nd generation, DNA forms two sedimens, one like the F1 generation and second lighter than it.
9. I generation DNA had intermediate density having both ^{15}N and ^{14}N. 2nd generation was one intermediate with (^{15}N and ^{14}N) and other lighter with only ^{14}N. Their ratio was 50-50 in 2nd generation.
10. In 3rd generation, same two types were produced, but ratio of intermediate reduced to 25% and intermediate percentage reduced to 12.5% and lighter one at 8.75%.
11. This is possible only when in each generation out of the two strands of DNA, one was obtained from parent double strand and other is formed new. This proves semi-conservative nature of DNA replication.



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Biology 2012 (Delhi) SET II

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous set.

SECTION–A

1. Cucurbits and papaya plants bear staminate and pistillate flowers. Mention the categories they are put under separately on the basis of the type of flowers they bear. [1]

Answer : Papaya is dioecious because the staminate and pistillate flowers are borne in two different plants while cucumber is monoecious because it bears both staminate and pistillate flowers in the same plant.

4. What is the interaction called between *Cuscuta* and shoe flower bush ? [1]

Answer : The interaction between *Cuscuta* and shoe flower bush is called parasitism.

5. When do the oogenesis and the spermatogenesis initiate in human females and males respectively ? [1]

Answer : Oogenesis starts in females in their foetal stage while spermatogenesis in males starts at puberty.

7. State the significance of the study of fossils in evolution. [1]

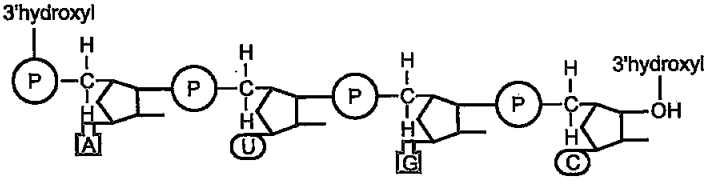
Answer : The significance of the study of fossils in evolution :

1. It indicates the geological period in which various life forms were arisen.
2. The calculation of geological period can be done via radioactive dating.
3. We can know the morphological details of the organisms in the past and can relate them to the organisms in the present to understand the process of evolution.

SECTION–B

13. Draw a schematic diagram of a part of double stranded dinucleotide DNA chain having all the four nitrogenous bases and showing the correct polarity. [2]

Answer : Schematic diagram of a double stranded dinucleotide DNA chain having all the four nitrogenous bases with polarity.



Double stranded dinucleotide DNA chain

14. Name of parasite that causes filariasis in humans. Mention its two diagnostic symptoms. How is this transmitted to others? [2]

Answer : *Wuchereria* (*W. bancrofti and W. malayi*), are the filarial worms that cause filariasis in humans.

Diagnostic symptoms :

1. Chronic inflammation of the organs in which they live for many years. Lymphatic organs are most affected.
2. The genital organs are also often affected resulting in gross deformities.

Transmission : The pathogens are transmitted to a healthy person through the bite by the female mosquito vectors.

15. Name the source of streptokinase. How does this bio–molecule function in our body ? [2]

Answer : Streptokinase enzyme is produced by the bacterium *Streptococcus*. It is modified by genetic engineering and is used as a clot buster for removing clots from the blood vessels of patients who have suffered from myocardial infraction leading to heart attack.

OR

How do mycorrhizae act as biofertilizers? Explain. Name a genus of fungi that forms a mycorrhizal association with plants.

Answer : Mycorrhizae acts as biofertilizers : The fungal symbiont in these associations absorbs phosphorus from soil and passes it

to the plant. The fungi helps the plant in the absorption of essential nutrients from the soil while the plant in turn provides the fungi with energy yielding carbohydrates.

The fungi belonging to the genus Glomus form mycorrhizal associations with plants.

SECTION–C

19. Write the function of each of the following : [3]

(a) Middle piece in human sperm.

(b) Tapetum in anthers.

(c) Luteinizing hormone in human males.

Answer :

(a) Middle piece in human sperm : It possesses numerous mitochondria, which produce energy for the movement of tail that facilitates sperm motility essential for fertilization.

(b) Tapetum in anthers : Tapetum is the inner most layer and the main function of tapetum is to provide nourishment to the developing pollen grains.

(c) Luteinizing hormones in human males : It stimulates the leydig cells to produce androgen like testosterone.

26. How does an algal bloom cause eutrophication of a water body? Name the weed that can grow in such a eutrophic lake. [3]

Answer : Algae are the major producers of any aquatic ecosystem. Presence of large amount of nutrients in water also causes excessive growth of planktonic algae called an algal bloom which imparts a distinct colour to the water bodies. Later, the decomposition of these algae depletes the supply of oxygen, leading to the death of other aquatic animal life. This phenomenon is called **eutrophication.**

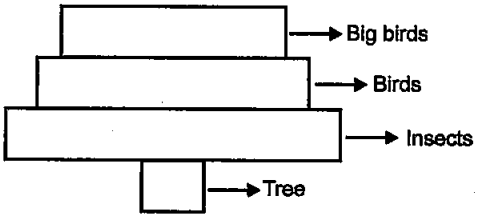
Water hyacinth (*Eichhornia crassipes*) is a weed that can grow in such an eutrophic lake.

SECTION–D

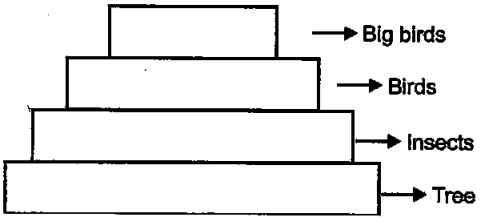
28. (a) Draw a 'pyramid of numbers' of a situation where a large population of insects feed upon a very big tree. The insects in turn, are eaten by small birds which in turn are fed upon by big birds.

(b) Differentiate giving reason, between the pyramid of biomass of the above situation and the pyramid of numbers that you have drawn. [5]

Answer : (a) Pyramid of numbers showing interaction between trees, insects, birds and big birds.



(b) 1. 'Pyramid of number' is spindle shaped as the number of insects is maximum. The number of trees and birds are less than the insects. The numbers is gradually decreasing at each trophic level.



2. The Pyramid of Biomass in this ecosystem is erect because the biomass decreases at each tropic level.

OR

(a) What are the two types of desirable approaches to conserve biodiversity? Explain with examples bringing out the difference between the two types.

(b) What is the association between the bumblebee and its favourite orchid *Ophrys* ? How would extinction or change of one affect the other ? [5]

Answer : (a) Two approaches to conserve biodiversity are :

1. *In situ* conservation

2. *Ex situ* conservation

S.No.	In situ conservation	Ex situ conservation
(i)	It is the "on site" approach for the conservation of endangered species. It involves conservation of endangered species in their natural environment.	It is the "off site" approach for the conservation of endangered species. In this method, the organism is taken out of its natural environment and placed in special settings and given special care.

(ii)	This method is characterised by the construction of biosphere reserves, national parks and wildlife sanctuaries.	This involves setting up of zoological parks, botanical gardens, etc., and employing modern techniques like cryopreservation of gametes, eggs and seeds.
(iii)	In this method organism along with its entire habitat is preserved. Chances of fertilization and propagation are higher.	Reproduction in captivity often slows down and may not give desired results.

(b) Mutualism is the type of association seen between the bumblebee and the orchid *Ophrys*. In this type of association, Orchids show a bewildering diversity of floral patterns many of which have evolved to attract the right pollinator insect (bees and bumblebees) and ensure guaranteed pollination by it. The petals of ophrys resemble the female bundle. If the female bee's colour patterns change even slightly for any reason during evolution, pollination success will be reduced unless the orchid flower co-evolves to maintain the resemblance of its petal to the female bee.

Extinction of bumble bee will definitely affect the orchid flowers because these bees are the means of pollination for the flowers and if they get extinct then the pollination percentage will be reduced. But the extinction of the orchid will not affect the bumble bee population.

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Biology 2012 (Delhi) SET III

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous sets.

SECTION–A

1. Mention the difference between spermiogenesis and spermiation. [1]

Answer : Spermiogenesis is the process of transforming spermatids into matured spermatozoa or sperms whereas Spermiation is the process when mature spermatozoa are released from the Sertoli cells into the cavity of seminiferous tubules.

3. What is an interaction called when an orchid grows on a mango plant ? [1]

Answer : The relationship between a mango tree and an orchid is an example of commensalism.

4. Write the names of the semi-dwarf and high yielding rice varieties developed in India after 1966. [1]

Answer : Jaya and Ratna are two semi-dwarf and high yielding rice varieties developed in India after 1966.

6. Mention the unique feature with respect to flowering and fruiting in bamboo species. [1]

Answer : Bamboo species flowers only once in their life time, generally after 50-100 years, bamboo species produce large number of fruits and then die.

8. State the significance of biochemical similarities among diverse organisms in evolution ? [1]

Answer : The significance of biochemical similarities in biochemicals such as DNA, helps in deriving the line of evolution.

SECTION–B

15. Mention the importance of Lactic acid bacteria to humans other than setting milk into curd. [2]

Answer : 1. Lactic acid bacteria play a very beneficial role in checking disease causing microbes.

2. It is also used to produce acid called lactic acid which is an important industrial product. It is used in bakery products, beverages, meat products, confectionery, dairy products, etc.

OR

How do methanogens help in producing biogas ?

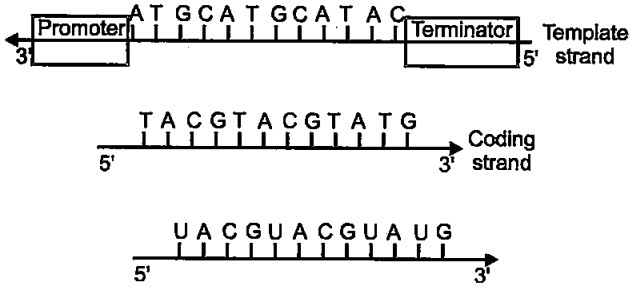
Answer : Methanogens such as *Methanobacterium*

acts on excreta of cattle and anaerobic sludge and grows anaerobically, producing large amount of methane along with CO_2 and H_2. Methanogens do not use oxygen to respire. In fact, oxygen inhibits the growth of methanogens.

19. (a) Construct a complete transcription unit with promoter and terminator on the basis of the hypothetical template strand given below :

(b) Write the RNA strand transcribed from the above transcription unit along with its polarity. [2]

Answer :



OR

How are the structural genes inactivated in lac operon in *E. coli* ? Explain.

Answer : The structural gene in the *lac* operon consists of three genes, *lac z*, *y* and *a*. The structural gene is inactivated in the presence of repressor and absence of inducer (lactose). The repressor of the operon produced by the *i* gene. The repressor protein when produced binds to the operator region of the operon and prevents RNA polymerase from transcribing the operon.

SECTION–C

20. Write the function of each of the following :

(a) Seminal vesicle (b) Scutellum (c) Acrosome of human sperm. [3]

Answer : (a) Seminal vesicle : It secretes an alkaline fluid that helps in neutralizing the acidity of the vaginal tract and thereby increasing the life-span of sperms.

(b) Scutellum : Scutellum is the tissue present in seed. It is the papery cotyledon of the monocot seed and acts as a passage for movement of nutrients from the endosperm to the developing embryo.

(c) Acrosome of human sperm : It is present at the tip of sperm. It is a cap-like structure which contains hydrolytic enzymes that helps in penetration of egg during fertilization.

25. (a) Why are the colourful polystyrene and plastic packagings used for protecting the food, considered an environmental menace ?

(b) Write about the remedy found for the efficient use of plastic waste by Ahmed Khan of Bangalore. [3]

Answer : (a) Polysterene and plastic packaging used for protecting food causes environmental pollution as these are non-biodegradable substances and its recycling process is very costly and includes manual participation thus exposing workers to toxic substances produced during recycling process.These polybags cause harm to aquatic life, choke the water pipes, etc.

(b) The efficient use of plastic waste by Ahmed Khan in Bangalore–He developed polyblend, a fine powder of recycled modified plastic. This mixture is mixed with the bitumen that is used to lay roads. Ahmed Khan proved that blends of Polyblend and bitumen, when used to lay roads, enhanced the bitumen's water repellant properties, and helped to increase road life.

SECTION–D

30. Name the scientists who proved experimentally that DNA is the genetic material ? Describe their experiment. [5]

Answer : Hershey and Chase worked with bacteriophage, E.coli and they proved that DNA is the genetic material. They worked on different radioactive isotopes to label DNA and protein coat of the bacteriophage.

Both of them grew some bacteriophages on a medium containing radioactive phosphorus (P^{32}) to identify DNA and some on a medium containing sulphur (S^{35}) to identify protein. These radioactive labelled phages were allowed to infect E.coli bacteria. After infecting, the protein coat of bacteriophage was separated from the bacterial cell by blending and then subjected to the process of centrifugation.

Since, the protein coat was lighter, it was found in the supernatant whereas the infected bacteria got settled at the bottom of the centrifuge tube. Hence, it was proved that DNA is the genetic material as it was transferred from virus to bacteria.

OR

(a) List the three different allelic forms of gene 'I' in humans. Explain the different phenotypic expressions, controlled by these three forms.

(b) A woman with blood group 'A' marries a man with blood group 'O'. Discuss the

possibilities of the inheritance of the blood groups in the folllowing starting with 'yes' or 'no' for each :

(i) They produce children with blood group 'A' only.

(ii) They produce children some with 'O' blood group and some with 'A' blood group.

Answer : (a) In humans, the ABO blood groups are controlled by a gene called gene 'I'. It has three alleles, namely I^A, I^B and *i*.

Table showing the Genetic Basis of Blood Groups in Human Population

Genotype of offspring	Blood-types of offspring
$I^A I^A$	A
$I^A I^B$	AB
$I^A i$	A
$I^A I^B$	AB
$I^B I^B$	B
$I^B i$	B
i i	O

(b) Possibility I

$I^A I^A$

	I^A	I^A
i	$I^A i$	$I^A i$
i	$I^A i$	$I^A i$

Yes. 'A' Blood group only

Possibility II

$I^A i$

	I^A	i
i	$I^A i$	ii
i	$I^A i$	ii

Yes. 50% 'A' Blood Group and 50% 'O' Blood Group

●●

Biology 2013 (Outside Delhi) SET I

Time allowed : 3 hours **Maximum marks : 70**

SECTION–A

1. **Name an organism where cell division in itself is mode of reproduction.** [1]

   Answer : The division of cell in itself is a mode of reproduction found in amoeba and paramoecium.

2. **When does a human body elicit a anamnestic response ?** [1]

   Answer : When our body is attacked by pathogens for the second time the memory cells which were formed during the first attack produce

a highly intensified secondary or anamnestic response.

3. **Name any two disease the 'Himgiri' variety of wheat is resistant to.** [1]

Answer : The 'Himgiri' variety of wheat is resistant to leaf and stripe rust and hill bunt disease.

4. **State the role of transposons in silencing of mRNA in eukaryotic cells.** [1]

Answer : Role of transposons : Silencing of a gene is done in order to prevent translation of mRNA, where transposons act as a complementary RNA that is used to stop translation.

5. **Why are green algae not likely to be found in the deepest strata of the ocean ?** [1]

Answer : Green algae are not likely to be found in the deepest strata of the ocean because deep inside the sea presence of sufficient light for photosynthesis and brackish water are not available so green algae are not present at this level, instead algae inhabits littoral zone of water.

6. **State what does 'standing crop' of a trophic level represent.** [1]

Answer : 'Standing crop' of a trophic level represents certain mass of a living material at a particular time.

7. **Why is the use of unleaded petrol recommended for motor vehicles equipped with catalytic converters ?** [1]

Answer : The use of unleaded petrol is recommended for motor vehicles equipped with catalytic converters because lead in petrol inactivates the catalysts which converts harmful pollutants (CO, unburnt hydrocarbons, nitric oxide) to lesser harmful pollutants (CO_2, H_2O, N_2).

8. **Name the type of biodiversity represented by the following :**

(i) **1000 varieties of mangoes in India** [1]

(ii) **Variations in terms of potency and concentration of reserpine in *Rauwolfia vomitoria* growing in different regions of Himalayas.**

Answer : (i) Genetic Biodiversity

(ii) Genetic Biodiversity.

SECTION–B

9. **In angiosperm, zygote is diploid while primary endosperm cell is triploid. Explain.** [2]

Answer : 1. Fertilisation of haploid egg cell by one haploid male gamete to form diploid zygote is called syngamy.

(a) Male gamete + Egg → Zygote

(n) (n) (2n)

(b) Secondary nucleus + Male gamete →

(2n) (n)

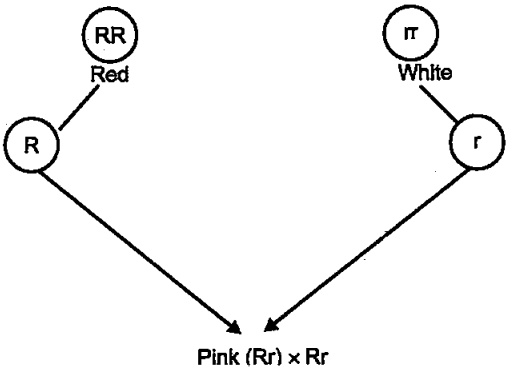
Primary endosperm cell

(3n)

2. Fertilisation of two (diploid) polar nuclei by the other haploid male gamete to form triploid primary endosperm nucleus is called triple fusion.

10. **A cross between red flower bearing plant and a white flower bearing plant of Antirrhinum produced all plants having pink flowers. Work out a cross to explain how this is possible.** [2]

Answer :



	R	r
R	RR Red	Rr Pink
r	Rr Pink	Rr White

Phenotypic ratio: 1 : 2 : 1

Genotypic ratio: 1 : 2 : 1

R (Red) factor is not completely dominant over r (white) factor and it is incomplete dominance.

11. **List the two main propositions of Oparin and Haldane.** [2]

Answer : The two main propositions of Oparin and Haldane are :

1. The first form of life could have come from pre-existing non-living organic molecules (*e.g.*, RNA, protein etc.) *i.e.*, first abiogenesis and biogenesis later.

(ii) The first form of life was preceded by chemical evolution *i.e.*, formation of organic molecules from inorganic molecules like CH_4, NH_3 etc.

12. Write the events that take place when a vaccine for any disease is introduced into the human body. [2]

Answer : Vaccines are a non-virulent form of pathogens, when administered into the body, the body starts making antibodies against the antigens present in the vaccine. The vaccine also generates memory - B and T - cells, that recognize the pathogen quickly on subsequent second exposure and wipe out the invaders with a massive production of antibodies.

OR

Why is a person with cuts and bruises following an accident administered tetanus antitoxin ? Give reasons.

Answer : Tetanus antitoxin neutralizes and provides passive immunity to the bacterial toxin. The antitoxin contains antibody against pathogen it attacks and inactivates pathogens.

13. Name the bacterium responsible for the large holes seen in 'Swiss Cheese'. What are these holes due to ? [2]

Answer : *Propionibacterium sharmanii* is responsible for the large holes seen in Swiss Cheese. The large holes are due to production of a large amount of CO_2 by the bacterium.

14. Name the source of the DNA polymerase used in PCR technique. Mention why it is used. [2]

Answer : Thermus aquaticus because it is heat stable DNA polymerase. Polymerase chain reaction (PCR) is a method in which the desired gene is synthesised in vitro in following steps :

1. Denaturation : The double-stranded DNA is denatured by applying high temperature of 95°C for 15 seconds. Each separated single stranded now acts as a template for DNA synthesis.

2. Annealing : Two sets of primers are added which anneals to the 3' end of each separated strand. Primers act as initiators of replication.

3. Extension : DNA polymerase extends the primers by adding nucleotides complementary to the template provided in the reaction. A thermostable DNA polymerase (*Taq* polymerase) is used in the reaction which can tolerate the high temperature of the reaction. All these steps are repeated many times to obtain several copies of desired DNA.

15. Write any four ways used to introduce a desired DNA segment into bacterial cell in recombinant technology experiment. [2]

Answer : The four ways used to introduce a desired DNA segment into bacterial cell in recombinant technology experiment are the following:

1. Chemical Method : Poration by divalent cation such as calcium.

2. Micro injection : Recombinant DNA is directly injected into the nucleus of an animal cell.

3. Biolistic or gene gun : Plant cells are bombarded with high velocity micro-particles of gold or tungsten coated with DNA.

4. Disarmed pathogen vectors : When allowed to infect the cell, transfer the recombinant DNA into the host.

16. Why is proinsulin so called ? How is insulin different from it ? [2]

Answer : Proinsulin is a protein molecule and like a pro-enzyme. It contains an extra strech of C peptide so it needs to be processed to become fully mature and functional hormone like insulin, it is a mature hormone and is produced by the beta cells. Proinsulin is different from insulin because it serves as a precursor hormone to insulin.

17. Where would you expect more species biodiversity in tropics or in polar region ? Give reasons in support of your answer. [2]

Answer : High species or biodiversity lies in tropical areas because tropics are :

1. Undistributed habitats since millions of year in comparison to temperate and polar region which faces frequent glaciation. It favours speciation, as speciation is product of time.
2. Less seasonal variation than polar areas.
3. High availability of solar radiations than polar area, which harbours more plant species.

18. "It is possible that a species may occupy more

than one trophic level in the same ecosystem at the same time." Explain with the help of one example. [2]

Answer : Yes, as the trophic level of a species represents the functional role of organism in energy flow which is determined by the food intake. The availability of food depends on what the organisms want to eat, so can have more than one trophic level at a time.

Ex. Sparrow is a Primary consumer, when eating seeds whereas Secondary consumer, when eating insects.

SECTION–C

19. **Explain the steps in the formation of an ovum from an oogonium in humans.** [3]

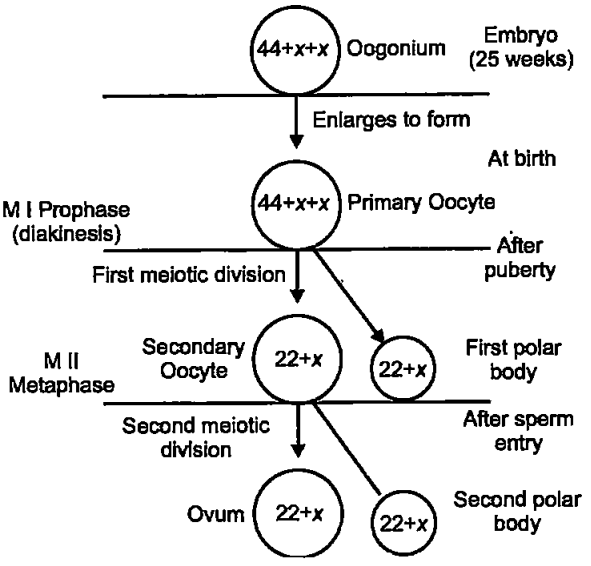
Answer : The steps in the formation of an ovum from an oogonium in humans involved in oogenesis process can be divided into three stages :

1. Multiplication phase 2. Growth phase
3. Maturation phase

1. Multiplication phase : In this stage primordial germ cells or ovum mother cells are repeatedly divided by mitosis to form large number of diploid oogonia. This process completes in embryo stage of female in most higher animals.

2. Growth phase : In this process oogonia grows in size and forms primary oocytes. The growth phase is the longest phase of oogenesis (except humans). During growth phase size of egg increases many times.

3. Maturation phase : Oogenesis takes place in the ovaries. In contrast to males the initial steps in egg production occur prior to birth. By the time the foetus is 25 weeks old, all the oogonia that she will ever produce, are already formed by mitosis. Hundreds of these diploid cells develop into primary oocytes, begins the first step of the first meiotic division, proceeds upto diakinesis, and then stops any further development. The oocytes grow much larger and complete the meiosis I, forming a large secondary oocyte and a small polar body that receives very little amount of cytoplasm but one full set of chromosomes.



OR

Suggest and explain any three Assisted Reproductive Technologies (ART) to an infertile couple.

Answer : Three assisted reproductive technologies (ART) to an infertile couple are :

1. In vitro fertilisation (IVF–fertilisation outside the body in almost similar conditions as that in the body) followed by embryo transfer (ET) is one of such methods. In this method, popularly known as test tube baby programme, ova from the wife/donor (female) and sperms from the husband/donor (male) are collected and are induced to form zygote under simulated conditions in the laboratory. The zygote or early embryos (with upto 8 blastomeres) could then be transferred into the fallopian tube (ZIFT–zygote intra fallopian transfer) and embryos with more than 8 blastomeres, into the uterus (IUT – intra uterine transfer), to complete its further development.

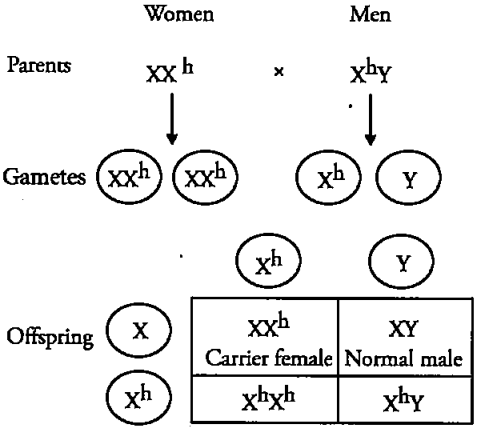
2. Embryos formed by *in-vivo* fertilization (fusion of gametes within the female) also could be used for such transfer to assist those females who cannot conceive. Transfer of an ovum collected from a donor into the fallopian tube (GIFT – gamete intra fallopian transfer) of another female who cannot produce one, but can provide suitable environment for fertilisation and further development is another method attempted.

3. **Intra cytoplasmic sperm injection** (ICSI) is another specialised procedure to form an

embryo in the laboratory in which a sperm is directly injected into the ovum. Infertility cases either due to inability of the male partner to inseminate the female or due to very low sperm counts in the ejaculates, could be corrected by Artificial Insemination (AI) technique. In this technique, the semen collected either from the husband or a healthy donor is artificially introduced either into the vagina or into the uterus (IUI–Intrauterine Insemination) of the female.

20. Why human females are rarely haemophilic? Explain. How do haemophilic patients suffer? [3]

Answer : Haemophilia is sex linked recessive disease; it is transmitted from unaffected female carrier to a male child with haemophilia. Y has no allele for this. If male inherits X^h from the mother, he will be haemophilic (with the genotype X^hY). If female inherits X^hX^h, one from the carrier mother and one from her haemophilic father, then she can be haemophilic. Simple cut will result in the increased bleeding time in haemophilic patients.



21. In a maternity clinic, for some reasons the authorities are not able to hand over the two newborns to their respective real parents. Name and describe the technique that you would suggest to sort out the matter. [3]

Answer : DNA Fingerprinting or DNA test is the technique that is suggested to describe the parental identification of these two newborn babies in a maternity clinic.

The procedure of finger printing is as follows :

1. Isolation of DNA.
2. Digestion of DNA by restriction endonucleases.
3. Separation of DNA fragments by electrophoresis.
4. Transferring (blotting) of separated DNA fragments to synthetic membranes, such as nitrocellulose or nylon.
5. Hybridisation using labelled VNTR probe.
6. Detection of hybridised DNA fragments by autoradiography. Half of the band of child will resemble to father and half to mother.

22. Explain the increase in the number of melanic (dark winged) moths in the urban areas of post-industrialisation period in England. [3]

Answer : In England, before industrial revolution the environment was unpolluted. The white-winged moths were more and lichens on the barks of trees were pale. The white-winged moths could easily camouflage, while the dark winged were spotted out by the birds for food. Hence, they could not survive. After industrial revolution the lichens became dark (due to soot deposit). This favoured the dark-winged moths while the white-winged were picked by birds. The population of the former which was naturally selected increased.

23. Describe how biogas is generated from activated sludge. List the components of biogas. [3]

Answer : Biogas can be produced by anaerobic digestion or fermentation of biodegradable materials. Bio wastes are collected and slurry of dung is mixed, a floating cover is placed over the slurry. The slurry having gas outlet is placed which keeps on rising as the gas is produced in the tank due to microbial activity of methanogens like Methanobacterium. Anaerobic fermentation of waste biomass can be visualized in three stages:

1. The facultative anaerobic microbes degrade the complex polymers to simple monomers by enzymatic action. The Polymer like cellulose, hemicellulose, proteins and lipids gets degraded into monomers but lignins and inorganic salts are left as residue because they do not degrade.

2. In second stage, monomers are converted into organic acids by microbial action under partially aerobic conditions which are finally converted to acetic acid.

3. In third stage acetic acid is oxidized into methane by the activity of anaerobic methanogenic bacteria. These bacteria are commonly found in the anaerobic sludge during sewage treatment. In this whole process digestion of cellulose takes place at very slow rate so that it is the "rate limiting factor in biogas production."

24. Name the pest that destroys the cotton balls. Explain the role of *Bacillus thuringiensis* in protecting the cotton crop against the pest to increase the yield. [3]

Answer: Cotton ballworm is the pest that destroys the cotton balls. Bt toxin protein is produced by a soil bacterium called *Bacillus thuringiensis* in inactive prototoxin and crystalline form. The prototoxin form does not kill the bacteria. It becomes active and toxic when it is consumed by insects such as lepidopterans (armyworm), coleopterans (beetles) and dipterans (flies/ mosquitoes) due to presence of alkaline pH in the gut. The activated toxin (delta endotoxins) binds to the epithelial cells in the midgut of an insect and creates pores that causes lyses and swelling, eventually killing the insect.

25. (a) Write the importance of measuring the size of a population in a habitat or an ecosystem.

(b) Explain with the help of an example how the percentage cover is a more meaningful measure of population size than more numbers. [3]

Answer : (a) The importance of measuring the size of a population cover is more meaningful measure of population size than numbers. The size of the population tells us a lot about its status in the habitat.

(b) Percentage cover is more meaningful measure of population size than more numbers because the relative abundance of a species is not only determined by number of individuals but by both *i.e.*, the relative abundance in number and relative abundance in biomass.

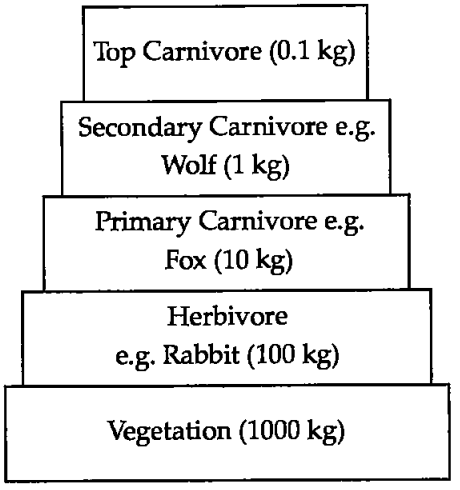
Ex. In unit area the number of a grass species individuals or relative abundance in number is high but not in relative abundance of biomass. If the same area has one or two *ficus benghalensis* (Bargad) tree as it is very low in relative abundance in number while high in relative abundance of biomass.

26. Differentiate between two different types of pyramids of biomass with the help of example of each. [3]

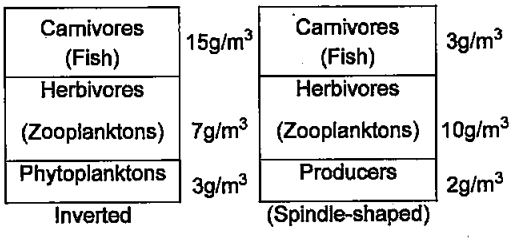
Answer : Difference between two types of pyramids of biomass :

Pyramid of Biomass is graphic representation of amount of biomass per unit area in the trophic levels with producers at the base and top carnivore at the apex. Biomass is maximum in producers. Only 10% of biomass is passed to next level. This is in accordance to the 10% law by **Lindeman,** (1942). Thus, the biomass at higher trophic levels becomes smaller and smaller.

The pyramid of biomass is upright in grassland ecosystem.



For an aquatic system, the pyramid of biomass may be inverted or spindle-shaped. This is because the diatoms and other phytoplankton have a small standing crop, but they have a high annual productivity and high turn over rate. The reason for small standing crop is their short life span.



27. (a) Describe the endosperm development in coconut.

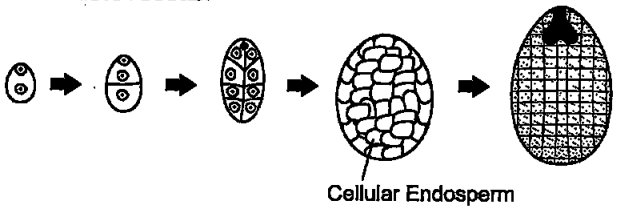
(b) Why is tender coconut considered a healthy source of nutrition ?

(c) How are pea seeds different from castor seeds with respect to endosperm ? [3]

Answer : (a) Endosperm is a nutritive triploid tissue formed from mitotic divisions in primary endosperm nucleus (PEN). The cells of this tissue are filled with reserve food material and are used for the nutrition of the developing embryo.

(b) In cococut, the type of endosperm formed is cellular endosperm, For this, the PEN divides many times and each division is followed by wall formation.

(c) The seeds of pea are non-endospemic while castor seeds are endospermic. The endosperm in pea seeds is consumed during embryo development, but endosperm is not utilised in castor seeds.



SECTION–D

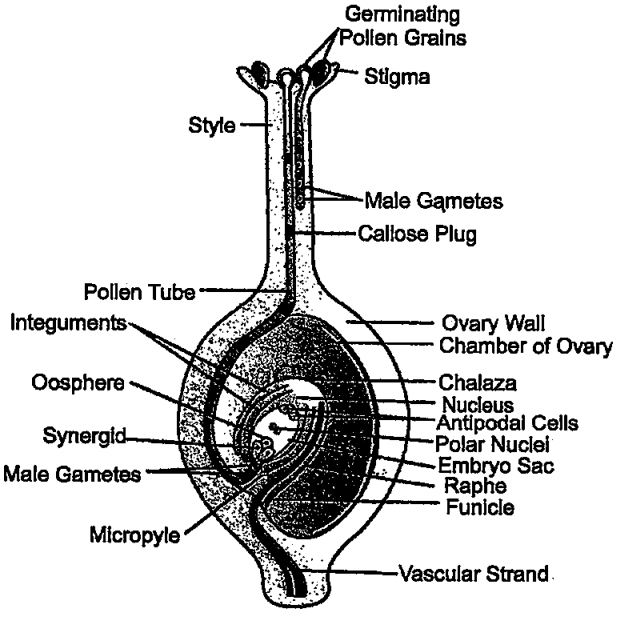
28. (a) Draw a L.S. of a pistil showing pollen tube entering the embryo-sac in an angiosperm and level any six parts other than stigma, style and ovary.

(b) Write the changes a fertilized ovule undergoes within the ovary in an angiosperm plant. [5]

OR

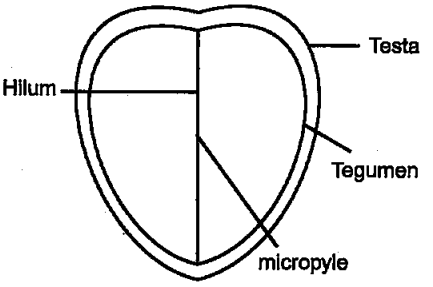
(a) Draw a diagrammatic sectional view of a human seminiferous tubule and label sertoli cells, primary spermatocyte, spermatogonium and spermatozoa in it.

Answer : (a)

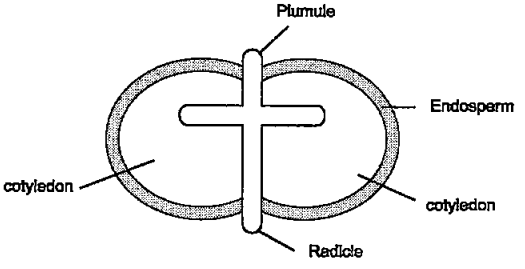


(b) Fertilised ovule forms seeds which contains embryonic plant, reserve food and protective coat. A seed consists of two parts :

1. **Seed Coat :** It is the outer covering of the seed, functioning as a protective coat. It is formed from the integuments of the ovule, which hardens after fertilisation. The outer seed coat is called Testa and is formed from outer integument. The inner seed coat called Tegumen is formed from inner integument. The micropyle remains as a small pore in the seed coat. It helps in the entry of oxygen and H_2O into the seed during germination. Above the micropyle, hilum is visible as a depression, being remanant of the attachment point.



2. **Embryo :** The embryo is made up of embryonal axis Cotyledon and endosperm. Embryonal axis is the central axis, also called Tigellum. One end of Tigellum bears Radicle (future root) and the other end bears plumule (future shoot). Cotyledon is present at the node of embryo axis. It is a fleshy structure, used for storage of food. Endosperm is the nutritive layer present inside the seed coat providing nutrition to growing embryo.



OR

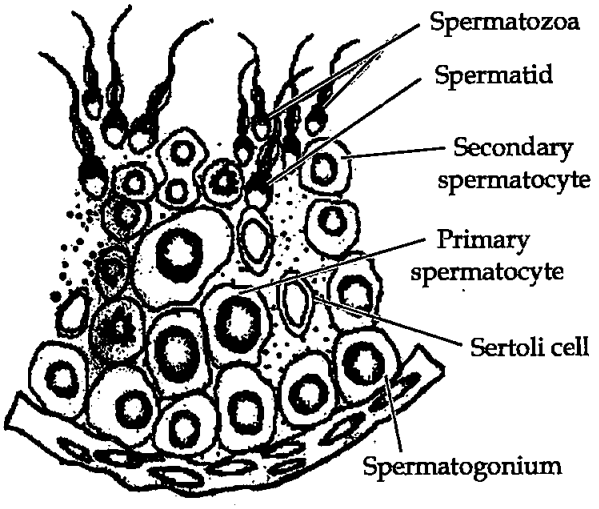
Answer : (a) Spermatogenesis is under the control of endocrine hormones.

1. Hypothalamus produces Gonadotropin Releasing Hormone (GnRH).
2. GnRH acts on anterior pituitary to produce gonadotropins, ICSH (Interstitial Cell stimulating Hormone) and FSH. ICSH acts on interstitial or leydig cells which produce testosterone.
3. FSH stimulates sertoli cells to develop ABP (Androgen Binding Protein) which helps in concentrating testosterone in seminiferous

tubules.

4. Excess testosterone inhibits LH or ICSH production by anterior pituitary and subsequently GnRH production by Hypothalamus.
5. Sertoli cells also produce a glycoprotein called Inhibition which suppresses FSH synthesis by anterior pituitary and GnRH by Hypothalamus.

This is called negative feedback control for release of testosterone.



29. (a) Write the conclusion drawn by Griffith at the end of his experiment with *streptococcus pneumonia*.

(b) How did O. Avery, C. MacLeod and M. McCarty prove the DNA was the genetic material ? **[5]**

Answer : (a) Griffith transformation experiment: Griffith performed his experiment in 1928 on *Streptococcus pneumonia* bacteria which cause pneumonia in mice.

He used two strains of bacteria.

1. Rough strain : Non–capsulate non-virulent rough colonies on culture media.

2. Smooth strain : Capsulated virulent form smooth colonies on media.

Experiment : 1. Mice + Smooth strain bacteria → Dead mice.

2. Mice + Rough strain bacteria → Living mice.

3. Mice + Heat killed bacteria + Rough bacteria → Dead Bacteria.

On the basis of third experiment he proposed that rough bacteria absorbed some heat stable material from dead smooth bacteria and transformed into smooth bacteria which killed the mice.

(b) O Avery, C. Macleod and M. McCarty proved that the DNA was the genetic material by purifying biochemicals (proteins, DNA, RNA, etc.) from the heat-killed S cells to see which ones could transform live R cells into S cells. They discovered that DNA alone forms S bacteria caused R bacteria to become transformed. They also discovered that protein - digesting enzymes (proteases) and RNA - digesting enzymes (RNases) did not affect transformation, so the transforming substance was not a protein or RNA. Digestion with DNase did inhibit transformation, suggesting that the DNA caused the transformation. They concluded that DNA is the hereditary material.

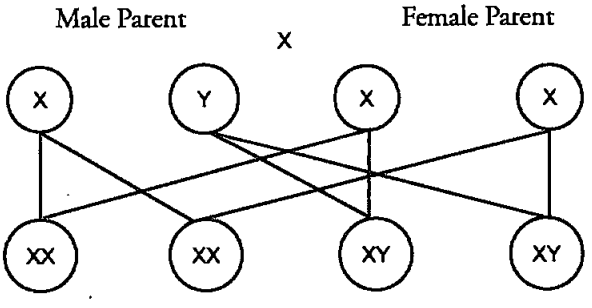
OR

(a) Explain the mechanism of sex-determination in humans.

(b) Differentiate between male heterogamety and female heterogamety with the help of an example of each.

Answer : (a) Sex determination in humans :

1. The males have 22 pairs autosomes and a pair of XY-chromosome.
2. The females have 22 pairs autosomes and a pair of XX-chromosomes.
3. In male, 50% of sperms carry X- chromosome and other 50% carry Y-chromosomes.
4. In females, all ova contain X-chromosomes.
5. The sex of an individual is determined by the type of sperm fertilizing the ovum.
6. If the ovum is fertilized by Y-chromosome, the zygote (XY) develops into a male and if the ovum is fertilized by X-chromosome, Zygote (XX) develops into a female.



(b) There are two types of sex determining mechanisms, *i.e.*, XO type and XY type. But in

both cases males produce two different types of gametes,

1. Either with or without X-chromosome.

2. Some gametes with X-chromosome and some with Y-chromosome.

Such types of sex determination mechanism is designated to be an example of **male heterogamety**. In some other organisms, *e.g.*, birds a different mechanism of sex determination is observed. In this case the total number of chromosomes are same in both males and females. But two different types of gametes in terms of the sex chromosomes, are produced by females, *i.e.*, **female heterogamety**. The two different sex chromosomes of a female bird have been designated to be the Z and W chromosomes. In these organisms the females have one Z and one W chromosome, whereas males have a pair of Z-chromosomes besides the autosomes.

30. A person in your colony has recently been diagnosed with AIDS. People/Residents in the colony want him to leave the colony for the fear spread of AIDS.

(a) Write your views on the situation, living reasons.

(b) List the possible preventive measures that you would suggest to the residents of your locality in a meeting organized by you so that they understand the situation.

(c) Write the symptoms and the causative agent of AIDS. **[5]**

Answer : (a) AIDS is infectious but not contagious, it does not spread by shaking hand and use of common utensils so there is no need of fear to live with AIDS patient.

(b) Making blood (from blood banks) safe from HIV, ensuring the use of only disposable needles and syringes in public and private hospitals and clinics, free distribution of condoms, controlling drug abuse, advocating safe sex and promoting regular check-ups for HIV in susceptible populations, are some such steps taken up.

(c) Symptoms and the causative agent of AIDS : AIDS is caused by the Human Immuno Deficiency Virus (HIV), a member of a group of viruses called retrovirus which have an envelope enclosing the RNA genome. These target the T lymphocytes, due to which the person starts suffering from infections that could have been otherwise overcome such as those due to bacteria especially Mycobacterium, viruses, fungi and even parasites like *Toxoplasma*. The patient becomes so immuno-deficient that he/she is unable to protect himself/herself against these infections.

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Biology 2013 (Outside Delhi) SET II

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous set.

SECTION–A

3. Write the basis on which an organism occupies a space in its community/natural surroundings. **[1]**

Answer : It is based on the feeding relationships of that organism with other organisms and source of their nutrition or food.

SECTION–B

8. Name an algae that reproduces asexually through zoospores. Why are these reproductive units so called? **[2]**

Answer : Algae that reproduce asexually through zoospores are "Chlamydomonas". They are microscopic and motile, due to flagella so known as zoospores.

SECTION–C

12. "Stability of a community depends on its species richness". Write how did David Tilman show this experimentally. **[3]**

Answer : 1. David Tilman's long term ecosystem

experiment shows that plots with more species show less year-to-year variation in total biomass.

2. He also showed in his experiment that, increased diversity contributed to higher productivity.

14. Name the haploid cells present in an unfertilized mature embryosac of a flowering plant. Write the total number of cells in it. [3]

Answer : In an unfertilized mature embryo sac of a flowering plant 6 haploid cells are present, three antipodal cells, two synergids and one egg cell.

15. In a typical monohybrid cross the F_2-population ratio is written as 3 : 1 for phenotype but expressed as 1 : 2 : 1 for genotype. Explain with the help of an example. [3]

Answer :

Parent — Tall TT ↓ × Short tt ↓

Gamete — T, t

F_1 Generation — Tt × Tt

Selfing

F_2 Generation

	T	t	
T	Tt	Tt	75% Tall
t	Tt	tt	25% Short

Genotype 1 : 2 : 1- One is homozygous dominant and 2 are heterozygous but dominant and one is homozygous recessive.

16. Mention the contribution of S. L. Miller's experiment on Origin of Life. [3]

Answer : Miller carried out the experiment as a proof of Oparin-Haldane hypothesis. The experiment was as follows :

1. Miller sealed a mixture of water vapour (H_2O), NH_3, CH_4 H_2 in a spark chamber, which was provided with electrodes to provide electrical discharges.

2. The electrical sparks were of 75,000 volts and the ratio of CH_4 : NH_3 : H_2 as 2 : 1 : 2 and water vapour at 800°C.

3. The spark chamber was connected to another flask with arrangement for boiling H_2O for evaporation.

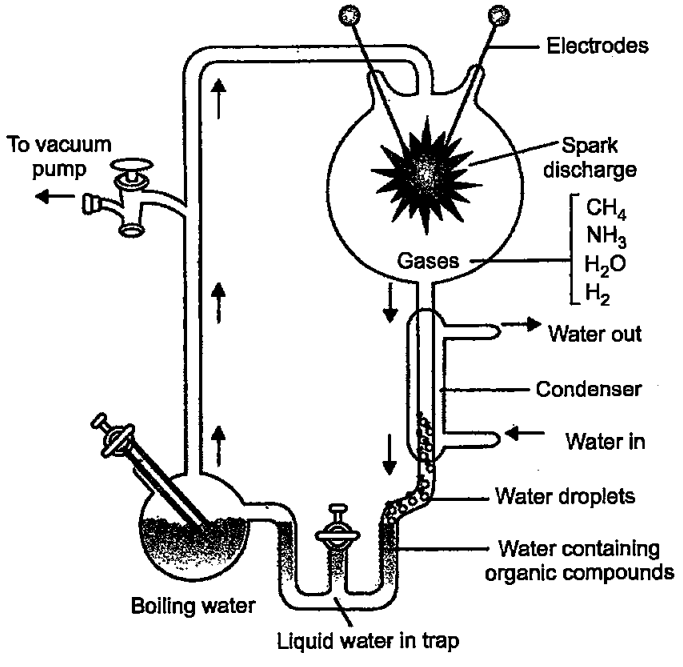
4. The other end of spark chamber was connected to a condenser for condensation and collection of aqueous solution.

5. A trap was connected with flask for boiling H_2O.

6. The apparatus was a controlled one, without any energy source.

7. After 18 days, he analysed the products after cooling them and proposed that HCN was formed from methane and NH_3 and reacted with other compounds of gas to form amino acids like Alanine, Glycine and Aspartic Acid.

He gave the conclusion that similar synthesis could have occurred in the primordial atmospheric conditions.



20. (a) Explain "birth rate" in a population by taking a suitable example.

(b) Write the other two characteristics which only a population shows but an individual cannot. [3]

Answer : (a) It is the average number of new individuals added per unit population per year due to births, hatchings and germinations. If in a pool there were 20 lotus plants last year and plants reproduced and gave rise to 8 new plants, the total population is now 28. Birth rate will be equal to 8/20 = 0.4 offspring per lotus per year

(b) 1. Death rate : per capita death.

2. Sex Ratio : An individual is either a male or female, but a population has a sex ratio, *e.g.*, 60% of the population of females and 40% of males.

SECTION–D

25. A burglar in a huff forgot to wipe off his blood-stains from the place of crime where he was involved in a theft. Name the technique which can help in identifying the burglar from the blood stains. Describe the technique. [5]

Answer : The technique which helps in identifying the burglar from the blood stain is DNA fingerprinting. The procedure of DNA fingerprinting is as follows :

1. **Isolation of DNA :** Isolation of DNA from the blood stain.
2. **Cutting, sizing and sorting :** Special enzymes called restriction enzymes are used to cut the DNA at specific places. The DNA pieces are sorted according to size by a sieving technique called electrophoresis. This technique is the biotechnology equivalent of screening and through progressively finer mesh screens to determine particle sizes. The DNA fragments contain VNTRs (Variable Number of Tandem Repeats).
3. **Transfer of DNA to nylon :** The distribution of DNA pieces is transferred to a nylon sheet by placing the sheet on the gel and soaking them overnight.
4. **Probing :** Adding radioactive or coloured probes to the nylon sheet produces a pattern called the DNA fingerprint. Each probe typically sticks in only one or two specific places on the nylon sheet.
5. **Radiograph :** The final DNA fingerprint is built by using several probes (5-10 or more) simultaneously. These places are marked as dark bands when X-ray film is developed. This process is called autoradiography.

28. (a) Write the specific features of the genetic code AUG.

(b) Genetic codes can be universal and degenerative. Write about them, giving one example of each. [5]

(c) Explain aminoacylation of tRNA.

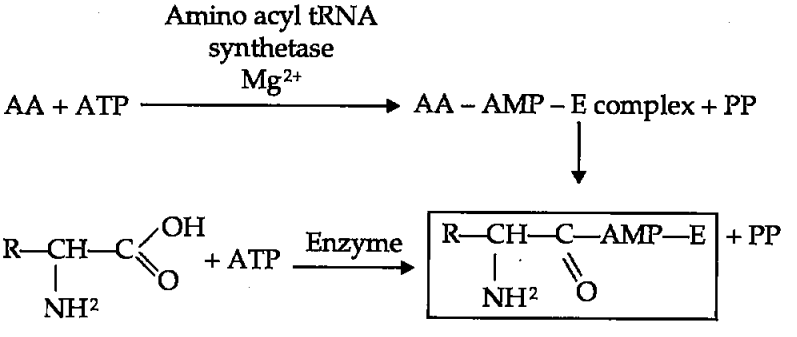
Answer : (a) Features of the genetic code AUG are as follows :

1. AUG has dual function.
2. AUG codes for Methionine and acts as an initiator codon.

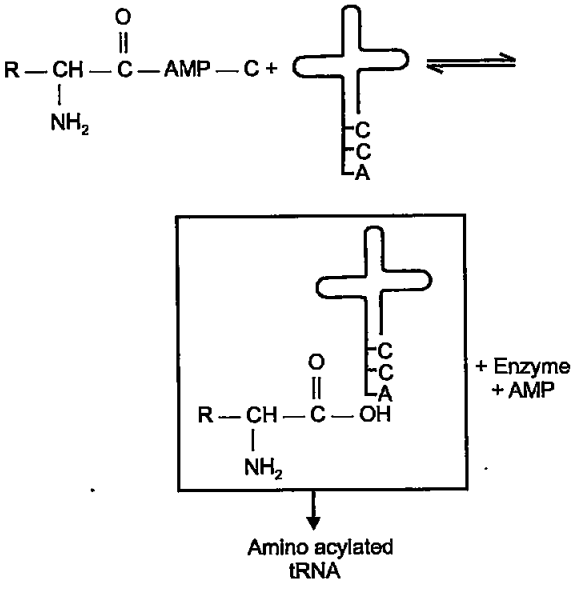
(b) 1. Universal : From bacteria to human UUU would code for Phenylalanine. Some exceptions are there in mitochondrial codons and in some protozoans.

2. Degenerate : Some amino acids are coded by more than one codon. *e.g.*, Phenylalanine is coded by UUU and UUC.

(c) Aminoacylation of tRNA : (i) In the presence of enzyme Amino-acyl-tRNA synthetase from DHU loop of tRNA, specific amino acid binds with ATP.



3. The AA–AMP–E complex formed in first step reacts with specific tRNA. Thus, amino acid is transferred to tRNA. The enzyme and AMP are then released.



OR

(a) Differentiate between dominance and co-dominance.

(b) Explain co-dominance taking an example of human blood groups in population.

Answer : (a)

S.No.	Dominance	Co-dominance
(i)	In heterozygote hybrid condition, when two different alleles are present, one expresses itself and the other gets suppressed for a character.	In a heterozygote hybrid condition, when both different alleles are present, both alleles express themselves in the presence of other.
(ii)	For e.g., Cross between the red flowers and yellow flowers, in F_1 generation red gene is expressed and yellow gene is suppressed.	For e.g., Cross between red flowers and white flowers, in F_1 generation both red and white gene are expressed.

(b) In humans, the ABO blood groups are controlled by a gene called gene 'I'. It has three alleles I^A, I^B and *i*. Hence, referred to as multiple allelism. A person possesses any two of the three alleles. I^A and I^B dominate over *i*. But with each other, I^A and I^B are co-dominant.

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Biology 2013 (Outside Delhi) SET III

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous sets.

SECTION–A

1. What is detritus food chain made up of ? How do they meet their energy and nutritional requirements ? [1]

Answer : Detritus food chain is made up of decomposers which are heterotrophic organisms, mainly fungi and bacteria. They get energy and nutrients by decomposing dead organic matter or detritus.

3. Name the phenomenon and one bird where the female gamete directly develops into a new organism. [1]

Answer : Phenomenon : Parthenogenesis

Bird : Turkey.

SECTION–B

10. What is meant by "alien species" invasion ? Name one plant one animal alien species that are a threat to our Indian species. [2]

Answer : An alien species whose introduction does or is likely to pose threat to the survival of many native species and cause their extinction.

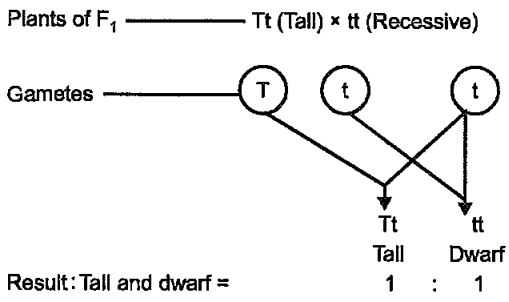
Plants : *Parthenium, Lantana, Eicchornia*

Animal : *African catfish, Clarias gariepinus*

SECTION–C

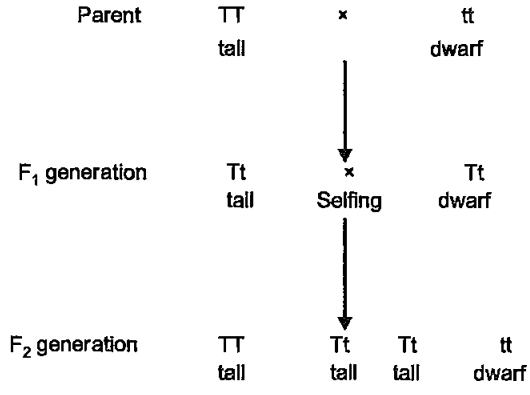
14. Work out a cross to find the genotype of a tall pea plant. Name the type of cross. [3]

Answer : 1. Test cross is used to find out the genotype of any trait. In this cross F_1 hybrid of pure tall plant and a pure dwarf plant is crossed with a dwarf plant. *e.g.*, Tt × tt



The progeny consists of tall and dwarf plants in the ratio of 1:1

2. If the dominant plants are homozygous *i.e.*, TT, then the progeny will have all tall plants :



15. Write the Oparin and Haldane's hypothesis about the origin of life on earth. How does meteorite analysis favour this hypothesis. [3]

Answer : Oparin–Haldane Hypothesis : Alexander I Oparin (1894–1980) a Russian biochemist and J.B.S. Haldane (1892–1964), a British Scientist, put forward the concept that the first living organism evolved from non-living material.

According to Oparin and Haldane (1929), spontaneous generation of early molecules might have taken place through a series of chemical reactions from the earth's primordial soup in a reducing atmosphere. The compounds of soup could be expected to react with one another producing a variety of chemical substances like amino acids, sugars, N_2 bases. These precursor molecules then combine resulting in the appearance of proteins, polysachharides and nucleic acids. Energy required for these reactions was provided by UV radiations, cosmic rays, electric discharges etc.

19. (i) Explain DNA polymorphism as the basis of genetic mapping of human genome.

(ii) State the role of VNTR in DNA fingerprinting. [3]

Answer : (i) Polymorphism (variation at genetic level) is the result of mutation. Variation in allele sequence is DNA polymorphism *i.e.*, if more than one variant (allele) at a locus occurs in human population with a frequency greater than 0.01. In other term we can say that if an inheritable mutation is observed in a population at high frequency, it is referred as DNA polymorphism. There is a variety of different types of polymorphism ranging from single nucleotide change to very large scale changes. For evolution and specification, such polymorphism is important. DNA polymorphism is also used in genetic and physical maps on the human genome. In genetic mapping, information on polymorphism of restriction endonuclease recognition sites are used.

(ii) Role of VNTR in DNA Finger printing : Radiolabelled VNTR (Variable Number of Tandem Repeat) is used as a probe in DNA finger-printing. A tandem repeat is a short sequence of DNA that is repeated in a head-to-tail fashion at a specific chromosomal locus. Tandem repeats are interspersed throughout the human genome. Some sequences are found at only one site – a single locus – in the human genome. For many tandem repeats, the number of repeated units vary between individuals. Such loci are termed as VNTRs.

SECTION–D

30. How does the process of natural selection affect Hardy-Weinberg equilibrium ? Explain. List other four factors that disturb the equilibrium. [5]

Answer : Population or Mendelian population is a group of individuals present in a geographical area which share a common pool. Gene frequency is the percentage of an allele in relation to the total alleles of a gene in an interbreeding population. All the genes and their alleles together constitute **gene pool.** Normally the alleles tend to maintain

an equilibrium with reference to one another over the generations. It is referred as genetic equilibrium. Such a population is referred as non-evolving populaiton. G.H. Harady and Withelm Weinberg proposed a principle independently in 1908, about the genetic structure of a non-evolving population. It is known as Hardy-Weinberg equilibrium. The allelic frequencies in non-evolving population are stable and remain constant from generation to generation.

The Hardy-Weinberg Equilibrium can change by process of natural selection. Natural or survival of the fittest is a major factor that adds variation in the population, changes the gene frequencies of the gene pool leading to evolution and formation of a new distinctive gene pool. It operates through differential or non-random reproduction. If same type of selection continues for a few generation; the gene pool will undergo change that the alleles having the advantage of surviving. Thus it leads to change of gene pool.

OR

(a) Explain Mendel's Law of independent assortment by taking a suitable example.

(b) How did Morgan show the deviation in inheritance pattern in Drosophila with respect to this law ?

Answer : (a) Dihybrid cross is based on Law of Independent Assortment. This law states that when two pairs of traits are combined in a hybrid, segregation of one pair of characters is independent of the other pair of characters.

The image shows a true-breeding plant with the dominant traits of green pod colour (GG) and yellow seed colour (YY) being cross-pollinated with a true-breeding plant with yellow pod colour (gg) and green seeds (yy). The resulting offspring are all heterozygous for green pod colour and yellow seeds (GgYy). If the offspring are allowed to self pollinate, a 9 : 3 : 3 : 1 ratio will be seen in the next generation. About 9 plants will have green pods and yellow seeds, 3 will have green pods and green seeds, 3 will have yellow pods and yellow seeds and 1 will have a yellow pod and green seeds.

Parents	GGYY		×		ggyy			
Gametes	Gy				gy			
F1 gen.			GgYy		×		GgYy	
Gametes	(Gy)	(Gy)	(gY)	(gy)	(Gy)	(Gy)	(gY)	(gy)

GgYy / Gg Yy	Gy	Gy	gY	gy
Gy	GGyy Green pod Yellow seed	GGYy Green pod Yellow seed	Ggyy Green pod Yellow seed	GgYy Green pod Yellow seed
Gy	GGYy Green pod Yellow seed	GGyy Green pod Green seed	GgYy Green pod Yellow seed	Ggyy Green pod Green seed
gY	Ggyy Green pod Yellow seed	GgYy Green pod Yellow seed	ggyy Yellow pod Yellow seed	ggYy Yellow pd Yellow seed
gy	GgYy Green pod Yellow seed	Ggyy Green pod Green seed	ggYy Yellow pod Yellow seed	ggyy yellow pod Green seed

Phenotypic ratio	=	9 : 3 : 3 : 1
Green pod Yellow seed	=	9
Green pod Green seed	=	3
Yellow pod yellow seed	=	3
Yellow pod green seed	=	1

(b) Morgan and his group observed that when the two genes in a dihybrid cross were located on the same chromosome, the proportion of parental gene combinations in the progeny were much higher than the non-parental or new combinations (recombinants) of genes.

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Biology 2013 (Delhi) SET I

Time allowed : 3 hours **Maximum marks : 70**

SECTION–A

1. **An anther with malfunctioning tapetum often fails to produce viable male gametophytes. Give any one reason.** [1]

   Answer : The tapetum is responsible for nourishing the pollen grains. Tapetum malfunctioning results in insufficient nutrition of the pollen grains, and will not be able to produce viable male gametophytes.

2. **Why sharing of injection needles between two individuals is not recommended ?** [1]

   Answer : Sharing of injection needle between two individuals could lead to the transfer of blood borne diseases *viz.*, HIV from infected person to a healthy person.

3. **Name the enzyme and state its property that is responsible for continuous and discontinuous replication of the two strands of a DNA molecule.** [1]

   Answer : DNA dependent DNA polymerase is the enzyme. The property that is enzyme catalyse polymerisation only in one direction, *i.e.*, $5' \rightarrow 3'$. As a result on template strand with $3' \rightarrow 5'$ the replication is continuous while on the template strand with polarity $5' \rightarrow 3'$ it is discontinuous.

4. **Identify the examples of convergent evolution from the following :** [1]

   (i) Flippers of penguins and dolphins

   (ii) Eyes of octopus and mammals

   (iii) Vertebrate brains

   Answer : The examples of convergent evolution are :

   (i) Flippers of penguins and dolphins.

   (ii) Eyes of octopus and mammals.

5. **Write the importance of MOET.** [1]

   Answer : This technique is used to increase the successful rate of production of hybrids in short duration of time. e.g., In MOET cow is given hormones with FSH like activity. These hormones induce follicular maturation and super-ovulation which produces 6–8 eggs per cycle instead of one egg.

6. **Why is the enzyme cellulase needed for isolating genetic material from plant cells and not from the animal cells ?** [1]

   Answer : Plant cells have cell wall of cellulose but animal cells have no cell wall and do not have cellulose. So the enzyme cellulase is required for isolating genetic material from plant cells only.

7. **Name the type of biodiversity represented by the following :** [1]

   (a) 50,000 different strains of rice in India.

   (b) Estuaries and alpine meadows in India.

   Answer : **(a)** Genetic diversity, **(b)** Ecological diversity.

8. **Write the equation that helps in deriving the net primary productivity of an ecosystem.** [1]

   Answer : Net primary productivity (NPP) in an ecosystem can be derived using the following equation,

   NPP = GPP (Gross primary productivity) – R (Respiratory losses)

SECTION–B

9. **Geitonogamous flowering plants are genetically autogamous but functionally cross-pollinated. Justify.** [2]

   Answer : Geitonogamy is a pollination where the pollen grains are transferred from the anther of

a flower to the stigma of another flower on the same plant.

Geitonogamous flowering plants are usually autogamous as the gametes come from the same parent plant, but since the pollen grains are being passed to a different flower which requires a pollinating agent, it is an example of cross pollination.

10. When and where do chorionic villi appear in humans ? State their function. [2]

Answer : Chorionic villi appear as finger like projections that arise from the trophoblast layer of blastocyst when it is undergoing implantation.

Functions of Chorionic villi :

1. It inter-digitates with projections from uterine tissue to form a structure called the placenta, which is the connecting link between the mother and the foetus.
2. It facilitates the supply of oxygen and nutrients to the embryo.

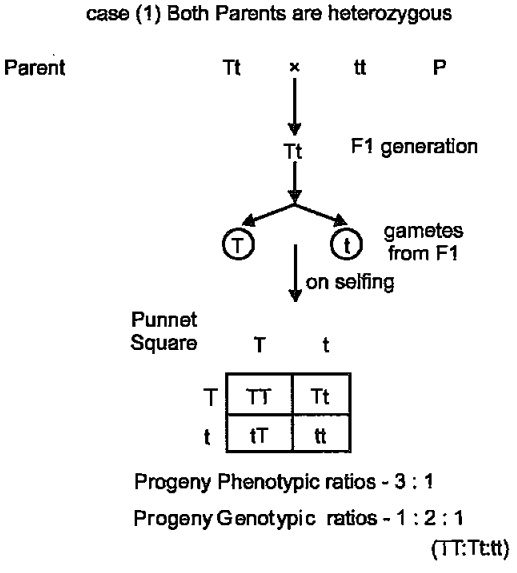
11. In a cross between two tall pea plants some of the offsprings produced were dwarf. Show with the help of Punett Square how this is possible. [2]

Answer : In a cross between 2 phenotypically tall plants, some of the progeny may become to be phenotypically dwarf. It defines both parents are heterozygous (Tt). The cross is demonstrated below by a Punnett Square.

Genotype of Parents = Tt.

Genotypic ratios of progeny after F_1 cross= TT, Tt, Tt, tt.

Phenotypic ratios= 1 TT+ 2 Tt : 1 tt or 3 Tall : 1 dwarf



Progeny Phenotypic ratios - 3 : 1

Progeny Genotypic ratios - 1 : 2 : 1 (TT:Tt:tt)

12. A student on a school trip started sneezing and wheezing soon after reaching the hill station for no explained reasons. But, on return to the plains, the symptoms disappeared. What is such a response called ? How does the body produce it ? [2]

Answer : The responses such as sneezing and wheezing for no explained reasons is called Allergy. The substance against which the immune system shows such exaggerated response are termed as allergens. Allergy is produced in a body due to release of chemicals like histamine and serotonin from mast cells. Body produces IgE type of antibody against allergens as a response. Most common example of such allergens are pollen grains, dust etc.

13. Name two commonly used bioreactors. State the importance of using a bioreactor. [2]

Answer : The two most widely used bioreactors are simple stirred - tank bioreactor and sparged stirred- tank bioreactor.

The importance of using bioreactors :

1. It gives huge amount for cultures. So, products are produced in large quantity.
2. It gives optimal conditions like temperature and pH for growth of desired product.

14. Write the function of adenosine deaminase enzyme. State the cause of ADA deficiency in humans. Mention a possible cure for a ADA deficiency patient. [2]

Answer: The enzyme adenosine deaminase (ADA) is very important for the proper functioning of our immune system. The cause of ADA deficiency in humans is deletion of the gene which codes for ADA. ADA deficiency can be cured permanently by gene therapy. Then functional ADA gene is inserted in the cells at early embryonic age for permanent cure.

15. Expand the following and mention one application of each :

(i) PCR (ii) ELISA [2]

Answer : (i) PCR-Polymerase chain reaction is a technique in molecular biology to amplify a gene or a piece of DNA to obtain its several copies. Each cycle of PCR has three steps :

(a) Denaturation of DNA Strand

(b) Primer annealing

(c) Extension of primers

Use : It is extensively used in the process of gene manipulation.

(ii) ELISA (Enzyme Linked Immunosorbent Assay) is a method in molecular biology which utilizes antigens and antibodies to find infectious diseases. An infection is found by the presence of antigens like proteins or by the synthesis of antibodies against the infection. This method is broadly used for finding AIDS.

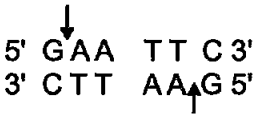
OR

(a) Mention the difference in the mode of action of exonuclease and endonuclease.

(b) How does restriction endonuclease function?

Answer : (a) Exonuclease removes the nucleotides from the ends of the DNA chain while endonuclease cuts the DNA at the specific positions within the DNA strand.

(b) Each restriction endonuclease finds its specific pallindromic nucleotide sequences in the DNA and cut the DNA at these specific sites. It does so by binding to the DNA at these sites and cutting both the strands at specific points in their sugar-phosphate backbones. *e.g.*, E CORI cuts the DNA at the following palindromic sequences.



16. Name any two sourc of e-waste and write two different ways for their disposal. [2]

Answer : Two sources of e-waste are :

1. Irreparable computers.
2. Electronic items like mobile phones, television sets etc.

Two different ways of disposal of e-waste :

1. Dumping the e-wastes into landfills.
2. Incinerating e-waste *i.e.*, burning the e-wastes completely into ashes.

These ways of disposal pose threat to the environment by releasing toxic substances into it. So, recycling of e-waste in an environment-friendly manner is the only solution for its disposal.

17. Why the pyramid of energy is always upright? Explain. [2]

Answer : The pyramid of energy shows the total quantity of energy used by each trophic level in a given food chain. An energy pyramid is always upright because the total quantity of energy available for utilisation at the upper trophic level is less than the energy available at the lower levels. This occurs because according to the 10% law of energy transfer, only 10% of the total energy is transmitted from one trophic level to another and when energy transmits from a one trophic level to next trophic level, some amount is always lost as heat at each step. Eventually it is lost to atmosphere and never goes back to Sun.

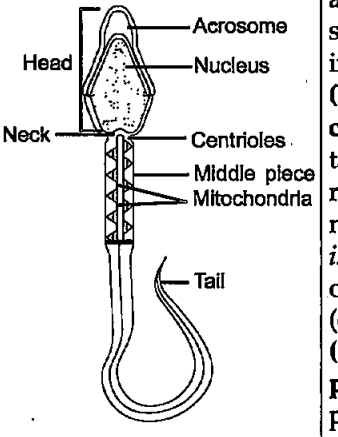
18. Explain why very small animals are rarely found in polar region ? [2]

Answer : Loss of body heat is directly proportional to the surface area. So, small animals have larger surface area as compared to their volume. They lose body heat rapidly in colder areas. Loss of body heat in colder areas can create challenge to their survival. That is why very small animals are rarely found in polar areas.

SECTION–C

19. Draw a diagram of the microscopic structure of human sperm. Label the following parts in it and write their functions : (a) Acrosome, (b) Nucleus, (c) Middle piece. [3]

Answer : Structure of human sperm :



(a) Function of Acrosome : It provides mobility to the sperm and releases acrosomal contents like hyaluronidase and acrosin which helps sperm to allow entry into the egg to fuse.

(b) Function of Nucleus : The nucleus contains the genetic material. It contains haploid number of chromosome *i.e.*, 22 autosomes and one sex chromosome (either X or Y).

(c) Function of Middle piece : The middle piece contains number of mitochondria. The mitochondria contains oxidative enzymes and enzymes ATP production. Therefore middle piece acts as a power-house for a sperm.

20. With the help of any two suitable examples explain the effect of anthropogenic action or organic evolution. [3]

Answer : The anthropogenic activities result in increased rate of organic evolution. For example:

1. The extreme use of herbicides and pesticides causes selection of resistant variety of pests and insects in a short time period. The change in the environment facilitates resistant pests and insects in their evolution.

2. The excessive use of antibiotics causes selection of drug resistant microbes. The micro-organisms which are sensitive to specific antibiotics died but few variants of micro-organisms which develop resistance against the specific antibiotics are survived. This assists in the evolution of deadly lethal micro-organisms.

21. (a) Why is human ABO blood group gene considered a good example of multiple alleles?

(b) Work out a cross up to F_1 generation only, between a mother with blood group A (Homozygous) and the father with blood group B (Homozygous). Explain the pattern of inheritance exhibited. [3]

Answer : (a) A gene is represented by two alleles. But, for the blood group in humans there are three alleles namely I^A, I^B and i governing a same character. Thus, it is an example of multiple allele. I^A and I^B alleles are dominant over I^O. These alleles decide the blood group of person.

Allele from parent 1	Allele from parent 2	Blood type of offspring
I^A	I^A	A
I^A	I^B	AB
I^A	i	A
I^B	I^A	AB
I^B	I^B	B
I^B	i	B
i	i	O

(b) Mother $(I^A I^A)$ × Father $(I^B I^B)$

↓

Child ← $(I^A I^B)$

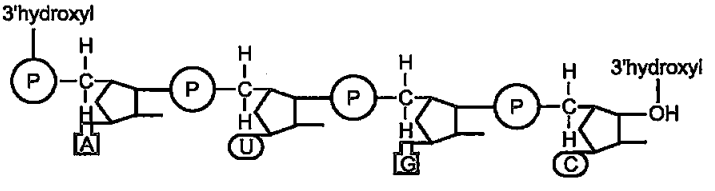
Thus, the child will have blood group AB.

The pattern of inheritance is called co-dominance.

22. Describe the structure of a RNA polynucleotide chain having four different types of nucleotides. [3]

Answer : A RNA nucleotide has three main components : **a nitrogenous base, a ribose sugar and a phosphate group.**

1. The ribose sugar and the phosphates form the backbone of a polynucleotide chain with nitrogenous bases linked to sugar moiety and projecting from the backbone.
2. Two types of nitrogenous bases are present *i.e.*, Purines (Adenine (A) and Guanine (G)) and Pyrimidines (Cytosine (C) and Uracil (U)).
3. A nitrogenous base is linked to the ribose sugar through N-glycosidic linkages to form a nucleoside (like adenosine, guanosine or cytidine and uridine).
4. A phosphate group is linked to 5′-OH of a nucleoside through phosphoester linkage to form a corresponding nucleotide.
5. Every nucleotide residue has an additional –OH group present at 2′ -position in the ribose.
6. Many nucleotides are linked through 3′-5′ phospho-diester linkages to each other to form the polynucleotide chain.
7. The end of the chain which has a free phosphate moiety at 5′- end of ribose sugar is referred to as 5′- end and the other end of the chain having a free 3′-OH group at the ribose sugar is referred to as 3′- end of the polynucleotide chain.



23. Differentiate between inbreeding and outbreeding in cattle. State one advantage and one disadvantage for each one of them. [3]

Answer : Difference between inbreeding and outbreeding

S.No.	Inbreeding	Outbreeding
(i)	Mating of closely related individuals within the same breed for 4–6 generations.	Breeding the unrelated animals of the same or different breed not having common ancestor.
(ii)	It cannot be divided into further types.	It includes out-crossing, cross-breeding, and interspecific hybridisation.
(iii)	Mating is between same species.	Mating can be between different species.

Inbreeding :

Advantage : Pure breed of progeny.

Disadvantage : It reduces the fertility and productivity of an organism because of constant inbreeding. This is also called as Inbreeding depression.

Outbreeding :

Advantage : Progeny has proffered features of both the parents.

Disadvantage : The hybrid animal produced is not every time fertile.

24. (a) Why are the fruit juices bought from market clearer as compared to those made at home? [3]

(b) Name the bioactive molecules produced by *Trichoderma polysporum* and *Monascus purpureus*.

Answer : (a) The fruit juices available in the market (the bottled ones) are made clear by treating them with the enzymes – pectinases and proteases. So, they are clearer as compared to those made at home.

(b) *Trichoderma polysporum* is used to produce immunosuppressive agent cyclosporin A.

Monascus purpureus is used to produce blood-cholesterol lowering agent called statin.

25. (a) Why are transgenic animals so called ?

(b) Explain the role of transgenic animals in (i) Vaccine safety and (ii) Biological products with the help of an example each. [3]

Answer : (a) Transgenic animals are called so as these animals acquire foreign gene that is intentionally inserted into the genome. The foreign gene is inserted in the genome of the organisms by recombinant DNA technology.

(b) (i) Role of transgenic animal in vaccine safety : Now a days transgenic mice are being used in testing the safety of vaccines before they are available to humans use.

Example : Transgenic mice are being used to test the safety of the polio vaccine. If the transgenic mice found doing well and trustworthy, they could substitute the use of monkeys to test the safety of batches of the vaccine.

(ii) Role of transgenic animal in production of biological products : Transgenic cow, Rosie is used for the production of human protein-enriched milk, which contains human α-lactalbumin and it was having increased nutrition more suitable for human babies.

26. How have human activities caused desertification ? Explain. [3]

Answer : Following human activities contribute to desertification :

1. **Deforestation :** To construct road, buildings, new city etc., the trees are being cut down which results in desertification.
2. **Improper farming practices :** If same crop is growing again and again over a longer period of time it makes the soil deprived resulting in the loss of fertility of soil.
3. Excessive ploughing of field.
4. **Soil erosion :** Soil erosion by deforestation due to industrialization and construction of houses.
5. Mining actions and leaching of minerals further obliterate soil quality results in infertile soil.

OR

How does algal bloom destroy the quality of a fresh water body ? Explain. [3]

Answer : An algal bloom is the result of excessive growth of planktons forms in a highly nutrient rich water body. When the planktonic species grow repetitively on the surface of water body, it results in a layer that finally covers the whole surface of the water body. They prevent sunlight to reach to the bottom and make unavailable to submerged aquatic species which is having role

in delivering essential nutrients to other aquatic life forms.

Some algal species discharge molecules that are toxic and lethal for other aquatic organisms. Because of high respiratory rate the biological oxygen demand (BOD) of the water body increases which causes death of a number of aquatic organisms. Their remains after their death again contribute to the deterioration of water quality.

27. Explain mutualism with the help of any two examples. How is it different from commensalism ? [3]

Answer : Mutualism is a kind of population interaction in which both the participating species derive a benefit from each other's presence. Examples of mutualism are given below :

1. Associations between fungi and plants, known as mycorrhizae : The plant gets benefits by soil nutrients that the fungus absorbs and transmits to the plant by its roots. The fungus then derives the benefit of getting energy yielding carbohydrates from plant.

2. Pollination : The flowers provide sweet, mucilaginous nectar to birds or insects on the contrary for getting benefit from the bird or insect in passing their pollen grains onto other flowers. The plant - pollinator pair often goes co-evolution to safeguard against the use of the nectar by other non-important organisms.

Mutualism is different from commensalism in that the latter gives benefit to just one of the participating species, the benefitted species being called a commensal.

SECTION–D

28. (a) Draw a diagrammatic sectional view of a mature anatropous ovule and label the following parts in it :

(i) that develops into seed coat.

(ii) that develops into an embryo after fertilization.

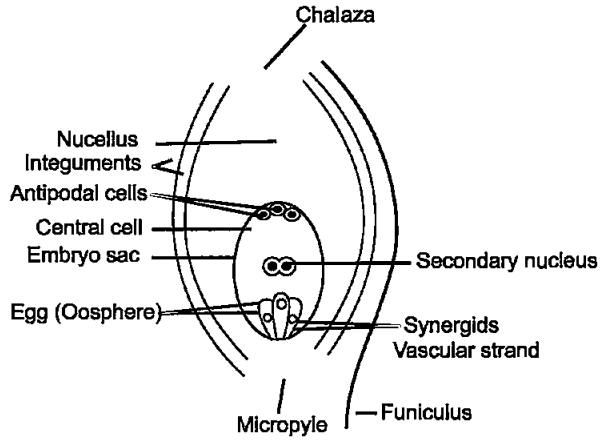
(iii) that develops into an endosperm in an albuminous seed.

(iv) through which the pollen tube gain entry into the embryo sac.

(v) that attaches the ovule to the placenta.

(b) Describe the characteristic features of wind pollinated flowers. [5]

Answer : (a)



(i) The part that develops into seed coat– **Integument**

(ii) The part that develops into an embryo after fertilization – **Embryo sac or ovule**

(iii) The part that develops into an endosperm in an albuminous seed – **Nucellus**

(iv) The part through which the pollen tube gains entry into the embryo sac – **Micropyle**

(v) The part that attaches the ovule to the placenta–**Funicle**

(b) Characteristics of wind pollinated flowers:

1. It shows compact inflorescence.
2. It has well exposed stamens.
3. The plants produce large quantity of pollens.
4. The pollens are dry and unwettable.

OR

(a) Draw a diagrammatic sectional view of the female reproductive system of human and label the parts :

(i) Where the secondary oocytes develop ?

(ii) Which helps in collection of ovum after ovulation ?

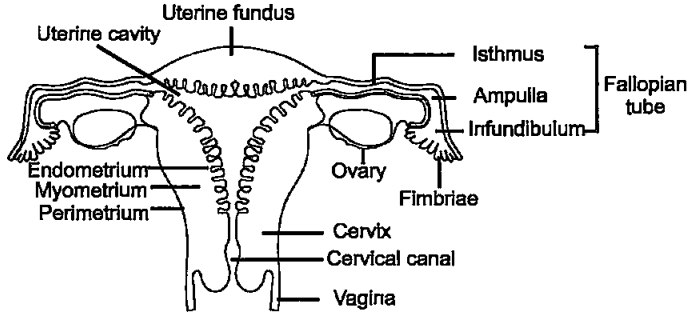
(iii) Where fertilization occurs ?

(iv) Where implantation of embryo occurs ?

(b) Explain the role of pituitary and the ovarian hormones in menstrual cycle in human females. [5]

Answer :

(a) The female Reproductive System



(i) The Ovary
(ii) Fimbriae
(iii) Fallopian tubes
(iv) Uterus

(b) The role of pituitary and the ovarian hormones in menstrual cycle in human females :

The Menstrual cycle lasts for about 4-5 days. If fertilization does not occur, the corpus luteum degenerates, and the inner lining of uterus and fallopian tubes which contains soft tissue and blood vesseles sheds off, resulting in menstrual flow. In this phase, the primary follicles grow into the Graffian follicles results in the regeneration of the endometrium.

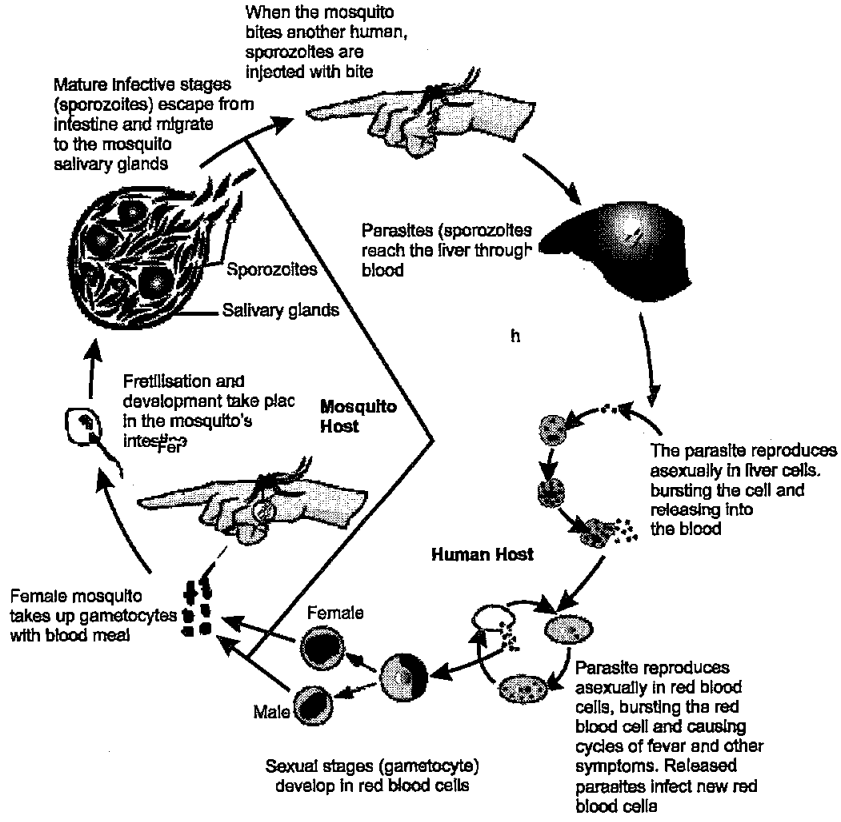
Ovarian and pituitary hormones are responsible for following changes :

1. The release of gonadotropins (LH and FSH) increases which facilitates follicular growth and the growing follicles produces oestrogen.
2. In the middle of the menstruation cycle (14th day) the LH and FSH are at their peak, assist rupture of the Graffian follicles to discharge ovum. This phase is known as ovulatory phase.
3. The remains of the Graffian follicles gets transformed into the corpus luteum, which secretes progesterone for the maintenance of the endometrium.

29. Describe the asexual and sexual phase of life cycle of *Plasmodium* that causes malaria in humans. [5]

Answer : Life Cycle of *Plasmodium* :

1. *Plasmodium* requires two hosts to complete its life cycle.
2. When female *Anopheles* mosquito bites a healthy human being, it injects *Plasmodium*, which lives in its *Anopheles* mosquito as sporozoite, the infectious form.
3. The parasites *Plasmodium* multiply (asexual reproduction) after transportation to the liver cells and finally ruptures the liver cells. Sporozoite parasites are then released into blood stream.
4. Bursting of RBCs is accompanied by release of a toxic substance called haemozoin (associated with fever and chills).
5. In the RBCs, only sporozoites change into gametocytes (sexual stage).
6. When the diseased person is bitten by a female *Anopheles* mosquito, gametocytes are introduced into the mosquito.
7. Gametocytes fertilise and develop inside the intestine of mosquito to form sporozoites.
8. Sporozoites are stored in the salivary glands of mosquito and are released into the healthy person who is bitten by this mosquito.



OR

(a) What is plant breeding ? List the two steps the classical plant breeding involves.

(b) How has the mutation breeding helped in improving crop varieties ? Give one example where this technique has helped.

(c) How has the breeding programme helped in improving the public nutritional health ? State two example in support of your answer. [5]

Answer : (a) Plant breeding is a method that involves the crossing of two plants to create the progeny with certain traits in their genes and transfer on to the future generations to create specific plant types which are more suitable for cultivation, give better yields, and are disease resistant.

Two steps involved in Classical plant breeding are :

1. Crossing of superior pure lines.
2. Selection of plants with desired characteristics.

(b) Mutation breeding : In this, genetic variations are made, which then creates traits, not found in the parental type. It has benefitted in making disease resistant plants by giving resistance against bacterial, fungal and viral diseases.

(c) Breeding helped in improvising the public nutritional health by growing crops that are good in nutrients. This is called bio-fortification of crops. Benefits of bio-fortification are to help :

1. Protein content and quality
2. Oil content and quality
3. Vitamin content
4. Micronutrient and mineral content

Two examples are :

1. Maize hybrids 2000 grow and have 2 times the quantity of lysine and tryptophan compared to other maize hybrids.
2. Atlas 66 (a wheat variety having higher protein content).

30. A child suffering from Thalassemia is born to a normal couple. But the mother is being blamed by the family for delivering a sick baby.

(a) What is Thalassemia ?

(b) How would you counsel the family not to blame the mother for delivering a child suffering from this disease ? Explain.

(c) List the values your counselling can propagate in the families. [5]

Answer : (a) Thalassemia is an autosomal recessive blood disorder. Thalassemia is illustrated by severe anaemia due to production of imperfect haemoglobin chains. Thalassemia is caused by mutations in the genes coding either the alpha, beta or delta chains constituting haemoglobin leads to the synthesis of incorrectly folded haemoglobin that is unable to transport oxygen proficiently.

(b) Thalassemia is an autosomal recessive disease, which means the mutation is carried on one of the autosomes, so the carrier can be any one of the two parents. It has an equal chance of coming from the mother or the father, so to just blame the mother for the child's defect is unfair.

(c) The values of counselling can propagate in the families are :

1. Provide healthy diet to the child.
2. Accepting their child with all his/her positives and negatives.
3. None of the parents is responsible for giving birth to a sick baby.
4. The defect in the gene is caused by a random changes in the genes of the child.
5. Encouraging the child to follow his/her treatment regularly and lead a happy and normal life.

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Biology 2013 (Delhi) SET II

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous set.

SECTION–A

5. Identify the examples of homologous structures from the following : [1]

(i) Vertebrate hearts

(ii) Thorns in Bougainvillea and tendrils of Cucurbita.

(iii) Food storage organs in sweet potato and potato.

Answer : (ii) Thorns in Bougainvillea and tendrils of Cucurbita.

SECTION–B

9. Describe the gene therapy procedure for an ADA-deficient patient. [2]

Answer : Gene therapy of ADA deficiency :

1. The term gene therapy describes as genetic modification of cells. The material transferred into patient's cell through genes, gene segment or oligonucleotides.
2. Lymphocytes isolated from patient's blood are cultured in vitro. Functional ADA are then introduced into the cultured lymphocytes.
3. These lymphocytes are returned back to the patient's body.
4. The gene must be delivered inside the target cells and work properly without causing adverse effects to cure the disease.
5. The introduction of isolated gene from bone marrow cell producing ADA into cells at early embryonic stages used can be a permanent cure for this disorder.

14. (a) How does cleistogamy ensure autogamy ? [2]

(b) State one advantage and one disadvantage of cleistogamy to the plant.

Answer : (a) Cleistogamous flowers do not open at all and pollen from other plants cannot fall on the stigma of these flowers. In this situation cross pollination cannot be possible and only autogamy occurs. Therefore, clesistogamy ensures autogamy.

(b) Cleistogamy has this advantage that the plant can propagate itself under unfavourable conditions and disadvantage is that, no chances of cross pollination, self pollination occurs therefore chances of variation and evolution of genetically superior progeny is reduced.

17. A young boy when brought a pet dog home started to complain of watery eyes and running nose. The symptoms disappeared when the boy was kept away from the pet.

(a) Name of type of antibody and the chemicals responsible for such a response in the boy.

(b) Mention the name of any one drug that could be given to the boy for immediate relief from such a response. [2]

Answer : (a) The IgE type of antibody and chemicals like histamine and serotonin released from mast cells are responsible for this type of response.

(b) 1. Anti–histamine **2.** Adrenalin

3. Steroids can be given to the boy for immediate relief from such a response.

18. (a) Explain how to find whether an *E. coli* bacterium has transformed or not when a recombinant DNA bearing ampicillin resistant gene is transferred into it.

(b) What does the ampicillin resistant gene act as in the above case ? [2]

Answer : (a) When *E. coli* with a recombinant DNA will be grown on culture media having ampicillin the transformed cells will survive as they carry recombinant DNA with ampicillin resistant gene; while the non–transformed cells will die as they are ampicillin sensitive.

(b) Antibiotic resistant genes such as amp^R (ampicillin resistant), act as selectable markers.

SECTION–C

22. (a) Explain how to overcome inbreeding depression in cattle.

(b) List three advantages of inbreeding in cattle.

(c) Name an improved breed of cattle. [3]

Answer : (a) Inbreeding depression in cattle can be overcome by mating selected animals with unrelated superior animals of the same breed. It is called out-breeding.

(b) Advantages of inbreeding in cattle :

1. Maintaining the accumulation of superior quality of breed of organisms.
2. Evolve a pure breed of progeny.
3. Elimination of deleterious alleles as they are not passed to future generations.

(c) Jersey cow is an improved breed of cattle.

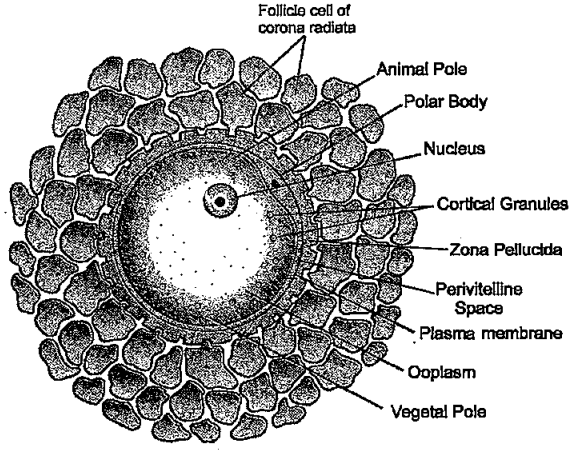
27. (a) Draw a diagram of the structure of a human ovum surrounded by corona radiate. Label the following parts :

(i) Ovum, (ii) Plasma Membrane,

(iii) Zona Pellucida,

(b) State the function of Zona Pellucida. [3]

Answer : (a) Diagram of a mature ovum



Structure of Ovum

(b) Zona pellucida layer of the ovum prevents entry of more than one sperm and inhibits

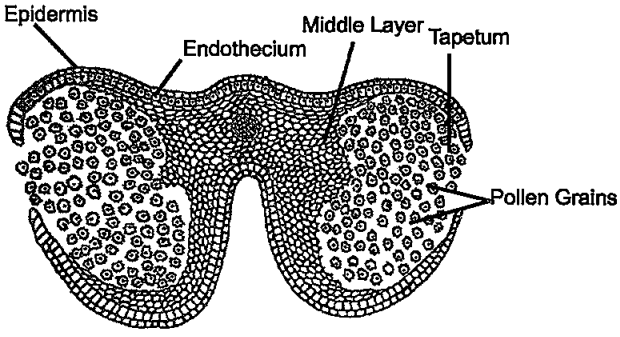
polyspermy in humans. It also facilitates changes in the membrane of the ovum to block the entry of additional sperms, thereby making sure the entry of only one sperm inside the ovum.

SECTION–D

30. (a) Draw a labelled schematic diagram of the transverse section of a mature anther of an angiosperm plant.

(b) Describe the characteristic feature of an insect pollinated flower. [5]

Answer : (a) Diagram of transverse section of a mature anther of an angiospermic plant.



T.S. of mature anther of an angiosperm plant

(b) Characteristic features of an insect pollinated flower :

1. Contains nectar to attract the animal pollinators
2. Large, colourful and fragrant flowers
3. Ovule may be one or more
4. Sticky pollen grains

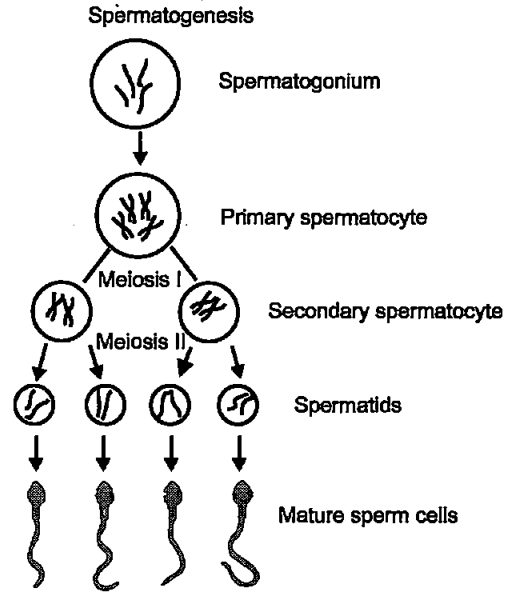
OR

(a) Describe the events of spermatogenesis with the help of a schematic representation.

(b) Write two differences between spermatogenesis and oogenesis.

Answer : (a)

1. Spermatogenesis starts at the age of puberty.
2. Spermatogonia are present on the inside wall of seminiferous tubules multiply by mitotic divisions and increase in number.
3. Each spermatogonium is diploid and contains 46 chromosomes.
4. Some of spermatogonia called primary spermatocytes undergo meiosis I to produce 2 equal haploid cells called - secondary spermatocytes with 23 chromosomes each.
5. Secondary spermatocyte undergoes second meiotic division to produce 4 equal haploid spermatids.
6. Spermatid later transforms into spermatozoa.



Schematic representation of spermatogenesis

(b)

S. No.	Spermatogenesis	Oogenesis
(i)	In male, spermatogenesis occurs thoughout the life of human male.	Oogenesis stops at the stage of menopause in human female.
(ii)	It is the process by which sperms are formed from the sperm mother cell in males.	It is the process by which ovum is formed from the oogonia in females.

●●

Biology 2013 (Delhi) SET III

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous sets.

SECTION–A

6. "Sweet potato tubers and potato tubers are the result of convergent evolution." Justify the statement. [1]

Answer : Convergent evolution is the process where some diverse organisms individually develop the traits which are similar in function. *i.e.*, sweet potato tubers and potato tubers are not anatomically similar structures even though they perform similar function, *e.g.*, storage of food and vegetative reproduction but both are different in origin *i.e.*, sweet potato is an adventitious root and potato tuber is an underground stem.

SECTION–B

13. Explain the steps that ensure cross pollination in an autogamous flower. [2]

Answer : Cross pollination in an autogamous flower represents by the following steps :

1. Pollen grains and stigma receptivity should not be synchronized.

2. Anther and stigma are placed at different positions so that pollen cannot come in contact with stigma of the same flower.

3. Self–incompatibility also prevents inbreeding.

16. A student on a picnic to a park on a windy day started sneezing and having difficulty in breathing on reaching the park. The teacher enquired whether the student was allergic to something. [2]

(a) What is an allergy ?

(b) Write the two unique characteristics of the system involved in the response observed in the student ?

Answer : (a) Allergy is a hypersensitive reaction of foreign substances by the immune system. The body system of defense against these substances particularly pathogens (the agents of infection) caused allergy. The inflammation of the tissues inside the nose causes allergy after allergens are inhaled.

(b) The two unique characteristics of the system involved in the response observed in the students are :

1. The immune system recognizes foreign antigens and responds to them.

2. It has a memory so it remembers antigens.

17. Why and how bacteria can be made 'competent'? [2]

Answer : The bacterial cells are made competent by treating them with a specific concentration of divalent cations like calcium or magnesium *e.g.*, $CaCl_2$ or $MgCl_2$. This makes the cell wall permeable and bacterial cell takes up the plasmid DNA.

18. (a) Name the deficiency for which first clinical gene therapy was given. [2]

(b) Mention the cause of and one cure for this deficiency.

Answer : (a) ADA (Adenosine deaminase) deficiency.

(b) Cause : The gene coding for enzyme ADA gets deleted leading to deficiency of ADA and problems in immune system.

Cure : It can be treated by isolating the gene for ADA from bone marrow cells at embryonic stage.

SECTION-C

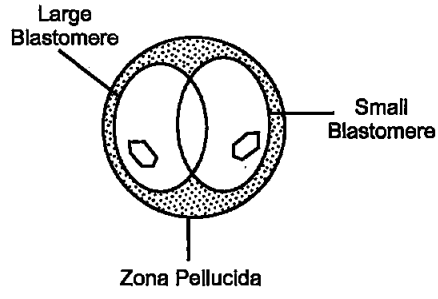
23. Draw the following diagrams related to human reproduction and label them.

(a) The zygote after the first cleavage division

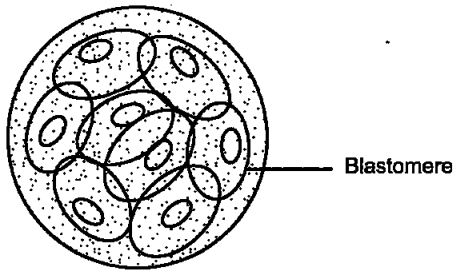
(b) Morula stage

(c) Blastocyst stage (sectional view) [3]

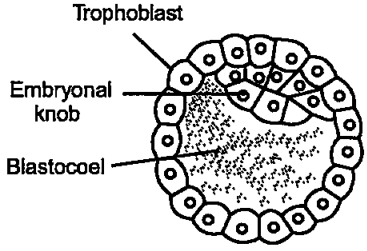
Answer : (a) The zygote after the first cleavage division



(b) Morula stage



(c) Blastocyst stage (sectional view)

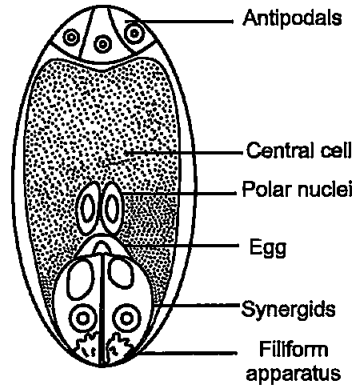


29. Draw a diagram of a mature embryo sac of an angiosperm and label the following parts in it. **[5]**

(i) Filiform apparatus (ii) Synergids
(iii) Central cell (iv) Egg cell
(v) Polar nuclei (vi) Antipodals

(b) Write the fate of egg cell and polar nuclei after fertilization.

Answer : (a)



Mature embryo sac of an angiosperm

(b) Fate of Egg cell and polar nuclei : Egg cell fuses with male gametes to form zygote. Zygote finally gives rise to Embryo while the polar nuclei fuses with the other male gamete to produce a triploid Primary Endosperm Nucleus (PEN). PEN develops into endosperm. Since two kinds of fusion syngamy and triple fusion takes place, the process is known as double fertilisation, and is a characteristic of flowering plants.

●●

Biology 2012 (Outside Delhi) SET I

Time allowed : 3 hours **Maximum marks : 70**

SECTION–A

1. Why is banana considered a good example of parthenocarpy ? **[1]**

Answer : Banana is considered a good example of parthenocarpy because formation of fruit in banana occurs without fertilization (parthenocarpy), *i.e.*, there is no formation of seeds.

2. State two different roles of spleen in the human body. **[1]**

Answer : The role of spleen in the human body is that the spleen is the secondary lymphoid organ that produces lymphocytes and the red pulp of spleen removes the old or damaged red blood cells from the body.

3. A garden pea plant produced axial white flowers. Another of the same species produced terminal violet flowers. Identify the dominant traits. **[1]**

Answer : The dominant traits are : Axial, violet flower.

4. Why is it desirable to use unleaded petrol in vehicles fitted with catalytic converters ? **[1]**

Answer : It is desirable to use unleaded petrol in vehicles fitted with catalytic converters because lead in petrol inactivates the catalysts which converts harmful pollutants (CO, unburnt hydrocarbons, nitric oxide) to lesser harmful pollutants (CO_2, H_2O, N_2).

5. Where is acrosome present in humans ? Write its function. **[1]**

Answer : The anterior portion of the sperm head in human beings is covered by a cap-like structure called acrosome.

Function of Acrosome :

Acrosome is filled with hydrolytic enzyme-Hyaluronidase that aids in the entry of sperm into the ovum.

Biology 2014 (Outside Delhi) SET I

Time allowed : 3 hours **Maximum marks : 70**

SECTION–A

1. **Name the part of the flower which the tassels of the corn-cob represent.** [1]

   Answer : Female reproductive parts are : stigma and style.

2. **Mention any two contrasting traits with respect to seeds in pea plant that were studied by Mendel.** [1]

   Answer : The two contrasting traits with respect to seeds in pea plant that were studied by Mendel are :

   1. Seed shape: round and wrinkled.
   2. Seed colour: yellow and green.

3. **Why is secondary immune response more intense than the primary immune response in human ?** [1]

   Answer : The primary immune response to antigen occurs on the first occasion and generate memory B and T cells with a high specificity for the inducing antigen. The secondary response, mediated by B cells with the help of T cells, quickly produces high-affinity and antigen-specific antibodies against pathogens.

4. **Why is it not possible for an alien DNA to become part of a chromosome anywhere along its length and replicate normally ?** [1]

   Answer : Alien DNA requires specific sequence called recognition sites (sites where restriction enzymes cut DNA) to ligate itself with host chromosome. Recognition sites sequence should be close to the origin of replication (ori sequence where DNA replication starts).

This site is necessary for the binding of DNA polymerase to start replication. As this site is not present in alien DNA molecules, so an alien piece of DNA cannot replicate normally by attaching to any DNA.

5. **State the role of C peptide in human insulin.** [1]

Answer : Human insulin is produced as a pro-hormone. The 31 amino acid C-peptide of proinsulin is important for the biosynthesis of insulin. It helps in maintaining the level of active insulin. C-peptide makes the insulin inactive.

6. **Name the enzymes that are used for the isolation of DNA from bacterial and fungal cells for recombination DNA technology.** [1]

Answer : Enzymes used to isolate DNA from bacteria : Lysozyme Enzymes used to isolate DNA from fungi : Chitinase

7. **State Gause's Competitive Exclusion Principle.** [1]

Answer : The principle that when two closely related species compete for the same resources within an environment, one of them will eventually outcompete and displace the other. The displaced species may become locally extinct, by either migration or death.

8. **Name the type of association that the genus *Glomus* exhibits with higher plants.** [1]

Answer : Mycorrhizal is the type of association.

SECTION–B

9. **Why are the human testes located outside the abdominal cavity ? Name the pouch in which they are present.** [2]

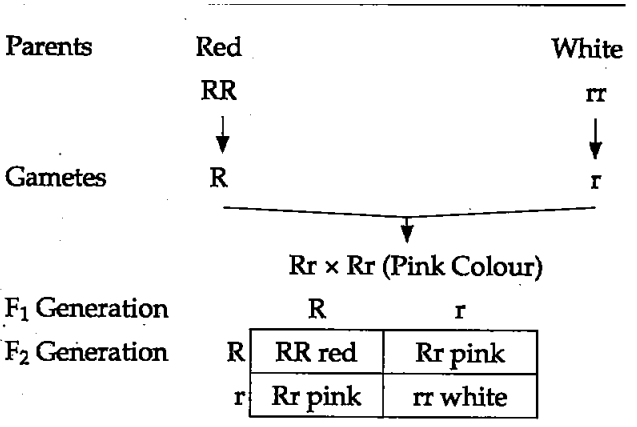
Answer : Testes lie in the scrotum outside the abdominal cavity. It is so as it keeps the temperature 2-2.5°C degree (approx. 35°C) less than that of the body (i.e about 37°C). A lesser temperature is required for the production of sperm through spermatogenesis.

10. **In Snapdragon, a cross between true-breeding red flowered (RR) plants and true-breeding white flowered (rr) plants showed a progeny of plants with all pink flowers.** [2]

(a) The appearance of pink flowers is not known as blending. Why ?

(b) What is this phenomenon known as ?

Answer :



Phenotypic ratio : 1 : 2 : 1 Genotypic ratio : 1 : 2 : 1

(a) The appearance of pink flower is not known as blending because it is due to partial influence of allele for white colour over the allele for red colour. On self-crossing the F_1 plants, the F_2 progeny are three types of plants-red flowered, pink flowered and white flowered in the ratio of 1 : 2 : 1. The occurrence of red and white flowered plants in F_2 generation, indicate that the two alleles (red and white flower colour) and not blended but partially expressed as pink flower plants.

(b) The above example is known as incomplete dominance.

11. **With the help of one example, explain the phenomena of co-dominance and multiple allelism in human population.** [2]

Answer : A condition in which two different alleles for a genetic trait in a heterozygote are fully expressed thereby resulting in offspring with a phenotype that is neither dominant nor recessive.

When three or more alternative forms of a particular gene exist in a population, it is called multiple allelism.

Example : A typical example showing co-dominance is the ABO blood group system. For instance, a person having I^A allele and I^B allele will have a blood type AB because both the I^A and I^B alleles are co-dominant with each other.

ABO blood group is controlled by I gene. The gene I has 3 different alleles I^A, I^B and i. I^A and I^B produce two different types of sugars on the plasma membrane of red blood cells. The gene I does not produce any sugars. I^A and I^B are completely dominant over i. When I^A and I^B are present together, they express their own type of sugars.

Genotypes	Blood Groups
1. $I^A I^B$	AB
2. $I^A I^A$, $I^A i$	A
3. $I^B I^B$, $I^B i$	B
4. *ii*	O

12. Write the scientific name of the fruit-fly. Why did Morgan prefer to work with fruit-flies for his experiments ? State any three reasons. [2]

OR

Linkage and crossing-over of genes are alternative of each other. Justify with the help of an example.

Answer : Scientific name of fruit-fly: *Drosophila melanogaster.*

Morgan used fruitfly for his experiment because :

1. The fruit-fly could be grown on a simple synthetic medium inside the laboratory.
2. The life cycle of a fruit-fly is about only two weeks.
3. A single mating could produce a large number of progeny offspring.

OR

1. There is some linkage between all genes located on the same chromosome. The linkage strength depends on the percentage of the distance between the two. But linkage can be easily broken by crossing over.
2. When genes are located on the same chromosome, then there is possibility of two situations, either a crossing over between the two genes or no crossing between two genes.
3. Crossing over always occurs if genes are located very far from each other – 50% recombinants, 50% parental.

Example : Morgan hybridized yellow-bodied, white-eyed females to brown-bodied, red eyed males and intercrossed their F_1 progeny. He found that the genes for white and yellow were very lightly linked and showed only 13% recombinant while white and miniature wing showed 37.2% recombination.

13. List the symptoms of Ascariasis. How does a healthy person acquire this infection ? [2]

Answer : Symptoms of Ascariasis include : Worms in stool, coughing up worms, loss of appetite, fever. **Severe symptoms of Ascariasis include :** Vomiting, shortness of breath, swelling of the abdomen, severe stomach pain, and intestinal blockage, internal bleeding, muscular pain and anaemia.

Mode of Transmission :

1. It is transmitted by improper disposal of human stool containing the eggs of Ascaris.
2. Healthy persons may get infection from contaminated water, vegetables, fruits, other food articles and fomites.

14. Explain the significant role of the genus Nucleopolyhedrovirus in an ecological sensitive area. [2]

Answer : The *Nucleopolyhedrovirus*, a sub group of Baculoviruses is a virus. It affects insects, predominantly moths and butterflies and used as a biological control agent. It has been used as a pesticide for crops infested by insects specially arthropods. Though this virus is species specific, making it effective under certain circumstances and there is no negative effect on plants, mammals, birds, fish or other is non-target insects.

15. How does a restriction nucleases function ? Explain. [2]

Answer : Restriction nucleases are of two different types- endonucleases cut at a specific position inside DNA strand. Exonuclease remove nucleotides from the end of a DNA. strand. Restriction endonucleases recognize short, usually palindromic (meaning the base sequence reads the same backwards and forwards), sequences of 4–8 bp and, in the presence of Mg^{2+}, cleave the DNA within or in close proximity to the recognition sequence. For example, EcoRI digestion produces "sticky" ends.

G|AATTC
CTTAA|G

Whereas, SmaI restriction enzyme cleavage produces "blunt" ends:

CCC|GGG
GGG|CCC

16. How have transgenic animals proved to be beneficial in : [2]

(a) Production of biological products,

(b) Chemical safety testing.

Answer : (a) Production of biological products: The transgenic farm mammal was produced,

a sheep called 'Rosie cow' had a human gene that expressed high levels of the human protein alpha-1-antitrypsin. The protein, which is missing in humans, can lead to a rare form of emphysema.

(b) Chemical safety testing :

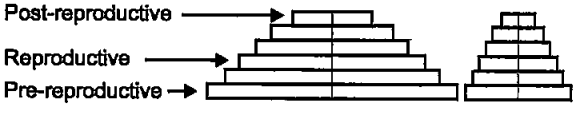
Transgenic animals, toxicity-sensitive transgenic animals have been produced for chemical safety testing. Transgenic animals can also be used to test the identity and purity of human proteins used as drugs. A transgenic animal that makes a human protein (*e.g.*, human insulin) will recognise this substance as its own and will therefore not produce an immune response against it.

17. Describe the mutual relationship between fig tree and wasp and comment on the phenomenon that operates in their relationship. [2]

Answer : Mutual relationship : Fig tree and wasp shows mutualism between them. The interaction in which both the interacting species get benefit of each other is called mutualism. Fig flower is pollinated only by wasp and not by any other species. Female wasp lays eggs inside the developing fruit and also uses the developing seeds within the fruit for nourishing its larvae. Co-evolution exists between their close specific tight relationship.

18. Construct an age pyramid which reflects an expanding growth status of human population. [2]

Answer :



Representation of age pyramids for human population

Expanding pyramids of human population :

1. A population at any given time is composed of different age groups. These three groups include :
   - **(a)** Pre-reproductive
   - **(b)** Reproductive
   - **(c)** Post-reproductive
2. If the age distribution (percent individuals of a given age or age group) is plotted for the population, the resulting structure is called an age pyramid.
3. In human beings, the age pyramids show the age distribution of male and female in a combined diagram.
4. In expanding pyramid, individuals in reproductive age group are more in number so the pyramid is expanding.

SECTION–C

19. Make a list of any three outbreeding devices that flowering plants have developed and explain how they help to encourage cross-pollination ? [3]

OR

Why are angiosperm anther called dithecous ? Describe the structure of its microsporangium.

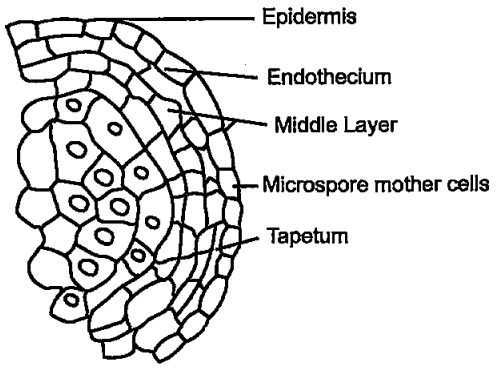
Answer : The three outbreeding devices to encourage cross-pollination :

1. **Protoandry :** The pollen grain and stigma of the flower mature at two different times, so that pollen release and stigma receptively are not simultaneous.
2. **Protogyny :** Mechanical barrier on the stigmatic surface of flowers, so that the anther and stigma of same flower cannot come in contact with each other.
3. **Self–incompatibility :** The receptive stigma retard the growth of the pollen tube of fallen mature pollen grains of the same flower.

OR

Answer : Angiosperm anther is bilobed. Each lobe has two theca (microsporangium) so it is known as dithecous.

Structure of microsporangium : The transverse section of a typical microsporangium is circular in outline. The microsporangium surrounded by four separate wall layers: epidermis, endothecium, middle layers and tapetum. The innermost wall layer tapetum provides nourishment to developing pollen grains. Tapetum cells are multi-nuclei and have dense cytoplasm. The outer three wall layers perform the function of protection and help in dehiscence of anther to release the pollen. When the anther is young, a group of compactly arranged homogeneous cells called the sporogenous tissue occupies the centre of each microsporangium which produce micropores or pollen grains.



20. If implementation of better techniques and new strategies are required to provide more efficient care and assistance to people, then why is there a statutory ban on amniocentesis ? Write the use of this technique and give reason to justify the ban. [3]

Answer : Amniocentesis is a prenatal technique of diagnosing the genetic and metabolic disorders of the foetus by taking out a small quantity of amniotic fluid. Amniotic fluid contains foetal cells, placental cell, foetal enzymes, proteins and other biochemicals. Foetal cells give information about the sex of the foetus and any abnormality in the chromosomes. If the foetus suffers from incurable genetic and metabolic disorders, then the foetus needs to be aborted through MTP.

But this very useful technique has been mis-used to know the sex of the developing foetus and destroying the same if the foetus is female. Therefore, the test has been banned except at few centres and this ban is justified as it will change the sex ratio of the population.

21. Why is pedigree analysis done in the study of human genetics ? State the conclusions that can be drawn from it. [3]

Answer : Pedigree analysis is the study of family history about the inheritance of a particular trait. It can be used to draw the inheritance of a specific trait, abnormality or disease in humans because control crosses are not possible in case of human being.

Conclusions :

1. Identification of the recessive or dominant nature of a specific trait could be done by pedigree analysis.
2. The trait is linked to sex chromosome or autosomal can be found out by pedigree analysis, for example, haemophilia is a sex linked recessive disease. X-linked recessive trait shows transmission from carrier female to male progeny.
3. The pattern of inheritance of Mendelian disorders can be traced in a family by pedigree analysis. For example, most common Mendelian disorders are haemophilia, cystic fibrosis, sickle cell anaemia, colour blindness, phenylketonuria, thalassemia, myotonic dystrophy (autosomal dominant trait), etc.

22. Identify 'a', 'b', 'c', 'd', 'e', and 'f' in the table given below : [3]

No.	Syndrome	Cause	Characteristics of affected individuals	Sex Male/ Female/Both
1.	Down's	Trisomy of 21	'a' (i) (ii)	'b'
2.	'c'	XXY	Overall masculine develoment	'd'
3.	Turner's	45 with XO	'e' (i) (ii)	'f'

Answer : (a) (i) Palm is broad with characteristics palm crease; short statured with small round head.

(ii) Physical, mental, psychomotor development is retarded.

(b) Both **(c)** Klinefelter's syndrome **(d)** Male

(e) (i) Short stature and underdeveloped feminine character.

(ii) Such females are sterile as ovaries are rudimentary. They also do not have well developed secondary sexual characters.

(f) Female

23. Community service department of your school plans a visit to a slum area near the school with an objective to educate the slum dwellers with respect to health and hygiene. [3]

(a) Why is there a need to organise such visits ?

(b) Write the steps you will highlight, as

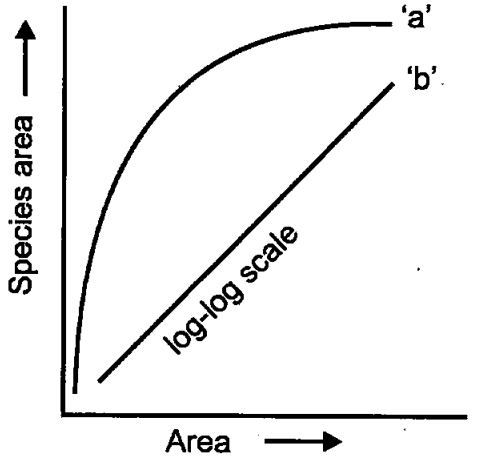
a member of this department, in your interaction with them to enable them to lead a healthy life.

Answer : **(a)** The well-being of each human being depends on their environment. In slum areas individuals live in congested and insanitary conditions. In this type of conditions they are more susceptible to suffer from diseased condition. So there is a need to organize such visits to educate them about the importance of health and hygiene.

(b) Steps to enable slum dwellers guide to healthy life :

1. Use of mosquito nets while sleeping, get wire mesh fixed to doors and windows, prevent water logging, regularly change water of water-coolers to avoid mosquito breeding.
2. Wash hands before eating and after toilet use, maintain the environment clean so that flies do not breed. Disinfect water by chlorine tablets if it is drawn from well or any other source.
3. Clean toilets and use disinfectants regulary.
4. Educate people about the benefit of vaccine which are available at the health centres such as DPT for diphtheria, pertusis (whooping cough) and tetanus, polio vaccine. MMR vaccine for measles, mumps, rubella.

24. The following graph shows the species–area relationship. Answer the following questions as directed. **[3]**



(a) Name the naturalist who studied the kind of relationship shown in the graph. Write the observations made by him.

(b) Write the situations as discovered by the ecologists when the value of 'Z' (slope of the line) lies between (i) 0.1 and 0.2 (ii) 0.6 and 1.2.

What does 'Z' stand for ?

(c) When would the slope of the line 'b' become steeper ?

Answer : **(a)** Species area relationship was studied by **Alexander Von Humboldt.** He made an observation that within a region, species richness increased with increasing explored area but only upto a limit.

(b) **1.** $Z = 0.1$ to 0.2 : the slope of regression lines are similar, the slope of regression is steeper when we analyse the species area relationship among very large areas like entire continent.

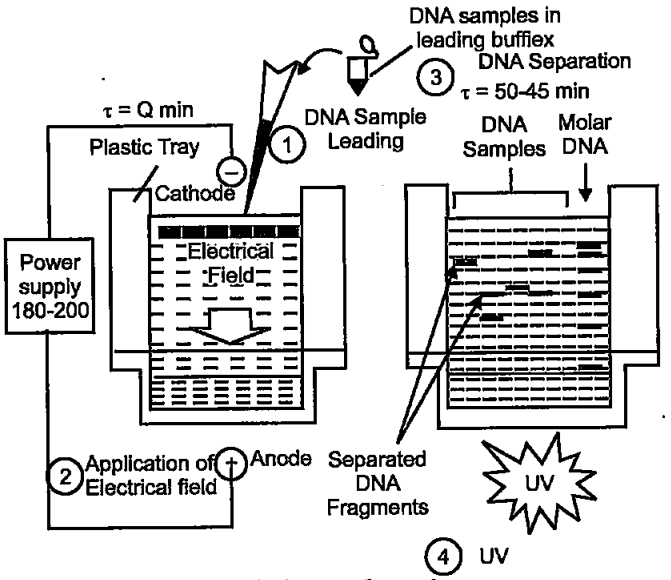
2. $Z = 0.6$ to 1.2 : for large area for example entire continent.

(c) The slope of the line b become steeper when species area relationship is analyzed in a very large area like the entire continents.

25. Name and describe the technique that helps in separating the DNA fragments formed by the use of restriction endonuclease. **[3]**

Answer : Agarose gel electrophoresis is used to separate DNA fragments formed by restriction endonuclease.

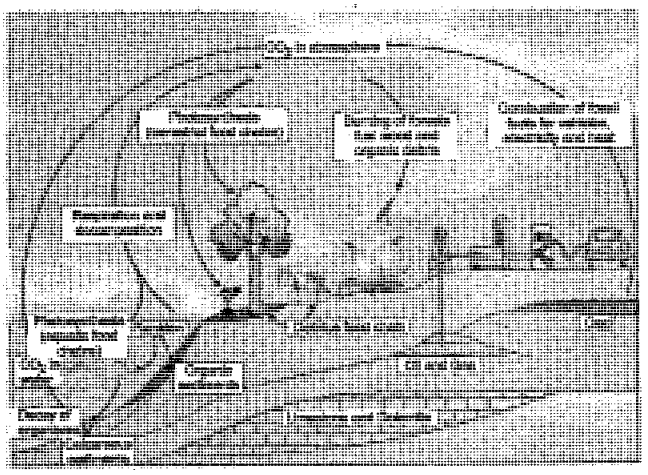
Agarose gel electrophoresis : The DNA cleavage by restriction endonucleases which results in DNA fragments. Electrophoresis is a technique used to separate and sometimes purify nucleic acids that differ in size, charge or conformation. As such, it is one of the most widely-used techniques in biochemistry and molecular biology. When DNA molecules are placed in an electric field, DNA molecules are negatively charged due to their phosphate backbone, and migrate toward the anode. The DNA fragments separate (resolve) according to their size through sieving effect provided by the agarose gel. Hence, the smaller the fragment size, the further it moves. The separated DNA fragments can be visualized only after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation (pure DNA fragments cannot be seen in the visible light and without staining). The bands are cut from the gel and extracted by using a convenient technique. This step is called elution. The eluted DNA fragments are then purified and used in constructing recombinant DNA by joining them with cloning vectors.



Agarose gel electrophoresis

26. State the function of a reservoir in a nutrient cycle. Explain the simplified model of carbon cycle in nature. [3]

Answer : Function of a reservoir : To meet with the deficit which occurs due to imbalance in the rate of influx and efflux of nutrients.



27. Since the origin of life on Earth, there were five episodes of mass extinction of species. [3]

(i) How is the 'Sixth Extinction', presently in progress, different from the previous episodes ?

(ii) Who is mainly responsible for the 'Sixth Extinction' ?

(iii) List any four points that can help to overcome this disaster.

Answer : (i) The current extinction "sixth extinction" rates are estimated to be 100 to 1000 times faster than in pre–human times.

(ii) Human activities in ecosystem are mainly responsible for sixth extinction.

Main reason for this extinction is :

1. Habitat loss and fragmentation.
2. Over–exploitation
3. Alien species introduction
4. Co–extinction

(iii) 1. Afforestation : Creation of sacred groves in which all the trees and wild life are venerated and given total protection.

2. By preventing habitat loss : Zoological parks, botanical gardens, wildlife sanctuaries can also help to overcome such extinction.

3. By the use of Diverse species.

4. By in-situ conservation and ex-situ conservation.

SECTION–D

28. (a) Where does fertilization occur in humans? Explain the events that occur during this process.

(b) A couple where both husband and wife are producing functional gametes, but the wife is still unable to conceive, is seeking medical aid. Describe any one method that you can suggest to this couple to become happy parents. [5]

Answer : (a) In humans fertilisation of male and female gamete occurs in the junction of ampulla and isthmus of fallopain tube. The various events which occur during the fusion of gametes are :

1. **Acrosomal reaction : (A)** As sperm comes in contact with the egg surface, it secretes or release enzyme Hyaluronidase which dissolves the corona radiata.

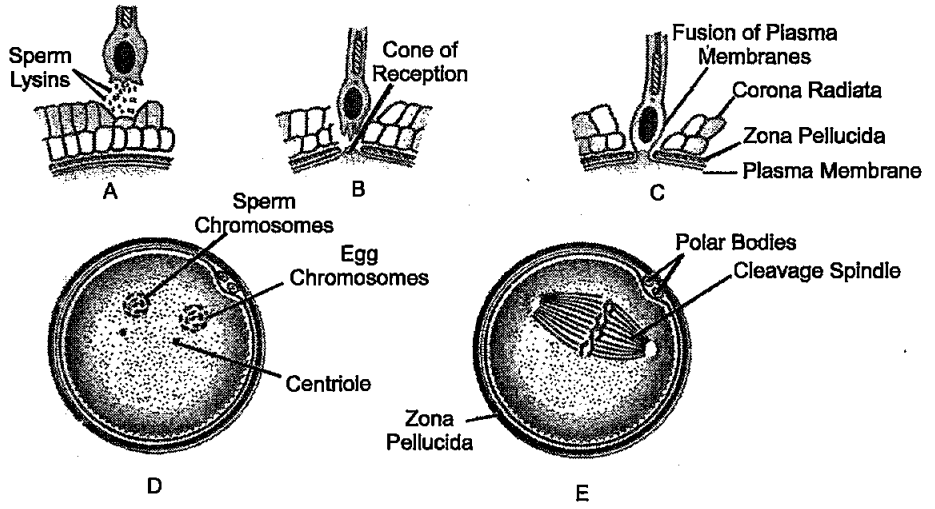
(B) As sperm reaches Zona pellucida, the acrosome releases Acrosin or zona lysin and dissolves zona pellucida.

(C) Compatibility reaction also stimulates development of an outgrowth by the oocyte called Fertilisation cone. Egg cell has fertilizin protein and sperm has antifertilizing protein.

2. **Sperm Entry :** Sperm head comes in contact with the fertilisation cone. Sperm and egg membrane dissolve at this point and components of head (nucleus), neck and

middle piece of sperm enter the cytoplasm of egg. Tail of sperm is left out.

3. **Zona Reaction :** The zona pellucida stiffens after entry and does not allow any other sperm to enter. The phenomenon is called Monospermy.
4. **Activation of oocyte to ovum :** Egg is secondary oocyte stage and undergoes meiosis II by removal by MPF and development of APC/APF resulting in mature ovum/ootid and second polar body.
5. **Karyogamy :** It is the final stage of fertilisation. The sperm nucleus fuses with the egg nucleus. Nuclear envelops breakdown forming a spindle and thus form the zygote under laboratory condition. The zygote or early embryo is transferred in the fallopian tube.



(b) Couple able to produce functional gamete but unable to conceive can assist to have children through one of following techniques commonly called as – Assisted Reproductive Technologies (ART).

In vitro fertilization followed by embryo transfer : Ova from the wife or donor and sperms from the husband or donor male are collected and fused to form zygote under laboratory condition. The zygote or early embryo is transferred in the fallopian tube.

OR

(a) Explain the different ways apomictic seeds can develop. Give an example of each.

(b) Mention one advantage of apomictic seeds to farmers.

(c) Draw a labelled mature stage of a dicotyledonous embryo.

Answer : (a) Different ways in apomictic seeds development :

1. The diploid egg cell is formed without reduction division and develops into an embryo without fertilization. Example : Grasses or Asteracease.

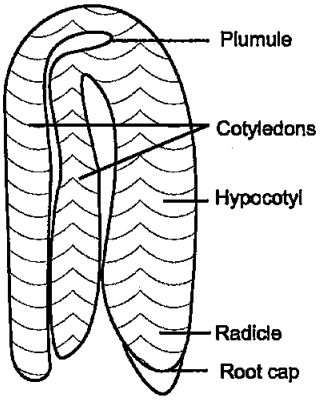
2. Nuclear cells surrounding the embryo sac start dividing and protrude into the embryo sac and develop into the embryo, for example, citrus and mango. They have more than one embryo in a seed known as polyembryony.

(b) Advantage of apomictic seeds to farmers :

As apomictic seed formation does not involve meiosis and fertilization, they are genetically identical to their parents.

If the hybrid seeds become apomictic they will maintain their traits generation after generation. As it does not involve meiosis so lack of segregation of characters and not involves fertilization so no recombination and trait will be maintained for several generations, so the farmers can use these apomictic seeds to raise new crop year after year.

(c)



Mature stage of a dicotyledonous embryo

29. (a) Describe the various steps of Griffith's experiment that led to the conclusion of the 'Transforming Principle'.

(b) How did the chemical nature of the 'Transforming Principle' get established ? **[5]**

OR

Describe how the *lac* operon operates, both in the presence and absence of inducer in *E.coli*.

Answer : (a) Transformation is change of genetic material of an organism by obtaining genes

from other organism (dead relative). Fredrick Griffith, a British bacteriologist in 1928, carried out experiments on 'Transforming principle'. He worked with strains of *Streptococcus pneumoniae*. These are two strains of this bacteria :

1. **Virulent or S-Strain,** which produces smooth colony and has the capacity to cause the disease (pneumonical).
2. **Non-virulent or R-strain,** which produces rough colony and does not cause pneumonia.

Griffith's experiment was carried out as follows:

(1) R-type (strain) of live bacteria injected in the mice. No disease observed in mice.
Mice + R-strain (live) ⟶ No disease in mice

(2) Live S-strain of bacteria injected in the mice. Mice have occurrence of pneumonia and die.
Mice + S-strain (live) ⟶ Disease seen and mice die

(3) Heat-killed S-strain bacteria injected in mice. No disease observed. Mice survive
Mice + S-strain (Heat-killed) ⟶ No diseas Mice Survive.

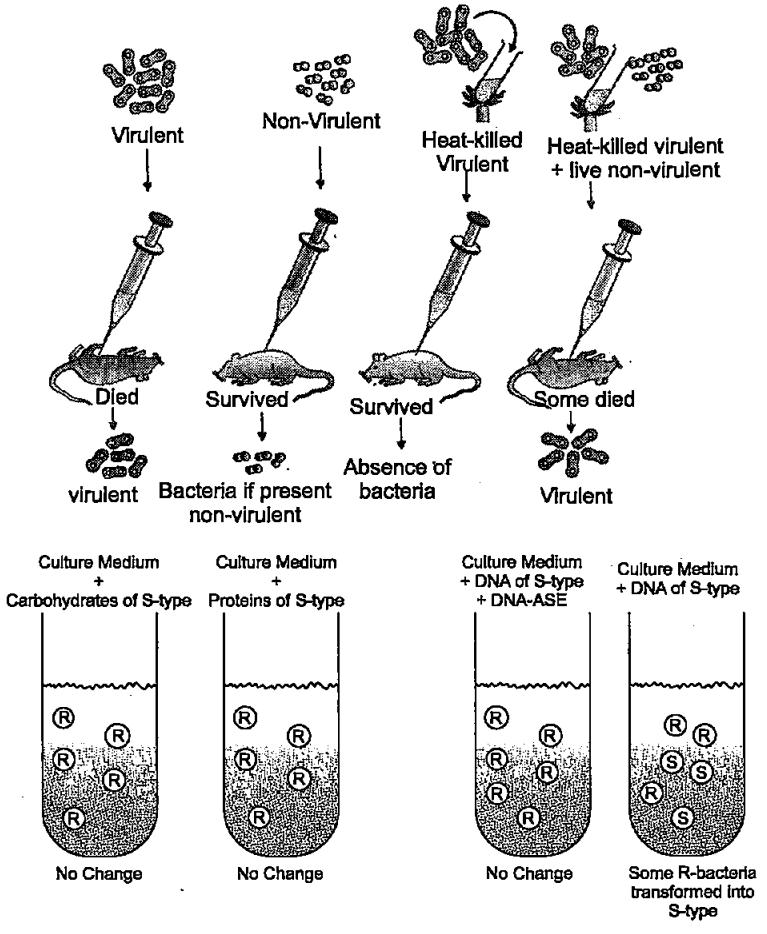
(4) Mice injected with a mixture of heat killed S-strain of bacteria and live R-strain. Mice die of pneumonia.
Mice + S-strain (heat killed) + R-strain (live) ⟶ Disease occurs Mice die

On observing the blood of mice, it showed presence of both R-strain and S-strain live bacteria. Occurrence of live S-strain was possible only through a change transformation of S-strain into s-strain through transfer of biochemical substance.

(b) Oswald T. Avery, Collin Macleod and Maclyn McCarty in 1944 established the chemical nature of transforming principle.

1. The heat killed S-strain of bacteria and separated their components – DNA, proteins and Carbohydrates.
2. The DNA component was segregated into two. One with hydrolysing enzyme DNA-ase and the other without it.
3. They then mixed these components of S-strain with live R-strain in Separate culture media.
5. There was no change in three cultures having additions of heat-killed S-strain carbohydrates, proteins and DNA (with DNAase).
6. But the fourth culture medium having heat-killed S-strain DNA without DNAase showed presence of live S-strain bacteria.

It was concluded that the live S-strain bacteria must have been formed from R-strain with the help of DNA of S-strain. Thus, DNA is the genetic material was established.



OR

Answer : In *E.coli*, the breakdown of lactose requires three enzymes. These enzymes are synthesized together in a coordinated manner and the unit is known as lac operon. Since the addition of lactose itself stimulates the production required enzymes. It is also referred as Inducible system. It gets switched off in normal conditions.

The genes involved in lac operon are as follows:

1. Strutural Genes : These genes code for the proteins needed by the cell which include enzymes or other proteins having structural functions. Lac operon has three structural genes:

(a) Lac *z* : Gene coding for enzyme b-galactosidase for splitting lactose into glucose and galactose.

(b) Lac *y* : Gene coding for enzyme permease or Galactoside permease which is required for entry of lactose.

(c) Lac *a* : Gene coding for enzyme transacetylase or Galactoside acetylase.

The three structural genes of lac operon produce a single polycistronic mRNA.

2. Operator gene (O) : It gives passage to RNA polymerase when the structural genes are to express themselves. Normally, it is covered by a repressor and is in off position.

3. Promoter gene (p) : This gene is the recognition centre/initiation point for RNA polymerase of the operon.

4. Regulator gene (i) : It is also called inhibitory gene. It produces a repressor protein that binds the operator gene, when the substrate (lactose) is not available, so as to keep it non-functional. It prevents the passage of RNA polymerase from promoter to structural gene.

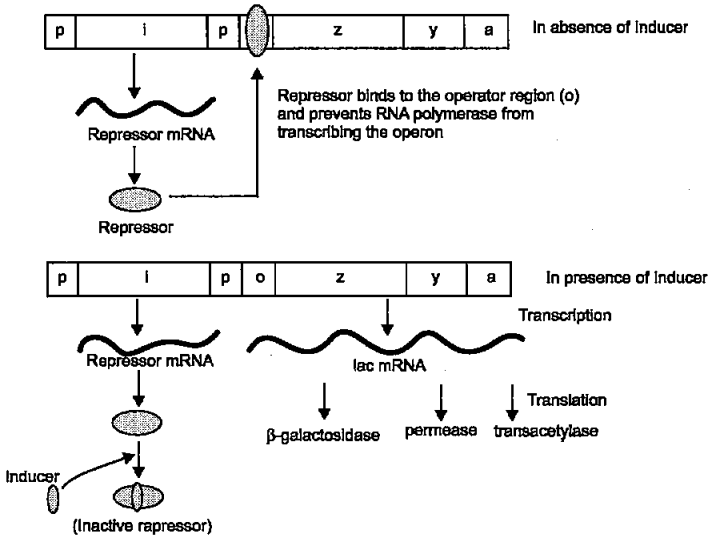
5. Repressor (p) : It is a small portion formed by regulator gene which binds to operator gene and blocks the passage of RNA polymerase towards the structural genes. It has two allosteric sites, one for attaching to operator gene and second for binding to the inducer.

6. Inducer : It is a chemical which attaches to repressor, and changes the shape of operator binding sites so that the repressor remains no more attached to the operator.

Mechanism of Lac Operon :

1. In the absence of inducer (lactose) : The lac operon is generally off which is ensured by the formation of repressor by the regulator gene which blocks the operator gene. Thus, there is no transcription and no enzymes are produced. Operon is switched off.

2. On the other hand, when inducer (lactose) is added, the repressor protein (produced by gene i) gets bound is removed from the operator. RNA Polymerase is now allowed to act and the transcription of lac genes take place. The operon is now switched ON. All the three genes are transcribed to form a single mRNA strand. It is a polycistronic mRNA. This process continues till the inducer is consumed. Once inducer finishes, the repressor again binds to the operator gene and switches OFF the operon.



30. With advancements in genetics, molecular biology and tissue culture, new traits have been incorporated into crop plants.

Explain the main steps in breeding a new genetic variety of a crop. **[5]**

OR

(a) State the objective of animal breeding.

(b) List the importance and limitations of in-breeding. How can the limitations be overcome ?

(c) Give an example of a new breed each of cattle and poultry.

Answer : Different steps in breeding a new crop variety.

1. Collection of variability : Genetic variability is essential for breeding program. If genetic variability is not present then new variety cannot be developed thus it is pre–requisite condition for breeding. The collection of all the different alleles for all genes in a given crop is called germplasm collection.

2. Evaluation and selection of parent : Different germplasm is evaluated for desired trait and plants having the desired character are selected as parent. The selected plants are multiplied and pure lines are obtained, which are used for hybridization.

3. Cross hybridization among the selected plant : The selected plants are hybridized to combine the character of two different parents.

4. Selection and testing of superior recombinants : On the basis of presence of desired character in hybrid, superior recombinants are selected. Plants are then self–pollinated for several generations.

5. Testing, release and commercialization of new cultivars: These new recombinant are evaluated for their yield and different agro–climatic condition (such as quality and disease resistance) for several years along with best available local check variety. If these lines are superior than local check then they are released for commercial cultivation.

OR

(a) Objective of animal breeding: To increase the yield of animal and improving the desirable qualities of product.

(b) Importance of Inbreeding :

1. Superior male and superior female of same breed are identified for mating.
2. To evolve a pure line of animal or to increase homozygosity.
3. Exposes harmful recessive genes that are eliminated by selection.
4. Also accumulates superior genes and elimination of less desirable gene.
5. Increases the productivity of inbreed population.

Limitation of Inbreeding :

Continued inbreeding specially closed inbreeding usually reduces fertility and productivity. This is called as inbreeding depression.

(c) New breed of cattle → Hisardale.

New breed of poultry → Leghorn.

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Biology 2014 (Outside Delhi) SET II

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous set.

SECTION–A

1. Why is Gambusia introduced into drains and ponds ? [1]

Answer : Gambusia introduced into drains and ponds because they feed on mosquito larvae which are responsible for causing malaria.

7. Why are analogous structures a result of convergent evolution ? [1]

Answer : Analogous structures are not anatomically similar though they perform similar functions so they are a result of convergent evolution.

8. Name the vegetative propagules in the following:
(a) Agave (b) Bryophyllum [1]

Answer : (a) Agave : Bulbils.

(b) Bryophyllum : Leaf buds or adventitious buds found in the notches of the leaf margin.

SECTION–B

11. State the difference between the structural gene in a Transcription Unit of Prokaryotes and Eukaryotes. [2]

Answer : Prokaryote structural genes consist of only exons (functional) while eukaryotes consist of both introns and exons. Introns are removed by the process of splicing before translation.

Prokaryotes are having polycistronic and continuous structural genes while eukaryotes have monocistronic and split.

13. Write the location and function of the following in human testes :

(a) Sertoli Cells (b) Leydig Cells [2]

Answer : (a) Sertoli Cells : The Sertoli cells are located within the seminiferous tubules. Their task is the creation of a hemato-testicular barrier and the nourishment of the spermatozoa.

(b) Leydig Cells: Leydig cells, also known as interstitial cells of Leydig, are found adjacent to the seminiferous tubules in the testicle. They produce testosterone in the presence of luteinizing hormone (LH).

SECTION–C

21. A woman has certain queries as listed below, before starting with contraceptive pills. Answer them. [3]

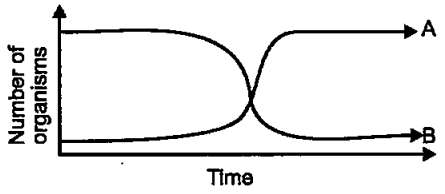
(a) What do contraceptive pills contain and how do they acts as contraceptive ?

(b) What schedule should be followed for taking these pills ?

Answer : (a) Contraceptive pills contain progesterone and estrogen combination. This disrupts hormone patterns needed for pregnancy and affects the ovaries and the development of the uterine lining, making pregnancy less likely. They prevent ovulation (the egg leaving the ovary and moving into the fallopian tube). They block the hormones needed for the egg to be able to be fertilized. They alter the quality of cervical mucus to prevent or retard the entry of sperms.

(b) The pills have to be taken daily for a period of 21 days starting from the fifth days of menstrual cycle to the 25th day. After a gap of 7 days (during which menstruation occurs), it has to be repeated in the same pattern till the female desires to prevent conception.

24. Two types of aquatic organisms in a lake show specific growth patterns as shown below, in a brief period of time. The lake is adjacent to an agricultural land extensively supplied with fertilizers. [3]



Answer the questions based on the fact given above :

(i) Name the organisms depicting the pattern A and B.

(ii) State the reason for the growth pattern seen in A.

(iii) Write the effects of the growth patterns seen above.

Answer : (i) A → Planktonic Algae (free floating);

B→Fish/Aquatic animals.

(ii) The reason for the growth pattern in A-Presence of large amount of nutrients in fertilizers from adjacent agricultural land in water causes excessive growth of planktonic (free - floating) algae known as Algal Bloom which consumes a lot of oxygen and nutrients. As a result there is a sharp decline in the dissolve oxygen in the lake.

(iii) The increase in BOD (Biochemical Oxygen Demand) due to algal bloom which causes deterioration of the water quality which results in fish mortality causing unpleasant odour (eutrophication). Some bloom forming algae are extremely toxic to human beings and animals also.

26. Explain, giving three reasons, why tropics show greatest levels of species diversity. [3]

Answer : 1. Tropical latitude has remained relatively undisturbed for million of years so they have greatest level of species diversity.

2. Tropical environment is less seasonal, relatively more constant and predictable. Such constant environment promotes niche specialization and leads to a greater species diversity.

3. There is more solar energy available in the tropics which contributes to higher productivity, so indirectly contribute to greater diversity.

SECTION–D

28. Describe the Hershey and Chase experiment. Write the conclusion drawn by the scientists after their experiment. [5]

Answer : Experiments by **Hershey** and **Chase** in the 1950's using the bacteriophage T2 and *E.coli* cells demonstrated that DNA is the genetic material of the bacteriophage.

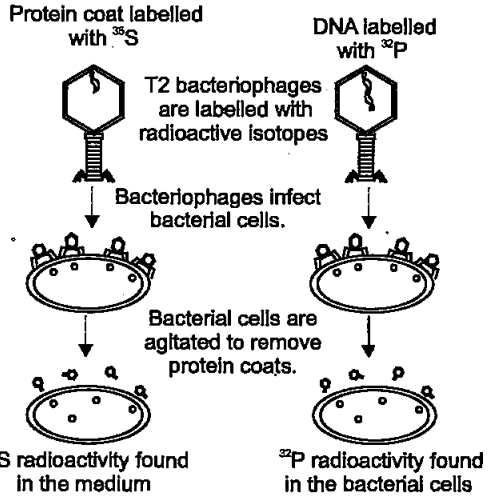
1. Hershey and Chase conducted their experiments on the T2 phage, a virus whose structure had recently been shown by electron microscopy.
2. The phage consists of a protein shell containing its genetic material. The phage infects a bacterium by attaching to its outer membrane and injecting its genetic material and leaving its empty shell attached to the bacterium.
3. In their first set of experiments, Hershey and Chase labelled the DNA of phages with radioactive Phosphorus-32 (the element

phosphorus is present in DNA but not present in any of the 20 amino acids from which proteins are made).

4. They allowed the phages to infect *E. coli* (*Escherichia coli*), observed that the transfer of P^{32} labelled phage DNA into the cytoplasm of the bacterium.
5. In their second set of experiments, they labelled the phages with radio-active Sulphur-35 (Sulphur is present in the amino acids cysteine and methionine, but not in DNA).
6. Following infection of *E. coli* they then sheared the viral protein shells off of infected cells using a high-speed blender and separated the cells and viral coats by using a centrifuge.
7. After separation, the radioactive S^{35} tracer was observed in the protein shells, but not in the infected bacteria, supporting the hypothesis that the genetic material which infects the bacteria was DNA and not protein.

Conclusion :

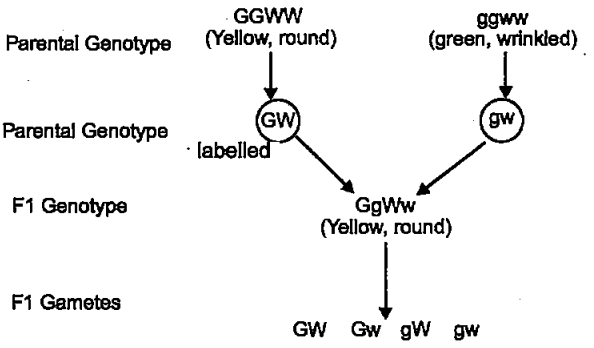
1. Hershey and Chase concluded that DNA, not protein was the genetic material. They determined that a protective protein coat formed around the bacteriophage, but that the internal DNA is conferred its ability to produce progeny inside a bacteria.
2. They showed that, in growth, protein has no function, while DNA has some function. Only 20% of the P^{32}(radioactive) remained outside the cell and it was incorporated with DNA in the cell's genetic material. All of S^{35}(radioactive) in the protein coats remained outside the cell, it was not incorporated into the cell, and protein was not the genetic material.



OR

Work out a typical Mendelian dihybrid cross and state the law that he derived from it.

Answer : Mendelian Dihybrid Cross : A cross between two parents that differ by two pairs of alleles (AABB × aabb) and he derived it from law of independent assortment.



Phenotypic ratio for F_2 cross :

Female Gametes

Male Gametes	GW	Gw	gW	gw
GW	GGWW (Yellow, round)	GGWw (Yellow, round)	GgWW (Yellow, round)	GgWw (Yellow, round)
Gw	GGWw (Yellow, round)	GGww (Yellow, wrinkled)	GgWw (Yellow, round)	Ggww (Yellow, wrinkled)
gW	GgWW (Yellow, round)	GgWw (Yellow, round)	ggWW (Green, round)	ggWw (Green, round)
gw	GgWw (Yellow, round)	Ggww (Yellow, wrinkled)	ggWw (Green, round)	ggww (Green, wrinkled)

The phenotypes and general genotypes from this cross can be represented in the following manner:

Phenotype	General Genotype
9 Yellow, Round Seed	GGWW
3 Yellow, Wrinkled Seed	Ggww
3 Green, Round Seed	ggWw
1 Green, Wrinkled Seed	ggww

●●

Biology 2014 (Outside Delhi) SET III

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous sets.

SECTION–A

2. Name the stage of cell division where segregation of an independent pair of chromosomes occurs. [1]

Answer : The stage of cell division in which the segregation of an independent pair of chromosomes occurs is Anaphase I of meiosis I.

3. Write an alternate source of protein for animal and human nutrition. [1]

Answer : Single cell protein is an alternative source of protein for animal and spirulina in human nutrition.

4. Give an example of a plant which came into India as a contaminant and is a cause of pollen allergy. [1]

Answer : Plant came into India as a contaminant and is a cause of pollen allergy is **Parthenium** [carrot grass].

SECTION–B

16. Explain the two factors responsible for conferring stability to double helix structure of DNA. [2]

Answer : Factors responsible for conferring stability to double helix structure of DNA :

1. Presence of Hydrogen bond in between base pair stack confers stability to DNA.
2. Presence of thymine at the place of uracil gives more stability to DNA.
3. The plane of one base pair stacks over the other.
4. Complementarity.

18. Write the effect of the high concentration of L.H. on a mature Graafian follicle. [2]

Answer : High levels of Luteinizing Hormone (LH) induces rupture of mature Graafian follicle and causes release of ovum known as ovulation.

SECTION–C

24. (a) Explain adaptive radiation with the help of suitable example.

(b) Cite an example where more than one adaptive radiations have occurred in an isolated geographical area. Name the type of evolution your example depicts and state why it is so named. [3]

Answer : (a) Adaptive radiation or divergent evolution: Different species are evolved in a given geographical area starting from the single point and literally radiating to other habitats in that area.

Example : In the Australian region, marsupials each different from the other evolved from an ancestral stock, but all within the Australian island continent when more than one adaptive radiation appeared to have occurred in an isolated geographical area, one can call this convergent evolution.

(b) Convergent evolution : Convergent evolution is the process by which unrelated or distantly related organisms evolve similar body forms, colouration, organs, and adaptations. Natural selection can result in evolutionary convergence under several different circumstances. Species can converge in sympatry, as in mimicry complexes among insects, especially butterflies.

Example : Marsupial fauna of Australia and the placental mammals of the Old World. The two lineages are clades *i.e.*, they each share a common ancestor that belongs to their own group, and are more closely related to one another than to any other clade—but very similar forms evolved in each isolated population.

25. (a) Name any two copper releasing IUDs.

(b) Explain how do they act as effective contraceptives in human females. [3]

Answer : Two copper releasing IUDs are CuT, Cu7, Multiload 375.

(b) CuT is a method of intrauterine devices (IUTs). These devices are administered by the doctor in the uterus through vagina. The CuT is a copper releasing device which increases phagocytosis of sperms within the uterus and the Cu ions released suppress sperm motility and fertilizing capacity of

the sperm. So they act as effective contraceptives in human females.

27. (a) State how the constant internal environment is beneficial to organisms.

(b) Explain any two alternatives by which organisms can overcome stressful external conditions. [3]

Answer : (a) A constant internal environment is beneficial to organisms as it permits all bio-chemical reactions to proceed with maximal efficiency. It also enhances fitness of the species.

(b) 1. Regulation : Maintaining internal environment by maintaining constant body temperature or osmotic concentration.

2. Suspend : By suspending metabolic activities through hibernation, aestivation or diapause.

3. Migration : Organisms migrate temporarily to more hospitable areas.

SECTION–D

28. Explain the process of sewage water treatment before it can be discharged into natural water bodies. Why is this treatment essential ? [5]

OR

Explain the process of replication of a retrovirus after it gains entry into the human body.

Answer : There are agronomic and economic benefits of waste water used in agriculture. Irrigation with waste water can increase the available water supply or release better quality supplies for alternative uses.

Sewage treatment generally involves three stages, called primary, secondary and tertiary treatment.

1. **Primary Treatment :** In primary treatment, the incoming flow is slowed in large tanks which allow the dirt, gravel, and other heavier components of the waste stream to settle out. Grease, oil and other floatables are also removed here. Rotating arms simultaneously remove the settled solids from the bottom and the separated floatables from the top. Both pollutants are pumped into large heated holding silos, called digesters.
2. **Secondary or Biological Treatment**—The effluent is passed into large aeration tanks and agitated mechanically. Air is pumped into it to allow vigorous growth of aerobic microbes into flocs, which consume major part of organic matter thus reducing the BOD. The effluent is then passed into settling tanks where flocs are allowed to settle (activated sludge) which is directed to anaerobic sludge digesters. Here anaerobic bacteria digest the bacteria and fungi in the sludge to produce biogas.

The treatment is essential to control pollution in natural water bodies and to check water borne diseases or pathogenic organisms.

OR

Answer : HIV multiplies in human body first in macrophages during inhibition period and later in Helper T-cells during which symptoms of AIDS appear.

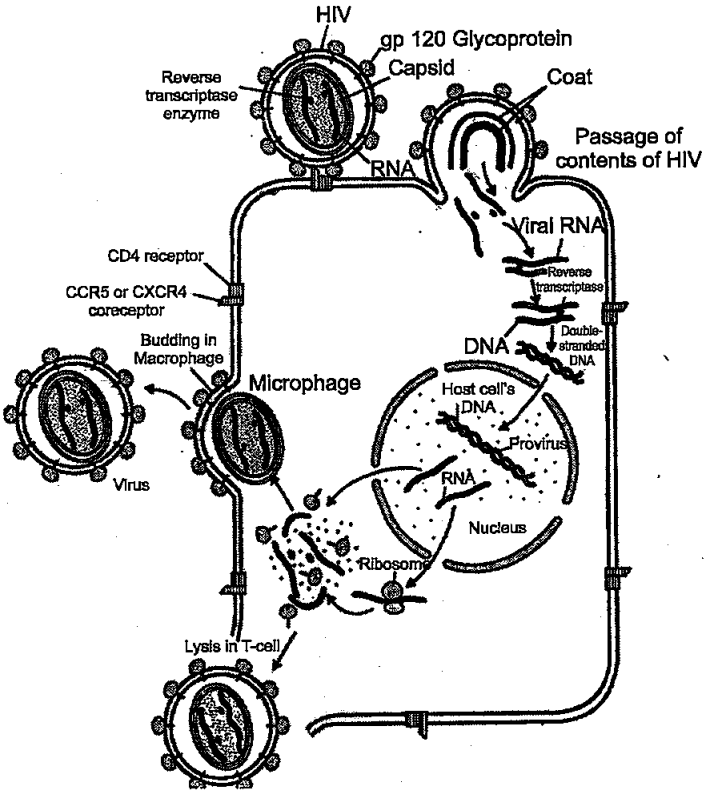
(I) Cycle in Macrophages :

1. After gaining entry into the human body, the HIV passes to all parts through blood and other body fluids.
2. When it comes in contact with macrophage, the gp 120 spilce of virus binds with CD4 receptor of the macrophage.
3. A conformational change aids the virus to attach to another co-receptor called CCR5.
4. This triggers change in cell membrane of the macrophage which then endocytose HIV.
5. Once inside, it sheds the protective cover. This frees the RNA along with **reverse transcriptase** in the cytoplasm of macrophage.
6. It synthesizes copy of DNA from which a complement DNA is produced.
7. The double stranded DNA attaches to host DNA in the form of **provirus**. It then directs the host cell machinery to form genomic RNA and mRNA.
8. mRNA synthesizes viral proteins including reverse transcriptase. Genomic RNA and viral proteins are packet together to form the virus. In this way, several copies of virus are formed.
9. These viruses then bud out of the macrophages by the process of exocytosis. These then invade new macrophages to further replicate.

The HIV undergoes similar cycle of replication

in the **Helper T-cells.**

1. The virus first attaches to CD4 receptor by it gp 120. The complex then comes in contact with conceptor CXCR4.
2. The virus then passes into the cytoplasm of T-lymphocytes through endocytosis.
3. Inside the cytoplasm of T-cell, the virus coat is shed, the naked RNA alongwith copy DNA and then complement DNA, which then gets integrated to host DNA as provirus.
4. The provirus directs the synthesis of two types of RNA-genomic and mRNA. mRNA forms viral proteins (including reverse transcriptase). Genomic RNA and viral proteins are packed together to form the **virion.**
5. The virion comes in contact with the surface of lymphocyte, ruptures its cell membrane and comes out. These further infect healthy cells.
6. Thus, number of T-cells decline, compromising the immune system of the body.



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Biology 2014 (Delhi)

SET I

Time allowed : 3 hours **Maximum marks : 70**

SECTION–A

1. **Write the name of the organism that is referred to as the 'Terror of Bengal'.** [1]

   Answer : Water hyacinth *(Eichhornia crassipes)*

2. **What are 'true breeding lines' that are used to study inheritance pattern of traits in plants ?** [1]

   Answer : Breeding line having undergone with a number of repeated self pollination and shows stable trait inheritance and expression for several generations called a true breeding line. They are homozygous.

3. **Name any two types of cells which act as a 'cellular barriers' to provide innate immunity in humans.** [1]

   Answer : 1. Monocytes (natural killer)

   2. PMNL-Neutrophils (polymorpho- nuclear leukocytes)

4. **Mention the type of host cells suitable for the gene guns to introduce an alien DNA.** [1]

Answer : The type of host cells suitable for the gene guns to introduce an alien DNA is plant cells.

5. How is 'stratification' represented in a forest ecosystem? [1]

Answer : Stratification is the way in which different species occupying different levels are arranged in a habitat. It is a way of minimizing competition for limited but vital resources, for survival.

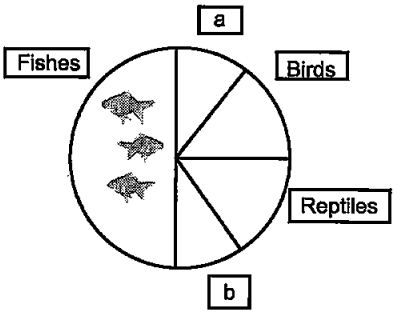
Vertical stratification in a forest ecosystem is represented by the following strata of plants starting from the lowest layer :

1. The herb layer
2. The shrub layer
3. The small tree layer
4. The canopy layer

6. Give an example of an organism that enters 'diapause' and why ? [1]

Answer : *Bombyx mori* (silk moth) is an insect that enters diapause to avoid adverse environmental conditions such as drought, extreme temperature, reduced food availability which in turn, delays the overall development. The physiological and metabolic activities are also diminished at this particular time or Zooplanktons enter a state of diapause to avoid unfavourable conditions.

7. Identify 'a' and 'b' in the figure given below representing proportionate number of major vertebrate taxa. [1]



Answer : 'a' represents mammals and 'b' represents amphibians.

8. State the cause of Accelerated Eutrophication. [1]

Answer : Accelerated Eutrophication is the aging of a water body due to nutrient enrichment of its water. Release of nutrient-rich sewage and industrial effluents containing nutrients such as nitrogen and phosphorus causes accelerated eutrophication.

SECTION–B

9. Why do algae and fungi shift to sexual mode of reproduction just before the onset of adverse conditions ? [2]

Answer : The fungi and algae switch to the sexual mode of reproduction during adverse conditions because sexual reproduction brings variation into the individuals. In algae and fungi, the zygote develops a thick wall that is resistant to dessication and damage. This ensures the continuity of species.

10. A cross was carried out between two pea plants showing the contrasting traits of height of the plants. The result of the cross showed 50% parental characters.

(i) Work out the cross with the help of a Punnett square.

(ii) Name the type of the cross carried out. [2]

Answer : (i)

Tt (tall) × tt (dwarf)

	(T)	(t)
(t)	Tt (tall)	tt (dwarf)
(t)	Tt (tall)	tt (dwarf)

(ii) The type of cross carried out here is a test cross.

11. How does the gene 'I' control ABO blood groups in humans ? Write the effect the gene has on the structure of red blood cells. [2]

Answer : In humans, the ABO blood groups are controlled by a gene called gene 'I'. Sugar polymers protrude from the surface of red blood cells and I controls the kind of sugar. It has three alleles, I^A, I^B and i. A person possesses any two of the three alleles. I^A and I^B dominate over *i*. But with each other, I^A and I^B are co-dominant.

Table : The Genetic Basis of Blood Groups in Human Population

Genotype of off-spring	Blood type of off-spring
$I^A I^A$	A
$I^A I^B$	AB
$I^A i$	A
$I^A I^B$	AB
$I^B I^B$	B
$I^B i$	B
$i i$	O

The red blood cells have sugar polymers protrude from the plasma membrane surface and it is regulated by the gene 'I' of ABO blood group. The alleles I^A and I^B produce A and B types of sugar, while allele *i* does not produce any sugar.

OR

Write the types of sex-determination mechanisms the following crosses show. Give an example of each type.

(i) Female XX with Male XO

(ii) Female ZW with Male ZZ

Answer : The types of sex-determination mechanisms in the following crosses are :

(i) Female XX with Male XO : In this case females have a pair of X chromosomes and males have only one X chromosomes (the O indicates absence of chromosome), so it is the case of male heterogamety *e.g.,* grasshopper.

(ii) Female ZW with Male ZZ : This cross shows ZW type of sex determination. In this case female has one Z and one W chromosome and these chromosomes produce different kinds of gametes, so it is the case of female heterogamety *e.g.,* birds.

12. (i) Name the scientist who suggested that the genetic code should be made of a combination of three nucleotides.

(ii) Explain the basis on which he arrived at this conclusion. **[2]**

Answer : (i) *George Gamow* suggested that the genetic code should be made up of a combination of three nucleotides.

(ii) He arrived at this conclusion by giving the explanation if a single nucleotide code for one amino acid, then only four amino acids could be provided. Alternatively, if two nucleotides specified one amino acid, then there could be a maximum number of 16 possible arrangements of three nucleotides code for one amino acid, then there could be 64 possible combinations. Later he suggested that every amino acid is coded by atleast one nucleotide triplet or codon.

13. State the disadvantage of inbreeding among cattle. How can it be overcome ? **[2]**

Answer : Continuous inbreeding among cattle causes inbreeding depression, decreases the fertility and, even, the productivity of an animal. It can be overcome by applying outbreeding, in which mating is done between different breeds or individuals of the same breed with unrelated superior animals or outbreeding.

14. Explain with the help of a suitable example the naming of a restriction endonuclease. **[2]**

Answer : The nomenclature of a restriction endonuclease follows a rule as follows :

1. I letter of the name represents the genus of the organism from which the enzyme is derived.
2. II and IIIrd letters represent the species of the organism, from where it is isolated.
3. IV letter represents the name of the strain.
4. Last is the Roman number which represents order of isolation.

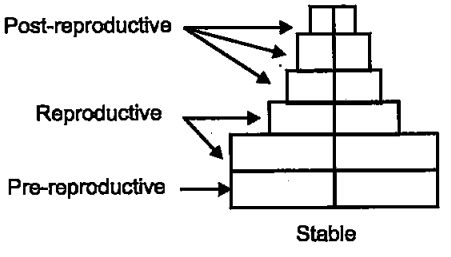
- For example, In EcoRI – Derived from *E.coli*, strain R. It is the first to be isolated from the bacteria.

15. State how has *Agrobacterium tumifaciens* been made a useful cloning vector to transfer DNA to plant cells. **[2]**

Answer : *Agrobacterium* is a bacterium that transfers a piece of DNA to plant tissues by transferring its plasmid T-DNA to the plant genome. The plasmid T-DNA of Agrobacterium is cut with restriction endonuclease and the desired gene that has to be transferred to a particular plant is inserted with the help of ligase enzyme. Then, this Agrobacterium plasmid is allowed to infect that particular plant, so that it can transfer the desired gene into the plant genome through its T-DNA.

16. Construct an age pyramid which reflects a stable growth status of human population. **[2]**

Answer : The age pyramid that reflects a stable growth status of human population can be represented as follows :



Growth Status of Human Population

17. Apart from being a part of the food chain, predators play other important roles. Mention any two such roles supported by examples. **[2]**

Answer : Predators play an important role in :

1. Maintaining the prey population under control, this regulates intra-species competition.

   For example, if tigers are removed from a forest, spotted deer will multiply rapidly. This

would result in rapid destruction of herbs and grasses in the forest and ultimately the whole forest.

2. Predators also help in maintaining species diversity in a community, by reducing the intensity of competition among prey species.

For Example: the starfish *Pisaster* is an important predator on the rocky intertidal communities of the American Pacific Coast. In a field experiment, when all the starfish were removed from the area, more than 10 species of invertebrates became extinct within a year, because of inter-specific competition.

18. How are 'sticky ends' formed on a DNA strand? Why are they so called ? [2]

Answer : Sticky ends in DNA strands are produced with the help of restriction enzymes. These enzymes cut the strand of DNA a little away from the centre of the palindrome sites but between the two same bases on the opposite strands. This leaves a single stranded portion at the ends. There are overhanging stretches called 'sticky ends' on each strand.

e.g. : 5′ - G ↓ AATTC - 3′ $\xrightarrow{\text{ECORI}}$

5′ G ← sticky ends

These are called sticky ends because they form hydrogen bonds with their complementary cut counterparts. This stickiness of the ends facilitates the action of the enzyme DNA ligase.

SECTION–C

19. Explain any three advantages the seeds offer to angiosperms. [3]

Answer : Seeds offer the following advantages to angiosperms :

1. Since reproductive processes such as pollination and fertilisation are independent of water, seed formation is more dependable.
2. Seeds have better adaptive strategies for dispersal to new habitats and help the species to colonise new areas.
3. As they have sufficient food reserves, young seedlings are nourished until they are capable of photosynthesis on their own.
4. Being products of sexual reproduction, they are capable of new genetic combinations or variations.

20. Name and explain the role of the inner and middle walls of the human uterus. [3]

Answer : The inner glandular wall of the uterus is known as **endometrium.**

Role : 1. During the menstrual cycle, the endometrium wall grows into a thick, blood vessel-rich, glandular layer. It is the place where embryo gets implanted. If fertilisation does not occur, the endometrium is shed during the **hemorrhagic** phase of the menstrual cycle.

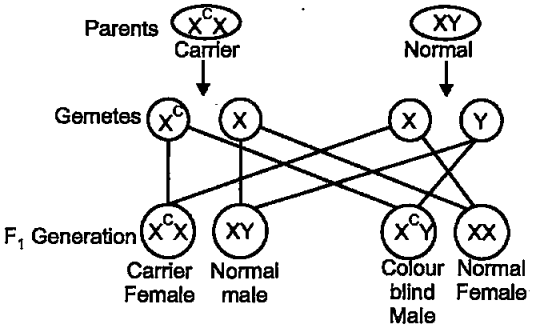
2. It helps in placenta formation after implantation.

The middle wall of the uterus is known as **myometrium.**

Role : It consists of smooth muscles. It brings strong contraction during delivery of the baby.

21. A colour-blind child is born to a normal couple. Work out a cross to show how it is possible. Mention the sex of this child. [3]

Answer : Colour blindness is a sex-linked disease. The gene for this disorder is present on the X chromosome. The colour blind child is son with genotype X^CY and sex of the child is male and carrier female.



OR

Mendel published his work on inheritance of characters in 1865, but it remained unrecognised till 1900. Give three reasons for the delay in accepting his work.

Answer : The three reasons that delay in accepting Mendel's work :

1. Lack of communication and publicity. He published it in a journal that had limited circulation.
2. His concept of factors (genes) as discrete units that did not blend with each other was not accepted in the light of variations occurring continuously in nature.
3. Mathematical approach : Mendel's approach to explain biological phenomenon with the help of mathematics was also not accepted.

22. Women are often blamed for producing female children. Consequently, they are ill-treated

and ostracized. How will you address this issue scientifically if you were to conduct an awareness programme to highlight the values involved ? [3]

Answer : Women are not responsible for determination of the gender of a child. It is absolutely wrong to ill-treat a woman for giving birth to a girl child.

In human there are 22 pairs of autosomal chromosomes and one pair of sex chromosome. In human sperm (haploid) has 22 autosomes and one of the two types of sex chromosomes, *i.e.*, either X or Y. While human females ova (haploid) have 22 autosomes and contain only X chromosomes. The gender of a child is determined by the type of the sex chromosome (X or Y) carried by sperm that fuses with the ovum at the time of fertilisation. If the fertilising sperm has an X chromosome, then the baby would be a female and if a sperm with Y chromosome fuses with the ovum, it will develop into a male child. Thus scientifically it is correct to say that males are responsible for determination of the gender of a child. Both males and females are equally important in every respect for the balance of nature and continuity of our species and it should be cause of equal joy to parents.

23. (a) Name the tropical sugar cane variety grown in South India. How has it helped in improving the sugar cane quality grown in North India ? [3]

(b) Identify 'a', 'b' and 'c' in the following table:

No.	Crop	Variety	Insect Pests
1.	Brassica	Pusa Gaurav	(a)
2.	Flat bean	Pusa Sem 2 Pusa Sem 3	(b)
3.	(c)	Pusa Sawani Pusa A-4	Shoot and fruit borer

Answer : (a) *Saccharum officinarum* variety grown in South India, which has a thicker stem and high sugar content but, it did not grow well in Northern India. *Saccharum barberi* is natively grown in Northern India. These two varieties were crossed to get the desirable qualities of both (high yield, higher sugar content, thicker stem and the ability to grow in Northern India).

(b) (a) Aphids **(b)** Jassids and fruit borer **(c)** Okra (*Bhindi*).

24. Why are beehives kept in a crop-field during flowering period ? Name any two crop fields where this is practised. [3]

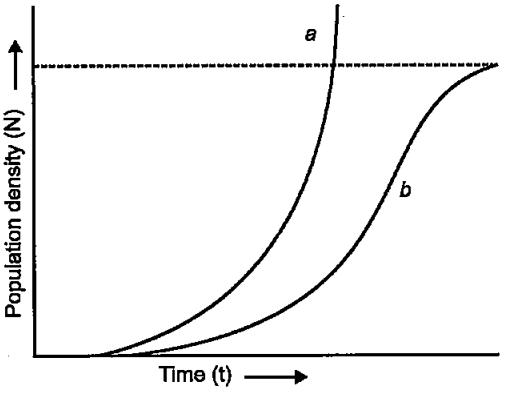
Answer : Beehives are kept in a crop field during flowering period to increase the pollination efficiency of the crop, which increases the crop yield. Also, bees collect huge amounts of nectar from the flowers on the crop in a close reach without much foraging without difficulty. This increases honey yield. Crop fields where this is practiced : Apple, sunflower watermelon fields, Brassica and pear.

25. How did the process of RNA interference help to control the nematode from infecting roots of tobacco plants ? Explain. [3]

Answer : RNA Interference (RNAi) is a gene-silencing process that blocks the expression of genes in the parasite when it enters the host's body.

1. *Meloidegyne incognitia* infects roots of tobacco plants and causes a severe loss by causing reduction in yield.
2. RNAi is a method to prevent infestation of roots of tobacco plants by a nematode *Meloidegyne incognitia.*
3. It is a defense in all eukaryotic organisms.
4. In RNAi, a complementary RNA binds to mRNA to form a double strand RNA(dsRNA) that cannot translate and block the expression of mRNA.
5. In this process, initially nematode-specific genes (DNA) are introduced in the host plant using Agrobacterium vectors.
6. This introduced DNA forms both sense and anti-sense RNA.
7. These two strands, being complementary to each other so that they form dsRNA.
8. This dsRNA results in RNA interference and finally silenced the specific mRNA of nematode.
9. Thus the parasite cannot survive in the transgenic host expressing specific RNAi. The transgenic plant therefore got itself protected from the parasite.

26. Study the graph given below and answer the questions that follow : [3]



(i) Write the status of food and space in the curves (a) and (b).

(ii) In the absence of predators, which one of the two curves would appropriately depict the prey population?

(iii) Time has been shown on X-axis and there is a parallel dotted line above it. Give the significance of this dotted line.

Answer : (i) This curve shows ample food and space for the population depicted by curve :

a : When the food and space are unlimited available.

b : When the resources are limiting, the curve becomes sigmoid.

(ii) In the absence of predators, curve a would appropriately depict the prey population.

(iii) The dotted line represents the carrying capacity. The carrying capacity represents the maximum possible size of population that the environment can hold by providing necessary resources.

27. (i) What is primary productivity ? Why does it vary in different types of ecosystems ?

(ii) State the relation between gross and net primary productivity. [3]

Answer : (i) Primary productivity is the amount of biomass produced per unit area in a certain time period by plants during photosynthesis. It is expressed in terms of g/m^2 or $Kcal/m^2$.

Primary productivity depends upon the type of plant species associated with an ecosystem, photosynthetic capacity of these plants and nutrient availability. This is the reason why it varies in different types of ecosystems.

(ii) The relation between the gross and net primary productivity can be shown as :

$$GPP - R = NPP$$

It is the rate of production of organic matter during photosynthesis, where,

NPP = Net primary productivity

GPP = Gross primary productivity

R = Respiration losses.

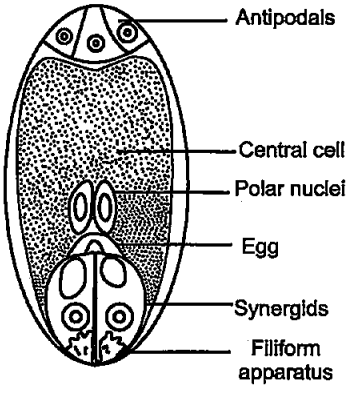
SECTION–D

28. (a) Coconut palm is monoecious, while date palm is dioecious. Why are they so called ?

(b) Draw a labelled diagram of sectional view of a mature embryo sac of an angiosperm. [5]

Answer : (a) Cocunut palm is monoecious, while date palm is dioecious because in coconut palm both male and female flowers are borne on the same plant, while date palm bears exclusively either male flowers or female flowers.

(b) Diagram showing sectional view of a mature embryo sac of an angiosperm



Mature Embryo sac of an angiosperm

OR

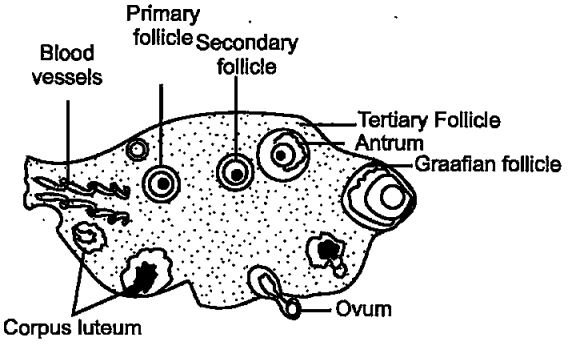
(a) How is 'oogenesis' markedly different from 'spermatogenesis' with respect to the growth till puberty in the humans ?

(b) Draw a sectional view of human ovary and label the different follicular stages, ovum and Corpus luteum.

Answer : (a)

1. Oogenesis is initiated at the embryonic stage.
2. Spermatogenesis begins only at puberty.

(b)



Sectional View of Human Ovary

29. (a) Explain the process of DNA replication with the help of a schematic diagram.

(b) In which phase of the cell cycle does replication occur in Eukaryotes ? What would happen if cell-division is not followed after DNA replication? [5]

Answer : (a) Mechanism of DNA Replication :
The following steps are involved in replication of DNA :

1. **Origin of Replication :** Replication begins at a particular region of DNA which has a particular nucleotide sequence called autonomic replicating sequence or ARS. It is called origin of Replication or ORI. Prokarytes have a single origin of replication while eukaryotes have several ORI.
2. **Activation of Deoxyribonucleotides :** There are 4 types of deoxyribonucleotides :

dAMP — dATP
dGMP — dGTP
$dTMP + 2H_3PO_4 \xrightarrow[\text{Energy}]{\text{Phosphorylase}}$ dTTP
dCMP — dCTP

3. **Initation of Replication :** Origin of replication is recognised by complex. The unwinding of DNA molecules starts at specific points called Initiation point. These are identified by specific initiator proteins.
4. **Unwinding of Helix :**

(a) The enzyme **Helicase** unwinds the DNA helix and unzips the double strands of DNA. This process is ATP dependent. It takes place by breaking of H-bonds.

(b) Unwinding of DNA molecule into two strands results in the formation of DNA replication bubble which later extend as a Y-shaped structure called Replication fork.

(c) The separated strands become stabilised in this condition with the help of single strand binding proteins (SSBPs).

(d) Due to unwinding, a supercoiling and tension is created, which is released by enzymes Topoisomerases I and II. Topoisomerase II of prokaryotes is also called Gyrase, which functions both as Helicase and Topoisomerase.

5. **Formation of Primer Strand :**

Elongation of New strand.

(a) Once the primer strand is formed, DNA replication occurs in 5′→3′ direction, *i.e.*, during synthesis of new strand, deoxyribonuleotides (dATP, dGTP, dTTP, dCTP) are added only to the free 3′ OH end.

d ATP — dAMP + 2pi + energy
d GTP $\xrightarrow[\text{Energy}]{\text{Pyrophosphate}}$ dGM + 2pi + energy
d TTP — dTMP + 2pi + energy
d CTP — dCMP + 2pi + energy

The release of 2 phosphate molecules and energy aid in formation of H-bonds.

(b) DNA replication occurs in S phase of cell cycle in eukaryotes.
If cell division is not followed after DNA replication then cell enters in G_0 phase and becomes permanent and specialized.

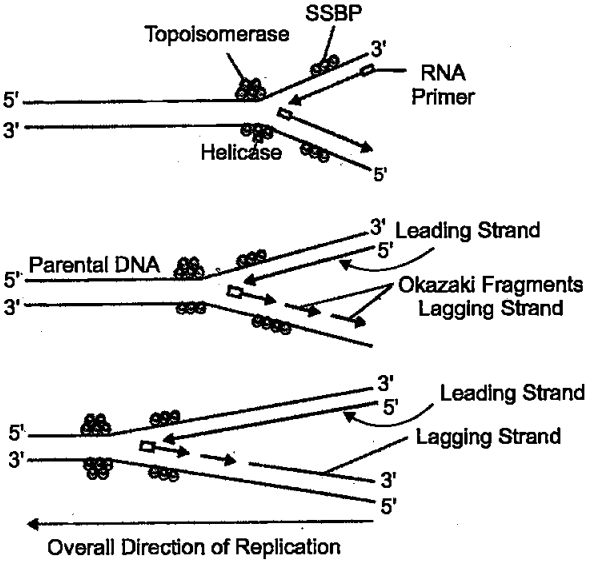
(c) As the DNA replication proceeds on the two parental strands, synthesis of daughter parent 3′→ 5′ strand. It is called Leading Daughter strand.

(d) Synthesis of the other daughter strand along the other parental strand, takes place in the form of short pieces because of the opposite arrangement of nucleotides. A new RNA primer is formed everytime, where new DNA strand is built in small segments. These RNA primers are removed by polymerase I and a enzymes in prokaryotes and eukaryotes respectively.

(e) This strand is called Lagging Daughter strand & the short pieces of DNA are called Okazaki fragments, named after its discover Okazaki (1968).

(f) Since replication is continuous over one strand and discontinuous over the other, it is called semi-continuous replication.

(g) Discontinuous pieces of the lagging strand are joined together by the enzyme DNA ligase (after removal of primers) to form continuous daughter strand.



(b) DNA replication occurs in S phase of cell cycle in eukaryotes.

If cell division is not followed after DNA replication, then polyploidy occurs.

OR

(a) Explain Darwinian theory of evolution with the help of one suitable example. State the two key concept of the theory.

(b) Mention any three characteristics of Neanderthal man that lived in near east and central Asia.

Answer : (a) Darwinian theory of Evolution took place by natural selection. The number of life forms depends upon their life span and their ability to multiply. Another aspect of Darwinian theory is natural selection, the survival of the fittest where nature selects the individuals, which are most fit to adapt to their environment. **Example:** Selection of the antibiotic resistance in bacteria. When a bacterial population grows on an agar plate containing antibiotic penicillin, the colonies that are sensitive to penicillin die, whereas one or few bacterial colonies that are resistant to penicillin survive. This is because these bacteria have undergone mutation results in evolution of a gene that made them resistant to penicillin drug. Hence, the advantage of an individual over the other helps in the struggle for existence.

The two key concepts of the theory are :

1. Branching descent : According to this concept, various species have come into existence from a common ancestor.

2. Natural selection : According to this concept, nature selects the individuals, which are most fit to adapt to their environment.

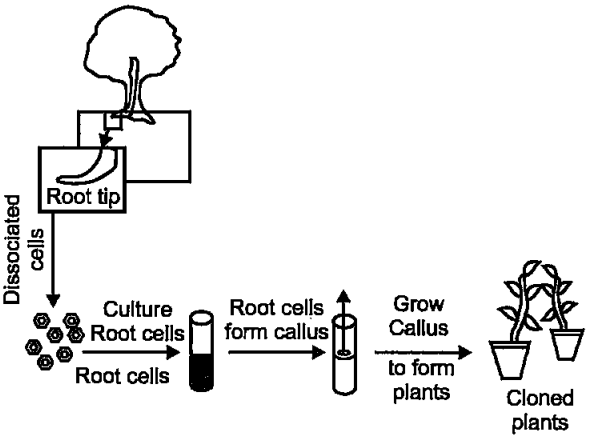
(b) Characteristics of Neanderthal man :

1. They possess a brain size of 1400 cc.
2. They were short but very strong with upwards curved thigh bones.
3. They used the hides to protect their body and they buried the dead.

30. (a) Name the technology that has helped scientists to propagate on a large scale the desired crops in a short duration. List the steps carried out to propagate the crops by the said technique.

(b) How are somatic hybrids obtained ? [5]

Answer : (a) Plant tissue culture or micro-propagation is the technique of in vitro maintenance and growth of plant cells, tissues and organs on a suitable culture medium. The technique of tissue culture was first suggested by Gottleib Haberlandt in 1902.



Tissue culture technique

The following steps are carried out to propagate crops by tissue culture :

1. **Preparation of suitable medium :** Suitable medium, containing a carbon source, such as sucrose, and inorganic salts, vitamins, amino acids and growth regulators like auxin, cytokinin etc.
2. **Selection of Explant :** Any part of the plant, especially apical and axillary meristem can be used as explant.
3. **Incubation :** Growing the explant in the test tube, under sterile conditions.
4. **Regeneration :** Since explant shows the property of totipotency, new plantlet can be regenerated in a special nutrient medium.
5. **Hardening :** Regenerated plants are grown in pots, to expose them to environmental conditions.
6. **Plantlet transfer :** After hardening, plantlets are transferred to field.

(b) Isolated single cells are taken and their cell walls are digested to obtain protoplasts from two different varieties. The protoplasts are fused to get hybrids.These hybrids are called somatic hybrid while the process is called somatic hybridisation.

OR

(a) Cancer is one of the most dreaded diseases of humans. Explain 'Contact inhibition' and 'Metastasis' with respect to the disease.

(b) Name the group of genes which have been identified in normal cells that could lead to cancer and how they do so ?

(c) Name any two techniques which are useful to detect cancers of internal organs.

(d) Why are cancer patients often given α-interferon as part of the treatment ?

Answer : (a) Cancer is one of the most dreaded disease of humans. Normal cells show a property called contact inhibition, by virtue of which contact with other cells inhibits their uncontrolled growth. Cancer cells lose this property. As a result, cancer cells divide continously to give rise to a mass of cells (tumours).

Metastasis is a property of malignant tumours. Some cancer cells from tumours get sloughed from the tumour and they reach distant sites through the blood and wherever they reach initiate the formation of new tumours by dividing actively. This property is called metastasis.

(b) Cellular oncogenes (c-onc) and proto-oncogenes are the group of genes that have been identified in normal cells. These genes when activated under certain conditions, would lead to oncogenic transformation of the cells.

(c) Techniques such as biopsy, radiography, CT (Computed Tomography) and MRI (Magnetic Resonance Imaging) are useful to detect cancers of internal organs.

(d) The biological response modifiers such as α-interferons are given to cancer patients as part of their treatment because it activates a patient's immune system and helps in destroying the tumour.

●●

Biology 2014 (Delhi) SET II

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous set.

SECTION–A

4. Name the two intermediate hosts which the human liver fluke depends on to complete its life cycle so as to facilitate parasitization of its primary host. **[1]**

Answer : Terrestrial snail and Fish, are two intermediate hosts on which the human liver fluke depends on to complete its life cycle so as to facilitate parasitization of its primary host.

7. Mention how does DNA polymorphism arise in a population. **[1]**

Answer : DNA polymorphism is a genetic variant and introduced in a population by mutation and genetic drift at a high frequency.

SECTION–B

9. Name the organic materials the exine and intine of an angiosperm pollen grain are made up of. Explain the role of exine. **[2]**

Answer : Exine is made of sporopollenin. Intine is made of cellulose and pectin. Sporopollenin (exine) is most resistant organic material which can withstand high temperature and acids and alkalies.

13. How can healthy potato plants be obtained from a desired potato variety which is viral infected ? Explain. **[2]**

Answer : Tissue culture can get us disease free potato plants from viral infected plants. The apical and axillary meristems of virus infected plant are free of virus. So meristems can be removed and their culture can give us virus free plants.

15. What is Biopiracy ? State the initiative taken by the Indian Parliament towards it. **[2]**

Answer : Biopiracy is defined as the use of bio-resources by multinational companies or other organisations without proper authorisation or compensation from concerned country or people. Indian Parliament has declared second amendment of Indian Patents Bill Act (1970), this bill considers patenting, its stern emergency provisions and research and development initiatives.

18. Write the role of 'Ori' and 'restriction' site in a

cloning vector pBR322. [2]

Answer : Role of Ori sequence and restriction site in pBR322 :

Ori is a genetic sequence that acts as the initiation site for replication of DNA, when any fragment linked to this sequence can be initiated to replicate within host cells. Ori is also responsible for controlling copy number.

Recognition site is the specific DNA sequences which contains different palindromic sequence, as recognized by respective restriction enzymes (such as EcoRI, Hind III, PvuI, BamHI etc.). Recognition sites are sequences where the restriction enzymes cut the DNA. It is the site of ligation of alien DNA in one of the two antibiotic resistance sites.

SECTION–C

20. A cross between a normal couple resulted in a son who was haemophilic and a normal daughter. In course of time, when the daughter was married to a normal man, to their surprise, the grandson was also haemophilic.

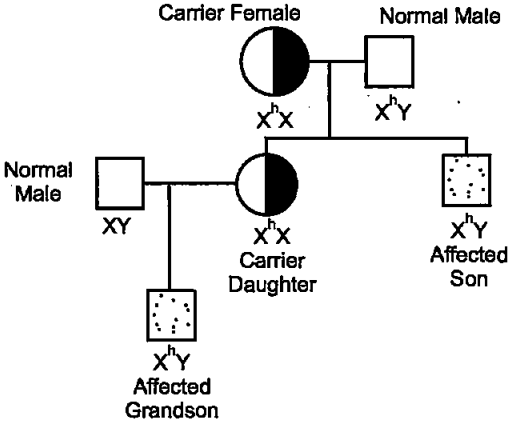
(a) Represent this cross in the form of a pedigree chart. Give the genotypes of the daughter and her husband.

(b) Write the conclusion you draw of the inheritance pattern of this disease. [3]

Answer : (a)

Genotype of daughter- XX^h

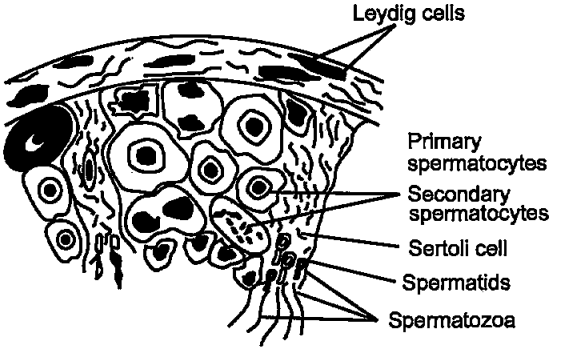
Genotype of husband- XY



(b) Conclusion : Haemophilia is a sex-linked recessive disease which shows it is transmitted from the carrier female to the sons. From the above pedigree chart, it can be observed that the disease is being transmitted from the carrier female to her daughter (carrier) and son (affected). The carrier daughter transmits this disease to the grandson and the possibility of a female becoming a haemophilic is extremely rare. This inheritance is called crisscross inheritance.

22. Draw a labelled diagram of the sectional view of a human seminiferous tubule. (six parts to be labelled) [3]

Answer :



Sectional view of human seminiferous tubule

SECTION–D

30. Explain the ovarian and uterine events that occur during a menstrual cycle in a human female, under the influence of Pituitary and Ovarian hormones respectively. [5]

Answer : Menstrual Cycle : Menstrual cycle is the reproductive cycle in all primates and begins at puberty (menarche). It involves cyclic changes in female's reproductive tract culminating in menstruation that is flow of cast off uterine and fallopian tube lining along with blood and tissue fluid through the vagina. In human females, menstruation occurs once in 28 to 29 days. The cycle of events starting from one menstruation till the next one is called the menstrual cycle.

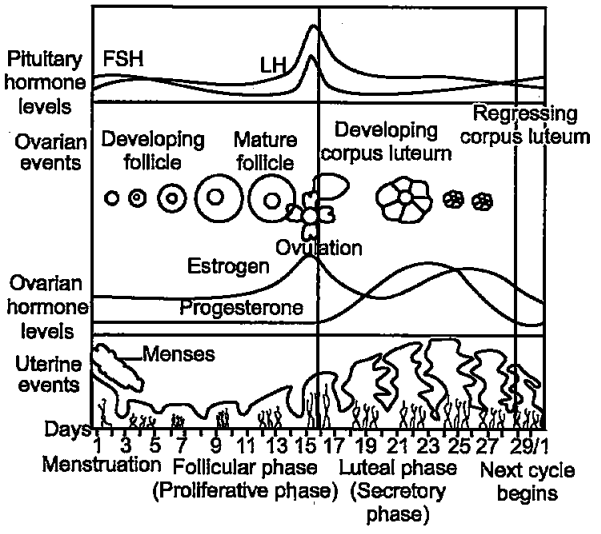
It consist of three phases :

1. Proliferating phase : It lasts for about 14 days. Lining of the uterus and fallopian tubes proliferates and its vascularization increases. A Graafian follicle grows, matures and secretes oestrogen. It ruptures to release its egg (secondary oocyte) after about 14 days. The LH and FSH are at their peak in the middle before release of oocyte. This phase is also called the ovulatory phase.

2. Secretory phase : It lasts for about 10 days. The empty Graafian follicle forms in it corpus luteum which secretes progesterone. The lining

of uterus and fallopian tubes undergoes further hypertrophy. Endometrial glands of the uterus secrete a nutritive fluid for the foetus.

3. Menstrual (Bleeding) phase : It lasts for about 4 days. If fertilization does not occur, the corpus luteum regresses, and the linning of uterus and fallopian tluteum reaksdown, resulting in menstrual flow. This occurs after 25 days and continues 3 to 5 days. The basal part of endometrial lining remain intact during menstruation and produces new uterine lining.



OR

(a) Why does endosperm development precede embryo development in angiosperm seeds? State the role of endosperm in mature albuminous seeds.

(b) Describe with the help of three labelled diagrams the different embryonic stages that include mature embryo of dicot plants.

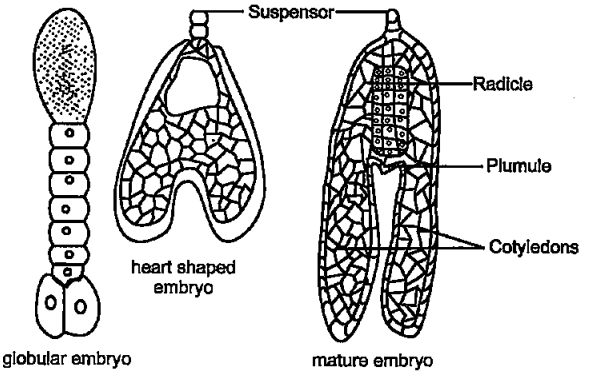
Answer : (a) Endosperm development precedes embryo development in angiosperm seeds because primary endosperm cell divides repeatedly and forms a triploid endosperm tissue. The cells of this tissue are filled with reserve food materials which provide nutrition to the developing embryo.

Albuminous seeds store starch and fat to retain a part of endosperm as it is not completely used up during embryo development (e.g. wheat, maize, barley, castor, sunflower).

(b) Development of embryo :

The Zygote formed after fertilization of egg cell starts dividing and gives rise to proembryo.

This proembryo further divides, forming a globular, heart-shaped and mature embryo.



Following are the steps that occur during the development of embryo :

1. In dicots zygote elongates and divides into upper and lower cell.
2. The lower one lying toward micropyle further divides in one direction into a row of cell called suspensor.
3. The upper cell lies towards the antipodal end is called embryo cell.
4. The first cell of the suspensor often enlarges and acts as haustorium or absorbing organ while its terminal cell called hypophysis cell divides giving rise to the apex of the radicle.
5. The upper cell or embryo cell enlarges and divides repeatedly to form eight cells that are arranged in two tiers – epibasal (terminal) and hypobasal (near the suspensor). A typical dicot embryo consists of an embryonal axis and two cotyledons.
6. The portion of the embryonal axis above the level of cotyledons is called epicotyl. It contains the plumule (shoot tip). The portion below the axis is called hypocotyl. It contains the radicle (root tip). The root tip is covered by the root cap.
7. Subsequent divisions give rise to globular heart-shaped embryo.

●●

Biology 2014 (Delhi)

SET III

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous sets.

SECTION–A

3. How is repetitive satellite DNA separated from bulk genomic DNA for various genetic experiments ? **[1]**

Answer : Satellite DNA is separated from bulk genomic DNA by density-gradient centrifugation technique. They are separated as different peaks. The bulk DNA forms a major peak and the other small peaks are referred to as satellite DNA.

5. **Name the Green House gases that contribute to total global warming.** [1]

Answer : Carbon dioxide, nitrous oxide, ozone and methane are the Greenhouse gases that are responsible for global warming.

SECTION–B

12. **What is gene therapy ? Name the first clinical case where it was used ?** [2]

Answer : Gene therapy is an experimental technique in which correction of a gene defect that has been diagnosed in a child or embryo is made A four year old girl became the first gene therapy patient on September 14, 1990 at the NIH clinical center. She was suffering from adenosine deaminase (ADA) deficiency.

15. **Why does Bt toxin not kill the bacterium that produces it, but kill the insect that ingests it ?** [2]

Answer : Bt toxin protein is produced by a soil bacterium called *Bacillus thuringiensis* in inactive prototoxin and crystalline form. The prototoxin form does not kill the bacteria. It becomes active and toxic when it is consumed by insects such as lepidopterans (armyworm), coleopterans (beetles) and dipterans (flies/mosquitoes) due to presence of alkaline pH in the gut. The activated toxin (delta endotoxins) binds to the epithelial cells in the midgut of an insect and creates pores that cause lyses and swelling, eventually killing the insect.

17. **Identify the following pairs as homologous of analogous organs :**
    - **(i) Sweet potato and potato**
    - **(ii) Eye of octopus and eye of mammals**
    - **(iii) Thorns of *Bougainvillea* and tendrils of Cucurbits**
    - **(iv) Fore limbs of bat and whale** [2]

Answer : (i) Analogous organs (ii) Analogous organs (iii) Homologous organs (iv) Homologous organs.

18. **List the post-fertilisation events in angiosperms** [2]

Answer : The various post-fertilisation events occurring in angiosperms are :

1. Sepals, petals and stamens of the flower dry up and fall off.
2. The zygote develops into an embryo.
3. Ovules develop into the seed.
4. The ovary develops into the fruit.
5. Development of endosperm.

SECTION–C

21. **What are Methanogens ? Name the animals they are present in and the role they play there.** [3]

Answer : Methanogens are anaerobic bacteria that grow anaerobically on cellulose material that produce large amounts of methane. Example : *Methanobacterium.* Methanogens are commonly found in the rumen of cattle and help in cellulose digestion. Hence, excreta of cattle (gobar) is rich in methanogens.

27. **There are many animals that have become extinct in the wild but continue to be maintained in Zoological parks.**
    - **(i) What type of biodiversity conservation is observed in this case ?**
    - **(ii) Explain any other two ways which help in this type of conservation.** [3]

Answer: (i) It is an example of ex-situ conservation.

(ii) Cryopreservation, Botanical garden, wild life safaries, seed banks and tissue culture are the ways that help in ex-situ conservation.

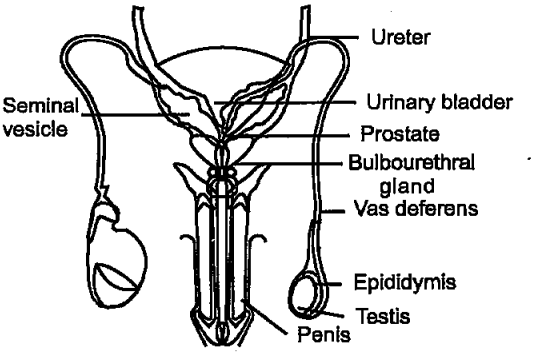
Cryopreservation : The preservation of gamates of threatened species in viable and fertile conditions at sub-zero temperatures which help in preserving these cells for longer periods.

Tissue culture : Plants are propagated from a small mass of tissue, called callus.

SECTION–D

29. **(a) Draw a labelled diagrammatic view of human male reproductive system.**
    - **(b) Differentiate between :**
    - **(i) Vas deferens and vasa efferentia**
    - **(ii) Spermatogenesis and spermiogenesis** [5]

Answer: (a) Diagrammatic view of a human male reproductive system



Male Reproductive system

(b) (i)

Vas deferens	Vasa efferentia
It is a tube-like structure which conducts the spermatozoa from the epididymis to the penis. Epididymis leads to vas deferens.	It connects the testis to the epididymis. The seminiferous tubules of testis open into the vasa efferentia and take sperms from the seminiferous tubules to the epdidymis.

(ii)

S.No.	Spermatogenesis	Spermiogenesis
(i)	It is the process of production of sperms from immature germ cells in males.	It is the process in which spermatids are transformed into mature spermatozoa.
(ii)	Number of cells are increased as each spermatogonium produces four spermatids.	There are no changes in the number of cells as only one spermatid develops into a spermatozoa.
(iii)	The genetic composition of primary sperm cells change from diploid to haploid status during sperma togenesis.	No effects on the gene-tic material of the germ cells.

OR

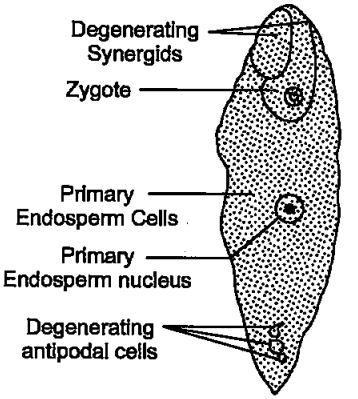
(a) Explain the phenomenon of double fertilization.

(b) Draw a labelled diagram of a typical anatropous ovule.

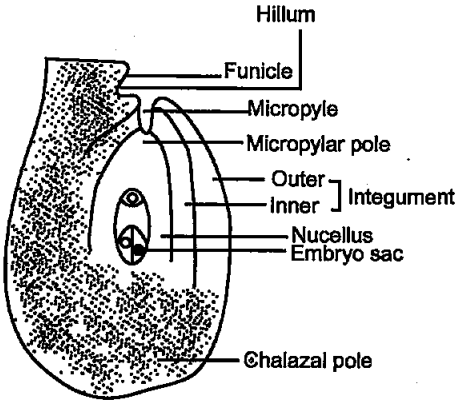
Answer : (a) Phenomenon of double fertilisation :

Pollen grains get transferred from the anther to the stigma, and then the pollen tube enters one of the synergids and releases two male gametes. One gamete moves towards the egg cell and fuses to form the zygote to complete the syngamy.

The other gamete fuses with the two polar nuclei and forms triploid Primary Endosperm Nucleus (PEN). This fusion of one male gamete with two polar nuclei is termed as triple fusion. Since, two kinds of fusion syngamy and triple fusion take place during fertilization in a flower, the process is known as double fertilization. It is a characteristic of flowering plants.



(b) Labelled diagram of a typical anatropous ovule :



Typical Anatropous ovule

Biology 2016 (Outside Delhi) SET I

Time allowed : 3 hours **Maximum marks : 70**

SECTION–A

1. **A male honeybee has 16 chromosomes whereas its female has 32 chromosomes. Give one reason.** [1]

   Answer : It is because of Haplodiploidy which is a sex determination system in which males develop parthenogenetically from unfertilized eggs and are haploid, and females develop from fertilized eggs and are diploid.

2. **Mention the role of 'genetic mother' in MOET.** [1]

   Answer : MOET is a programme for herd improvement to get more eggs. The genetic mother is available for another round of super ovulation in this technology.

3. **What is biopiracy ?** [1]

   Answer : Biopiracy is the term used to refer to the use of bioresources without proper authorisation, payment or fair compensation by the multinational companies and other organisations.

4. **Mention two advantages for preferring CNG over diesel as an automobile fuel.** [1]

   Answer : Two advantages for preferring CNG over diesel are:

   1. It is a very cheap fuel.
   2. It is a greener fuel.

5. **Write the probable differences in eating habits of *Homo habilis* and *Homo erectus*.** [1]

   Answer :

   Homo habilis did not eat meat while *Homo erectus* ate meat.

SECTION-B

6. **A single pea plant in your kitchen garden produces pods with viable seeds, but the individual papaya plant does not. Explain.** [2]

   Answer : In pea plant both male and female flowers are present on the same plant which results in producing viable seeds after self pollination. In papaya plant, male and female flowers are present on different plants *i.e.*, each plant is either male or female. Thus, a single papaya plant cannot produce viable seeds.

7. **Following are the features of genetic codes. What does each one indicate ?** [2]

   Stop codon; Unambiguous codon; Degenerate codon; Universal codon.

   Answer : Stop Codon : They do not code for any amino acids and terminate the synthesis of polypeptide chain.

   Unambiguous Codon : One codon codes for only one amino acid.

   Degenerate Codon : Some amino acids are coded by more than one codon.

   Universal Codon : It is same for all organisms (either bacteria or human).

8. **Suggest four important steps to produce a disease resistant plant through conventional plant breeding technology.** [2]

   Answer : Important steps to produce a disease resistant plant through conventional plant breeding technology are :

   1. Collection of variability and screening of germplasm.

2. Cross hybridisation among the selected parents.

3. Selection and evaluation of hybrids.

4. Testing and release of new hybrids.

9. Name a genus of baculovirus. Why are they considered good biocontrol agents ? [2]

Answer : Nuclear Polyhedrosis virus is a genus baculovirus which are efficient bio-control agents. They are considered to be good bio-control agents because these viruses are excellent candidates for species-specific, narrow spectrum insecticidal applications and show no negative impacts on plants, mammals, birds or even non-target insects.

10. Explain the relationship between CFC's and Ozone in the stratosphere. [2]

OR

Why are sacred groves highly protected ?

Answer : Relationship between CFCs and Ozone : When CFCs are released into the stratosphere, they end up being broken up by the UV light, resulting in chlorine atoms being released. This acts like a catalyst which splits ozone molecules creating O_2 and O. Cl^- atoms are not consumed in the reaction. Hence whatever CFCs are added to the stratosphere, they have permanent and continuing effects on ozone level.

OR

Sacred Groves are relic forest patches traditionally protected by communities in reverence of a deity. Sacred Groves form important repositories of forest biodiversity. It also provides vital ecosystem services to local people and are the last refuges for a large number of rare and threatened plants and animal species.

SECTION-C

11. (a) Name the organic material exine of the pollen grain is made up of. How is this material advantageous to pollen grain ?

(b) Still it is observed that it does not form a continuous layer around the pollen grain. Give reason.

(c) How are 'pollen banks' useful ? [3]

OR

(a) Mention the problems that are taken care of by Reproduction and Child Health Care programme.

(b) What is amniocentesis and why there is a statutory ban on it ?

Answer : (a) The hard outer layer called exine is made up of sporopollenin which is one of the most resistant organic materials. It can withstand high temperature, strong acids and alkalis. It cannot be degraded by any of the known enzymes.

Hence, it acts as a shield and protects the pollen grain from getting damaged.

(b) Exine does not form a continuous layer around the pollen grain. Pollen grain exine has prominent aperture called germ pore where sporopollenin is absent. Germ pores serve as an outlet for the formation of pollen tube.

(c) Pollen grains at a large can be stored for years in liquid nitrogen (– 196°C). So, after this treatment they are stored in pollen banks. Such conserved pollen grains can be used in plant breeding programs.

OR

(a) The problems which are addressed through Reproduction and Child Health Care Programme are :

Creating awareness among people about the various reproduction related aspects and providing facilities for building up a reproductively healthy society by controlling population growth, social evils like child marriage and sexual abuse and sex related crimes. It also helps in prevention of STDs.

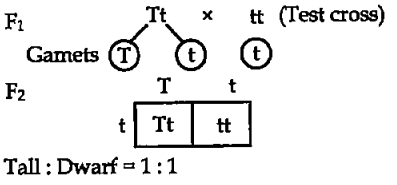
(b) A foetal sex determination test based on the chromosomal pattern in the amniotic fluid surrounding the developing embryo is called amniocentesis. Statutory ban on amniocentesis is imposed because this test can be used for determining the sex of foetus which is increasing female foeticides.

12. What is a test cross ? How can it decipher the heterozygosity of a plant ? [3]

Answer : If the progenies produced by a test cross show 50% dominant trait and 50% recessive trait, then the cross in which the genotype of an unknown dominant phenotype can be determined by crossing it with an individual homozygous recessive phenotype for that trait is called a test cross.

This cross determines whether the dominant character is coming from homozygous dominant genotype or heterozygous genotype. (*e.g.*,

tallness coming from Tt) when Tt is crosed with tt, we obtain all Tt (tall) individuals in the program. Thus, this test can be used to determine the heterozygosity of the plants.



Tall : Dwarf = 1 : 1

13. (a) What do 'Y' and 'B' stand for in 'YAC' and 'BAC' used in Human Genome Project (HGP)? Mention their role in the project.

(b) Write the percentage of the total human genome that codes for proteins and the percentage of discovered genes whose functions are known as observed during HGP.

(c) Expand 'SNPs' identified by scientists in HGP. [3]

Answer : (a) Y in YAC stands for yeast and B in BAC stands for bacteria they are specialized cloning vectors used in human genome project for cloning or amplification of foreign DNA fragments.

(b) Less than 2% of total genome codes for proteins in humans and around 50% of gene functions are known during HGP.

(c) SNP—Single Nucleotide Polymorphism.

14. Differentiate between homology and analogy. Give one example of each. [3]

Answer :

S.No.	Homology	Analogy
(i)	The organs which have similar origin (same internal structure) but different functions are called homologous organs.	The organs which have same function but are different in their origin are called analogous organs.
(ii)	Homology indicates-divergent evolution and common ancestory. Example : Wings of birds and forelimbs of humans	Analogy indicates convergent evolution. Example : Eye of the octopus and of mammals.

15. (a) It is generally observed that the children who had suffered from chicken-pox in their childhood may not contract the same disease in their adulthood. Explain giving reasons the basis of such an immunity in an individual. Name this kind of immunity.

(b) What are interferons ? Mention their role. [3]

Answer : (a) The type of immunity is Active immunity. Due to the development of memory-B cells in person's body after primary exposure to the disease, the generated antibodies help to prevent the second recurrence of the disease in adulthood by eliciting a highly intensified secondary or anamnestic response.

(b) Interferon : These are proteins made and released by viral infected cells which protect other non-infected cells from viral infection.

Role : α-interferons are given to cancer patients to destroy tumour as it activates the immune system.

16. (a) Write the two limitations of traditional breeding technique that led to promotion of micro–propagation.

(b) Mention two advantages of micro–propagation.

(c) Give two examples where it is commercially adopted. [3]

Answer : (a) Two limitations of traditional breeding are :

1. Traditional breeding techniques could not keep pace with demand and hence enough yield was not produced.

2. It also failed to provide fast and efficient system for crop improvement.

(b) Advantages of micropropagation are :

1. Production of many plants that are clones of each other.

2. It can be used to produce disease free plants.

(c) It is commercially adopted for Banana and Tomato.

17. (a) How do organic farmers control pests ? Give two examples.

(b) State the difference in their approach from that of conventional pest control methods. [3]

Answer : (a) Organic farmers create a system where the insects are not eradicated, but are kept at manageable levels by a complex system within living and vibrant ecosystem. It is a holistic approach.

Examples are :

1. The lady bird and dragon flies are useful to get rid of aphids and mosquitoes respectively.
2. *Bacillus thuringiensis* (Bt) are used to control butterfly caterpillars.

(b)

S.No.	Conventional Pest Control	Organic Pest Control
(i)	Use of chemical insecticide and pesticide.	Non–chemical based.
(ii)	Harmful to non-target organisms.	Not harmful to non-target organisms.
(iii)	It causres environmental pollution.	No adverse impact on environment.

18. (a) Name the selectable markers in the cloning vector pBR322 ? Mention the role they play.

(b) Why is the coding sequence of an enzyme β-galactosidase a preferred selectable marker in comparison to the ones named above ? [3]

Answer : (a) Genes encoding resistance to Ampicillin, chloramphenicol are selectable markers in the cloning vector pBR322. Selectable marker, helps in identifying and eliminating non-transformants and selectively permitting the growth of the transformants.

(b) Alternative selectable marker which differentiate recombinants from non-recombinants on the basis of their ability to produce colour in the presence of a chromogenic substrate. In this, a recombinant DNA is inserted within the coding sequence of an enzyme, β–galactosidase, which results in the activation of the enzyme referred as insertional inactivation coding sequence for the enzyme β-galactosidase is preferred over antibiotic resistance genes because recombinants can be easily visualised.

19. (a) Why must a cell be made 'competent' in biotechnology experiments ? How does calcium ion help in doing so ?

(b) State the role of 'biolistic gun' in biotechnology experiments. [3]

Answer : (a) DNA being a hydrophilic molecule, can not pass through cell membranes, hence the cells should be made competent to accept the DNA molecules as competency is the ability of a cell to take up foreign DNA.

Calcium ion helps in increasing the pore size in cell wall which enables the cell to take up the recombinant DNA.

(b) To introduce alien DNA into host cells, suitable for plants, cells are bombarded with high velocity micro-particles of gold or tungsten coated with DNA molecules known as biolistic or gene gun which play important role in biotechnology experiments.

20. Explain enzyme-replacement therapy to treat adenosine deaminase deficiency. Mention two disadvantages of this procedure. [3]

Answer : Adenosine deaminase (ADA) deficiency is a genetic disorder. In this disease, the gene coding for the enzyme ADA gets deleted leading to deficiency of ADA and problems in immune system. Adenosine deaminase (ADA) deficiency in patients can be treated by gene replacement therapy or enzyme replacement therapy. In this treatment, patients are regularly injected with the functional ADA enzyme.

Disadvantages of this procedure :

1. It does not completely eradicate the disease.
2. Requirement of repeated doses of the enzyme makes it expensive.

21. Name and explain the type of interaction that exists in mycorrhizae and between cattle egret and cattle. [3]

Answer : Mycorrhizae are associations between fungi and the roots of higher plants. The type of interaction that exists in mycorrhizae is mutualism in which both fungi and plants are mutually benefitted. Fungi absorb and transport essential nutrients to the plants and in turn plants provide the fungi with other energy carbohydrates.

The interaction that exists between cattle egret and cattle is known as commensalism. In this type of interaction, one species is benefitted whereas the other is neither benefitted nor harmed. The cattle egrets (bird) always forage close to where the cattle are grazing because the cattle, as they move, stir up and flush out from the vegetation insects that otherwise might be difficult for the egrets to find and catch. Thus, the cattle is neither benefitted nor harmed but the egret is benefitted.

22. Differentiate between primary and secondary succession. Provide one example of each. [3]

Answer :

S.No.	Primary Succession	Secondary Succession
(i)	It occurs in an area which is barren or lifeless.	It occurs in an area which has been devoid recently and previously inhabited.
(ii)	Soil is absent at the beginning of primary succession and the environment is not suitable for sustaining normal life forms.	Soil is present at the beginning of secondary succession with some organisms.
(iii)	There is no humus in the beginning as soil is absent.	Humus is present from the very beginning by the decomposition of previous occupants.
(iv)	Establishment of biotic community is very slow. *e.g.* succession on newly cooled lava.	Establishment of biotic community is faster. *e.g.* succession in a burnt forest.

SECTION-D

23. A large number of married couples the world over are childless. It is shocking to know that in India the female partner is often blamed for the couple being childless. [4]

(a) Why in your opinion the female partner is often blamed for such situations in India? Mention any two values that you as a biology student can promote to check this social evil.

(b) State any two reasons responsible for the cause of infertility.

(c) Suggest a technique that can help the couple to have a child where the problem is with male partner.

Answer : (a) Due to improper educational existence and lack of moral values and also along with the orthodox male dominant society nature in India, females are blamed for infertility issues.

As a biology student :

1. We must provide proper biological or sex education at such a basic stand which can be clear to every individual.
2. General health awareness programme must be scheduled to persons for their health related queries.

(b) Causes of Infertility in Females :

1. Ovulation disorders.
2. Problems in the uterus or fallopian tubes.

Causes of Infertility in Males :

(i) Low sperm count or low sperm mobility.

(ii) Genetic abnormality.

(c) Artificial Insemination (AI) is a technique that can help the couple to have a child where the problem is with male partner. In this technique, the semen collected either from the husband or a healthy donor is artificilly introduced into the vagina or into the uterus of the female.

ICSI (Intra Cytoplamsic Sperm Injection) is another specialized procedure to form an embryo in the lab in which a sperm is directly injected into the ovum.

SECTION–E

24. (a) Explain the menstrual phase in a human female. State the levels of ovarian and pituitary hormones during this phase.

(b) Why is follicular phase in the menstrual cycle also referred as proliferative phase ? Explain.

(c) Explain the events that occur in a Graafian follicle at the time of ovulation and thereafter.

(d) Draw a Graafian follicle and label antrum and secondary oocyte. [5]

OR

(a) As a senior biology student you have been asked to demonstrate to the students of secondary level in your school, the procedure(s) that shall ensure cross-pollination in a hermaphrodite flower. List the different steps that you would suggest and provide reasons for each one of them.

(b) Draw a diagram of a section of a megasporangium of an angiosperm and label funiculus, micropyle, embryosac and nucellus.

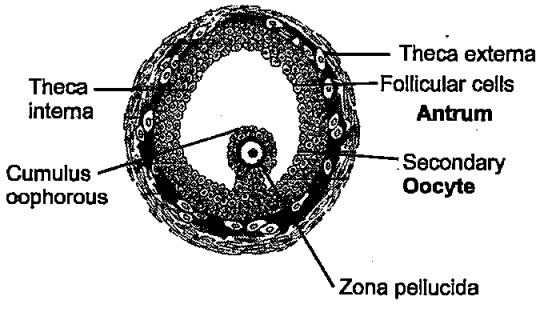
Answer : (a) In human females, menstruation is repeated at an average interval of about 28/29 days and the cycle of events starting from one menstruation till the next one is called the menstrual cycle. This cycle starts with the menstrual phase, when menstrual flow occurs and it lasts for 3-5 days. The menstrual flow results due to breakdown of endometrial lining of the uterus and its blood vessels which forms liquid that comes out through vagina. During this phase the levels of estrogen and progesterone are low.

(b) The proliferative phase is the part of the menstrual cycle during which the primary follicles grow into graafian folicle inside the ovaries, it develops and matures for the ovulation.

The levels of FSH increase in the bloodstream during the proliferation phase, stimulating the maturation of follicles. Each follicle contains an ovum or egg. Although many follicles may grow and increase in size during this phase, only one will reach full growth and release the ovum at the time of ovulation.

(c) During the mid cycle Leutinizing hormone is secreted to its maximum level which induces rupture of Graafian follicle and thereby the release of ovum (ovulation). The ovulation is followed by the luteal phase during which the remaining parts of the Graafian follicle transform as the corpus luteum which secretes large amounts of progesterone which is essential for maintenance of the endometrium. Such an endometrium is necessary for implantation of the fertilised ovum and other events of pregnancy.

(d)

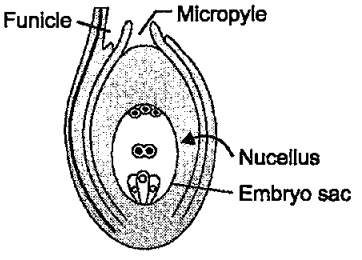


OR

(a) The different steps that would suggest for cross pollination in a hermaphrodite flower are :

1. Removal of anthers from the flower bud before the anther dehisces using a pair of forceps is necessary to avoid self pollination. It is referred as **emasculation.**
2. Emasculated flowers covered with a bag of suitable size to prevent contamination of its stigma called **Bagging.**
3. When the stigma of bagged flower attains receptivity, mature pollen grains collected from anther of the male parent are dusted on the stigma, and the flowers are rebagged to allow the fruit to develop.

(b)



25. Describe Meselson and Stahl's experiment that was carried in 1958 on *E. coli*. Write the conclusion they arrived at after the experiment. [5]

OR

(a) Describe the process of transcription in bacteria.

(b) Explain the processing the hnRNA needs to undergo before becoming functional mRNA eukaryotes.

Answer : The experiment was performed by Meselson and Stahl. The following steps were followed in the experiment.

E. coli was grown in a medium containing $^{15}NH_4Cl$ the heavy isotope ^{15}N as the sole nitrogen source. This led to the incorporation of ^{15}N into the newly synthesised DNA which ultimately made the DNA heavy. This heavy DNA was separated from the normal DNA by density gradient centrifugation using cesium chloride as the gradient. The cells were then transferred into a medium with ^{14}N as the nitorgen source. Samples were taken from this medium after every 20 minutes and the DNA was extracted.

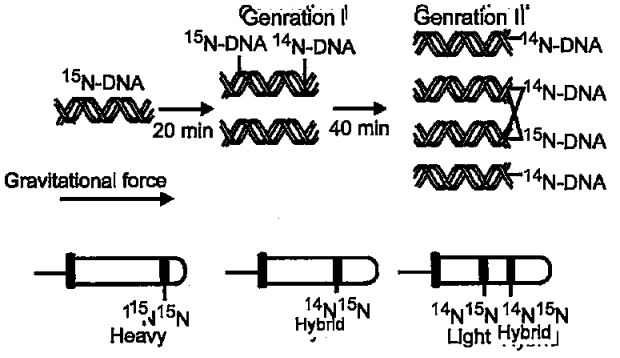
Observation :

Since *E. coli* divides every 20 minutes, the DNA extracted after 20 minutes in the experiment had a hybrid density. The DNA extracted after 40 minutes had equal amounts of hybrid and light densities.

Conclusion :

DNA extracted from the culture after another generation was composed of equal amounts of this hybrid DNA and of light DNA.

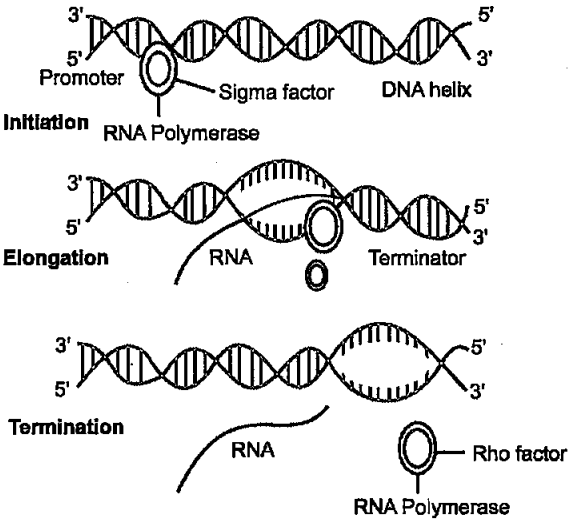
This implies that the newly synthesised DNA obtained one of its strands from the parent. Thus, replication was semi-conservative.



OR

(a) Transcription has three steps : Initiation, elongation and termination.

1. **Initiation :** RNA polymerase binds to promoter and initiates transcription. It associates with initiation factor and alters the specificity of RNA polymerase to initiate the transcription.
2. **Elongation :** RNA polymerase uses ribonucleoside triphosphate as substrate, and polymerises in a template depended fashion following the rule of complementarity and facilitates opening of the helix and continues elongation.
3. **Termination** occurs when termination factor (rho) alters the specificity of RNA polymerase. Only a short stretch of RNA remains bound to the enzyme. Once the polymerases reaches the terminator region, the nascent RNA falls off, so also the RNA polymerase. This results in termination for translation of transcription.



(b) The precursor of mRNA, *i.e.*, hnRNA, contains both introns and exons. Introns are removed and exons are joined by a process called splicing. The remaining mRNA is processed in two ways :

Capping : An unusual nucleotide (methyl guanosine triphosphate) is added to the 5′-end of hnRNA.

Tailing : Adenylate residues (200-300) are added at 3′-end in a template independent manner.

When hnRNA is full processed, it is known as mRNA, which is transported out of the nucleus.

26. (a) Name the two growth models that represent population growth and draw the respective growth curves they represent.

(b) State the basis for the difference in the shape of these curves.

(c) Which one of the curves represent the human population growth at present ? Do you think such a curve is sustainable ? Give reason in support of your answer. [5]

OR

(a) Taking an example of a small pond, explain how the four components of an ecosystem function as a unit.

(b) Name the type of food chain that exists in a pond.

Answer : (a) Two growth models are :

(1) Exponential **(2)** Logistic

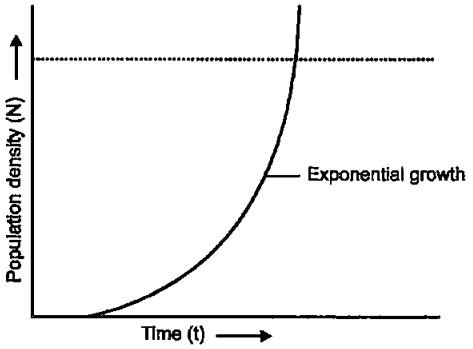
(1) Exponential Growth :

N : Population size

b : Birth rates

d : Death rates

: increase/decrease in N during time t



Then, $\frac{dN}{dt} = (b-d)\,N$

Let $(b-d) = r$, then

$$\frac{dN}{dt} = rN$$

$$\boxed{Nt = N_0 e^{rt}}$$

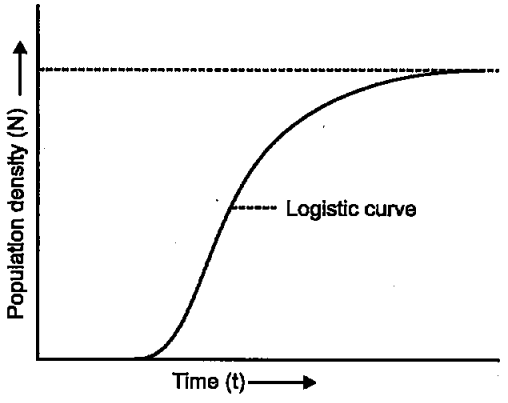
(2) Logistic Growth :

$$dN/dt = rN\left[\frac{K-N}{K}\right]$$

where, N = Population density at time t

r = Intrinsic rate of natural increase

K = Carrying capcity.



(b) The difference in the shape of these curves is the amount of resources available for the given population. When resources are unlimited each species realizes its innate potential to grow in number and result in a J-shaped curve in exponential growth while in logistic growth no population has unlimited resources which leads to competition for resources and shows S-shaped curve.

(c) Exponential growth curve represents the human population growth at present because the number of human beings are increasing rapidly. Such a curve is not sustainable because at one point the human population would reach a place where there would not be finite resources for every one.

OR

(a) 1. Productivity—Conversion of inorganic substances into organic substances with the help of radiant energy (sunlight) by producers (phytoplanktons algae, floating and submerged plants).

2. Decomposition—Decomposers (fungi, bacteria, flagellates) breakdown dead or decaying organic matter into simpler compounds.

3. Energy flow—Unidirectional movement of energy towards higher trophic levels and its dissipation and loss as heat to the environment.

4. Nutrient cycling—Mineralisation of dead matter to release them back for reuse by autotrophs.

(b) Grazing food chain or detritus food chain exists in a pond.

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Biology 2016 (Outside Delhi) SET II

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous set.

SECTION–A

4. Mention two objectives of setting up GEAC by our Government. **[1]**

Answer : Two objectives of setting up GEAC by our Government are :

1. GEAC (Genetic Engineering Approval Committee), will make decisions regarding the validity of GM research.

2. To check the safety of introducing GM-organisms for public services.

SECTION-B

6. What is aminoacylation ? State its significance. [2]

Answer : In translation, amino acids are activated in the presence of ATP and linked to their cognate tRNA, this process called as aminoacylation of tRNA or charging of tRNA.

Aminoacylation catalyses the formation of a specific aminoacyl-tRNA from an amino acid and enhances the rate of peptide bond formation.

8. Gynoecium of a flower may be apocarpous or syncarpous. Explain with the help of an example each. [2]

Answer : Apocarpous : When there are more than one carpel, the pistils are free.

E.g., A multicarpellary, apocarpous gynoecium of michelia, also found in lotus, rose flowers.

Syncarpous : Have more than one carpel and pistils are fused together.

E.g., Multicarpellary syncarpous pistil of papaver, found in flower of tomato, mustard, etc.

9. "Large scale cultivation of *spirullina* is highly advantageous for human population." Explain giving two reasons. [2]

Answer : 1. Microbes like Spirullina can be grown easily on materials like waste water, molasses, animal manure, etc. to produce large quantities and can serve as food rich in proteins, minerals, fats, vitamins and carbohydrates.

2. It also reduces environmental pollution.

SECTION-C

12. Differentiate between divergent and convergent evolution. Give one example of each. [3]

Answer :

S.No.	Divergent Evolution	Convergent Evolution
(i)	It occurs when two different species share a common ancestor but have different characteristics from one another.	It occurs when two different species do not share a common ancestor but have developed similar characteristics.
(ii)	It is supported by the homologous structures. *E.g.*, Whales, bats, cheetah and human share similarities in the pattern of bones of forelimbs.	It is supported by the analogous structures. *E.g.*, Wings of insect, bats and birds are a result of convergent evolution.

13. (a) List any four characteristics of an ideal contraceptive.

(b) Name two intra-uterine contraceptive devices that affect the motility of sperms. [3]

OR

(a) How does a farmer use the dormancy of seeds to his advantages ?

(b) What advantages a seed provides to a plant?

Answer : (a) Characteristics of an ideal contraceptive are as follow :

1. It should be user friendly.
2. Reversible with no or least side effects.
3. It should be easily available.
4. It should also in no way interfere with the sexual drive or desire and sexual act of the user.

(b) Two intra-uterine devices that affect the motility of sperms are :

1. Copper releasing IUDs (CUT, CU7).
2. Hormone releasing IUDs (Progestasert, LNG-20).

OR

(a) Dehydration and dormancy of seeds are crucial for storage of seeds which can be used as food throughout the year and also to raise crop in the next season which provides advantage to farmer in the agriculture.

(b) Seeds offer several advantages to a plant which are:

1. Since reproductive processes such as pollination and fertilisation are independent of water, seed formation is more dependable.
2. Seeds have better adaptive strategies for dispersal to new habitats and help the species to colonise in other areas.

17. Predation is usually referred to as a detrimental association. State any three positive roles that a predator plays in an ecosystem. [3]

Answer : Positive roles that a predator plays in an ecosystem are :

1. They keep prey population under control otherwise high population densities of prey cause ecosystem instability.
2. Predators help in maintaining species diversity in a community by reducing the intensity of competition among competing prey species.

(iii) Biological control methods adopted in agricultural pest control are based on the ability of the predator to regulate prey population.

SECTION-E

26. Give a genetic explanation for the following cross. When a tall pea plant with round seeds was crossed with a dwarf pea plant with wrinkled seeds then all the individuals of F_1-populations were tall with round seeds. However selfing among F_1-population led to a 9 : 3 : 3 : 1 phenotypic ratio. [5]

OR

(a) Describe the series of experiments of F. Griffith. Comment on the significance of the results obtained.

(b) State the contribution of Macleod, McCarty and Avery.

Answer: When a tall pea plant with round seeds (TTRR) was crossed with a dwarf pea plant with wrinkled seeds (ttrr). Let T for dominant tall height and t for recessive dwarf height, R for dominant round shaped seeds and r for recessive wrinkled seed shape. The genotype of the parents can then be written as **TTRR** and **ttrr**. The gametes TR and tr unite on fertilisation to produce the F_1 hybrid TrtR

Parents TTRR × ttrr
(Tall Round) (Dwarf wrinkled)
TT ↓ RR tt ↓ rr
Gametes (TR) (tr)
F_1 generation TtRr
(Tall Round)

F_2 gen.

	TR	*Tr*	*tR*	*tr*
TR	*TTRR*	*TTRr*	*TtRR*	*TtRr*
Tr	*TTRr*	*TTrr*	*TtRr*	*Ttrr*
tR	*TtRR*	*TtRr*	*ttRR*	*ttRr*
tr	*TtRr*	*Ttrr*	*ttRr*	*ttrr*

Phenotypic ratio : 9 : 3 : 3 : 1
(Dwarf Wrinkled):
(Tall Round) : (Tall Wrinkled) : (Dwarf Round) :

Based upon such observations on dihybrid crosses (crosses between plants differing in two traits), Mendel proposed a second set of generalisation called "Law of Independent Assortment" which states that 'When two pairs of traits are combined in a hybrid, segregration of one pair of characters is independent of the other pair of characters'.

Thus, there are four genotypes of gametes (four types of pollen and four types of eggs). The four types are TR, Tr, tR and tr each with a frequency of 25% or 1/4th of the total gametes produced.

OR

(a) In 1928 Frederick Griffith, in a series of experiments with *Streptococcus pneumoniae* (bacterium responsible for pneumonia), witnessed a miraculous transformation in the bacteria. During the course of his experiment, a living organism (bacteria) had changed in physical form.

When *Streptococcus pneumoniae* (pneumococcus) bacteria are grown on a culture plate, some produce smooth shiny colonies (S) while others produce rough colonies (R). This is because the S strain bacteria have a mucous (polysaccharide) coat, while R strain does not. Mice infected with the S strain (virulent) die from pneumonia infection but mice infected with the R strain do not develop pneumonia.

S strain ⟶ Inject into mice ⟶ Mice die

R strain ⟶ Inject into mice ⟶ Mice live

Griffith was able to kill bacteria by heating them. He observed that heat-killed S strain bacteria injected into mice did not kill them.

S strain ⟶ Inject into mice ⟶ Mice live
(heat-killed)

S strain
(heat-killed)
\+ ⟶ Inject into mice ⟶
R strain Mice die
(live)

When he injected a mixture of heat-killed S and live R bacteria, the mice died. Moreover, he recovered living S bacteria from the dead mice.

He concluded that the R strain bacteria had somehow been transformed by the heat-killed S strain bacteria. Some 'transforming principle', transferred from the heat-killed S strain, had enabled the R strain to synthesise a smooth polysaccharide coat and become virulent. This must be due to the transfer of the genetic material. However, the biochemical nature of genetic material was not defined from his experiments.

(b) Contribution of Macleod, Mc Carty and Avery : Oswald Avery, Coin Macleod and Maclyn Mc Carty worked on the Biochemical characterisation of transforming principle in Griffith's experiment. They purified biochemicals (proteins, DNA, RNA) from the heat killed S cells to see which ones could transform live R cells into S cells. They discovered that DNA alone from S bacteria caused R bacteria to become transformed. They also discovered protein digesting enzymes did not affect transformation.

They concluded that DNA is the hereditary material.

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Biology 2016 (Outside Delhi) SET III

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous sets.

SECTION–A

2. What are transgenic animals? Give an example. [1]

Answer : Transgenic animals : A transgenic animal is one that carries a foreign gene that has been deliberately inserted into its genome. *e.g.*, Transgenic mice, rabbits, pigs, etc.

SECTION-B

6. Name a free-living and a symbiotic bacterium that serve as bio-fertilizer. Why are they so called ? [2]

Answer : Free living Bacteria — *Azotobacter clostridium*

Symbiotic Bacteria — *Rhizobium*

They are so called because these are the micro-organisms that enrich the nutrient quality of the soil.

7. Name the cells HIV (Human Immunodeficiency Virus) gains entry into after infecting the human body. Explain the events that occur in these cells. [2]

Answer : T-Lymphocytes gain entry into after infecting the human body. HIV enters into helper T-lymphocytes (T_H), replicates and produces progeny viruses. The progeny viruses released in the blood attack other helper T-lymphocytes. This is repeated leading to a progressive decrease in the number of helper T-lymphocytes in the body of the infected person. During this period, the person suffers from bouts of fever, diarrhoea and weight loss.

10. Out of many papaya plants growing in your garden, only a few bear fruits. Give reason. [2]

Answer : It is due to natural abortion of a female flower that had not been pollinated and therefore failed to develop into a fruit.

SECTION-C

13. How do homologous organs represent divergent evolution ? Explain with the help of a suitable example. [3]

Answer : Whales, bats, cheetah and human (all mammals) share similarities in the pattern of bones of forelimbs. Though these forelimbs perform different functions in these animals, they have similar anatomical structure. All of them have humerus, radius, ulna, carpals, meta carpals and phalanges in their forelimbs. Hence, in these animals, the same structure developes along different directions due to adaptations to different needs. This is divergent evolution and these structures are homologous. Homology indicates common ancestry. Other examples are vertebrate hearts or brains. The thorn and tendrils of Bougainvillea and cucurbita represent homology which is based on divergent evolution.

14. Name two hormones that are constituents of contraceptive pills. Why do they have high and effective contraceptive value ? Name a commonly prescribed non-steroidal oral pill. [3]

OR

(a) How are Parthenocarpic fruits produced by some plants and apomictic seeds by some others ? Explain.

(b) When do farmers prefer using apomictic seeds ?

Answer : Two hormones that are constituents of contraceptive pills are :

(1) Estrogen (2) Progesterone

Commonly prescribed non-steroidal oral pills are : Saheli, Centron, Novex-DS etc.

Estrogen and Progesterone combination in birth control pills suppresses ovulation-keeping ovaries from releasing an egg. It also alters the quality of cervical mucus and thins the lining of the uterus to prevent implantation. So, they have high and effective contraceptive value.

OR

(a) Parthenocarpy is phenomenon of formation of fruits without fertilization. Here the ovary transforms into fruits. These fruits are seedless while Apomixis is a form of asexual reproduction where seeds are formed without fertilization.

(b) Farmers prefer using apomictic seeds because of its lower cost of production and increase in the yield. Also unlike the hybrid seeds they don't have to be produced every year and can be stored, thus saving time and money.

22. Explain Parasitism and co-evolution with the help of one example of each. [3]

Answer : Parasitism : It is the interaction where one species (parasite) depends on the other species (host) for food and shelter. Many parasites have evolved to be host specific in such a way that both host and the parasite tend to co-evolve, that is if the host evolves special mechanisms for rejecting the parasite, the parasite has to evolve mechanisms to counteract and neutralize them in order to be successful with the same host species.

Types of Parasite :

1. **Ectoparasite :** Depend on external surface of host. *e.g.*, ticks on dogs, head lice on humans etc.
2. **Endoparasite :** Take shelter within the body of the host organism. *e.g.*, Liverfluke, Plasmodium etc.

Co-evolution : It is used to describe cases where two or more species reciprocally affect each other's evolution. It is a complex process that occurs on many levels. It may appear in situations where one species interacts closely with several others, such as the interactions between European Cuckoos (*Cuculus canorus*) and the other species whose nests they parasite. Coevolution of flowers and its pollinator species are tightly linked with one another e.g., pollinator wasp and fig species, Mediterranean orchid Ophrys and bumblebee.

SECTION-E

24. (a) What is polygenic inheritance ? Explain with the help of a suitable example.

(b) How are pleiotropy and Mendelian pattern of inheritance different from polygenic pattern of inheritance ? [5]

OR

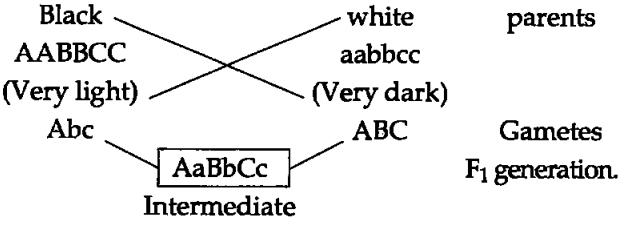
(a) Name the stage in the cell cycle where DNA replication occurs.

(b) Explain the mechanism of DNA replication. Highlight the role of enzymes in the process.

(c) Why is DNA replication said to be semi-conservative ?

Answer : (a) Polygenic Inheritance : Polygenic inheritance occurs when one characteristic is controlled by two or more genes. Often the genes are large in quantity but small in effect. Examples of human polygenic inheritance are skin colour, height, eye colour and weight. Assume that three genes A, B, C control the skin colour in human. Dominant forms A, B and are responsible for dark colour and the recessive forms a, b, c for light colour of the skin.

Genotype with dominant alleles (AABBCC) will have darkest skin colour while Genotype with recessive alleles (aabbcc) will have lightest skin colour.



(b) Mendelian inheritance refers to the expression of inheritance of monogenic

traits, that is traits that are controlled by one gene and the interaction between alleles is dominance-recessive. It is also called as qualitative inheritance.

In polygenic inheritance, one trait may be controlled by two or more genes. The interaction among the genes is usually additive. It is also known as quantitative inheritance.

In Pleiotropy, a single gene can exhibit multiple phenotypic expression. The mechanism of pleiotropy in most cases is the effect of a gene on metabolic pathways which contributes towards different phenotype.

E.g. : Phenyl ketonuria disease which is caused due to mutation in the gene that codes for the enzyme phenyl alanine hydroxylase.

OR

(a) During S-Phase (Synthesis phase), DNA replicates in cell cycle.

(b) Mechanism of DNA replication : The interwined DNA strands start separating from a particular point called origin of replication (single in prokaryotes and many in eukaryotes). This unwinding is catalysed by enzyme called **Helicases.** Enzymes called **Topoisomerases** break and reseal one of the strands of DNA so that the unwound strands will not wind back. When the double stranded DNA is unwounded upto Replication Fork, Enzyme DNA dependent **DNA polymerase** catalyses the joining of Deoxyribonucleotide (A, G, C and T) in the 5′–3′ direction. The enzyme forms one new strand in a continuous stretch (leading strand) in the 5′–3′ direction on one of the template strands. On the other template strand, the enzyme forms short stretches (discontinuous) strand of DNA also in the 5′–3′. The discontinuous fragments are later joined by **DNA-ligase**. The two strands are held together by hydrogen bonds between nucleotides.

(c) DNA replication is semi-conservative because each helix that is created contains one strand from the helix from which it was copied. The replication of one helix results in two daughter helices each of which contains one of the original parental helical strands.

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Biology 2016 (Delhi) SET I

Time allowed : 3 hours **Maximum marks : 70**

SECTION–A

1. According to de-Vries what is saltation ? [1]

Answer : Saltation is a single step, large mutation.

2. Excessive nutrients in a fresh water body cause fish mortality. Give two reasons. [1]

Answer : Excessive nutrients result in excessive algal growth which produce toxins in water. Water quality becomes poor as Dissolved Oxygen decreases leading to increase in BOD.

3. Suggest the breeding method most suitable for animals that are below average in milk productivity. [1]

Answer : Artificial insemination technique can be used to improve the milk productivity in animals.

4. State a difference between a gene and an allele. [1]

Answer : Gene : It contains information that is required to express a particular trait.

Allele : Genes which code for a pair of contrasting traits.

5. Suggest a technique to a researcher who needs to separate fragments of DNA. [1]

Answer : Gel electrophoresis.

SECTION–B

6. Explain the significance of meiocytes in a diploid organism. [2]

Answer : 1. Meiocytes undergo meiosis or gametogenesis to produce haploid gametes.

2. They help to restore diploidy through zygote formation or syngamy.

7. Mention the kind of biodiversity of more than a thousand varieties of mangoes in India represent. How is it possible ? [2]

Answer : Varieties of mango shows genetic diversity. Single species of mango show high diversity at genetic level over its distributional range.

8. **List the events that reduce the Biological Oxygen Demand (BOD) of a primary effluent during sewage treatment.** [2]

Answer : 1. Effluent from primary settling tank is passed into aeration tank agitated mechanically and air is pumped into it.

2. This allows vigorous growth of aerobic microbes into flocs which consume major part of organic matter in the effluent.

9. **Discuss the role the enzyme DNA ligase plays during DNA replication.** [2]

Answer : 1. Discontinuous DNA fragments are joined or sealed by DNA ligase.

2. DNA ligase adds on nucleotide in the usual 5′ to 3′ direction along the DNA strand.

10. **Name the causative organism of the disease amoebiasis. List three symptoms of the disease.** [2]

OR

Identify 'A', 'B', 'C' and 'D' in the given table.

Crop	Variety	Resistance to disease
A	Himgiri	Leaf rust
Cauliflower	Pusa Shubhra	B
Brassica	Pusa Swarnim	C
Cowpea	D	Bacterial blight

Answer : Amoebiasis is caused by ***Entamoeba histolytica.*** The symptoms of this disease are constipation, abdominal pain, cramps, stools with excess mucous and blood clots.

OR

A—Wheat

B—Black rot or Curl blight black rot

C—White rust

D—Pusa Komal

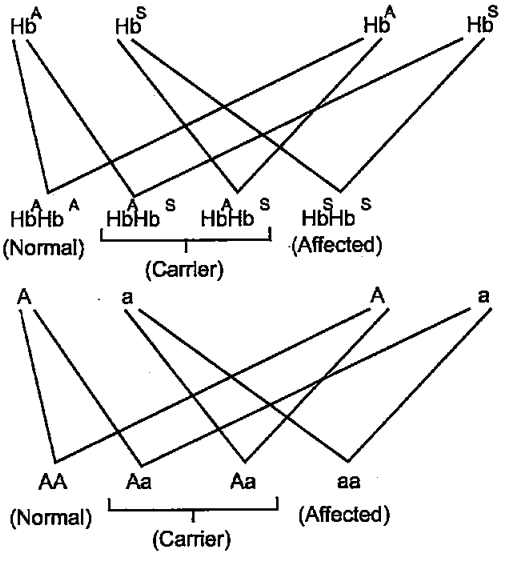
SECTION–C

11. **Why is breast-feeding recommended during the initial period of an infant's growth ? Give reasons.** [3]

Answer : During initial period of infant's growth, colostrum is produced. It is rich in nutrients and antibodies (IgA) which provide passive immunity to the newborn.

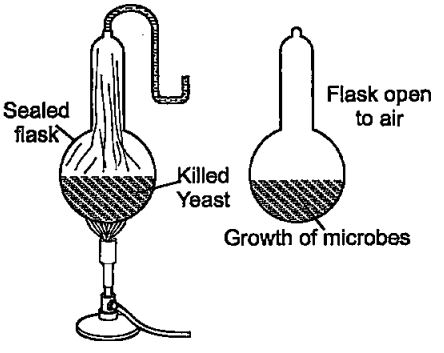
12. **Give an example of an autosomal recessive trait in humans. Explain its pattern of inheritance with the help of a cross.** [3]

Answer : Sickle cell anaemia is an autosomal recessive trait disease than can be transmitted from parents to the offspring when both the partners are carrier for the gene. The disease is controlled by a single pair of allele, Hb^A and HB^S. Out of three possible genotypes only homozygous individuals for Hb^S ($Hb^S Hb^S$) show the diseased phenotype while heterozygous ($Hb^A Hb^S$) individuals are carrier of the disease.



13. **Describe the experiment that helped Louis Pasteur to dismiss the theory of spontaneous generation of life.** [3]

Answer : Louis Pasteur took two pre-sterilised flasks with killed yeast. One flask was sealed



while the other was kept open to air. Differential growth of life was observed in the flasks and life was found only in the open flask. It proved that life comes from pre-existing life (theory of biogenesis).

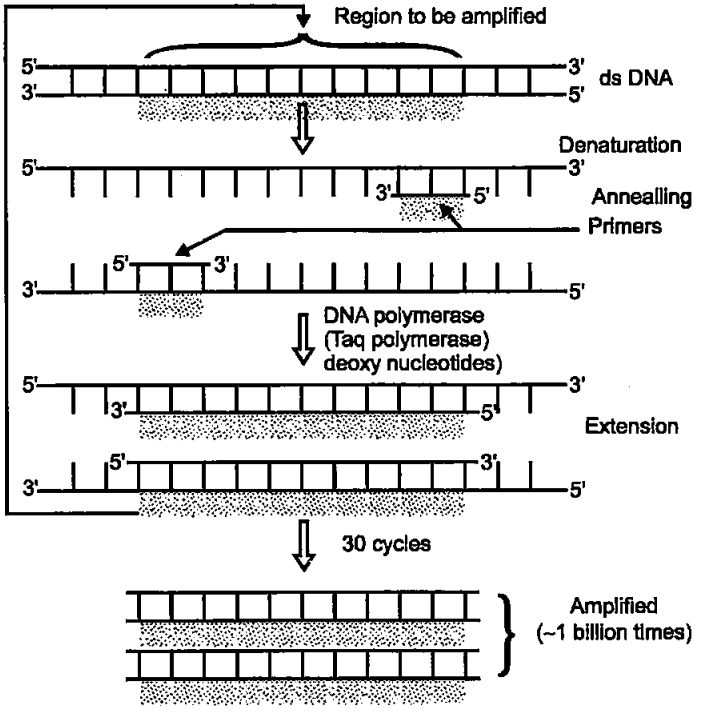
14. Plant breeding technique has helped sugar industry in North India. Explain how. [3]

Answer : ***Saccharum barberi*** was originally grown in North India, but had poor sugar content and yield. Sugar cane grown in South India, ***Saccharum officinarum*** had thicker stems and higher sugar content but did not grow well in North India. The two species were crossed to get desirable qualities of high yield, thick stems, high sugar and ability to grow in North India.

15. Suggest and describe a technique to obtain multiple copies of a gene of interest *in vitro*. [3]

Answer : Polymerase Chain Reaction. (PCR) technique is used to obtain multiple copies of a gene of interest.

Multiple copies of the gene of interest is synthesised *in vitro* using two sets of primers and enzyme DNA polymerase. The enzyme extends the primers using nucleotides provided and genomic DNA as template. The process of DNA replication is repeated several times for amplification of DNA with the help of thermostable DNA polymerase which remains active during high temperature induced denaturation of double stranded DNA.



16. What is a GMO ? List any five possible advantages of a GMO to a farmer. [3]

Answer : Those plants, bacteria, fungi or animals whose genes have been altered by manipulation are called Genetically Modified Organisms (GMOs).

Advantages :

1. Tolerance to abiotic stresses like cold, drought, salt, heat etc.
2. Reduce reliance on chemical pesticides.
3. Reduced post harvest losses.
4. Increased efficiency of mineral usage by plants.
5. Enhanced nutritional value.
6. To create tailor made plants.

17. During a school trip to 'Rohtang Pass', one of your classmates suddenly developed 'altitude sickness'. But, she recovered after some time. [3]

(a) Mention one symptom to diagnose the sickness.

(b) What caused the sickness ?

(c) How could she recover by herself after some time?

Answer : (a) The symptoms may be nausea, fatigue or heart palpitation.

(b) The sickness was caused due to low atmospheric pressure which prevails at high altitude. The body does not get enough oxygen.

(c) The body compensates low oxygen availability by increasing RBC production, decreasing the binding affinity of haemoglobin and by increasing breathing rate.

18. **How has RNAi technique helped to prevent the infestation of roots in tobacco plants by a nematode *Meloidegyne incognitia* ?** [3]

Answer : Using **Agrobacterium** vectors, nematode specific genes were introduced into the host plant. This DNA produced both sense and antisense RNA in the host cells. These two RNAs being complementary to each other formed a double strand (dsRNA) that initiated RNAi and thus silenced the specific mRNA of the nematode. Hence the parasite could not survive in the transgenic host.

19. **"In a food-chain, a trophic level represents a functional level, not a species." Explain.** [3]

OR

(a) Name any two places where it is essential to install electrostatic precipitators. Why it is required to do so ?

(b) Mention one limitation of the electrostatic precipitator.

Answer : Position of a species in any trophic level is determined by the function performed by that mode of nutrition of species in a particular food chain. A given species may occupy more than one trophic level in the same ecosystem at a given time. If the function of the mode of nutrition of species changes, its position shall change in the trophic levels. The same species can be at the primary level of consumer in one food chain and at the secondary consumer level in another food chain in the same ecosystem at a given time.

OR

(a) Electrostatic precipitators can be installed in thermal power plants, smelters or other particulate matter releasing industries. They are important for removing particulate matter.

(b) Limitations : 1. Very, very small particulate matter which are less than 2.5 micrometres are not removed.

2. The velocity of air between the plates must be low enough to allow the dust to fall.

3. It cannot work without electricity.

20. **Prior to a sports event blood and urine samples of sports-persons are collected for drug tests.** [3]

(a) Why is there a need to conduct such tests ?

(b) Name the drugs the authorities usually look for.

(c) Write the generic names of two plants from which these drugs are obtained.

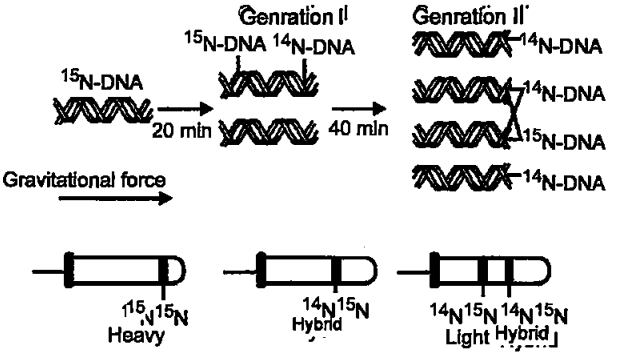
Answer : (a) To detect drug abuse or use of banned drugs cannabinoids, narcotic analgesic, diuretics, hormones or drugs used to accelerate performance, increase muscle strength etc.

(b) Cannabinoids, cocaine, coka alkaloid etc.

(c) Cannabis and Atropa.

21. **Describe the experiment that helped demonstrate the semi-conservative mode of DNA replication.** [3]

Answer :



Meselson and Stahl grew *E. coli* in a medium containing $^{15}NH_4Cl$ (N^{15} is the heavy isotope of nitrogen) for many generations to get ^{15}N incorporated into DNA. Then the cells were transferred into $^{14}NH_4Cl$. The extracted DNA was centrifuged in a CsCl density gradients to measure the densities of DNA. The DNA extracted from the culture after one generation (20 minutes) showed intermediate or hybrid density. The DNA extracted after two generations (40 minutes) showed equal amounts of hybrid and of 'light' DNA.

22. **Given below is a list of six micro-organisms. State their usefulness to humans.** [3]

(a) *Nucleopolyhedrovirus*

(b) *Saccharomyces cerevisiae*

(c) *Monascus purpureus*

(d) *Trichoderma polysporum*

(e) *Penicillium notatum*

(f) *Propionibacterium sharmanii*

Answer : (a) As bio–control agents for Integrated Pest Management.

(b) It is used in bread making, brewing industry or for production of ethanol.

(c) It is a cholesterol lowering agent.

(d) It produces Cyclosporin A which is an immuno-suppressive agent.

(e) It produces antibiotic penicillin.

(f) It produces large holes in swiss cheese by releasing large amount of CO_2.

SECTION–D

23. Reproductive and Child Healthcare (RCH) programmes are currently in operation. One of the major tasks of these programmes is to create awareness amongst people about the wide range of reproduction related aspects. As this is important and essential for building a reproductively healthy society. [4]

(a) "Providing sex education in schools is one of the ways to meet this goal." Give four points in support of your opinion regarding this statement.

(b) List any two 'indicators' that indicate a reproductively healthy society.

Answer : (a) It is a means of providing right information to the young so as to discourage children from believing in myths and misconceptions about sex related aspects. Knowledge is also imparted about reproductive organs, adolescence and related changes, safe hygienic practices, STD, AIDS available birth control options, care of pregnant mothers, post-natal care, importance of breast feeding, sex abuse and sex related crimes.

(b) 1. Decrease in IMR (Infant Mortality Rate), MMR (Maternal Mortality Rate).

2. Increase in number of couples with small families, better detection and cure of STDs.

3. Total well being in all aspects of reproduction, normal emotional and behavioural interaction among all sex related aspects.

SECTION–E

24. (a) Explain the post-pollination events leading to seed production in angiospersms. [3]

(b) List the different types of pollination depending upon the source of pollen grain. [2]

OR

(a) Briefly explain the events of fertilisation and implantation in an adult human female.

(b) Comment on the role of placenta as an endocrine gland.

Answer : (a) As a result of pollen-pistil interaction, germination of pollen tube takes place carrying two male gametes. One male gamete fuses with the egg cell (syngamy), while the other fuses with two polar nuclei to form primary endosperm nucleus (PEN). The zygote develops into an embryo while the PEN develops to form endosperm. After double fertilisation, the ovule matures into a seed while the ovary matures into a fruit.

(b) Different types of pollination depending upon the source of pollen grain are :

1. Autogamy : Transfer of pollen grains from the anther to the stigma of the same flower.

2. Geitonogamy : Transfer of pollen grain from the anther to the stigma of another flower of the same plant.

3.) Xenogamy : Only types of pollination which brings genetically different types of pollen grains to the stigma.

OR

(a) Fertilisation : A sperm comes in contact with the zona pellucida layer of ovum and induces changes to block entry of additional sperms. The entry of sperm induces completion of meiosis II leading to the formation of an ootid and second polar body. The haploid nucleus of the sperm and that of the ovum fuse to form a dipoloid zygote.

Implantation : The trophoblast layer of the blastocyst attaches to the endometrium of the uterus. The uterine cells divide rapidly and cover the blastocyst which becomes embedded in the endometrium and implantation is completed.

(b) Placenta acts as an endocrine tissue and produces several hormones like :

1. Human chorionic gonadotropin (hCG)

2. Human placental lactogen (hPL)

3. Estrogens, progestogens, etc.

25. (a) How are the following formed and involved in DNA packaging in a nucleus of a cell ?

(i) Histone octomer

(ii) Nucleosome

(iii) Chromatin [3]

(b) Differentiate between Euchromatin and Heterochromatin. [2]

OR

Explain the role of lactose as an inducer in a *lac* operon. [5]

Answer : (a) (i) Eight molecules of positively charged basic proteins called histones are organised to form histone octomer.

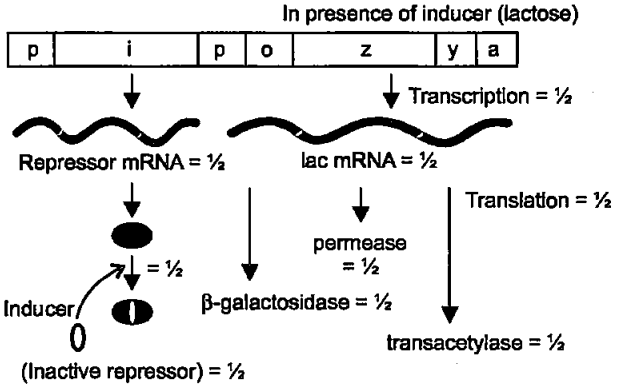
(ii) Negatively charged DNA is wrapped around positively charged histone octomer to give rise to a nucleosome.

(iii) Nucleosomes constitute repeating unit of a structure called chromatin.

(b)

S.No.	Euchromatin	Heterochromatin
(i)	It is loosely packed and stains light chromatin.	More densely packed and stains dark chromatin.
(ii)	Transcriptionally active chromatin.	Transcriptionally is inactive chromatin.

OR



Lactose is the substrate for the enzyme beta galactosidase and it regulates switching ON and OFF of the operon. In the presence of an inducer such as lactose, the repressor is inactivated by interaction with the inducer. This allows RNA polymerase access to the promoter and transcription proceeds.

26. (a) Why should we conserve biodiversity ? How can we do it ? [2]

(b) Explain the importance of biodiversity hot-spots and sacred groves. [3]

OR

(a) Represent diagrammatically three kinds of age-pyramids for human populations. [3]

(b) How does an age pyramid for human population at given point of time helps the policy-makers in planning for future. [2]

Answer : (a) 1. Narrowly utilitarian : We derive economic benefits from nature such as food (cereals, pulses, fruits). We also get firewood, fibre, construction material, industrial products (tannins, lubricants, dyes, resins, perfumes), products of medicinal importance etc.

Broadly utilitarian : We get 20% of the total O_2 from the Amazon rain forests. Pollination is also achieved and we also derive several aesthetic pleasures from them.

Ethical Argument : Millions of species of plants, animals and microbes share this planet with us. We need to realise that every species has an intrinsic value. We have a moral duty to care for their well being and pass on our biological legacy to future generations.

2. In situ conservation in biosphere reserves, national parks, sanctuaries, sacred groves etc.

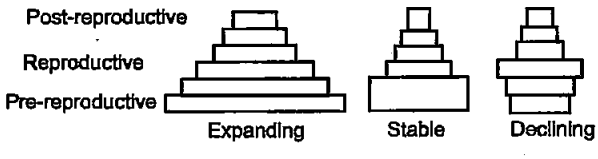
Ex situ biopreservation in zoological parks, botanical gardens, safari parks, cryopreservation, seed banks, tissue culture etc.

(b) Three of these hotspots are Western Ghats and Sri lanka, Indo-Burma and Himalaya-cover our country's exceptionally high biodiversity regions.

Sacred Groves : They are tracts of forests containing wild life which are venerated and given total protection. Such sacred groves are found in Khasi and Jaintia Hills in Meghalaya, Aravalli hills of Rajasthan, Chand and Bastar areas of Chattisghar. In Meghalaya, the sacred groves are the last refuges for a large number of rare and threatened plants.

OR

(a)



(b) Age pyramid analysis of a population helps in planning of health, education, transport, infrastructure, finance, food or employment.

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Biology 2016 (Delhi) SET II

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous set.

SECTION–A

3. Give an example of a human disorder that is caused due to a single gene mutation. [1]

Answer : Sickle cell anaemia is the human disorder that is caused due to a single gene mutation.

SECTION-B

8. Explain the importance of syngamy and meiosis in a sexual life cycle of an organism. [2]

Answer : Syngamy : It ensures restoration of diploid chromosome number through zygote formation. Variations are an important characteristic of this process.

Meiosis : Gamete formation takes place as a result of meiosis which involves reduction in chromosome number or haploidy. It also leads to variations (due to crossing over).

9. List the events that lead to biogas production from waste water whose BOD has been reduced significantly. [2]

Answer : After significant reduction of BOD, the effluent is passed into a settling tank where the flocs are allowed to sediment to form activated sludge. This sludge is pumped into anaerobic sludge digesters where anaerobic bacteria digest the microbes of the sludge to release a mixture of gases such as methane, H_2S and CO_2. These gases form biogas which can be used as a source of energy.

10. Why the plants that inhabit a desert are not found in a mangrove ? Give reasons. [2]

Answer : Desert plants are not adapted to survive in saline or aquatic conditions prevailing in a mangrove. Plants are conformers. They are also stenothermal and cannot maintain constant internal environment. The osmotic concentration of their body fluids affect the kinetics of enzymes through basal metabolism.

SECTION–C

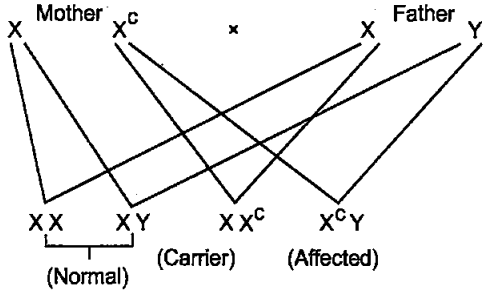
12. Differentiate between somaclones and somatic hybrids. Give one example of each. [3]

Answer : Somaclones are produced through micro-propagation or tissue culture. They are genetically identical, *e.g.*, apple, tomato or banana.

Somatic hybrids are produced by fusion of protoplast of two different plants. They are genetically dissimilar *e.g.*, Pomato (hybrid of potato and tomato).

17. A couple with normal vision bear a colour blind child. Work out a cross to show how it is possible and mention the sex of the affected child. [3]

Answer :



The affected child is male.

19. In certain seasons we sweat profusely while in some other season we shiver. Explain. [3]

Answer : Mammals are able to maintain homeostasis means which ensure constant body temperature.

1. In summer, the outside temperature is higher than the body temperature. Hence sweating causes cooling by evaporation of sweat.
2. In winter the outside temperature is lower than the body temperature. Hence shivering is an involuntary exercise which produces heat.
3. Both the above exercises help to regulate our body temperature.

SECTION–E

26. List the criteria a molecule that can act as genetic material must fulfill. Which one of the criteria are best fulfilled by DNA or by RNA thus making one of them a better genetic material than the other ? Explain. [5]

OR

(a) Differentiate between analogy and homology giving one example each of plant and animal respectively.

(b) How are they considered as an evidence in support of evolution ?

Answer : 1. The genetic material should be able to carry out replication or generate a replica.

2. It should be chemically or structurally stable.

3. It should provide scope for slow mutation.

(iv) It should be able to express itself as characters.

Out of the two, clearly, DNA is more stable because of the following factors :

1. Presence of H and not OH at 2′ position.
2. Presence of thiamine instead of uracil.
3. It is less reactive.
4. It is structurally more stable because of its double stranded structure with hydrogen bonding.
5. DNA is slower to mutate than RNA.
6. Complementary strands of DNA further resist changes by evolving a process of repair.

OR

(a) Homology : Those structures which have similar origin but perform different functions show homology.

E.g., Forelimbs of mammals, heart of vertebrates, brain of vertebrates etc.

Thorns of bougainvillea and tendrils of cucurbits.

Analogy : Those structures which have a different origin, but perform similar functions show analogy.

E.g., Wings of bat and birds, flippers of penguin and dolphin, eye of octopus and mammals etc.

Sweet potato and potato tuber.

(b) Homology shows common ancestry and divergent evolution.

Analogy does not show common ancestry. It shows convergent evolution.

●●

Biology 2016 (Delhi) SET III

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous sets.

SECTION–A

5. Give an example of a codon having dual function. [1]

Answer : AUG codes for methionine and also act as an initiator codon.

SECTION–B

7. Distinguish between the roles of flocks and anaerobic sludge digesters in sewage treatments. [2]

Answer :

Flocs	Anaerobic Sludge Digester
(i) They breakdown organic matter aerobically.	They breakdown organic matter anaerobically.
(ii) They breakdown organic matter in primary effluent.	They breakdown organic matter in secondary effluent.
(iii) They do not produce biogas.	They produce biogas (mixture of methane, H_2S and CO_2).

9. Plants that inhabit a rain-forest are not found in a wetland. Explain. [2]

Answer : Plants inhabiting a rain forest are not adapted to survive in aquatic conditions or wetlands. Plants are conformers. They are stenothermal. They cannot maintain a constant internal environment or temperature. The osmotic concentration of their body fluids affects the kinetics of enzymes through basal metabolic activity.

10. Angiosperms bearing unisexual flowers are said to be either monoecious or dioecious. Explain with the help of one example each. [2]

Answer : Monoecious : Plants bear both male and female unisexual flowers on the same plant. *E.g.,* cucurbits, coconut, maize etc.

Dioecious : Plants bear either male or female unisexual flowers on different plants. *e.g.,* papaya, date palms etc.

SECTION–C

13. (a) Name any two fowls other than chicken reared in a poultry farm.

(b) Enlist four important components of poultry farm management. [3]

Answer : (a) Ducks, turkey, geese etc.

(b) 1. Selection of disease free and suitable breeds.
2. Proper and safe farm conditions.
3. Proper food and water.
4. Maintenance of hygiene and health care.

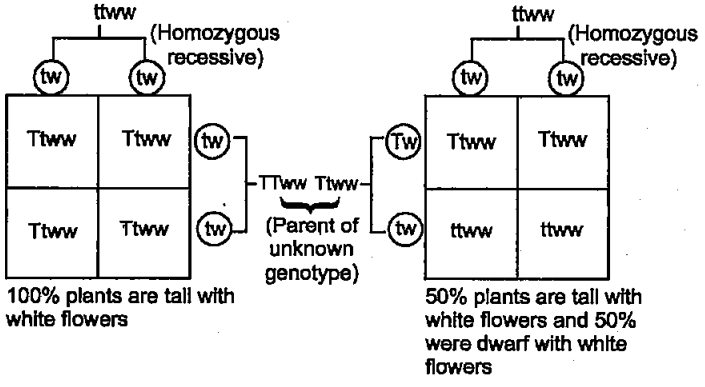
18. Explain with the help of suitable examples the three different ways by which organisms overcome their stressful conditions lasting for short duration. [3]

Answer : Three different ways are :

1. **Migration :** Organisms can move away temporarily from stressful habitat to a more hospitable area and return when stressful period is over. *E.g.*, humans moving from Delhi to Shimla during summer.
2. **Spore Formation :** Various kinds of thick walled spores are formed which germinate on availability of suitable environment, *e.g.*, bacteria, fungi etc.
3. **Dormancy :** Seeds or Vegetative reproductive structures help to tide over stress by reducing their metabolic activity, *e.g.*, seeds or vegetative reproductive structures of higher plants.

22. How would you find genotype of a tall pea plant bearing white flowers ? Explain with the help of a cross. Name the type of cross you would use. [3]

Answer : Test cross should be used.



SECTION–E

24. Answer the following questions based on Hershey and Chases's experiments : [5]

(a) Name the kind of virus they worked with and why?

(b) Why did they use two types of culture media to grow viruses in ? Explain.

(c) What was the need for using a blender and later a centrifuge during their experiments?

(d) State the conclusion drawn by them after the experiments.

OR

(a) How did Darwin explain adaptive radiation ? Give another example exhibiting adaptive radiation.

(b) Name the scientist who influenced Darwin and how ?

Answer : (a) They worked with bacteriophage which infect bacteria because they wanted to discover whether it was protein or DNA from the viruses that entered the bacteria.

(b) They used two types of culture media in order to make protein of viruses radioactive with the help of ^{35}S in one case, and DNA molecule in virus radioactive by using ^{32}P in the other case. This was done to identify which one of the two had entered into the bacteria during viral infection.

(c) **Blender** was used to separate viral protein coats that were still attached to the surface of bacteria.

Centrifuge was used to separate lighter supernatent containing viral protein coats from denser residue containing bacteria.

(d) They concluded that DNA is the genetic material that is passed from virus to bacteria.

OR

(a) Darwin observed that from original seed eating features in finches, altered beaks arose enabling them to become insectivorous and vegetarian finches.

Adaptive Radiation : Is the process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography.

e.g., Australian marsupials, placental mammals in Australia.

(b) **Thomas Malthus.** Population size grows exponentially. However population size remains limited due to limited natural resources leading to competition.

●●

Biology 2017 (Outside Delhi) SET I

Time allowed : 3 hours **Maximum marks : 70**

SECTION-A

1. **Name the type of cross that would help to find the genotype of a pea plant bearing violet flowers.** [1]

   Answer : Test cross.

2. **State two postulates of Oparin and Haldane with reference to origin of life.** [1]

   Answer : 1. The first form of life could have come from pre-existing non-living organic molecules.

   2. Formation of life was preceded by chemical evolution.

3. **A herd of cattle is showing reduced fertility and productivity. Provide one reason and one suggestion to overcome this problem.** [1]

   Answer : 1. The reason may have been inbreeding depression.

   2. **Suggestion**–They should be mated with unrelated superior cattle of the same breed.

4. **What are *Cry* genes ? In which organism are they present?** [1]

   Answer : *Cry* genes code for Bt toxin. They are found in *Bacillus thuringiensis*.

5. **An electrostatic precipitator in a thermal power plant is not able to generate high voltage of several thousands. Write the ecological implication because of it.** [1]

   Answer : It may cause air pollution by releasing various kinds of particulate matter in the air.

SECTION-B

6. **A pollen grain in angiosperm at the time of dehiscence from an anther could be 2-celled or 3-celled. Explain. How are the cells placed within the pollen grain when shed at a 2-celled stage ?** [2]

   Answer : 1. A two celled pollen grain contains a generative and a vegetative cell. A three celled pollen grain contains a vegetative cell and two male gametes.

   2. The generative cell floats in the cytoplasm of the vegetative cell.

7. **Differentiate between the genetic codes given below :**

   (a) Unambiguous and Universal

   (b) Degenerate and Initiator [2]

   Answer :

   (a)

S. No.	Unambiguous	Universal
(i)	One codon codes for only one amino acid.	The codons are the same for all organisms from bacteria to humans.

   (b)

S. No.	Degenerate	Initiator
(i)	More than one codon codes for the same amino acid.	It acts as a start codon (AUG).

8. **Mention one application for each of the following :**

   (a) Passive immunization

   (b) Antihistamine

   (c) Colostrum

   (d) Cytokinin-barrier [2]

   Answer : (a) Preformed antibodies are supplied for quick response in case of infection by deadly microbes (tetanus) or snake bite.

   (b) It reduces the symptoms of allergy.

   (c) It provides passive immunity in the form of IgA/antibodies to the newborn.

   (d) It provides protection to non-infected cells from further viral infection.

9. **Name the microbes that help production of the following products commercially :**

   (a) Statin

   (b) Citric acid

   (c) Penicillin

   (d) Butyric acid [2]

   Answer : (a) *Monascus purpureus*

   (b) *Aspergillus niger*

   (c) *Penicillium notatum*

   (d) *Clostridium butylicum*

10. **List four benefits to human life by eliminating the use of CFCs.**

OR

Suggest two practices giving one example of each, that help protect rare or threatened species. [2]

Answer : 1. It prevents damage to skin cells.

2. Delays aging of skin.

3. Prevents cataract.

4. Prevents skin cancer.

OR

1. In-situ conservation–*e.g.*, Biosphere reserves, National parks, sanctuaries, sacred groves, biodiversity hotspots, Ramsar sites etc.

2. Ex-situ conservation–*e.g.*, Wildlife safari parks, botanical gardens, zoological parks, tissue culture, cryopreservation techniques, tissue culture, seed banks, pollen banks etc.

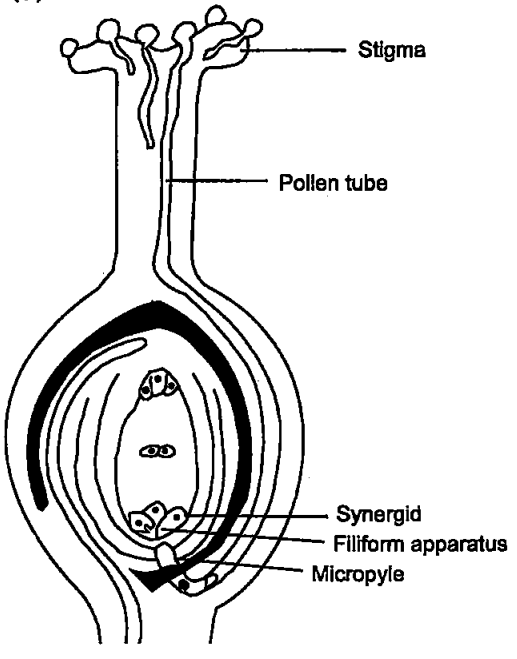
SECTION—C

11. (a) Can a plant flowering in Mumbai be pollinated by pollen grains of the same species growing in New Delhi ? Provide explanations to your answer.

(b) Draw the diagram of a pistil where pollination has successfully occurred. Label the parts involved in reaching the male gametes to its desired destination.[3]

Answer : (a) Yes, it can be done by artificial means such as carefully carrying the pollen grains from New Delhi to Mumbai and transferring them to the stigma of the flower growing in Mumbai.

(b)



12. Both Haemophilia and Thalassemia are blood related disorders in humans. Write their causes and the difference between the two. Name the category of genetic disorder they both come under. [3]

Answer :

S. No.	Haemophilia	Thalassemia
(i)	Single protein involved in the clotting of blood affected.	Defects in the synthesis of globin chain lead to formation of abnormal haemoglobin.
(ii)	Sex linked recessive disorder.	Autosomal recessive disorder.
(iii)	Blood does not clot.	Results in anaemia.

Both Haemophilia and Thalassemia are Mendelian disorders.

13. (a) List the two methodologies which were involved in human genome project. Mention how they were used.

(b) Expand 'YAC' and mention what was it used for. [3]

Answer : (a) Expressed Sequence Tags–Identifying all the genes that are expressed as RNA.

Sequence Annotation–Sequencing the whole set of genome coding or non-coding sequences and later assigning different regions with different functions.

(b) Yeast Artificial Chromosome. It was used as a cloning vector.

14. Write the characteristics of *Ramapithecus*, *Dryopithecus* and *Neanderthal man*. [3]

Answer : (a) Ramapithecus :

1. They were hairy.

2. They walked like gorillas and chimpanzees.

3. They were more man like.

(b) Dryopithecus :

1. They were hairy.

2. They walked like gorillas and chimpanzees.

3. They were more ape like.

(c) Neanderthal man :

1. The brain size was 1400 cc.

2. They used hides to protect their body.

3. They buried their dead.

15. Name a human disease, its causal organism, symptoms (any three) and vector, spread by intake of water and food contaminated by human faecal matter. [3]

OR

(a) Why is there a fear amongst the guardians that their adolescent wards may get trapped in drug/alcohol abuse?

(b) Explain 'addiction' and 'dependence' in respect of drug/alcohol abuse in youth.

Answer : Amoebiasis caused by *Entamoeba histolytica.*

Symptoms : 1. Early symptoms included loose stools and mild abdominal cramping.

2. Weight and Appetite loss.

3. Blood clots and Anaemia.

Vector : Housefly.

OR

(a) Adolescents are easily affected by peer pressure, adventure, curiosity, excitement or experimentation.

(b) Addiction : Psychological attachment to certain effects such as euphoria or temporary feeling of well being.

Dependence : Tendency of the body to show withdrawal symptoms if regular doses of drug or alcohol is abruptly discontinued.

16. (a) Write the desirable characters a farmer looks for in his sugarcane crop.

(b) How did plant breeding techniques help north Indian farmers to develop cane with desired characters ? [3]

Answer : (a) The desirable characters of a sugarcane crop should be high yield, thick stem, high sugar content, ability to grow in other area etc.

(b) By crossing the South Indian variety *Saccharum officinarum* having desired characteristics with the North Indian low yielding variety called *Saccharum barberi.*

17. Secondary treatment of the sewage is also called Biological treatment. Justify this statement and explain the process. [3]

Answer : 1. It is called biological treatment because it involves living organisms such as aerobic or anaerobic bacteria and fungi to digest organic waste.

2. The primary effluent is passed into an aeration tank where vigorous growth of aerobic microbes (flocs) takes place as a result of which BOD gets reduced. The effluent is passed to a settling tank where flocs sediment to produce activated sludge. The sludge is pumped to an anaerobic sludge digester to digest the bacteria and fungi.

18. (a) Explain the significance of 'palindromic nucleotide sequence' in the formation of recombinant DNA.

(b) Write the use of restriction endonuclease in the above process. [3]

Answer : (a) Palindromic nucleotide sequence is the recognition sequence present both on the vector and on a desired or alien DNA for the action of the same restriction endonuclease to act upon.

(b) The same restriction endonuclease binds to both Vector and the foreign DNA, it cuts each of the two strands of the double helix at specific points in their sugar phosphate backbone of recognition sequence for restriction endonuclease to create overhanging stretches called sticky ends.

19. Describe the roles of heat, primers and the bacterium *Thermus aquaticus* in the process of PCR. [3]

Answer : Heat : Causes denaturation or separation of DNA into two strands.

Primer : Enzyme DNA polymerase extends the primers using the nucleotides provided in the reaction and the genomic DNA as template.

Thermus aquaticus : It is a source of thermostable DNA polymerase or Taq polymerase.

20. Explain the various steps involved in the production of artificial insulin. [3]

Answer : Steps involved in production of artificial insulin:

1. The plasmid of *E.coli* is removed and isolated using specific techniques.

2. The isolated plasmid is opened by specified enzyme.

3. In the open site of the bacterial plasmid the segment of DNA which codes for human insulin is inserted.

4. After insertion, the plasmid is closed by using another special enzyme to make it a recombinant plasmid.

5. This recombinant plasmid is again introduced into *E. coli* host cells.

6. Now, *E. coli* cells become capable of synthesising human insulin. These bacteria are then cultivated in fermenters to produce a large amount of insulin.

7. Insulin is then extracted from bacterial culture and purified.

21. (a) "Organisms may be conformers or regulators." Explain this statement and give one example of each.

(b) Why are there more conformers than regulators in the animal world ? [3]

Answer : (a) Conformers : Organisms which cannot maintain a constant internal environment under varying external environment conditions *e.g.*, all plants, fishes, reptiles, amphibians etc.

Regulators : Organisms which can maintain homeostasis by physiological or behavioural means *e.g.*, birds or mammals etc.

(b) There are more conformers than regulators in the animal world because the process of thermoregulation is energetically not favourable for all organisms.

22. Describe the inter-relationship between productivity, gross primary productivity and net productivity. [3]

Answer : Productivity is the rate of biomass production per unit area over a period of time.

Gross Primary Productivity is the rate of production of organic matter during photosynthesis in an ecosystem.

Net Productivity is the gross primary productivity minus respiratory losses.

SECTION-D

23. It is commonly observed that parents feel embarrassed to discuss freely with their adolescent children about sexuality and reproduction. The result of this parental inhibition is that the children go astray sometimes.

(a) Explain the reasons that you feel are behind such embarrassment amongst some parents to freely discuss such issues with their growing children.

(b) By taking one example of a local plant and animal, how would you help these parents to overcome such inhibitions about reproduction and sexuality ? [4]

Answer : (a) Such an embarrasement may primarily because of a conservative attitude. They may be suffering from misconceptions that children should be kept away from such discussions. It is seen that illiteracy often breeds such social myths.

(b) The parents will have to be told that such things happens very commonly in nature. When a flower blooms on attaining reproductive maturity, it is often visited by a bee which carries the male gametes inside the pollen grains and deposits them on the stigma. Such an event leads to fruit and seed formation.

SECTION-E

24. (a) When a seed of an orange is squeezed, many embryos, instead of one are observed. Explain how it is possible.

(b) Are these embryos genetically similar or different ? Comment. [5]

OR

(a) Explain the following phases in the menstrual cycle of a human female :

(i) Menstrual phase

(ii) Follicular phase

(iii) Luteal phase

(b) A proper understanding of menstrual cycle can help immensely in family planning. Do you agree with the statement ? Provide reasons for your answer.

Answer : (a) It is called polyembryony. The nucellar cells surrounding the embryo sac starts dividing and protrudes into the embryo sac and develops into many embryos. It became possible due to the embryos resulting from the same egg, the embryos are identical to one another, but are genetically diverse from the parents.

(b) These embryos are genetically similar as they are produced from nucellar cells by mitotic division and parental characters are maintained since there is no segregation of characters in the offsprings.

OR

(a) (i) Menstrual phase : During the first 3-5 days of the cycle where menstrual flow occurs due to breakdown of endometrial lining of the uterus, if the released ovum is not fertilised.

(ii) Follicular Phase : From 5th to 14th day of the cycle, primary follicles grow to become fully mature graafian follicles. The endometrium regenerates. The Graafian follicle ruptures to release ova.

(iii) Luteal Phase : During 15th to 28^{th} day, the remaining part of the Graafian follicle transforms into corpus luteum which secretes progesterone. All these phases are under the influence of varying concentrations of pituitary and ovarian hormones.

(b) Yes, I agree with the statement since appropriate precautions can be taken between the 10^{th} to 17^{th} day of the menstrual cycle when chances of fertilisation are high.

25. (a) Compare, giving reasons, the J-shaped and S-shaped models of population growth of a species.

(b) Explain "fitness of a species" as mentioned by Darwin. **[5]**

OR

(a) What is an ecological pyramid ? Compare the pyramids of energy, biomass and numbers.

(b) Write any two limitations of ecological pyramids.

Answer : (a)

S. No.	J-shaped	S-shaped
(i)	Resources are unlimited	Resources are limited.
(ii)	Growth is exponential.	Logistic growth.
(iii)	As resources are unlimited all individuals survive and reproduce.	The fittest individuals will survive and reproduce.

(b) According to Darwin, "Fitness of a species" means reproductive fitness. When resources are limited , competition occurs between individuals. The fittest will survive and reproduces to leave more progeny.

OR

(a) Ecological pyramids are graphical representation of the relationship among the organisms at different trophic levels.

Pyramid of Energy :

1. Shows transfer of energy from one trophic level to another.

2. Always upright.

Pyramid of biomass :

1. Shows transfer of amount of food from one trophic level to another.

2. Mostly upright but can be inverted also.

Pyramid of Numbers :

1. It shows the number of organisms at each trophic level.

2. Mostly upright. It can be inverted.

(b) 1. It does not accommodate the food web.

2. It does not takes into account the same species and saprophytes are not given any place.

26. (a) Describe the structure and function of a *t*-RNA molecule. Why is it referred to as an adapter molecule ?

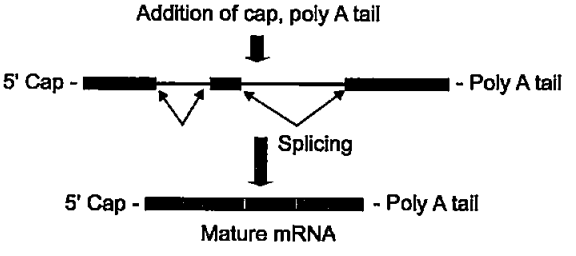
(b) Explain the process of splicing of hn-RNA in a eukaryotic cell. **[5]**

OR

Write the different components of a lac-operon in *E. coli*. Explain its expression while in an 'open' state.

Answer : (a) *t*-RNA has clover leaf shape or the shape of an inverted L. It has an anticodon loop with bases which are complementary to a specific codon. It has an amino acid acceptor end. As it reads the code on one hand and binds with the specific amino acid on the other hand, it is referred to as an adapter molecule.

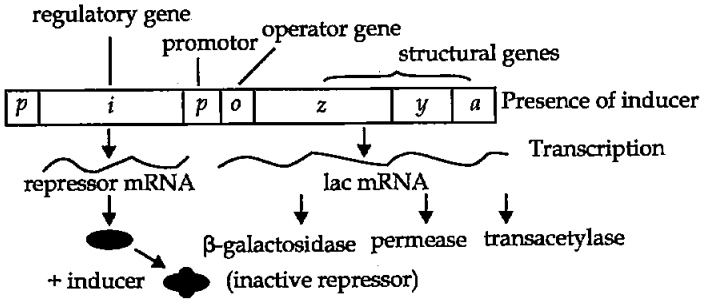
(b) The hn-RNA in a eukaryotic cell is subjected to a process called splicing where the introns are removed and the exons are joined in a defined order.



OR

The lac-operon in *E.coli* consists of one regulatory gene (i), promotor gene, operator gene and three structural genes (z, y, and a).

When lactose or the inducer binds to the repressor protein, it is made inactive so it cannot bind with operator and hence allows RNA polymerase to access the promotor. Transcription proceeds, β-galactosidase, permease and transacetylase are formed by translation process for lactose metabolism.



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Biology 2017 (Outside Delhi) SET II

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions. All the remaining questions have been asked in previous set.

SECTION-A

3. Name the specific type of gene that is incorporated in a cotton plant to protect the plant against cotton boll worm infestation. [1]

Answer : Cry I Ac or cry II Ab.

SECTION-B

6. Name the type of immunity the colostrum provides to a newborn baby. Write giving an example where this type of immunity should be provided to a person. [2]

Answer : Colostrum provides passive immunity to a newborn baby. Such type of immunity can be provided in case of an infection by deadly microbes (tetanus) or in case of snake bite where quick immune response is required.

8. Write the binomials of two fungi and mention the products/bioactive molecules they help to produce. [2]

Answer : *Trichoderma polysporum* produces cyclosporin A.

Aspergillus niger produces citric acid.

SECTION-C

13. Explain the process of pollination in *Vallisneria*. How is it different in water-lily, which is also an aquatic plant ? [3]

Answer : In *Vallisneria*, pollination takes place through water. The female flower reaches the surface of water by a long stalk, while male flowers or pollen grains are released on to the surface of water. They are carried passively by the water current and reach the female flowers or stigma.

In water lily, pollination takes place through wind or insect as the female flower emerges above the surface of water and gets pollinated.

15. What is disturbance in Hardy-Weinberg genetic equilibrium indicative of ? Explain how it is caused. [3]

Answer : 1. Disturbance in Hardy-Weinberg equilibrium is an indicator of change of frequency of alleles in a population, resulting in evolution.

2. Five factors are known to affect Hardy-Weinberg's principle, They are :

(i) Gene flow or gene migration : When migration of a section of population to another place or population occurs, new genes are added to the new population and these are lost from the old population.

(ii) Genetic Drift : When the same change occurs by chance.

(iii) Mutation : Any alternation of DNA sequences which results in consequent changes in genotype and phenotype.

(iv) Genetic Recombination : Generation of non-parental gene combinations.

(v) Natural Selection : Heritable variations enabling better survival helps the organism to reproduce and leave greater number of progeny.

18. Different animals respond to changes in their surroundings in different ways. Taking one example each, explain "some animals undergo aestivation while some others hibernation". How do fungi respond to adverse climatic conditions ? [3]

Answer : 1. Some animals go into aestivation to avoid summer related problems such as heat and dessication *e.g.*, snails or fish.

2. Some animals go into hibernation to avoid winter related problems *e.g.*, polar bear.

3. Fungi forms thick walled spores and suspend their activities to respond to adverse climatic conditions.

20. (a) Explain the significance of 'palindromic nucleotide sequence' in the formation of recombinant DNA.

(b) Write the use of restriction endonuclease in the above process. [3]

Answer : (a) Palindromic nucleotide sequence is the recognition sequence present both on the vector and on desired or alien DNA for the action of the same restriction endonuclease to act upon.

(b) Same restriction endonuclease binds to both the vector and the foreign DNA and cuts each of the two strands of the double helix at specific points in their sugar phosphate backbone of recognition sequence of vector and foreign DNA. It cuts the strands the little away from the centre of the palindromic sites to create overhanging streches or sticky ends.

SECTION-E

25. (a) Explain Polygenic inheritance and Multiple allelism with the help of suitable examples.

(b) "Phenylketonuria is a good example that explains Pleiotropy." Justify. [5]

OR

(a) What is an operon ?

(b) Explain how a polycistronic structural gene is regulated by a common promoter and a combination of regulatory genes in a lac-operon.

Answer : (a) Polygenic Inheritance : Traits that are generally controlled by three or more genes. The phenotype reflects the contribution of each allele *i.e.*, effect of each allele is additive. *e.g.*, Human skin colour is controlled by three genes such as A, B and C.

Multiple Allelism : In multiple allelism, more than two alleles govern the same character or phenotype *e.g.*, Human Blood Group-ABO system is controlled by three different alleles– I^A, I^B, i.

(b) In pleiotropy, a single gene can exhibit multiple phenotypic expressions. In phenylketonuria, a single mutated gene expresses mental retardation, reduction in hair and skin pigmentation.

OR

(a) An Operon is a polycistronic structural gene which is regulated by a common promoter and regulator gene.

(b) 1. Lac operon consists of one regulatory gene i which codes for the repressor protein. Promoter (P) and operator (O) are adjacent to gene i.

2. Structural genes Z, y and a code for enzymes β-galactosidase, permease and transacetylase, respectively.

3. The regulator gene i synthesises the repressor protein. In the absence of the inducer, the repressor protein binds to the operator region of the operon and prevents transcription by RNA polymerase.

4. The repressor is inactivated in the presence of an inducer (lactose) that binds with it. This allows RNA polymerase access to the promoter. In this manner transcription proceeds.

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Biology 2017 (Outside Delhi) SET III

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous sets.

SECTION–A

2. Bt-toxins are released as inactive crystals in the bacterial body. What happens to it in the cotton boll worm body that it kills the boll worm? [1]

Answer : In the cotton boll worm body, Bt-toxin is converted into an active protein due to the alkaline pH of its gut. The toxin binds to the midgut cells, creates pores and causes swelling and lysis of the cells. This kills the boll worm.

SECTION–B

7. Give the bionomials of two types of yeast and the commercial bioactive products they help to produce. [2]

Answer : *Saccharomyces cerevisiae* → ethanol
Monascus purpureus → statin.

9. How many cells are present in the pollen grains at the time of their release from anther? Name the cells. [2]

Answer : Pollen grains may be released at :

1. 2–celled stage having one vegetative and one generative cell.

2. 3–celled stage having one vegetative cell and two male gametes.

10. Name the group of cells the HIV enters after getting into the human body. What happens in these cells and what are these cells subsequently referred to as ? Name the next group of cells the HIV attacks from here. [2]

Answer : After getting into the human body, HIV enters macrophages. In these cells reverse transcription occurs. Subsequently they are referred to as HIV factory. The next group of cells HIV attacks are the helper T-lymphocytes or T_H.

SECTION–C

11. Rearrange *Ramapithecus, Australopithecus* and *Homo habilis* in the order of their evolution on the Earth. Comment on their evolutionary characteristics. [3]

Answer : *Ramapithecus* → *Australopithecus* → *Homo habilis.*

Ramapithecus-hairy, walked like a gorilla or chimpanzees. They were more man like.

Australopitheus–Hunted with stone weapons, they ate fruits.

Homo habilis–Brain capacity was 650-800 cc, they probably did not eat meat.

16. (a) Trace the development of an endosperm after fertilisation with reference to coconut. Mention the importance of endosperm development.

(b) Write the importance of 'pollen bank'. [3]

Answer : (a) In coconut, the Primary Endosperm Nucleus (PEN) undergoes successive nuclear divisions to give rise to free nuclear endosperm known as coconut water. White kernel is the cellular endosperm. The endosperm provides nourishment to the growing embryo.

(b) Pollen banks are used for storage or cryo-preservation of pollensso that they could be used in crop breeeding programmes.

22. How do kangaroo rats and desert plants adapt themselves to survive in their extreme habitat? Explain. [3]

Answer : Kangaroo rats undergo internal fat oxidation where water is a byproduct. It excretes concentrated urine. Desert plants have thick cuticle, sunken stomata, leaves reduced to spines, deep roots, special photosynthetic pathway (CAM) etc. which helps them to survive in their extreme habitat.

SECTION–E

24. (a) A pea plant bearing axial flowers is crossed with a pea plant bearing terminal flowers. The cross is carried out to find the genotype of the pea plant bearing axial flowers. Work out the cross to show the conclusions you arrive at.

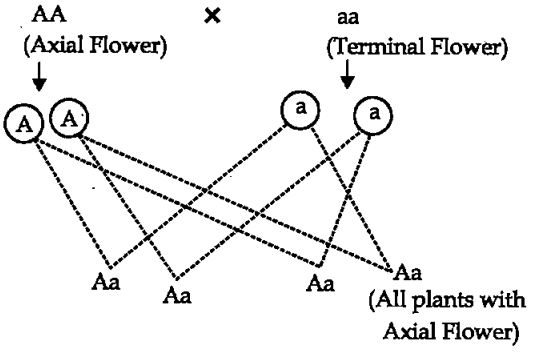
(b) State the Mendel's law of inheritance that is universally acceptable. [5]

OR

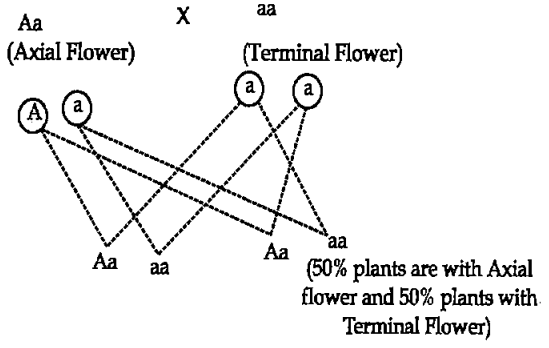
(a) Absence of lactose in the culture medium affects the expression of a lac-operon in *E.coli*. Why and how ? Explain.

(b) Write any two ways in which the gene expression is regulated in eukaryotes.

Answer : (a) 1. If the pea plant is homozygous for the dominant trait.



2. If the pea plant is heterozygous for the dominant trait.



Conclusion : If all the progeny shows axial flowers (dominant), the plant is homozygous (AA). If 50% of the progeny shows axial flowers (dominant) and 50% shows terminal flowers (recessive), the plant is heterozygous.

(b) Law of segregation : The factors or alleles of a pair segregate or separate during gamete formation such that a gamete receives only one of the two factors.

OR

(a) 1. Lactose acts as an inducer in a Lac-operon. Thus absence of lactose switches off the operon.

2. The repressor protein produced by the regulatory gene (i gene) is free in the absence of inducer.

3. The repressor protein binds with the operator gene, preventing RNA polymerase to transcribe the structural gene and the operon is switched off.

(b) In eukaryotes, gene expression is regulated at :

1. Transcriptional level.

2. Processing level (regulation of splicing).

●●

Biology 2017 (Delhi) SET I

Time allowed : 3 hours **Maximum marks : 70**

SECTION–A

1. **Our government has intentionally imposed strict conditions for M.T.P. in our country. Justify giving a reason.** [1]

   Answer : Our government has intentionally imposed strict conditions for MTP in our country to prevent female foeticide, to maintain sex ratio and to avoid any danger for the young mother or foetus.

2. **State the fate of a pair of autosomes during gamete formation.** [1]

   Answer : The pair of autosomes will segregate during gamete formation. So, that each gamete receives haploid set of chromosome.

3. **What role does an individual organism play as per Darwin's theory of natural selection ?** [1]

   Answer : As per Darwin's theory of natural selection, an individual with reproductive fitness passes on the useful genes to the next generation.

4. **Suggest a method to ensure an anamnestic response in humans.** [1]

   Answer : Vaccination, Immunization, weakened or inactive microbes introduced into the body can be a method to ensure an anamnestic response in humans.

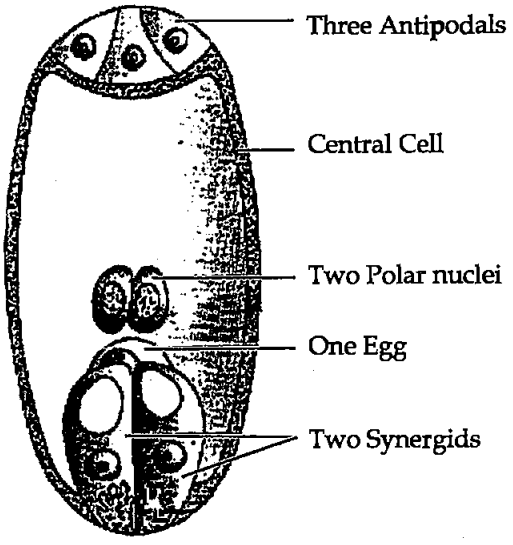
5. What is biopiracy ? [1]

Answer : Biopiracy is use of bioresources by an MNC or organisation without proper authorisation or compensatory payment.

SECTION–B

6. A mature embryo-sac in a flowering plant may possess 7-cells, but 8-nuclei. Explain with the help of a diagram only. [2]

Answer :



7. Describe the structure of a nucleosome. [2]

OR

Mention the evolutionary significance of the following organisms :

(a) Shrews

(b) Lobefins

(c) *Homo habilis*

(d) *Homo erectus*

Answer : A nucleosome is a unit of eight moles of positively charged histones with negatively charged DNA wrapped around the histone octomer. There are 200 bp of DNA helix in a nucleosome.

OR

(a) Shrews were the first mammals, on the earth.

(b) Lobefins were the first amphibians (lived both on land and in water). They were fish with stout and strong fins which helped them move on land and go back to water.

(c) *Homo habilis* were the first human like beings or hominids having a brain capacity from 650-800 cc. They did not eat meat.

(d) *Homo erectus* had a brain capacity of about 900 cc. They ate meat.

8. In an agricultural field there is a prevalence of the following organisms and crop diseases which are affecting the crop yield badly : [2]

(a) White rust

(b) Leaf and stripe rust

(c) Black rot

(d) Jassids

Recommend the varieties of crops the farmers should grow to, get rid of the existing problem and thus improve the crop yield.

Answer : (a) *Pusa swarnim* or *Karan rai.*

(b) *Himgiri.*

(c) *Pusa shubhra or pusa snowball K-1.*

(d) *Pusa sem 2 or Pusa sem 3.*

9. How does the application of the fungal genus, *Glomus*, to the agricultural farm increase the farm output? [2]

Answer : The fungal genus *Glomus* forms a mycorrhizal association. It absorbs phosphorus, provides resistance to root borne pathogens. It also enhances the capacity to tolerate salinity or drought.

10. Plenty of algal bloom is observed in a pond in your locality.

(a)Write what has caused this bloom and how does it affect the quality of water.

(b) Suggest a preventive measure. [2]

Answer : (a) Presence of large amounts of phosphorus or nitrogenous nutrients in the water causes excessive growth of algae which depletes dissolved oxygen and imparts a distinct colour to the water bodies. The bloom forming algae besides being extremely toxic, deteriorate water quality and causes fish mortality.

(b) Any one of the following methods can be used as a preventive measures :

1. Treatment of waste water before it reaches the pond.
2. Integrate waste water treatment.
3. Avoid use of NPK fertilisers.
4. Use of organic or biodegradable manure.
5. Resort to organic farming.

SECTION–C

11. (a) List the three stages the annuals and biennial angiosperms have to pass through during their life cycle.

(b) List and describe any two vegetative propagules in flowering plants. [3]

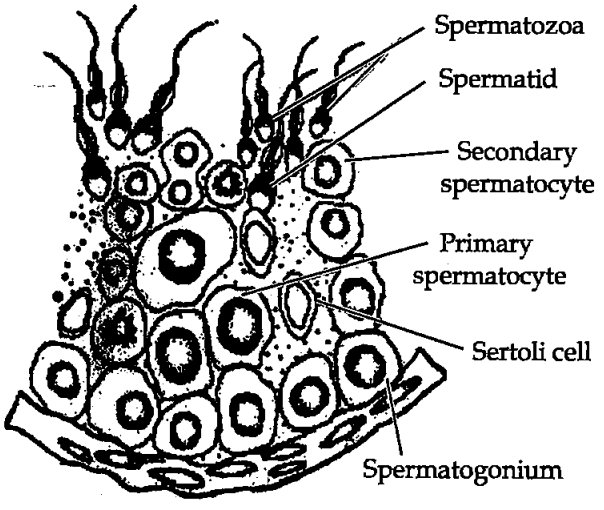
Answer : (a) They have to pass through vegetative, reproductive and senescent stages during their life cycle.

(b) 1. Eyes of potato have nodes from which new plant gets developed.

2. Offset of water hyacinth is a one internode long runner.

12. Draw a labelled diagrammatic sectional view of a human seminiferous tubule. [3]

Answer :



13. During a medical investigation, an infant was found to possess an extra chromosome 21. Describe the symptoms the child is likely to develop later in the life. [3]

Answer : The infant seems to be suffering from Down's syndrome. The symptoms are short statured, small round head, furrowed tongue, partially open mouth, broad palm with characteristic palm crease, physical psychomotor and mental development retarded, big and wrinkled tongue, broad flat face, flat back of head, many "loops" on finger tips etc.

14. A number of passengers were severely burnt beyond recognition during a train accident. Name and describe a modern technique that can help hand over the dead to their relatives. [3]

Answer : The technique is called DNA finger printing. The steps involved in it are :

1. Isolation of DNA and its digestion by restriction endonucleases.

2. Separation of DNA fragments by gel electrophoresis.

3. Transferring separated DNA fragments to synthetic membrane or nitrocellulose or nylon.

4. Hybridization of these DNA molecule with VNTR probes.

5. Detection of hybridized DNA fragments by autoradiography.

6. Matching the banding pattern so obtained with that of relative.

15. $p^2 + 2pq + q^2 = 1$. Explain this algebraic equation on the basis of Hardy–Weinberg's principle. [3]

Answer : If p represents the frequency of allele A, q represents the frequency of allele of a, then frequency of AA = p^2, aa = q^2 and Aa = 2 pq. Total genes and their alleles in a population or gene pool remain constant (called as genetic equilibrium). The sum total of all allelic frequencies is :

$$1/\ p + q = 1\ (p + q)^2 = 1.$$

16. (a) What precaution(s) would you recommend to a patient requiring repeated blood transfusion ?

(b) If the advise is not followed by the patient, there is an apprehension that the patient might contract a disease that would destroy the immune system of his/her body. Explain with the help of schematic diagram only how the immune system would get affected and destroyed. [3]

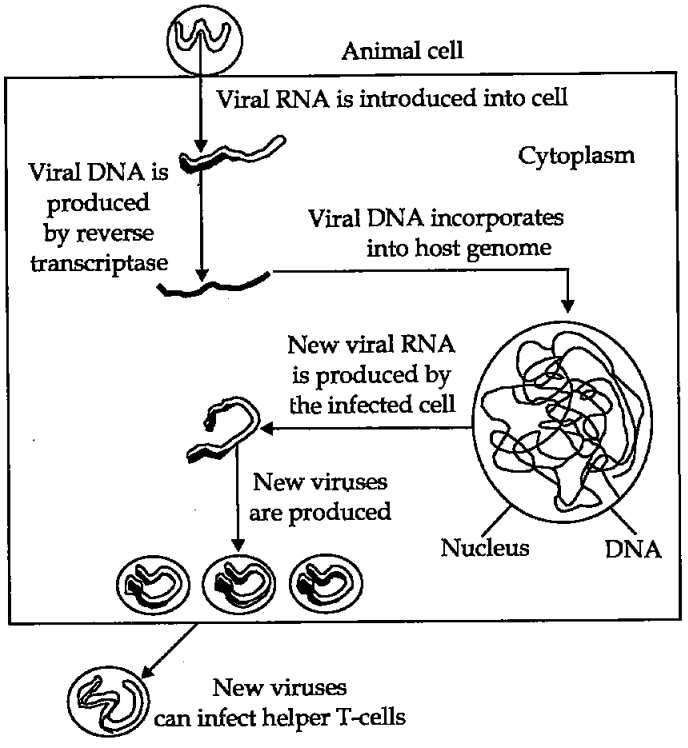
Answer : (a) A patient requiring repeated blood transfusions should observe the following precautions :

1. Ensuring that blood from blood banks is safe from HIV.

2. Screening blood for HIV/Hepatitis etc.

3. Ensuring use of only disposable needles and syringes.

(b)



17. (a) What is inbreeding depression ?

(b) Explain the importance of "selection" during inbreeding in cattle. [3]

Answer : (a) Inbreeding depression–Continuous inbreeding especially close inbreeding usually reduces fertility and even productivity.

(b) "Selection" in cattle helps in accumulation of superior genes or elimination of less desirable genes. It increases homozygosity and helps to develop pure lines. It also helps to restore fertility, to increase productivity, to produce more milk per lactation, to produce superior progeny or to produce disease resistant breeds.

18. Describe how do 'flocs' and 'activated sludge' help in Sewage Treatment. [3]

Answer : 'Flocs' : They are aerobic microbes that consume a major part of organic matter in the effluent. They also significantly reduce BOD.

Activated sludge : A small part of activated sludge is used as an innoculum and pumped back to the aeration tank. They are pumped into anaerobic sludge digesters where microbes grow anerobically to produce CH_4, H_2S, CO_2 (biogas) etc.

19. Explain the role(s) of the following in Biotechnology :

(a) Restriction endonuclease

(b) Gel-electrophoresis

(c) Selectable markers in pBR322. [3]

Answer : (a) Restriction endonuclease : cuts the DNA molecule at a specific nucleotide sequence.

(b) Gel-electrophoresis : It is a technique which ensures separation of DNA fragments under the influence of electric field.

(c) Selectable markers in pBR322 : Helps in identifying and eliminating non-transformants from transformants and selection of transformants.

20. Write the steps you would suggest to be undertaken to obtain a foreign-gene-product. [3]

Answer : To obtain a foreign gene product, the following steps may be undertaken :

1. Insert a piece of alien or desired DNA into a cloning vector.

2. Transfer it into a bacterial, plant or animal cell.

3. The alien DNA gets multiplied.

4. Optimised conditions of temperature, pH, substrate, salts, vitamins, O_2 etc., are provided to the culture in a bioreactor.

5. Extracting the desired product.

6. Purifying it by using different separation techniques.

21. Why do Iepidoplerans die when they feed on Bt cotton plant ? Explain how does it happen. [3]

Answer : Bt cotton plant contains inactive toxin protein. Once the insect ingests it, the inactive protoxins are converted into active form due to alkaline pH in the gut which solubilises the crystals. The activated toxins bind to the surface of the midgut, creates pores, causes swelling, lysis eventually leading to the death of the insect pest.

22. *'in-situ'* conservation can help endangered/ threatened species. Justify the statement. [3]

OR

Name and describe any three causes of biodiversity losses.

Answer : In *"In-situ"* conservation, the threatened organisms are conserved in their natural habitat or ecosystem. Such habitats are legally protected as hotspots, biosphere reserves, national parks, sanctuaries, sacred groves or Ramsar sites.

OR

Causes of biodiversity loss :

1. Habitat loss or fragmentation : The Amazon rain forest is being out and cleared for raising cattle, or conversion to grasslands or cultivating soyabeans. The large habitats are broken up into small fragments due to human activities. Mammals and birds which require large territories are badly affected leading to decline in population.

2. Over exploitation : When "need" turns to "greed", it leads to overexploitation of natural resources. *e.g.*, Stellar's sea cow, passenge pigeon, marine fish population were over-exploited.

3. Alien species Invasions : When alien species are introduced deliberately, some of them turn invasive and cause decline in indigenous species *e.g.*, carrot grass, African catfish (*Clarias gariepinus*) poses a threat to the indigenous cat fishes.

SECTION-D

23. Public all over India is very much concerned about the deteriorating air quality in large parts of North India. Alarmed by this situation the Resident's Welfare Association of your locality organized an awareness programme entitled "Bury not burn". They invited you, being a biology student to participate.

(a) How would you justify your arguments that promote burying and discourage burning? (Give two reasons)

(b) With the help of flow charts, one for each practice depict the chain of events that follow. [4]

Answer : (a) Burying of biodegradable or agricultural wastes should be done in a pit. The pit should be covered with soil leading to decomposition of organic matter which increases soil fertility. If the above mentioned things are burned it will lead to formation of harmful gases, smoke etc. which may cause air pollution and respiratory diseases.

(b) Burying biodegradable or agricultural waste in a pit covered with moist soil decomposes the compost and increases the soil fertility which in turn results in the recycling of the nutrients.

SECTION-E

24. Read the following statement and answer the questions that follow :

"A guava fruit has 200 viable seeds."

(a) What are viable seeds ?

(b) Write the total number of :

(i) Pollen grains

(ii) Gametes in producing 200 viable guava seeds.

(c) Prepare a flow-chart to depict the post-pollination events leading to viable-seed production in flowering plant. [5]

OR

(a) Arrange the following hormones in sequence of their secretion in a pregnant woman.

(b) Mention their source and the function they perform :

hcG; LH; FSH; Relaxin.

Answer : **(a)** Seeds that have the ability to germinate and give rise to a new plant are called viable seeds.

(b) **(i)** 200 pollen grains.

(ii) 600 gametes (400 males gametes + 200 female gametes)

(c) After pollination, the pollen grain starts germinating on the stigma and then the pollen tube carrying male gametes reaches the ovule and discharges the gametes near the egg and thus the syngamy of male gamete and egg occurs to form zygote leading to triple fusion of male gamete with two polar nuclei which results in the formation of PEN and thus ovule develops into a viable seed.

OR

(a) FSH, LH, hCG, relaxin.

(b)

Hormone	Source	Function
1. FSH	Anterior pituitary	Stimulates follicular development
2. LH	Anterior pituitary	Release of ovum from Graafian follicle
3. hCG	Placenta	Supports foetal growth
4. Relaxin	Ovary	Softens public symphysis during later stages of pregnancy

25. State and explain the "law of independent assortment" in a typical Mendelian dihybrid cross. **[5]**

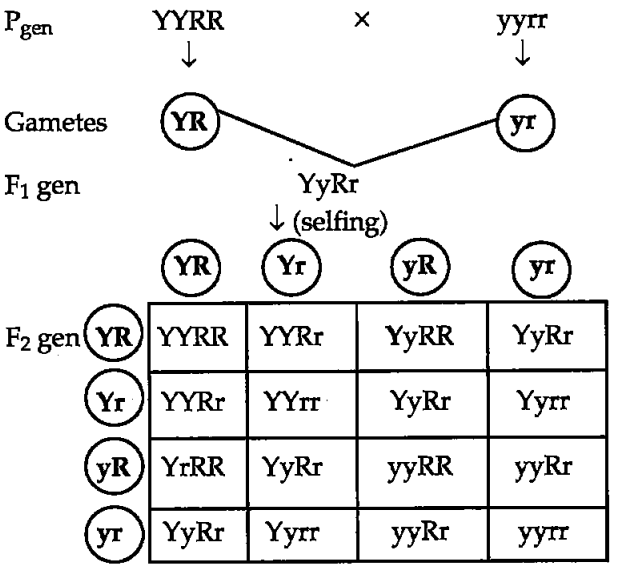
OR

(a) How do the observations made during moth collection in pre- and post-industrialized area in England support evolution by Natural Selection ?

(b) Explain the phenomenon that is well represented by Darwin's finches other than natural selection.

Answer : Law of Independent Assortment : When two pairs of traits are combined in a hybrid, inheritance of one pair of characters is independent of the other pair.

Explanation : Mendel took homozygous pea plant producing yellow and round seeds and crossed them with homozygous pea plant producing green and wrinkled seeds.



Phenotypes – Yellow round : Yellow wrinkled : Green round : Green wrinkled

Phenotypic ratio – 9 : 3 : 3 : 1

OR

(a) 1. Before industrialisation white coloured lichens covered the trees in which white winged moths camouflaged themselves from predators.

2. More white winged moths existed on trees than dark winged moths.

3. After industrialisation there were more dark winged moths in the same area.

4. These moths could not be easily spotted by the predators against tree trunks which became dark due to industrial smoke and spot.

5. Hence dark winged moths survived by Natural Selection.

(b) The process of evolution of different species in a given geographical area starting from a point, radiating to other areas of geography is called adaptive radiation. Finches evolved on the same island from original seed eating features, many others have altered beaks arose enabling them to become insectivorous and vegetarian finches.

26. (a) What is an age-pyramid ?

(b) Name three representative kinds of age-pyramids for human population and list the characteristics for each one of them.

OR

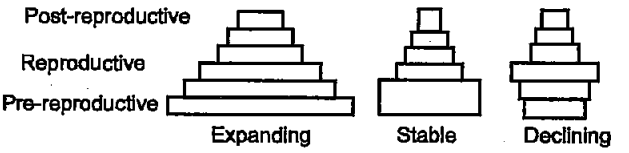
Discuss the role of healthy ecosystem services as a pre-requisite for a wide range of economic, environmental and aesthetic goods and services. [5]

Answer : (a) Age Pyramid : If age distribution (percent individuals of a given age group) is plotted for the population, the resulting structure is called an age pyramid.

(b) 1. Expanding : Pre-reproductive population is greater than reproductive or post reproductive population.

2. Stable : Pre-reproductive and reproductive population are almost similar but less than post reproductive population.

3. Declining : Pre-reproductive population is less than reproductive population.



OR

Role of Healthy Ecosystem Services :

1. Purification of air and water
2. Cycling of nutrients
3. Mitigating droughts and floods
4. Generating fertile soils
5. Providing wild-life habitats
6. Pollinating crops
7. Maintaining biodiversity
8. Providing storage site for carbon
9. Providing aesthetic, cultural and spiritual values
10. Climate regulation

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Biology 2017 (Delhi) SET II

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous set.

SECTION–A

1. **What is "fitness of an individual" according to Darwin ?** [1]

Answer : An individual with reproductive fitness passes on its useful gene to the next generation.

SECTION-B

6. **By taking two examples explain how has bio-fortification helped in improving food quality.** [2]

Answer : 1. A maize hybrid was developed that had twice the amount of amino acids lysine and tryptophan.

2. Atlas 66 wheat variety has high protein content used as donor for improving wheat.

3. IARI has released.

(a) Vitamin A enriched carrots, spinach or pumpkin.

(b) Vitamin C enriched bitter gourd, bathua, mustard or tomato.

(c) Iron and Calcium enriched spinach and bathua.

(d) Protein enriched beans-broad, French beans, peas, garden peas etc.

8. **How does the application of cyanobacteria help improve agriculture output ?** [2]

Answer : Cyanobacteria fixes atmospheric nitrogen, adds organic matter, increases soil fertility, replenish soil nutrients, acts as biofertiliser and reduces dependence on chemical fertilisers.

9. **In a flowering plant a microspore mother cell produces four male gametophytes while a megaspore mother cell form only one female gametophyte. Explain.** [2]

Answer : A microspore mother cell on meiosis produces four functional pollen grains while a Megaspore mother cell on meiosis forms four megaspores out of which only one is functional and the other three degenrate (monosporic development).

SECTION-C

13. Differentiate between an annual and a biennial plant. Provide one example of each. [3]

Answer :

S. No.	Annual	Biennial
(i)	They complete their life cycle in one season.	They complete their life cycle in two seasons.
(ii)	They complete their vegetative reproductive and senescent phases in one season. *e.g.*, Wheat, barley, rice etc.	They complete their vegetative phase in one season, reproductive and senescent phases in the second season. *e.g.*, sugarbeet, cabbage, carrot, radish etc.

22. A group of youth were having a 'rave party' in an isolated area and was raided by police. Packets of "smack" and syringes with needles were found littered around.

(a) Why is taking "smack" considered an abuse ?

(b) Write the chemical name of "smack" and the name of its source plant.

(c) Syringes and needles used by the youth for taking the drug could prove to be very fatal. Why ? [3]

Answer : (a) Smack is an additive substance. It causes drug dependence. If affects the nervous system. It is used in amounts or frequencies that impairs one's physical, physiological or psychological functions.

(b) Diacetyl morphine and its source plant is *Papaver somniferum*.

(c) They may cause serious infections such as HIV or AIDS.

SECTION-E

25. Read the statement and answer the questions that follow :

A flower of brinjal has 520 ovules in its ovary. However, it produces a fruit with only 480 viable seeds.

(a) What could have prevented the rest of the 40 ovules from maturing into viable seeds? Explain giving a reason.

(b) Describe the development of a dicot embryo in a viable seed.

(c) Why certain angiospermic seed are albuminous while others are exalbuminous ? Explain. [5]

OR

(a) Name the hormones secreted and write their functions :

(i) by corpus luteum and placenta (any two).

(ii) during follicular phase and parturition.

(b) Name the stages in a human female where:

(i) Corpus luteum and placenta co-exist.

(ii) Corpus luteum temporarily ceases to exist.

Answer : (a) Less than the required number of pollen grains may have been present or all pollen grains may not have germinated to form pollen tubes or probably all the pollen grains present on the stigma may not have been the compatible type.

(b) The zygote formed as a result of syngamy divides mitotically to give rise to pro–embryo, which is globular and heart-shaped and finally to the mature embryo.

(c) Some angiospermic seeds are albuminous while others are exalbuminous because in certain angiospermic seeds the endosperm is not completely consumed during embryo development and residual endosperm is found in such seeds whereas in some seeds it is completely consumed and hence no residual endosperm is found in such seeds.

OR

(a) (i) By Corpus luteum secretes progesterone which is essential for maintenance of endometrium.

Placenta secretes hCG which stimulates and maintains corpus luteum for secretion of progesterone. hPL is helpful in supplying energy to the growing foetus. Estrogen supports foetal growth and brings about metabolic changes in mother. Progesterone helps in maintenance of pregnancy.

(ii) During follicular phase : FSH stimulates follicular development.

During parturition : Oxytocin causes stronger uterine contraction.

(b) (i) They co-exist during pregnancy or gestation.

(ii) It happens during menstruation.

●●

Biology 2017 (Delhi) SET III

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions, all the remaining questions have been asked in previous sets.

SECTION–A

5. Rearrange the human activities mentioned below as per the order in which they developed after the modern *Homo sapiens* came into existence during ice age :

(i) Human Settlements.

(ii) Prehistoric cave art.

(iii) Agriculture. **[1]**

Answer : (i) Pre-historic cave art

(ii) Agriculture

(iii) Human settlement

SECTION–B

7. How do mycorrhizae help the plants to grow better ? **[2]**

Answer : 1. They additionally absorb phosphorus.

2. They provide resistance to root borne pathogens.

3. They enhance the capability of the plant to tolerate salinity or even drought.

8. Mention the ploidy of the different types of cells present in the female gametophyte of an angiosperm. **[2]**

Answer : All types of cells present in a female gametophyte (such as synergids, egg, antipodals and polar nuclei) are haploid.

10. "Growing *spirullina* on a large scale is beneficial both environmentally and nutritionally for humans." Justify. **[2]**

Answer : 1. *Spirullina* can easily be grown on materials like waste water from potato processing plant, straw, molasses, animal manure, sewage which helps to reduce environmental pollution.

2. *Spirullina* also serves as food rich in proteins, carbohydrates, fats, vitamins and minerals.

SECTION-C

11. During a fire in an auditorium a large number of assembled guests got burnt beyond recognition. Suggest and describe a modern technique that can help hand over the dead to their relatives. **[3]**

Answer : DNA fingerprinting is the modern technique that can help the authorities to hand over the dead to their relatives. It includes series of steps which are as follows :

1. Isolation and digestion of DNA by restriction endonuclease.

2. Separation of DNA fragments by electrophoresis and transferring them to synthetic membranes such as the nitro-cellulose or nylon membrane.

3. Hybridisation using labelled probe.

4. Detection of hybridised DNA fragements by autoradiography.

5. Matching banding pattern of DNA, DNA fingerprints or autoradiograms of the guests who lost their lifes during the accident and that of their relatives.

16. Parthenocarpy and apomixis have been observed in some plants. Give an example of each. State a similarity and a difference observed between the two processes. **[3]**

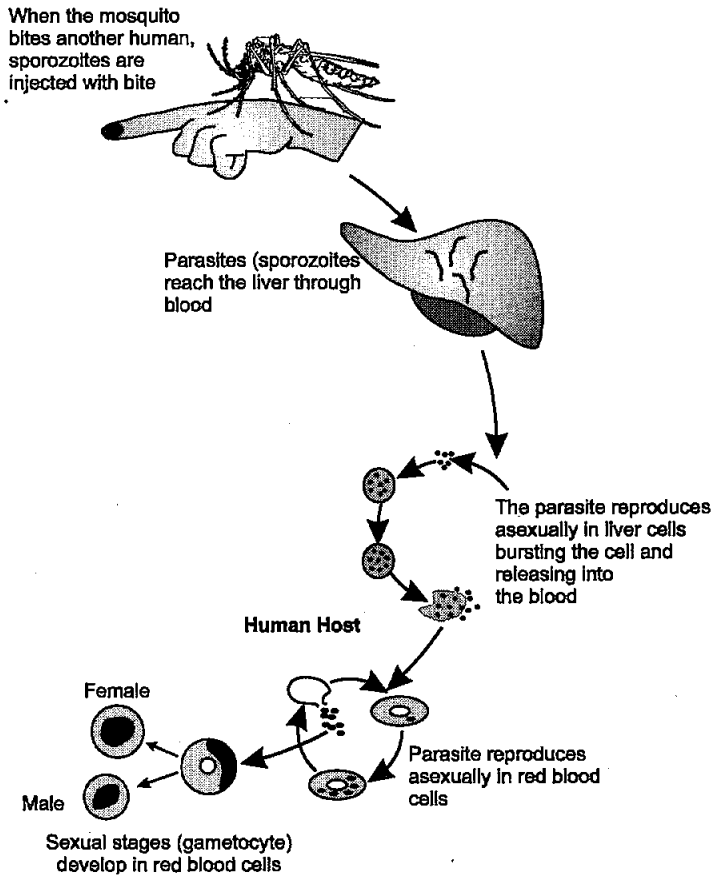
Answer : Difference :

S. No.	Parthenocarpy	Apomixis
(i)	Fruit is formed without fertilisation.	Seed is formed without fertilisation.
(ii)	Seedless fruits are produced *e.g.*, banana or grapes etc.	Fruits with seeds are produced *e.g.*, species of Asteraceae or grasses etc.

Similarity : In both processes development takes place without fertilisation.

20. Show with the help of a flow chart only, the life cycle of malerial parasite in humans beings. [3]

Answer :



SECTION–E

26. (a) A capsicum flower has 240 ovules in its ovary. But it produces a fruit with only 180 viable seeds.

Explain giving a reason that could be responsible for such a result.

(b) Describe the development of an endosperm in a viable seed. Why does endosperm development precede embryo development ?

(c) Give an example of an angiosperm seed that has a perisperm. Name the part the perisperm develops from. [5]

OR

(a) Where in the fallopian tube does fertilisation occur in humans ? Describe the development of a fertilized ovum upto implantation.

(b) How is polyspermy prevented in humans?

Answer : (a) 1. This result may be possible because of less number of pollen grains or male gametes.

2. All pollen grains may not have germinated to form pollen tubes.

3. Many pollen grains may not have been of the compatible type.

(b) 1. The PEN undergoes successive nuclear division to give rise to free nuclei (free nuclear endosperms), after which cell wall formation occurs and the endosperm becomes cellular.

2. The cells of the endosperm are filled with reserve food materials that are used for providing nutrition to the developing embryo.

3. Black pepper or beet has perisperm. It is the remnant nucleus.

OR

(a) Fertilisation occurs in the ampullary or ampullary isthmic junction :

1. Cleavage occurs in the zygote to form 2, 4, 8, 16 blastomeres.

2. 8-16 blastomere stage is called morula.

3. The morula continues to divide and transforms into blastocyst.

4. The blastomeres in the blastocyst are arranged into an outer trophoblast which gets attached to the endometrium pellucida.

5. The inner cell mass gets differentiated into an embryo.

6. The uterine cells divide rapidly and cover the blastocyst leading to implantation.

(b) When a sperm comes in contact with the zona pellucida layer of the ovum, it induces changes in the membrane to block the entry of additional sperms.

●●

Biology 2018

SET I

Time allowed : 3 hours **Maximum marks : 70**

SECTION-A

1. **Write the dual purpose served by Deoxyribonucleoside triphosphates in polymerisation.** [1]

Answer : Deoxyribonucleoside triphosphate acts as a substrate in polymerisation. It also provides energy from the terminal two phosphates.

2. **Name two diseases whose spread can be controlled by the eradication of *Aedes* mosquitoes.** [1]

Answer : Dengue and Chikungunya.

3. **How do cytokine barriers provide innate immunity in humans ?** [1]

Answer : The virus infected cells secrete Interferon proteins, which protects non-infected cells from further viral infection and innate immunity in humans is provided.

4. **Write the names of the following :** [1]

(a) A 15 *mya* primate that was ape-like.

(b) A 2 *mya* primate that lived in East African grasslands.

Answer : (a) Dryopithecus was ape-like.

(b) Australopithecines or *Homo habilis* lived in East African Grasslands.

5. **Mention the chemical change that proinsulin undergoes, to be able to act as mature insulin.** [1]

Answer : Removal of C-peptide from proinsulin helps to produce mature insulin.

SECTION B

6. **Your advice is sought to improve the nitrogen content of the soil to be used for cultivation of a non-leguminous terrestrial crop.** [2]

(a) Recommend two microbes that can enrich the soil with nitrogen.

(b) Why do leguminous crops not require such enrichment of the soil ?

Answer : (a) *Azospirillum* or *Azotobacter* are two microbes that can enrich the soil with nitrogen.

(b) They can fix atmospheric N_2 due to the presence of Rhizobium in their root nodules, thus they do not require such enrichment of the soil.

7. **With the help of an algebraic equation, how did Hardy-Weinberg explain that in a given population the frequency of occurrence of alleles of a gene is supposed to remain the same through generations ?** [2]

OR

Although a prokaryotic cell has no defined nucleus, yet DNA is not scattered throughout the cell. Explain.

Answer : In a population of diploid organisms,

If frequency of allele A = p

And frequency of allele $a = q$, then the expected genotype frequency under random mating are :

AA = P^2 (for AA homozygotes)

Aa = q^2 (for aa homozygotes)

Aa = 2pq (for Aa heterozygotes)

In the absence of selection, mutation, genetic drift or other forces, p and q are constant through generations.

Therefore $p^2 + 2pq + q^2 = 1$

OR

DNA is negatively charged. The positively charged proteins hold it in places, in large loops in a region called nucleoid. Hence, DNA is not scattered in the cytoplasm of a prokaryotic cell.

8. **How did a citizen group called Friends of Arcata Marsh, Arcata California, USA, help to improve water quality of the marshland using Integrated Waste Water Treatment ? Explain in four steps.** [2]

Answer : Integrated Waste Water Treatment by FOAM involves the following four steps :

1. Initially water is treated by conventional methods such as sedimentation, filtration and chlorination.
2. Water is made to flow through six connected marshes.
3. The water in marshes is seeded with appropriate plants, algae, fungi and bacteria.
4. This helps to neutralise or assimilate the pollutants and also remove heavy metals.

9. You have obtained a high yielding variety of tomato. Name and explain the procedure that ensures retention of the desired characteristics repeatedly in large populations of future generations of the tomato crop. [2]

Answer : The procedure that ensures retention of desired characteristics in a large population is tissue culture, micropropagation or somaclonal propagation.

In this procedure, any part of a plant or explant is taken and grown in a test tube or vessel under sterile conditions, in a special nutrient medium containing a carbon source such as sucrose, inorganic salts, vitamins, amino acids as well as growth regulators.

10. (a) Name the source plant of heroin drug. How is it obtained from the plant ?

(b) Write the effects of heroin on the human body. [2]

Answer :

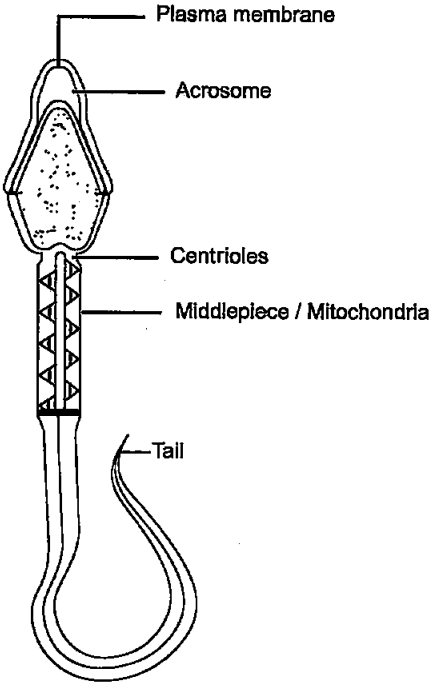
(a) *Papaver somniferum* or poppy plant. It is extracted from the latex of the plant containing morphine. Acetylation of morphine yields heroin.

(b) It acts as a depressant and slows down body functions.

SECTION-C

11. Draw a diagram of a mature human sperm. Label any three parts and write their functions. [3]

Answer :



1. **Plasma Membrane :** Envelope of the sperm.
2. **Acrosome :** Filled with enzymes that help in the entry of sperm nucleus into the ovum.
3. **Mitochondria :** It is an energy source for swimming.

12. (a) Expand VNTR and describe its role in DNA fingerprinting.

(b) List any two applications of DNA fingerprinting technique. [3]

Answer : (a) VNTR—Variable Number of Tandem Repeats. It is used as a probe because of its high degree of polymorphism.

(b) 1. DNA fingerprinting is used for paternity testing through the use of PCR technique which produces the genetic fingerprint and is highly specific for each individual.

2. It is used in the Data security where DNA regions used for individual identification are specific isolated genetic loci in the non-coding regions of the genomic DNA.

13. Differentiate between Parthenocarpy and Parthenogenesis. Give one example of each. [3]

Answer :

S. No.	Parthenocarpy	Parthenogenesis
(i)	It is the formation of fruit without fertilisation.	Ovum develops into a new oraganism without fertilisation.
(ii)	It is the normal process shown by plants.	It is the method of asexual reproduction.
(iii)	It always produces seedless fruits. **Example :** Banana	It produces haploid organisms. **Example :** Turkey

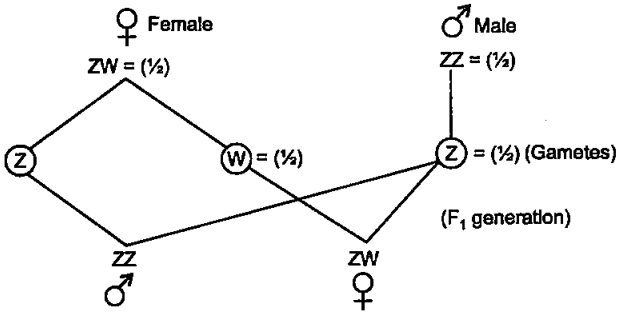
14. Medically it is advised to all young mothers that breastfeeding is the best for their newborn babies. Do you agree ? Give reasons in support of your answer. [3]

Answer : Yes, I agree with the statement.

1. Breastfeeding provides nutrition (Calcium, fats, lactose etc.)
2. It also provides passive immunity to the newborn by producing antibodies such as IgA in the colostrum.
3. It protects the baby against infections such as diabetes and cancer.

15. Explain the mechanism of 'sex determination' in birds. How does it differ from that of human beings? [3]

Answer : In birds–ZZ-ZW type



In Birds the females are heterogametic (ZW) and produce two types of gametes whereas in Humans the males are heterogametic (XY) and produce two types of gametes.

16. (a) How has the development of bioreactor helped in biotechnology ?

(b) Name the most commonly used bioreactor and describe its working. [3]

Answer : (a) A larger biomass or large volume of culture can be processed leading to higher yields of desired specific products (proteins or enzymes), under controlled conditions.

(b) Stirring type of biorector is most commonly used.

Working :

1. Mixing of reactor contents evenly with an agitator system or a stirrer.
2. Facilitates O_2 availability.
3. Temperature, pH and Foam are controlled under optimum conditions.

17. Explain the roles of the following with the help of an example each in recombinant DNA technology : [3]

(a) Restriction Enzymes

(b) Plasmids

(a) Restriction Enzymes—1. It recognises a specific sequence of base pairs or palindromes and cuts the DNA strand at a specific site.

e.g., EcoRI/Hind II etc.

2. It is apparently evolved as a primitive immune system in bacteria.

(b) Plasmids—1. It acts as a vector. It is also responsible for cloning of desired alien or foreign gene. *e.g.*, pBR322, plasmid of salmonella, plasmid of Agrobacterium or Ti-plasmid etc.

2. They are most commonly used in DNA technology to optimize their use as vectors in DNA cloning.

18. Explain out-breeding, out-crossing and cross-breeding practices in animal husbandry. [3]

Answer : Out–breeding–Breeding of unrelated animals which may be between individuals of the same breed or between individuals of different species.

Out-crossing–A kind of out-breeding in which animals are mated within the same breed but having no common ancestors on either side of their pedigree upto 4–6 generations.

Cross-breeding–Another type of outbreeding in which superior males of one breed are mated with superior females of another breed.

19. (a) Organic farmers prefer biological control of diseases and pests to the use of chemicals for the same purpose. Justify. [3]

(b) Give an example of a bacterium, a fungus and an insect that are used as biocontrol agents.

Answer : (a) Organic farmers prefer biological control of diseases and pests to the use of chemicals for the same purpose due to the following reasons :

1. Biological control of diseases and pests reduces dependence on toxic chemicals.
2. These chemicals being biodegradable do not accumulate or pollute the environment.
3. They protect or conserves non-target organisms since they are species-specific.

(b) Bacterium—*Bacillus thuringiensis*

Fungus—*Trichoderma*

Insect—Ladybird

20. (a) Differentiate between analogous and homologous structures. [3]

(b) Select and write analogous structures from the list given below :

(i) Wings of butterfly and birds

(ii) Vertebrate hearts

(iii) Tendrils of bougainvillea and cucurbita

(iv) Tubers of sweet potato and potato

Answer : (a)

S. No.	Analogous Organs	Homologous Organs
(i)	Anatomically dissimilar though perform similar function.	Anatomically similar but perform different functions.
(ii)	They are a result of convergent evolution. Example : Wings of Butterfly and Birds.	They are a result of divergent evolution. Example : Wings of Bat and Fore limb of horse.

(b) (i) Wings of butterfly and Birds.

(ii) Tuber of sweet potato and potato.

21. (a) "India has greater ecosystem diversity than Norway." Do you agree with the statement? Give reasons in support of your answer.

(b) Write the difference between genetic biodiversity and species biodiversity that exist at all the levels of biological organisation. [3]

OR

Explain the effect on the characteristics of a river when urban sewage is discharged into it.

Answer : (a) Yes, I agree with the statement.

S.No.	India/Tropical Region	Norway/ Temperate Region
(i)	It is less seasonal, more constant and more predictable.	More seasonal, less constant and less predictable.
(ii)	Promote niche specialisation leading to greater biodiversity.	Does not promote niche specialisation leading to low biodiversity.
(iii)	Species diversity increases as we move towards equator.	Species diversity decrea-ses as we move away from equator.
(iv)	More number of species exist.	Less number of species exist.

(b)

S. No.	Genetic Biodiversity	Species Biodiversity
(i)	Diversity within a species over its distributional range.	Diversity at a species level.
(ii)	It is trait of the species.	It is trait of the community.
(iii)	It influences adaptability and distribution of species found in an area.	It influences biotic interactions and stability of the community.

OR

When urban sewage is discharged in a river, there is rise in organic matter which leads to increased microbial activity. It results in decreased DO and rise in BOD which leads to fish mortality, algae bloom, colour change, foul odour and increase in toxicity.

22. How has the use of *Agrobacterium* as vectors helped in controlling *Meloidegyne incogntia* infestation in tobacco plants ? Explain in correct sequence. [3]

Answer : 1. Using *Agrobacterium* vector, nematode specific genes are introduced into the host plant.

2. Both sense and antisense strands of m-RNA are produced.

3. Double stranded RNA (ds RNA) is formed.

4. dsRNA initiates RNA interference.

5. It prevents translation of mRNA resulting in silencing of mRNA of parasite or nematode.

6. This causes parasite to die.

SECTION-D

23. Looking at the deteriorating air quality because of air pollution in many cities of the country, the citizens are very much worried and concerned about their health. The doctors have declared health emergency in the cities where the air quality is very severely poor.

(a) Mention any two major causes of air pollution.

(b) Write any two harmful effects of air pollution to plants and humans.

(c) As a captain of your school Eco-club, suggest any two programmes you would

plan to organise in the school so as to bring awareness among the students on how to check air pollution in and around the school. [4]

Answer : (a) Major causes of air pollution are :

1. Vehicular discharge and dust.

2. Smoke from industries and thermal plants.

(b) 1. Reduces the yield of crops.

2. Retardation of the growth of plants.

(c) 1. Plantation drive.

2. Awareness through posters.

SECTION-E

24. (a) Describe any two devices in a flowering plant which prevent both autogamy and geitonogamy.

(b) Explain the events upto double fertilisation after the pollen tube enters one of the synergids in an ovule of an angiosperm. [5]

OR

(a) Explain menstrual cycle in human females.

(b) How can the scientific understanding of the menstrual cycle of human females help as a contraceptive measure ?

Answer : (a) 1. Dioecy or production of unisexual flowers in different plants.

2. Self-incompatibility.

There are two devices in a flowering plant which prevent both autogamy and geitonogamy.

(b) The pollen tube releases two male gametes in the cytoplasm of a synergid.

1. One male gamete fuses with the egg cell (nuclei), resulting in a diploid zygote.

2. The other male gamete fuses with the polar nuclei (triple fusion), to form a triploid Primary Endosperm Cell (PEC).

OR

(a) Menstrual cycle in Human females–

1. Menstrual Phase : Menstrual flow occurs between day 1-day 5 due to breakdown of the endometrial lining of the uterus, when fertilisation does not occur.

2. Follicular Phase : Primary follicles grow to mature Graafian follicles and the endometrium regenerates through proliferation because of changes induced by the pituitary and ovarian hormones.

3. Ovulatory Phase : Because of LH surge around the 14th day, the Graafian Follicle gets reptured to release the secondary oocyte.

4. Lutial Phase : The ruptured Graafian Follicle transforms into Corpus Luteum which secretes large amount of progesterone essential for maintaining endometrium.

(b) Scientific understanding of the menstrual cycle of human females helps as a contraceptive measure, ovulation occurs during the mid cycle, the chances of fertilisation are very high. Hence the couples should abstain from coitus between day 10-17.

25. (a) Write the scientific name of the organism Thomas Hunt Morgan and his colleagues worked with for their experiments. Explain the correlation between linkage and recombination with respect to genes as studied by them.

(b) How did Sturtevant explain gene mapping while working with Morgan ? [5]

OR

(a) State the 'Central dogma' as proposed by Francis Crick. Are there any exceptions to it ? Support your answer with a reason and an example.

(b) Explain how the biochemical characterisation (nature) of 'Transforming Principle' was determined, which was not defined from Griffith's experiments.

Answer : (a) *Drosophila melanogaster* was the organism on which Thomas Hunt Morgan and his colleagues worked with for their experiments.

1. Thomas Hunt Morgan and his colleagues observed that two genes located closely on a chromosome did not segregate independently of each other. The F_2 ratio deviated significantly from 9 : 3 : 3 : 1.

2. Tightly linked genes tend to show lesser recombination frequency of parental traits and higher frequency of parental types.

3. Loosely linked genes show higher percentage of recombinant frequency of parental traits and lower frequency percentage of parental type.

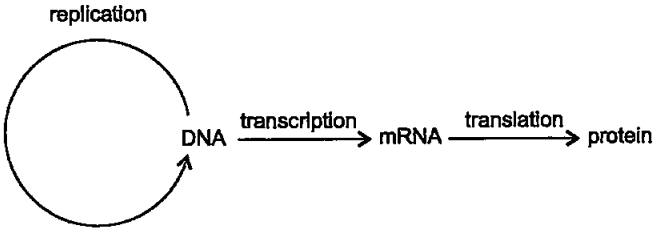
4. They concluded that the genes present on the same chromosome are said to be linked and the

recombinant frequency depends on the relative distance on the chromosome.

(b) Sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes and mapped their positions on the chromosome while working with Morgan.

OR

(a)



Yes, there are exceptions to it. In some viruses, flow of information is in the reverse direction by reverse transcription. *e.g.*, HIV also, some virus species are so primitive that they use only RNA → proteins, having not developed DNA. With the discovery of prions, a new exception to the central dogma has been discovered,

Protein ⟶ Protein.

OR

(b) Protein, DNA and RNA were purified from heat killed S-strain of *Streptococcus*.

1. Protein + Protease ⟶ transformation occured (R cell to S type).
2. RNA + RNAase ⟶ transformation occured (R cell to S type).
3. DNA + DNAase ⟶ transformation inhibited.

Hence DNA alone is the transforming material.

26. (a) Following are the responses of different animals to various abiotic factors. Describe each one with the help of an example.

(i) Regulate

(ii) Conform

(iii) Migrate

(iv) Suspend

(b) If 8 individuals in a population of 80 butterflies die in a week, calculate the death rate of population of butterflies during that period. [5]

OR

(a) What is a trophic level in an ecosystem ? What is 'standing crop' with reference to it ?

(b) Explain the role of the 'first trophic level' in an ecosystem.

(c) How is the detritus food chain connected with the grazing food chain in a natural ecosystem ?

Answer : (a) (i) Regulate : To maintain constant internal temperature or osmotic concentration by homeostasis *e,g.*, birds, mammals etc.

(ii) Conform : Do not maintain constant internal temperature or osmotic concentration. No homeostasis occurs *e,g.*, any animal other than birds or mammals.

(iii) Migrate : Temporary movement of organisms from stresses of a habitat to hospitable area and return when stressful period is over. *e.g.*, Birds from Siberia.

(iv) Suspend : Reducing or minimising the metabolic activities during unfavourable conditions *e.g.*, Polar bear hibernate or fish, amphibian and snails aestivate.

(b) Death rate = $\frac{\text{Number of deaths}}{\text{Totalpopulation}} = \frac{dN}{dt}$

Death rate = 8/80 = 0.1 individuals per butterfly per week.

OR

(a) Trophic level is the specific place of an organism in a food chain and the standing crop is the biomass at each trophic level at a particular time.

(b) 1. The first trophic level has producers or autotrophs which trap solar energy to produce food for other trophic levels by photosynthesis.

2. Organic compounds formed in this process are very essential in the process of building of bodies and also help in releasing energy.

(c) Organisms of the Detritus Food Chain (DFC) are the prey to Grazing Food Chain (GFC). The dead remains of GFC are decomposed into simple inorganic substances and absorbed by DFC organisms.

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Biology 2019 (Outside Delhi) SET I

Time allowed : 3 hours **Maximum marks : 70**

General Instructions :

(i) There are a total of 27 questions and four sections in the question paper. All questions are compulsory.

(ii) Section A contains questions number 1 to 5 very short-answer type questions of 1 mark each.

(iii) Section B contains questions number 6 to 12, short-answer type I questions of 2 marks each.

(iv) Section C contains questions number 13 to 24, short-answer type II questions of 3 marks each.

(v) Section D contains questions number 25 to 27, long-answer type questions of 5 marks each.

(vi) There is no overall choice in the question paper, however, an internal choice is provided in two questions of 1 mark, two questions of 2 marks, four questions of 3 marks and all the three questions of 5 marks. In these questions, an examinee is to attempt any one of the two given alternatives.

(vii) Wherever necessary, the diagram drawn should be neat and properly labelled.

SECTION–A

1. **Give one reason to justify statutory ban on amniocentesis.** [1]

Answer : Amniocentesis is being used to detect the gender of the foetus that results in several female foeticides. This declines the gender ratio. Therefore, there is a statutory ban on amniocentesis to avoid female foeticides.

2. **Name a human genetic disorder due to the following :** [1]

(a) An additional X-chromosome in a male.

(b) Deletion of one-X-chromosome in a female.

OR

State what does aneuploidy lead to.

Answer :

(a) Klinefelter syndrome

(b) Turner syndrome

OR

Aneuploidy refers to the presence of an abnormal number of chromosomes in a cell, for example a human cell that has 45 or 47 chromosomes instead of the usual 46. An extra or missing chromosome is a common cause of genetic disorders. For example : Down's syndrome and Turner's syndrome, including some human birth defects.

3. **Mention one exmaple each from plants and animals exhibiting divergent evolution.** [1]

Answer : Most famous examples of divergent evolution is of Darwin's Finches. Some Galapagos finches have beaks that are larger and more powerful to crack nuts with. Example in plants uincludes thorn of Bougainvillea or a tendril of Cucurbita both arising in axillary position, these modifications indicate the evolution of organ to suit different functions.

4. **Name any two physiological barriers that provide innate immunity.** [1]

OR

Select two disease resistant crop varieties from the list of crop varieties given below :

Himgiri, Pusa Gaurav, Pusa Komal, Pusa A-4

Answer : The innate immune system includes Physical Barriers such as skin, the gastrointestinal tract, the respiratory tract, the nasopharynx, cilia, eyelashes acid in stomach, Saliva in mouth, tear in eyes and other body hair.

OR

Himgiri, Pusa Komal

5. **Give two reasons as to why a weed such a Calotropis flourishes in abandoned fields.** [1]

Answer : *Calotropis* flourish in abandoned fields because *Calotropis* thrives on poor soils, particularly where overgrazing has removed competition from native grasses. Moreover, *Calotropis* produces highly poisonous cardiac glycosides as a means of chemical defences against herbivores such as cattle or goats.

SECTION–B

6. **Mosses and frogs both need water as a medium for fertilisation. Where does syngamy occur and how is it ensured in both these organisms?** [2]

OR

Write the basis of categorising animals as oviparous or viviparous giving one example of each.

Answer : Fertilisation or syngamy is the process of fusion of male and female gametes, which leads to the formation of a diploid zygote. In frogs, syngamy occurs in the external medium such as water *i.e.*, outside the body of organism. This type of gametic fusion is called external fertilisation. It requires a media (water) for combination of gametes. Creature delivers extensive number of gametes.

While in mosses, syngamy occurs inside the body of organism, hence known as internal-fertilisation. The antherozoids or male gametes in moss plants are motile and depend on water for transport towards female gametes (non-motile). During gamete transfer, large number of male gametes are lost. Thus, to ensure fertilisation, large number of male gametes are released to reach the non-motile female gametes.

OR

Animals that give birth to offspring are classified as viviparous whereas animals that lay eggs are called oviparous. In viviparous animals, both fertilisation, as well as the development of the embryo, takes place inside the female parent. Once the foetus development is complete, the mother delivers the baby. In oviparous animals, fertilisation takes place internally but embryo development takes place externally. The eggs of hen, ducks, etc; carry immature embryo in them. Once the foetus is matured, the egg hatches. Human beings, dogs, cats, elephants, etc. are few examples of viviparous animals.

7. **(a) You are given castor and bean seeds. Which one of the two would you select to observe the endosperm ?**

(b) The development of endosperm precedes that of embryo in plants. Justify. [2]

Answer :

(a) We would select castor seed to view endosperm since in castor seed, the endosperm is formed as a result of double fertilisation, and is a food storing tissue. Whereas in bean, the endosperm is not present in the matured seed and is non-endospermous.

(b) Endosperm is formed during double fertilisation, it is a nutritive tissue, from which the growing embryo gets its nourishment therefore, endosperm develops before the embryo. In mature albuminous seeds, endosperm exists as storage tissue. It stores starch and fat.

8. **A segment of DNA molecules comprises of 546 nuelotides. How many cytosine nucleotides would be present in it if the number of adenine nucleotides is 96 ?** [2]

Answer :

In a double stranded DNA,

Number of Adenine = Number of Thymine

Number of Guanine = Number of Cytosine

Given that, number of Adenine = 96

$\therefore$ Number of Thymine = 96

Total number of Adenine and Thymine = 192

Total number of Nucleotide = 546

Number of Cytosine and Guanine = 546 – 192

= 354

Since Number of Guanine = Number of Cytosine

Number of Cytosine = 354 / 2 = 177

9. **How is 'somatic hybridization' carried out ? Mention one example of a somatic hybrid.** [2]

Answer : Somatic hybridization, also called protoplast fusion, is a type of genetic modification in plants by which two distinct species of plants are fused together to form a new hybrid plant with the characteristics of both. Example : Pomato (Fusion of potato and tomato)

Various steps involved in production of somatic hybridization are :

1. Single cells are isolated from a single plant.
2. The cell walls are digested by enzymes such as pectinase and cellulose to liberate the protoplasts.
3. Naked protoplasts surrounded only by plasma membranes are isolated.
4. The isolated protoplasts are fused to obtain hybrid protoplasts under sterile conditions in a nutrient medium.
5. The hybrid protoplasts are cultured in a suitable media to form new plants.

For example, production of potato plants resistant to potato leaf roll disease. Through somatic fusion, the crop potato plant *Solanum tuberosum*, the yield of which is severely reduced by a viral disease transmitted on by the aphid vector, is fused with the wild, non-tuber-bearing potato *Solanum brevidens*, which is resistant to the disease.

10. **How are DNA fragments visualised during gel-electrophoresis ? What is elution ?** [2]

Answer : To visualise the DNA, the gel is stained with a fluorescent dye that binds to the DNA, and is placed on an ultraviolet transilluminator that shows up the stained DNA as bright bands. The dye can also be mixed with the gel before it is poured. The DNA fragments glow, allowing

to see the DNA present at different locations along the length of the gel.

In gel-electrophoresis, the separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is called elution.

11. A corn farmer has perennial problem of corn-borer infestation in his crop. Being environmentally conscious he does want to spray insecticides. Suggest solution based on your knoweldge of biotechnology. Write the steps to be carried out to achieve it. [2]

Answer : With the advent of genetic engineering, genes for insect resistance now can be moved into plants more quickly and deliberately. Bt technology is only one example of ways genetic engineering may be used to develop insect resistant crops now and in the future. Bt proteins lethal to insects and transfer the gene into crop plants.

Steps Involved are :

1. Identification of a strain of Bt that kills the targeted insect.
2. Isolation of gene that produces the lethal protein.
3. Gene is removed from the Bt bacterium and a gene conferring resistance to a chemical usually antibiotic or herbicide is attached.

12. State 'two' observations made by German naturalist. Alexender von Humboldt during his extensive explorations in South American jungles. [2]

OR

If in a population of size 'N' the birth rate is represented as '*b*' and the death rate as 'd', the increase or decrease in 'N' during a unit time period '*t*' will be :

$$\frac{dN}{dt} = (b - d) \times N$$

The equation given above can also be represented as :

$$\frac{dN}{dt} = r \times N, \text{ where } r = (b - d)$$

What does '*r*' represent ? Write any one significance of calculating '*r*' for any population.

Answer : German naturalist, Alexender von Humboldt laid the foundation for the field of biogeography.

1. Humboldt discovered that the distribution of plant groups could be correlated with changes in temperature and rainfall.
2. He suggested that within a region species richness increases with increasing explored area but only upto a limit. The relation between species richness and area for a wide variety of taxa is a rectangular hyperbola.

OR

R = Intrinsic rate of natural increase. It is a very important parameter as required for assessing impacts of any biotic or abiotic factor on population growth.

SECTION–C

13. When and where do tapetum and synergids develop in flowering plants ? Mention their functions. [3]

OR

Where are the following structures present in a male gametophyte of an angiosperm? Mention the function of each one of them.

(a) Germ pore

(b) Sporopollenin

(c) Generative cell

Answer :

Tapetum is formed during the process of formation of microsporangium. It is formed as a cellular layer outside the sporogenous tissue.The innermost wall layer is the tapetum. It nourishes the developing pollen grains.

Many physiological functions have been accredited to the tapetum, but they all congregate on the ability of its cells to synthesize metabolites for the nourishment of microsporocytes, regulation of meiosis, pollen wall formation etc.

Synergids are present in the female gametophyte (embryo sac) in the majority of flowering plants. These are haploid in condition and formed as a result of free nuclear division. Synergids are present at the micropylar end and have special cellular thickenings at the tip called Filliform apparatus, which plays an important role in guiding the pollen tubes into the synergid.

OR

(a) Germ pore is a prominent aperture on pollen grain exine. It is the place where exine and sporopollenin is absent.

Function : The contents of the pollen grain move into the pollen tube through the germ pore.

(b) Sporopollenin is a major component of the tough outer (exine) walls of plant spores and pollen grains. It is chemically very stable and is usually well preserved in soils and sediments.

Function : Sporopollenin can withstand high temperatures and strong acids and alkali. Pollen grains are well preserved as fossils

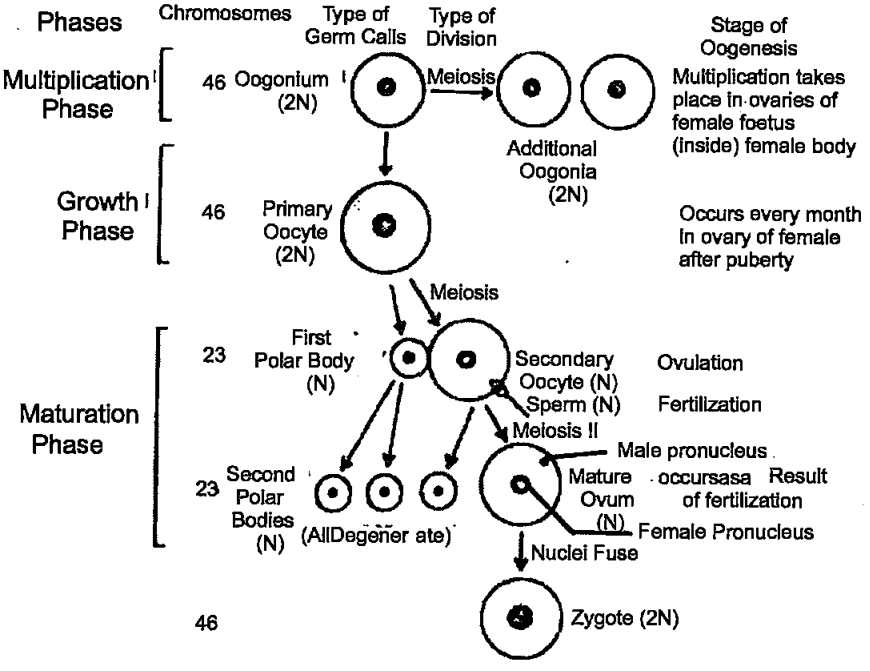
because of the presence of sporopollenin.

(c) Pollen grain on maturity contains two cells, the vegetative cell and generative cell. The generative cell is small and floats in the cytoplasm of the vegetative cell.

Function : In some species, the generative cell divides mitotically to give rise to the two male gametes before pollen grains are shed (3-celled stage).

14. Construct a flow chart exibiting sequential events of oogenesis. **[3]**

Answer : Flow chart of sequential events of oogenesis:

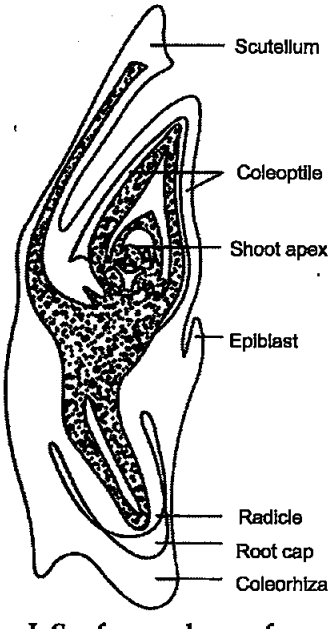


15. Draw L.S. of an embryo of grass and label its parts. **[3]**

OR

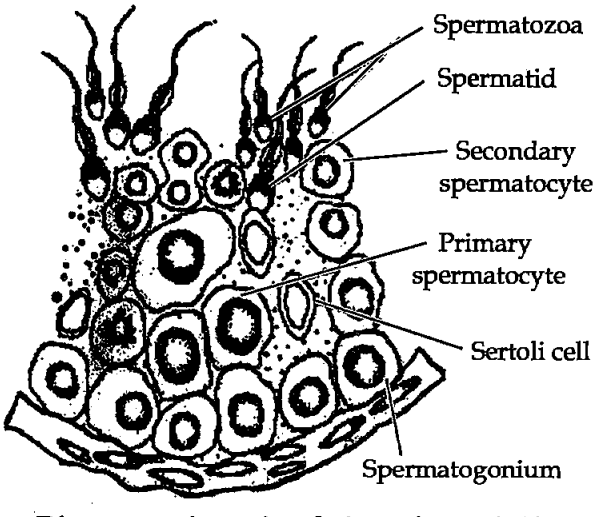
Draw a diagrammatic sectional view of a seminiferous tubule (enlarged) in humans and label its parts.

Answer :



L.S. of an embryo of grass

OR



Diagrammatic sectional view of a seminiferous tubule (enlarged) in humans.

16. (a) How does mutation occur ?

(b) Differentiate between point mutation and frame shift mutation. **[3]**

Answer :

(a) Mutation can be defined as changes in chromosomes and genes. Any change in the DNA helical structure is a cause of mutation.

When a segment or base pair of a DNA is either deleted or inserted, it may lead to chromosome abnormalities or aberrations. Developments of cancerous cells are due to these chromosomal aberrations. This can be either due to internal factors or external factors (smoking, UV rays, etc.).

(b)

S.No.	Point Mutation	Frame shift mutation
(i)	It occurs as a result of replacement of one nucleotide by other in specific nucleotide sequence of gene.	It occurs as a result of addition or deletion of nucleotide in the sequence of DNA. Addition or deletion of nucleotide causes shift of the reading frame of mRNA.
(ii)	Brings little phenotypic change Example : Sickle cell anemia.	Brings greater phenotypic change than point mutation. Example : Tay Sacch's disease.

17. "Use of heavy isotope of nitrogen by Meselson and Stahl demonstrated semi-conservative mode of replication of a DNA molecule. Explain how did they arrive at this conclusion. [3]

OR

Explain the mechanism of tanslation that occurs in the ribosomes in a prokaryote.

Answer :

1. In semi-conservative model, the two strands of DNA unwind from each other, and each acts as a template for synthesis of a new, complementary strand. This results in two DNA molecules with one original strand and one new strand.
2. Meselson and Stahl conducted their famous experiments on DNA replication using *E. coli* bacteria as a model system. *E. coli* was grown in nutrient broth containing a "heavy" isotope of nitrogen, ^{15}N When grown on medium containing heavy ^{15}N, the bacteria took up the nitrogen and used it to synthesize new biological molecules, including DNA.
3. After many generations growing in heavy ^{15}N medium, the nitrogenous bases of the bacteria's DNA were all labelled with heavy ^{15}N. Then, the bacteria were switched to medium containing a "light" ^{14}N isotope and allowed to grow for several generations. DNA made after the switch would have to be made up of ^{14}N, as this would have been the only nitrogen available for DNA synthesis.
4. Meselson and Stahl knew how often *E. coli* cells divided, so they were able to collect small samples in each generation and extract and purify the DNA. They then measured the density of the DNA using density gradient centrifugation.
5. This method separates molecules such as DNA into bands by spinning them at high speeds in the presence of another molecule, such as cesium chloride.
6. DNA isolated from cells at the start of the experiment "generation 0," just before the switch produced a single band after centrifugation. This result made sense because the DNA should have contained only heavy ^{15}N.

Generation 1

DNA isolated after one generation (one round of DNA replication) also produced a single band when centrifuged. However, this band was higher, intermediate in density between the heavy ^{15}N and the light ^{14}N DNA.

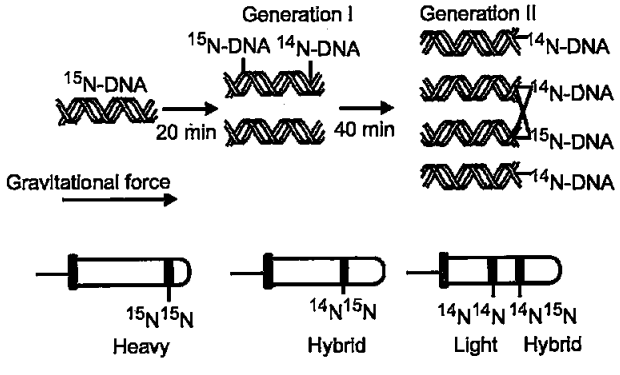
The intermediate band helped Meselson and Stahl to determine that the DNA molecules made in the first round of replication was a hybrid of light and heavy DNA. This result fits with the dispersive and semi-conservative models, but not with the conservative model.

Generation 2

Information from the second generation let Meselson and Stahl determine which of the remaining models (semi-conservative or dispersive) was actually correct.

When second-generation DNA was centrifuged, it produced two bands. One was in the same position as the intermediate band from the first generation, while the second was higher (appeared to be labelled only with ^{14}N.

This result told Meselson and Stahl that the DNA was being replicated semi-conservatively.



OR

Translation is the process of synthesis of protein by encoding information on mRNA. It requires mRNA, tRNA, aminoacids, ribosome and enzyme aminoacyl tRNA synthase.

Steps :

1. **Activation :** The activation of amino acids take place in cytosol, catalyzed by their aminoacyl tRNA synthetases. The N-formylated methionine is chain initiating amino acid in bacteria whereas methionine is chain initiating amino acid in eukaryotes. Methionine is activated by methionyl-tRNA synthetase.
2. **Initiation :** Translation begins with the binding of the small ribosomal subunit to a specific sequence on the mRNA chain. mRNA binds to 30S ribosomal subunit in such a way that AUG codon lie on the peptidyl (P) site and the second codon lies on aminoacyl (A) site.

   Initiator tRNA recognises the start codon. t-RNA-amino acid complexes bind to their corresponding codon on the mRNA and base pairing occurs between codon on mRNA and tRNA anticodon.
3. **Elongation :** t-RNA moves from codon to codon on the mRNA and amino acids are added one by one.
4. **Termination :** Release factor binds to stop codon to terminate the translation.

18. According to Darwinian theory of natural selection the rate of appreance of new forms is linked to the life-cycle or the life-span of an organism. Explain with the help of an example. [3]

Answer :

1. One of the key concepts of Darwinian theory of evolution is the natural selection.
2. The variations and therefore, the rate of appearance of new forms is linked with life cycle and life span of individuals of a species usually, high degree of variations are seen in the individuals having shorter life span whereas, the individuals which have a longer life and cycle life span show lesser variations. For example, the microbes like bacteria which have low generation time have the ability to multiply in geometrical progression produce millions of individuals within hours time.
3. Thus, it is easy to see variant population in less span of time.
4. These variants can easily adapt and grow better in the new changed condition.
5. In due course of time the variant populations can outgrow the other and appear as new species on the other hand higher organisms having a long span and the variations are not visible fast.
6. Thus the rate of appearance of new forms is faster in species having a short life cycle and life span as compared to in the species having a longer life span.

19. (a) Name the causative agents of pneumonia and common cold.

(b) How do these differ in their symptoms ?

(c) Mention two symptoms common to both. [3]

OR

(a) Write the scientific names of the causative agent and vector of malaria, and write its symptoms.

(b) Name any two diseases spread by *Aedes* sp.

Answer :

(a) *Streptococcus pneumoniae* and *Haemophilus influenzae* are responsible for the disease pneumonia and common cold is caused by *rhinoviruses*.

(b) The symptoms of pneumonia include fever, chills, cough and headache. The common cold is characterised by nasal congestion and discharge, sore throat, hoarseness, cough, headache, tiredness, etc., which usually last for 3-7 days.

(c) Cough and headache are the symptoms common in both.

OR

(a) *Plasmodium vivax*, *P. malaria* and *P. falciparum* are causative agents of malaria. Female Anopheles mosquito is the vector of malaria and symptoms include chill and high fever recurring every three to four days.

(b) *Aedes* mosquitoes spread diseases like dengue and chikunguniya.

20. (a) Differentiate between inbreeding and outbreeding.

(b) List any three advantage and one important disadvantage of inbreading practice in animal husbandry. [3]

Answer :

(a)

S.No.	Inbreeding	Outbreeding
(i)	Inbreeding refers to the mating of more closely related individuals.	Outbreeding is the breeding of the unrelated animals.
(ii)	Parents are from within the same breed for 4-6 generations.	Parents used for outbreeding should not be the common ancestor for 4-6 generations.
(iii)	Mating occurs between individuals of the same species in inbreeding.	Mating occurs between separate species, genera, breeds or varieties.

(b)

Advantages of inbreeding practice in animal husbandry are :

1. Inbreeding increases homozygosity .
2. It helps in accumulation of superior genes and elimination of less desirable genes.
3. Inbreeding exposes harmful recessive genes that are eliminated by selection.

Disadvantage of inbreeding practice in animal husbandry is that inbreeding also leads to decrease or loss of vigour and fertility as a result of inbreeding.

21. Name the most commonly used bioreactor in biotechnology labs. Mention the most essential components this bioreactor have so as to provide the optimum conditions to the culture medium, resulting in production of large volume of desired product. [3]

Answer : Most commonly used type of a bioreactor is stirred tank bioreactor. A bioreactor provides the optimal conditions for achieving the desired product by providing optimum growth conditions such as temperature, pH, substrate, salts, vitamins, oxygen.

A stirred-tank reactor is usually cylindrical or with a curved base to facilitate the mixing of the reactor contents and the stirrer facilitates even mixing and oxygen availability throughout the bioreactor.

The good bioreactor has an agitator system, an oxygen delivery system and a foam control system, a temperature control system, pH control system and sampling ports so that small volumes of the culture can be withdrawn periodically.

22. A child is born with ADA–deficiency.

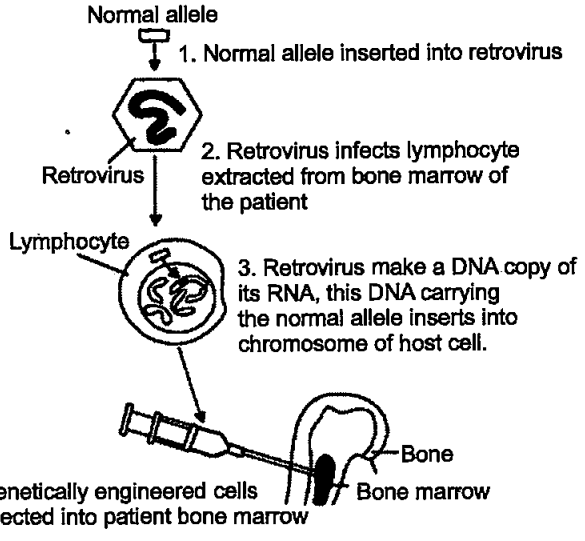
(a) Suggest and explain a procedure for possible life-long (permanent) cure.

(b) Name any other possible treatment for this disease. [3]

Answer :

(a) Gene therapy is the technique of genetic engineering to replace a faulty gene by a normal healthy functional gene. Gene isolated from marrow cells producing ADA is introduced into cells at early embryonic stages, it could be a permanent cure.

(b) ADA deficiency can be cured by bone marrow transplantation or by enzyme replacement therapy, in which functional ADA is given to the patient by injection. Gene therapy is other option in which lymphocytes from the blood of the patient are grown in a culture outside the body. A functional ADA cDNA (using a retroviral vector) is then introduced into these lymphocytes, which are subsequently returned to the patient.



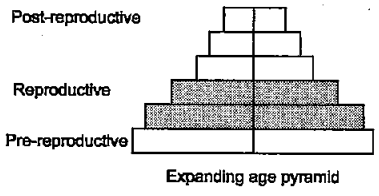
23. Differentiate between an 'Expanding age pyramid' and a 'Stable age pyramid'. Substantiate your answer with diagrams. [3]

Answer :

S.No.	Expanding age pyramid	Stable age pyramid
(i)	High proportion pre-reproductive individuals occur in expanding population.	Pre-reproductive individuals are uniform in stable population.
(ii)	Graph has a triangular shape, with a very wide base and pointed apex.	Graph is rectangular or squarish shape, with almost the same number of people in all age groups.
(iii)	Each age group shows a bar less wider than that of the age group before it, indicating that more people die at each higher group.	There is a slight taper at the top, which is perfectly natural, due to more deaths occurring among the elderly.

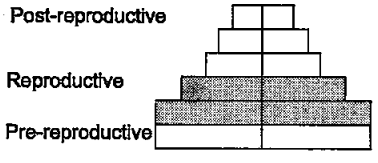
(iv)	The large base shows a high birth rate, which is probably due to factors like a developing economy, poverty, low levels of female education, and less awareness of birth control measures.	Such countries have a high life expectancy, where more people live to a ripe old age, due to better living conditions.

(i)



Expanding age pyramid

(ii)



Stable age pyramid

24. Analyse the effect of 'Alien speciea invasion' on the biodiversity of a given area. Provide two examples. [3]

Answer : When alien species are introduced unintentionally or deliberately in a particular area, some of them turn invasive, and cause decline or extinction of indigenous species, it might use up most of the resources to grow devoiding the rest of the organisms of their minimum requirement. For example, The Nile perch introduced into Lake Victoria in East Africa led eventually to the extinction of an ecologically unique assemblage of more than 200 species of cichlid fish in the lake. Similarly, the illegal introduction of the African catfish *Clariasgariepinus* for aquaculture purposes is posing a threat to the indigenous catfishes in rivers.

SECTION–D

25. Mendel crossed a homozygous pea plant having yellow and round seeds with another pea plant bearing green and wrinkled seeds. He found that in some of the F_2 population new combination of parental characters were observed.

How will you explain the appearance of a new combination of parental characters in F_2 offsprings ? Support your answer with the help of Punnett square. [5]

OR

Describe S.L. Miller's experiment. Comment on the observations he made and his contribution towards the origin of life on Earth.

Answer : The appearance of new possible phenotypic combinations in F_2 generation is possible if the two pairs of characters are believed to behave independent of each other. Each pair of contrasting characters bear no permanent association with particular other character.

Mendel formulated his second law from the conclusions drawn out of his di-hybrid experiments.

The Law of Independent Assortment states :

When the two parents differ from each other in two or more pairs of contrasting characters or factors, then the assortment of alleles of one character is independent of assortment of alleles of other characters. Each member of an allelic pair may combine randomly with either of another pair during the formation of gametes.

Gametes	RY	Ry	rY	ry
RY	RRYY round yellow	RRYy round yellow	RrYY round yellow	RrYy round yellow
Ry	RRYy round yellow	RRyy round green	RrYy round yellow	Rryy round green
rY	RrYY round yellow	RrYy round yellow	rrYY wrinkled yellow	rrYy wrinkled yellow
ry	RrYy round yellow	Rryy round green	rrYy wrinkled yellow	Rryy wrinkeled green

9 round yellow : 3 round green : 3 wrinkled yellow : 1 wrinkled green

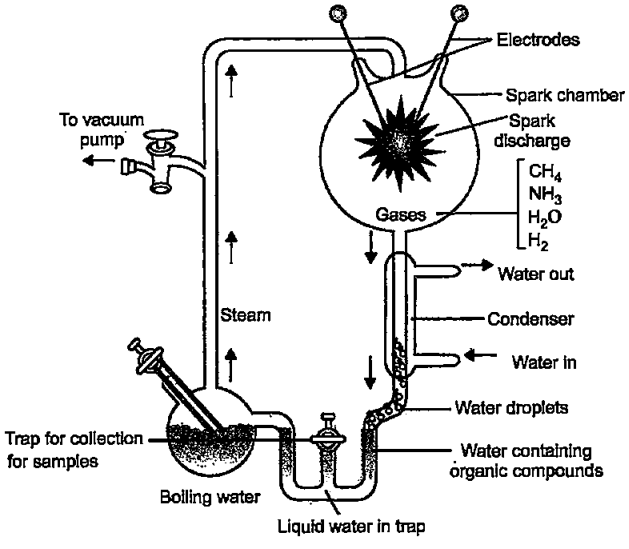
OR

The Miller–Urey experiment was a chemical experiment conducted in 1953, University of Chicago by researchers Stanley L. Miller and Harold C. Urey to investigate the molecular origins of life. They simulated the conditions thought at the time to be present on the early Earth and tested the chemical origin of life under those conditions. The experiment supported Alexander Oparin's and J. B. S. Haldane's hypothesis that putative conditions on the primitive earth supported chemical reactions that synthesised more complex organic compounds from simpler inorganic precursors.

S.L.Miller created an environment in a laboratory similar to the one that existed before life originated. In a closed flask containing hydrogen

and water vapour at 800 degree centigrade, electric discharge was created. The conditions were similar to those in primitive atmosphere. After a week, they observed presence of amino acids and complex molecules like sugars, nitrogen bases, pigments and fats in the flask. This provided experimental evidence for the theory of chemical origin.

The Miller-Urey experiment was immediately recognised as an important breakthrough in the study of the origin of life. It was received as confirmation that several of the key molecules of life could have been synthesised on the primitive Earth.



26. (a) Differentiate between active and passive immunity.

(b) Comment on the role of vaccination and immuzation in keeping human population healthy. **[5]**

OR

Describe the process of secondary treatement given to municipal waste water (sewage) before it can be released into fresh waterbodies. Mention another benefit provided by this process.

Answer :

(a)

S.No.	Active immunity	Passive immunity
(i)	Involves bodies direct response to an unknown pathogen.	Involves antibodies obtained from outside the body.
(ii)	Antibodies are produced specific to the antigen of a particular pathogen.	Antibodies are obtained from outside.
(iii)	Not immediate as it takes time to create enough of the correct antibodies to fight the pathogen.	Immediate, as no time is needed to create antibodies since they are obtained from outside.
(iv)	The response lasts for a long period of time and in some cases, where antibodies remain in the body as memory cells, immunity to the specific pathogen may be life long.	Immunity is not long term and may only last a few days.
(v)	Side effects are very few.	Sometimes the body reacts to the antisera. It is called serum sickness.

(b) Immunization is the process whereby a person is made immune or resistant to an infectious disease, typically by the administration of a vaccine. Vaccines stimulate the body's own immune system to protect the person against subsequent infection or disease. Immunization is one of the best ways to wipe out disease that could spread now and into the future. Vaccination has greatly reduced the burden of infectious diseases. Modern research has spurred the development of less reactogenic products, such as a cellular pertussis vaccines and rabies vaccines produced in cell culture. Today, vaccines have an excellent safety record and most "vaccine scares" have been shown to be false alarms. While eradication may be an ideal goal for an immunization programme, to date only smallpox has been eradicated, allowing discontinuation of routine smallpox immunization globally. Potentially, other infectious diseases with no extra human reservoir can be eradicated provided an effective vaccine and specific diagnostic tests are available.

OR

Secondary treatment or biological treatment :

1. The activated sludge process is a type of wastewater treatment process for treating sewage or industrial wastewaters using aeration and a biological floc composed of bacteria and protozoa. When primary effluent is passed into large aeration tanks and constantly agitated mechanically with pumping in of air, it results in production of vigorous growth of useful aerobic microbes called flocs. While growing, these microbes

consume the major part of the organic matter in the effluent resulting in significant reduction of BOD of the effluent.

2. Flocks are masses of bacteria associated with fungal filaments to form mesh like structure. It helps in aerobic decomposition as well as filament helps in trapping particles.
3. Activated sludges is used as inoculum to produce flocks during secondary treatment.
4. Process for treating sewage and in industrial waste water using air and a biological floc composed of bacteria and protozoa.
5. The sewage water is treated till the BOD is reduced. Once the BOD of sewage or wastewater is reduced significantly, the effluent is then passed into a settling tank where the bacterial 'flocs' are allowed to sediment.
6. This sediment is called activated sludge. A small part of the activated sludge is pumped back into the aeration tank to serve as the inoculum.
7. The remaining major part of the sludge is pumped into large tanks called anaerobic sludge digesters. Here, other kinds of bacteria, which grow anaerobically, digest the bacteria and the fungi in the sludge.
8. Additional benefit of this process is that, during this digestion, bacteria produce a mixture of gases such as methane, hydrogen sulphide and carbon dioxide. These gases form biogas and can be used as source of energy as it is inflammable.

27. A plastic sack manufacturer in Bengaluru, Ahmed Khan has managed to find an ideal solution to the problem of plastic waste. Explain in five steps the efforts of Ahmed Khan to meet challenges of solid waste managment. [1×5=5]

OR

(a) What does an ecological pyramid represent? State any two limitations that these pyramids have.

(b) Describe an inverted pyramid of biomass with the help of an example. [3+2=5]

Answer : Ahmed Khan, a plastic sack manufacturer in Bengaluru was successful in finding a problem of plastic waste accumulation.

1. He developed polyblend, a powdered structure manufactured from waste plastic.
2. This mixture with the bitumen that is used to lay roads which is an important ingredient for constructing roads.
3. In collaboration with R. V. College of Engineering and the Bengaluru City Corporation, Ahmed Khan proved that blends of polyblend and bitumen, when used to lay roads, enhanced the bitumen's water repellent properties and helped to increase average lifetime of roads by a multiple of three.
4. The raw material for creating polyblend is any plastic film waste.
5. So, against the price of ₹. 0.40 per kg that rag pickers had been getting for plastic waste, Khan now offers ₹. 6.

OR

(a) An ecological pyramid is a graphical representation designed to show the biomass or bio productivity at each trophic level in a given ecosystem. There are three ways we can represent the trophic levels in an ecological pyramid the amount of organisms (number), the mass of all the organisms in each level (biomass), or the amount of energy contained in each level.

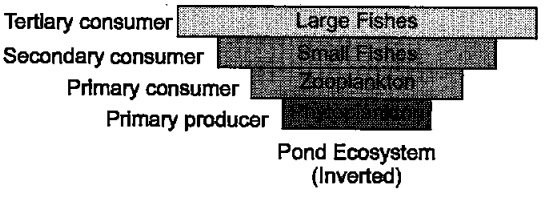
Limitations of ecological pyramids are :

1. It never takes into account the same species belonging to two or more trophic levels.
2. It assumes a simple food chain, something that almost never exists in nature.

(b) A pyramid of biomass is a graphical representation of biomass present in a unit area of various trophic levels. It shows the relationship between biomass and trophic level quantifying the biomass available in each trophic level of an energy community at a given time.

In aquatic ecosystem the producers are small organisms with least biomass and the biomass gradually increases towards the apex of the pyramid. Thus, the pyramid of biomass of aquatic ecosystems is inverted in shape.

A good example of the inverted pyramid is in a pond ecosystem where the mass of phytoplankton, the major producers will always be lower than the mass of the heterotrophs like fish and insects. As the value of biomass becomes larger, the pyramid gains an inverted shape with tertiary consumers appearing at the top in biomass.



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Biology 2019 (Outside Delhi) SET II

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions. All the remaining questions have been asked in previous set.

SECTION–A

5. Name the pioneer species that invade in primary succession on bare rocks and in water. [1]

Answer : Bacteria small phytoplanktons and lichen.

SECTION–B

9. "For a common man both mango and strawberry are fruits, but not for a biology student." Justify. [2]

Answer : Mango is an example of true fruit. A true fruit or eucarp is a mature or ripened ovary, developed after fertilization, whereas strawberry is an example of aggregate fruit, flowers with polycarpellary and apocarpous gynoecium which give rise to a number of fruitlets as there are a number of free ovaries, each giving rise to one fruitlet. Aggregate of achenes are found in Fragaria (strawberry).

10. Explain the process of gel-electrophoresis technique. [2]

Answer : Gel-Electrophoresis is an analytical separation procedure used in molecular biology to separate and identify molecules such as DNA, RNA, protein, complexes on the basis of size. The separation is achieved by loading the sample in a gel made up of small pores and setting an electric field across the gel. The molecules migrate across the gel based on the electric charge (*i.e.*, negatively charged molecules move away from the negative pole) and smaller molecules move faster than larger molecules; thus, a size separation is achieved. The gel offers molecular sieving effect and thus helps in separation of charged sample based on size.

11. Why is the genetically engineered insulin by American company Eli Lilly preferred to the one produced by conventional methods ? Explain. [2]

Answer : Conventionally Insulin was extracted from the pancreas of cattle and pigs and purified. The chemical structure of insulin in these animals is only slightly different than human insulin, which is why it functions so well in the human body. However, some people had negative immune system or allergic reactions.

In the early 1980s biotechnology revolutionized insulin synthesis, researchers used genetic engineering to manufacture a human insulin. In 1982, the Eli Lilly Corporation produced a human insulin that became the first approved genetically engineered pharmaceutical product. Without needing to depend on animals, researchers could produce genetically engineered insulin in unlimited supplies. It also did not contain any animal contaminants. Thus, using human insulin also took away any concerns about transferring any potential animal diseases into the insulin.

Thus, genetically engineered insulin is preferred over conventional one.

SECTION–C

16. Name the enzyme that transcribes hnRNA in eukaryotes. Explain the steps that the hnRNA undergoes before it is processed into mRNA. [3]

Answer : Unlike prokaryotic mRNA, eukaryotic mRNAs are monocistronic. The primary transcript in eukaryotes is much larger than the mature mRNA and is called heterogeneous nuclear RNA (hnRNA).

RNA Polymerase Type II transcribes heterogenous nuclear RNA (hnRNA).

The primary transcript in eukaryotes is non-functional since it contains exons and introns. It undergoes splicing, a process that removes introns and joins the exons together in a specific order. The precursor hnRNA undergoes additional processing called capping and tailing.

An unusual nucleotide is added to the 5′ end of hnRNA during capping. In tailing, 200-300 adenylate residues are added to the 3′ end of hnRNA. This fully processed hnRNA, called mRNA is now transported out of the nucleus for translation.

18. Darwin on his voyage to Galapagos Islands had observed finches having different varieties of beaks. Write the explanation he gave for his observations and the conclusions he arrived at. [3]

Answer : Darwin on his visit to Galapagos Island observed that there were finches with different types of beaks. He suggested that all these finches radiated on the same island from a single ancestor finch and developed beaks according to the kind of food available to them. Hence, they evolved from the conventional seed-eating

finches to vegetarian and insectivorous finches.

According to Darwin's Theory of Evolution, living organisms change their physical and anatomical structure over a long period of time for better adaptations to the changing environment. Organisms started to split and adopt various versions for better survival. He gave the concept of adaptive radiation, which is the evolutionary process by which many species originate from one species in an area and radiate to different areas.

24. What is productivity in an ecosystem? Explain the relationoship between gross primary productivity and net primary productivity in an ecosystem. [3]

Answer : Productivity refers to the rate at which energy is added to the bodies of a group of organisms such as primary producers in the form of biomass.

Gross primary productivity or GPP, is the rate at which solar energy is captured in sugar molecules during photosynthesis. Producers such as plants use some of this energy for metabolism or cellular respiration and some for growth (building tissues).

Net primary productivity or NPP, is gross primary productivity minus the rate of energy loss to metabolism and maintenance. In other words, it's the rate at which energy is stored as biomass by plants or other primary producers and made available to the consumers in the ecosystem.

Thus, Net Primary Productivity (NPP), is equal to all of the carbon taken up by the vegetation through photosynthesis (called Gross Primary Production or GPP) minus the carbon that is lost to respiration.

SECTION–D

25. (a) Work out a cross upto F_2-generation between true breeding tall pea plants bearing violet flowers and dwarf pea plants bearing white flowers.

(b) Explain Mendel's laws of segregation and independent assortment on the basis of the cross. [5]

OR

Answer the following questions based on the experiment conducted by S.L. Miller in 1953 :

(a) Name the gases present in the closed flask.

(b) Why was the flask fitted with electrodes?

(c) Write the observation he made.

(d) State the significance of the observation made by him.

Answer :

(a) A dihybrid cross between a homozygous :

1. Tall pea plant bearing violet flowers (dominant) Genotype TTVV
2. Dwarf pea plant bearing white flowers (recessive) Genotype ttvv

	Tall violet	Dwarf white
Parent pea plants	TTVV	ttvv

Gametes

(TV) (TV) (tv) (tv)

All hybrid Tall pea plants bearing violet flower

F_1 TtVv (Selfing) TtVv

Gametes

♀ / ♂	TV	tv	Tv	tv
TV	TTVV	TtVV	TTVv	TtVv
tV	TtVV	ttVV	TtVv	TtVv
Tv	TTVv	TtVv	TTvv	Ttvv
tv	TtVv	ttVv	Ttvv	ttvv

F_2

Phenotypic ratio– : Tall violet : Tall white : dwarf violet : dwarf white

9 : 3 : 3 : 1

(b) Genes for a trait from the two parents remain separate they do not blend. This explains the fact that Dwarf plants and plants with white flowers disappear in F_1 but reappear in F_2. This is Mendel's Law of Segregation.

The law of independent assortment states that the alleles for two different genes sort independently into gametes. When Mendel measured two or more traits (*e.g.*, height and flower colour) in an experiment he found that each trait was transmitted independently. For example, tall or short plants can have violet or white flowers. This is Mendel's law of independent assortment.

OR

(a) The gases present in flask used by S.L. Miller in his experimental setup was CH_4 (methane) , NH_3 (ammonia) , H_2O (water vapours) , H_2 (hydrogen).

(b) S.L. Miller created an environment in a laboratory similar to the one that existed before life originated. In a closed flask containing hydrogen and water vapour at 800 degree centigrade, electric discharge was created using electrodes. The conditions were similar to those in primitive atmosphere.

(c) After a week, they observed presence of

amino acids and complex molecules like sugars, nitrogen bases, pigments and fats in the flask.

(d) Stanley L. Miller and Harold C. Urey wanted to investigate the molecular origin of life. They simulated the conditions thought at the time to be present on the early Earth and tested the chemical origin of life under those conditions. The Miller-Urey experiment was immediately recognised as an important breakthrough in the study of the origin of life. It was received as confirmation that several of the key molecules of life could have been synthesised on the primitive Earth.

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Biology 2019 (Outside Delhi) SET III

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions. All the remaining questions have been asked in previous sets.

SECTION–A

5. Why is the rate of secondary succession much faster than that of primary succession ? [1]

Answer : Secondary succession is usually faster than primary succession as, soil is already present, so there is no need for pioneer species, Moreover, seeds, roots and underground vegetative organs of plants may still survive in the soil.

SECTION–B

9. Name the distinguishing structure seen in the mature black pepper seed and not in a pea seed. State how does it develop. [2]

Answer : In some angiosperm seeds remnants of nucellus are persistent which is referred to as perisperm, *e.g.*, black pepper. It is a nutritive tissue surrounding the embryo. It originates from the nucellus, which is the central part of the ovule in the embryo sac.

10. Why does the insecticidal protein produced by *Bacillus thuringiensis* not kill the bacterium, but kills the cotton bollworm? Explain. [2]

Answer : The Bt toxin protein exists as inactive prototoxin. The Bt toxin dissolves in the high pH insect gut and becomes active. The toxins then attack the gut cells of the insect, punching holes in the lining. The Bt spores spill out of the gut and germinate in the insect causing death. Therefore, it does not kill the bacteria.

11. Write the palindromic nucleotide sequence that EcoRI reads, and indicate the site of its action. [2]

Answer : The restriction enzyme EcoRI recognizes the following palindromic sequence :

5′–G AA T T C–3′

3′–C TT A A G–5′

The top strand reads 5′-GAATTC-3′, while the bottom strand reads 3′-CTTAAG-5′.

Recognition sequence	Cut site
5′ GAATTC	5′—G AATTC—3′
3′ CTTAAG	3′—CTTAA G—5′

SECTION–C

16. A tall pea plant bearing violet flowers is crossed with a tall pea plant bearing white flowers. In the F_1 progeny, there were tall pea plants with white flowers, tall pea plants with violet flowers, dwarf pea plants with violet flowers and dwarf pea plant with white flowers. Work out the cross to show how is it possible. [3]

Answer : A cross of tall pea plant with violet flowers and dwarf pea plant with white flowers.

(a) Parent pea plants — Tall violet TTVV × Dwarf white ttvv

Gametes: (TV) (TV) (tv) (tv)

All hybrid Tall pea plants bearing violet flower

F_1 TtVv (Selfing) TtVv

Gametes

♀ ↓ ♂ →	TV	tV	Tv	tv
TV	TTVV	TtVV	TTVv	TtVv
tV	TtVV	ttVV	TtVv	TtVv
Tv	TTVv	TtVv	TTvv	Ttvv
tv	TtVv	ttVv	Ttvv	ttvv

F_2

In the above cross we could notice that :

Ttvv are tall with white flowers

TtVv are tall with violet flowers

ttVv are dwarf plant with violet flowers and

ttvv are dwarf and with white flowers

18. Explain Hardy-Weinberg principle. [3]

Answer : Hardy–Weinberg principle mathematically explains the occurrence and consistency of gene frequency for a particular gene. The principle states that the allelic frequency remains constant through generations and the gene pool remains constant. This phenomenon is called genetic equilibrium. Also, all the allelic frequencies sum up to 1.

Let us assume, the frequency for the allele X in a population is a and that of the allele x is b.

Thus, the frequency of XX is a^2, xx is b^2 and Xx is $2ab$. The equation can thus be represented as

$$a^2 + b^2 + 2ab = 1$$

or

$$(a + b)^2 = 1$$

The factors which affects the Hardy-Weinberg principle are :

1. Mutation
2. Genetic drift
3. Natural selection
4. Genetic recombination
5. Gene flow

24. Describe the carbon cycle in nature. How does deforestation affect this cycle ? [3]

Answer : The carbon cycle is the process that redistributes carbon on earth. Carbon enters the atmosphere as carbon dioxide from respiration (breathing) and combustion (burning).

Plants use carbon dioxide and sunlight to make their food, this process is called photosynthesis. When the plants use carbon to create food it becomes part of the plant. Animals feed on the plants. Thus, passing the carbon compounds along the food chain. Most of the carbon these animals consume however is exhaled as carbon dioxide in the process of respiration. Plants that die and are buried may turn into fossil fuels made of carbon like coal and oil over millions of years.

When humans burn fossil fuels, most of the carbon enters the atmosphere as carbon dioxide. Once the carbon is released into the atmosphere the cycle starts again as the plants begin to create their food and so on.

Deforestation has an effect on the carbon cycle also known as the Greenhouse gas effect and global warming. Trees and forest balance the amount of carbon in the atmosphere through the process of photosynthesis in which plants make their own food with carbon dioxide. When there is an access amount of carbon dioxide in the atmosphere a 'blanket' of carbon dioxide is created and this 'blanket' traps heat and prevents it from leaving the earth surface in the atmosphere. This excess heat warms the earth. If there is too much of it, this causes Global warming and the heating of the Earth.

SECTION–D

25. A normal couple has a colour-blind child, whereas a child suffering from thalassemia is born to normal parents.

Compare the pattern of inheritance of these two traits in the said cases. State the reasons how is it possible? [5]

OR

(a) State the reasons for which Hershey and Chase carried out their experiments.

(b) Answer the following question based on the experiments of Hershey and Chase :

(i) Name the different radioactive isotopes they used, and explain how they used them?

(ii) Why did they need to agitate and spin their culture ?

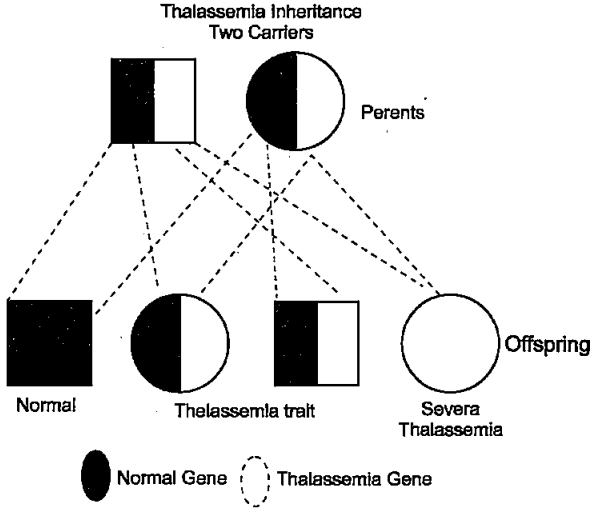
(iii) Write their observations and the conclusions they arrived at.

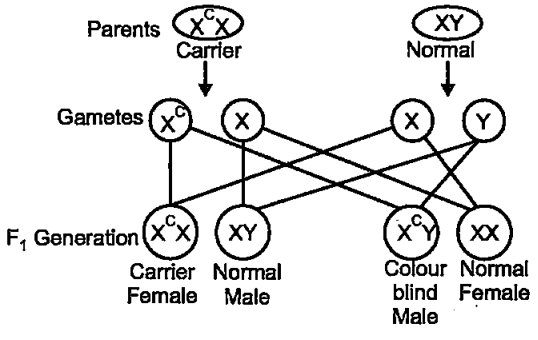
Answer : Colour blindness is a sex linked recessive disorder whereas thalassemia is an autosome linked recessive.

Colour blindness : Red-green colour blindness means that a person cannot distinguish shades of red and green (usually blue-green), but their ability to see is normal. Colour blindness is X-inked sex inheritance. For becoming colour blind, the female must have the allele for it in both her X-chromosomes and if only one X-chromosome of female posseses allele for colour blind character she becomes the carrier for this characteristics. But males develop colour blindness when their sole X-chromosome has the allele for it. Thus, males are more prone to colour blindness while females are carriers.

Thalassemia : Thalassemia is an autosomal recessively inherited disorder transmitted to the offspring when both the parents are heterozygous or carriers for the disease. Alpha

Thalassemia is controlled by two closely linked genes HBA1 and HBA2 located on chromosome 16. Beta Thalassemia is controlled by a single gene HBB located on chromosome 11.





OR

(a) Hershey and Chase carried out their experiment to determine whether the genetic material is DNA or protein.

(b)

(i) Hershey and Chase used T2 phage, a bacteriophage, that infects a bacterium by attaching to it and transfers its genetic material into it.

They used labelled phage DNA with radioactive Phosphorus-32.

In a second experiment, Hershey and Chase labelled phage protein with radioactive Sulphur-35.

(ii) Radioactive phages were allowed to attach to *E. coli* bacteria. Then, as the infection proceeded, the viral coats were removed from the bacteria by agitating them in a blender. The virus particles were separated from the bacteria by spinning them in a centrifuge.

(iii) *E.coli* bacteria which were infected by radioactive DNA viruses were radioactive but the ones that were infected by radioactive protein viruses were non-radioactive.

Conclusion : Resultant radioactive and non-radioactive bacteria infer that the viruses that had radioactive DNA transferred their DNA to the bacteria but viruses that had radioactive protein didn't get transferred to the bacteria. Hence, DNA is the genetic material and not the protein.

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Biology 2019 (Delhi) SET I

Time allowed : 3 hours **Maximum marks : 70**

SECTION–A

1. **British geneticist R.C. Punnett developed a graphical representation of a genetic cross called "Punnett Square". Mention the possible result this representation predicts of the genetic cross carried.** [1]

Answer : The result of the genetic cross indicates probability of all genotypes and phenotypes along with their ratio.

2. **State the two principal outcomes of the experiments conducted by Louis Pasteur on origin of life.** [1]

Answer : In his experiment, Louis Pasteur proved that live comes only from pre-existing life. He also dismissed the concept of spotaneous generation.

3. **Name the layer of the atmosphere that is associated with 'good ozone'.** [1]

OR

Mention the term used to describe a population interaction between an orchid growing on a forest tree.

Answer : The layer of atmosphere that is associated with good ozone is called stratosphere.

OR

Commensalism is the term used to describe a population interaction between an orchid growing on a forest tree.

4. What are 'flocs', formed during secondary treatment of sewage ? [1]

OR

Write any two places where methanogens can be found.

Answer : 'Flocs' are masses of bacteria associated with fungal filaments to form a mesh-like structure.

OR

Methanogens can be found in rumen of cattle, marshy area, flooded rice field or in biogas plants in anaerobic sludge etc.

5. At what stage does the meiosis occur in an organism exhibiting haploidic life cycle and mention the fate of the products thus produced. [1]

Answer : In an organism exhibiting haplontic life cycle, meiosis occurs after zygote formation. The products thus formed are haploid organisms, haploid spores or haploid gametophyte.

SECTION–B

6. You are conducting artificial hybridization on papaya and patato. Which one of them would require the Step of emasculation and why ? However for both you will use the process of bagging. Justify giving one reason. [2]

Answer : We need to carry out emasculation on potato plant because it is a monoecious plant carrying bisexual flowers. However, bagging is important for both plants to prevent the unwanted pollen from contaminating the stigma.

7. How would the gene flow or genetic drift affect the population in which either of them happens to take palce ? [2]

Answer : Gene flow or genetic drift results in changed frequency of genes in both populations. It also causes variation leading to evolution or speciation (founder's effect).

8. Differentiate between the roles of B-lymphocytes and T-lymphocytes in generating immune responses. [2]

OR

Principle of vaccination is based on the property of "memory" of the immune system. Taking one suitable example, justify the statement.

Answer : B-lymphocytes produce antiobodies while T-lymphocytes help B-lymphocytes to produce antibodies.

OR

When a vaccine containing heat-killed or attenuated pathogen is introduced into the body to prevent chickenpox or measles it produces antibodies against the antigen of the pathogen. This also generates B and T memory cells that recognise the pathogen quickly on subsequent exposure to produce large amount of antibodies which inactivate the pathogen causing the disease.

9. Explain the relevance of "Totipotency" and "Somaclones" in raising healthy banana plants from virus infected banana plants. [2]

Answer : Totipotency : The meristematic tissue of banana plant remains virus free. Totipotency is the capacity of the meristematic tissue to regenerate a whole plant through tissue culture or micropropagation.

Somaclones : They are produced via tissue culture so such plant are genetically identical to the original plant.

10. How is a continuous culture system maintained in bioreactors and why ? [2]

Answer : In a bioreactor, the used medium is drained out from one side and fresh medium is added from the other side. Also this type of culturing method produces a large biomass leading to higher yields of desired protein.

11. List any four ways by which GMO's have been useful for enhanced crop output. [2]

Answer :

1. Make crops more tolerant to abiotic, cold, heat, drought or salt stresses.
2. Reduces reliance on chemical pesticides.
3. Reduces post harvest losses.
4. Increase efficiency of mineral usage by plant.
5. Enhanced nutritional value of food (e.g Vitamin A enriched rice)
6. To create tailor made plants for non-food purposes (to supply alternative resources of fuels or pharmaceuticals to industreis).

(Any four)

12. Mention four significant services that a healthy forest ecosystem provide. [2]

OR

Substantiate with the help of one example that in an ecosystem mutualists :

(i) tend to co-evolve and

(ii) are also one of the major causes of biodiversity loss.

Answer :

1. Purify air
2. Production of oxygen

3. Purify water
4. Mitigate droughts and floods
5. Nutrient cycling
6. Generate fertile soil
7. Provide wildlife habitat
8. Maintain biodiversity
9. Pollinate crops
10. Provide site for carbon storage
11. Provide aesthetic cultural and spiritual values. *(any four)*

OR

(i) In case of fig species, it is pollinated only by its partner wasp species. The female wasp uses the fruit of the fig as a site for egg laying and nourishing its larvae. They tend to co-evolve, *e.g.*, the moth and the yucca plant cannot complete their life cycle without each other. The moth deposits its eggs in the locule of the ovary and the flower in turn gets pollinated by the moth.

(ii) When any of the two species becomes extinct, the other species associated with it in an obligatory way also becomes extinct and leads to biodiversity loss.

SECTION–C

13. Pollen banks are playing a very important role in promoting plant breeding programme the world over. How are pollens preserved in the pollen banks ? Explain. How are such banks benefitting our farmer ? Write any two ways. [3]

Answer : In pollen banks, pollen are preserved by cryopresevration in liquid nitrogen at - 196°C.

Advantages of pollen banks are :

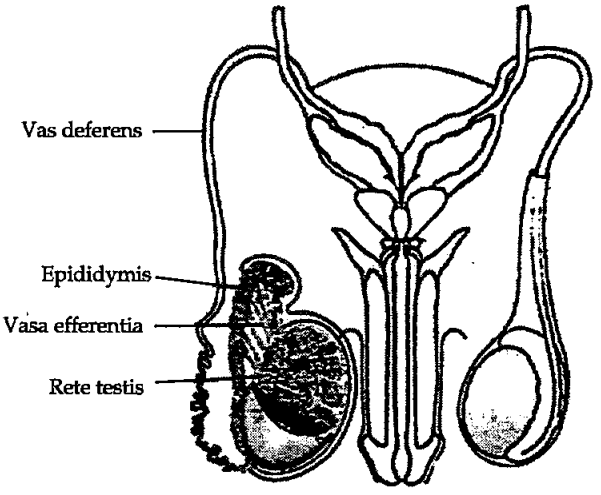
1. Availability of pollen of different genetic strains.
2. Cryopreservation increases viability of pollen.
3. Preservation of pollen for longer duration.
4. To prevent complete extinction of any species.
5. To maintain biodiversity.

14. Draw a labelled diagram to show interrelationship of four accessory ducts in a human male reproductive system. [3]

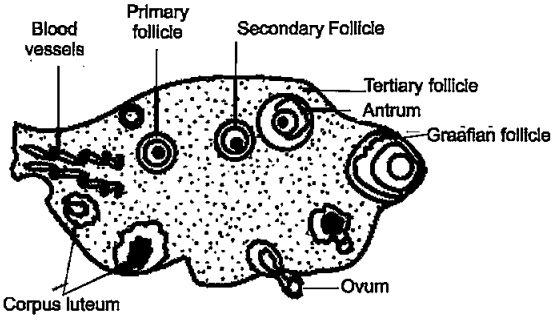
OR

Draw a sectional view of the human ovary showing the different stages of developing follicles, corpus luteum and ovulation.

Answer :



OR



15. Compare in any three ways the chromosomal theory of inheritance as proposed by Sutton and Bovery with that of experimental results on pea plant presented by Mendel. [3]

OR

(a) Explain linkage and recombination as put forth by T.H. Morgan based on his observations with *Drsophila melanogaster* crossing experiment.

(b) Write the basis on which Alfred Sturtevant explained gene mapping.

Answer :

S.No.	Sutton and Boveri	Mendel
(i)	Chrosomsomes occurs in pairs.	Factors occur in pairs.
(ii)	Chromosomes segregate at the time of gamete formation such that only one of each pair is transmitted to a gamete.	Factors segregate at gamete formation and only one of each pair is transmited to a gamate.
(iii)	Independent pairs of chromosomes segregate inde-pendent of other pairs.	One pair of factors segregate independent of another pair.

OR

(a) Linkage – It is the physical association of genes on a chromosomes where the two genes do not segregate independent of each other. In such a case the F_2 phenotypic ratio deviates significantly from 9 : 3 : 3 : 1.

Recombination :

1. Tigthly linked genes tend to show fewer recombination frequency (1.3%).
2. Loosely linked genes show higher percentage of recombinant frequency (37.2%).

(b) Alfred sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of distance between genes and mapped their position on the chromosome. This method of generating linkage map was extensively used during Human genome project.

16. Explain the mechanism of DNA replication with the help of a replication fork. What role does the enzyme DNA-ligase play in a DNA replication work? [3]

OR

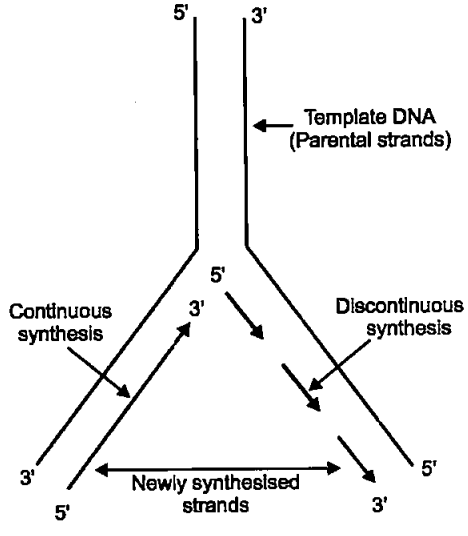
Construct and label a transcription, unit from which the RNA segment given below has been transcribed. Write the complete name of the enzyme that transcribed this RNA.

A T G C A T G C A T G C

5′

"RNA molecule"

Answer : In DNA molecules since the two strands of DNA cannot be separated in its entire length, replication occurs within a small opening of the DNA helix, referred to as a replication fork. DNA dependent DNA polymerases catalyse polymerisation only in one direction that is 5′ → 3′. Conrequently on one strand (3′ → 5′) the replication is continuous while on the other (5′→3′), it is discontinuous. The discontinously synthesised fragments are later joined by the enzyme DNA ligase.



Replication Fork

OR

Answer is not given due to ambiguity in the Question.

17. (a) Write two differences between Homo *erectus* and *Homo habilis*.

(b) Rearrange the following from early to late geologic periods :

Carboniferous, Silurian, Jurassic. [3]

Answer :

S.No.	*Homo erectus*	*Homo habilis*
(i)	Brain capacity 900 cc	Brain capacity 650-800 cc
(ii)	Probably ate meat.	Probably did not eat meat.

(b) Silurian → Carboniferous → Jurrasic

18. Name the group of bacteria involved in setting milk into curd. Explain the process they carry in doing so. Write another beneficial role of such bacteria. [3]

Answer : The group of bacteria involved in setting curd is called LAB (Lactic Acid Bacteria)

These bacteria utilise and act upon the milk sugar lactose leading to its oxidation to lactic acid. This lactic acid produced in turn leads to partial digestion and coagulation of milk proteins to form curd.

Such bacteria increase Vitamin B_{12}. They also check disease causing microbes in the stomach.

19. Bee keeping practice is a good income generating industry. Write the different points to be kept in mind for successful bee keeping. Write the scientific name of the most common Indian species used for the purpose. [3]

Answer :

1. To have knowledge of the nature and habits of bees.
2. Selection of suitable location for keeping the behave.
3. Catching and hiving of swarms.
4. Management of beehives during different seasons.
5. Handling and collection of honey and bees wax.

Common Indian species in *Apis indica*.

20. (a) Match the microbes listed under Column-A with the products mentioned under Column-B.

Column-A	Column-B
(H) *Penicillium notatum*	(i) Statin
(I) *Trichoderma polysporum*	(ii) ethanol

(J) *Monascus purpurea* (iii) antibiotic

(K) *Saccharomyces cerevisiae* (iv) Cyclosporin-A

(b) Why does 'Swiss Cheese' develop large holes? [3]

Answer :

(a)

Column-A	Column-B
(H) *Penicillium notatum*	(iii) antibiotic
(I) *Trichoderma polysporum*	(iv) Cyclosporin A
(J) *Monascus purpurea*	(i) Statin
(K) *Saccharomyces cerevisiae*	(ii) ethanol

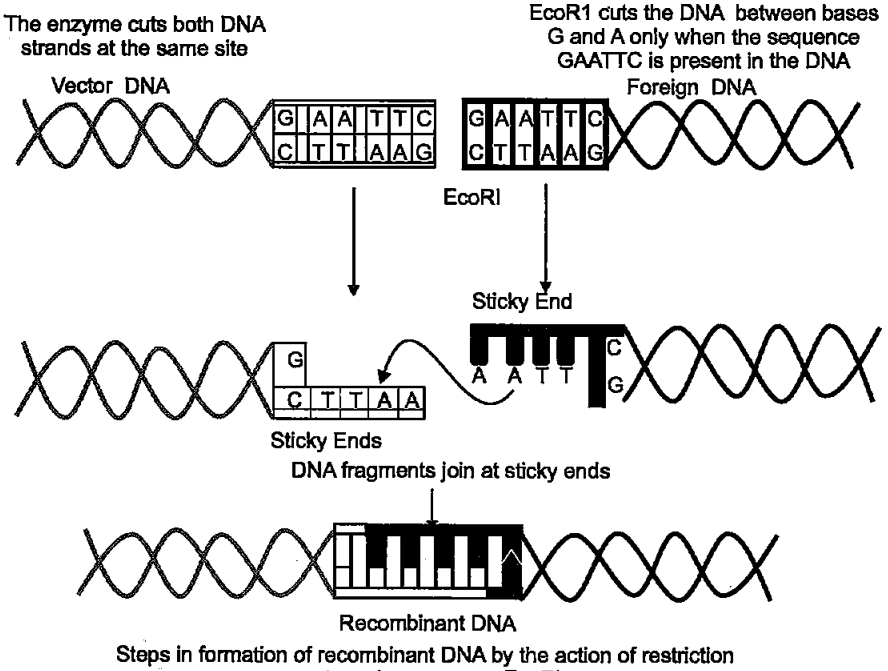
(b) Large holes in Swiss Cheese is because of production of large amount of CO_2 by *Propionibacterium sharmanii.*

21. Describe the formation of recombinant DNA by the action of EcoRI. [3]

OR

Describe the process of amplification of "gene of interest" using PCR technique.

Answer : EcoRI identifies its palindromic sequence on both vector DNA and foreign DNA (GAATTC). It cuts strands of DNA a little away from the centre of palindromic sites but between the same two bases (G and A). This leave single stranded portion at the end (sticky ends) on each strand. For recombination both vector DNA and foreign DNA with similar sticky ends are joined by the enzyme DNA ligase.



Steps in formation of recombinant DNA by the action of restriction endonuclese enzyme-EcoRI

OR

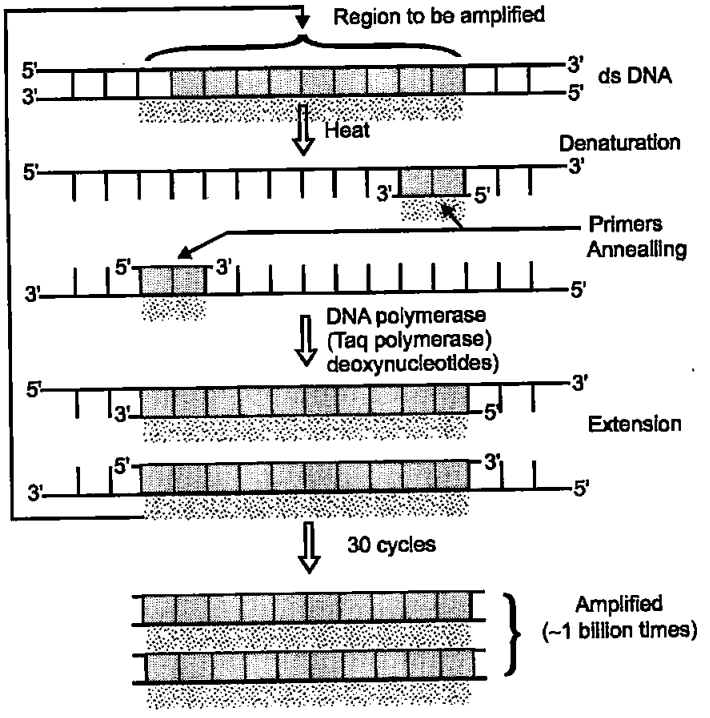
The PCR technique begins with denaturation of desired DNA into two strands, each acting as a template. For each strand, separate set of primers are used. DNA polymerase extends the primers using nucleotides provided in the reaction. If the process of replication of DNA is repeated many times, the segment of DNA can be amplified to approximately billion times. Such repeated amplification is achieved by the use of a thermostable DNA polymerase which is isolated from a bacterium *Thermus aquaticus.*

Denaturation—Double helical DNA is denatured by providing high temperature (95-degree Celsius). DNA polymerase does not get degraded in such high temperture. The DNA polymerase used in this reaction is thermostable and is isolated from the thermophilic bacteria. *Thermus aquaticus* (*Taq*).

Annealing—It is the step in which primers are

annealed to single stranded DNA templates. Two sets of primers are used. The temperatures of the reaction mixture is lowered to 50–65°C for some seconds to allow annealing of primers. DNA polymerase extends the primer in 5′ to 3′ direction.

Extension—Replication of DNA occurs in vitro.



This cycle is repeated several times to generate up to 1 billion identical copies of the DNA.

22. Two children, A and B aged 4 and 5 years respectively visited a hospital with a similar genetic disorder. The girl A was provided enzyme-replacement therapy and was advised to revisit periodically for further treatment. The girl, B was, however, given a therapy that did not require revisit for further treatment.

(a) Name the ailments the two girls were suffering from. ?

(b) Why did the treatment provided to girl A required repeated visits ?

(c) How was the girl B cured permanentaly ? **[3]**

Answer :

(a) Adenosine deaminase or ADA deficiency.

(b) Girl 'A' was treated by 'Enzyme Replacement Therapy' in which functional ADA is introduced to the patient. This therapy is not completely curable since the enzyme can act only for a limited time period.

(c) Girl 'B' may have undergone bone marrow transplant. However, if the gene isolated from marrow cells producing ADA is introduced into cells at early embryonic stages, it could be a permanant cure.

23. List six advantages of *"ex-situ"* approach to conservation of bidoversity. **[3]**

Answer :

1. An endangered or threatened species can be conserved.
2. Only desired species can be focussed upon.
3. Conservation is easier to manage.
4. Conservation can be done by minimum resources.
5. Genetic strains of commercially important plant can be preserved for a long time (seed banks).
6. Biodiversity loss can be reduced.
7. Gametes of threatened species can be preserved in a viable and fertile condition for long periods using cyropreservation.
8. Eggs can be fertilised in-vitro.
9. Plants can be propagated using tissue culture. ***(any six)***

24. While on a visit to a pond in the city-neighbourhood, the visitors were delighted to find large expanse of water covered with colourful algal mass.

(a) As a student of biology, do you agree with their delight ? Give reason in support of your answer.

(b) Explain the cause of such algal growth. **[3]**

Answer :

(a) No. These algal masses or algal bloom cause deterioration of water quality, increase fish

mortality, are extremely toxic to humans and animals and impart distinct colour to water bodies.

(b) Presence of large amount of nutrients such as a nitrates and phosphates in water body are in the major cause of such algal growth. This phenomenon is often termed as cultural or accelerated eutrophication.

SECTION–D

25. (a) Explain one application of each one of the following :

(A) Amniocentesis

(B) Lactational amenorrhea

(C) ZIFT

(b) Prepare a poster for the school programme depicting the objective of :

"Reproductive and Child Health Care Programme" **[3+2=5]**

OR

(a) Explain any two ways by which apomictic seed can develop.

(b) List one advantage and one disadvantage of a apomictic crop.

(c) Why do farmers find production of hybrid seeds costly ? **[2+2+1=5]**

Answer :

(a) (A) To detect chromosomal disorders or determination of sex of the unborn foetus (legally banned).

(B) To prevent pregnancy since it is a natural means of contraception.

(C) To help an infertile couple to have children by transferring the zygote or early embryo upto 8 blastomere stage into the fallopian tube.

(b)

OR

(a) 1. A diploid egg is formed without reductional division which directly develops into embryo without fertilisation.

2. Some diploid cells of the nucellus start dividing and develop into a embryo.

(b) **Advantage :** No segregation of characters in hybrid progeny.

1. Apomicitic hybrid can be used to grow crop year after year.

2. It is economical as ordinary hybrid seeds are costly.

Disadvantage :

1. They lack ability to adopt to changing environment.

2. Cannot control deleterious genetic mutation.

(c) Hybrid seeds are costly as farmers have to purchase seeds year after year. Production of hybrid seeds is a highly technical and expensive method. It requires intensive labour and is not easily feasible.

26. Differentiate between incomplete dominance and co-dominance. Substantiate your answer with one example of each. **[4+1=5]**

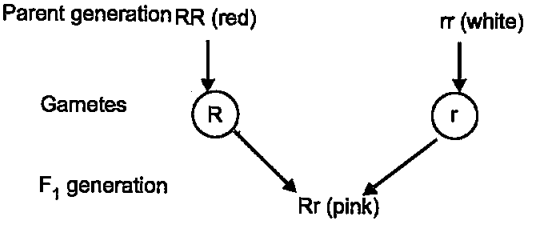
OR

(a) Write the contributions of the following scientists in deciphering the genetic code.

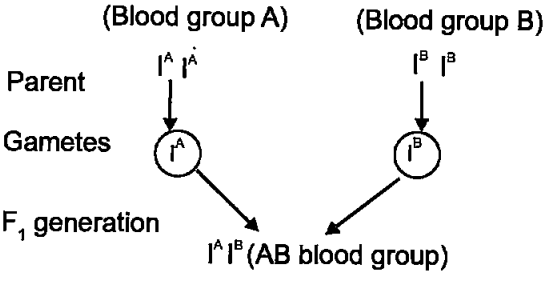
Georce Gamow : Hargobind Khorana; Marshall Nirenberg ; Severo Ochoa

(b) State the importance of a Genetic code in protein biosythesis.

Answer : Incomplete Dominace : The F_1 generation does not resemble either of the parent but shows an intermediate trait *e.g.,* Snapdragon or *Antirrhinum* species. When homozygous dominant and homozygous recessive parents are crossed, all members of F_1 progeny show an intermediate trait.



Co-Dominance : In such a case both the dominant alleles express themselve in F_1 generation *e.g.,* AB blood group in humans. When I^A and I^B are present together they both produce their own antigens.



OR

(a) **1. George Gamow :** He proposed that the genetic code is constituted of 3 nucleotide bases. He also provided proof that the codon is a triplet.

2. **Hargobind Khorana :** He synthesized RNA molecule with a defined combination of bases.

3. **Marshall Nirenberg :** Developed cell free system for protein synthesis. He also helped the genetic code to deciphered.
4. **Severo Ochoa :** He described the enzyme which polymerises RNA with defined sequence in a template independent manner.

(b) **Genetic Codes :** It cods for a specific amino-acid which is required for protein synthesis. It provides information about the specific amino acid that forms a particular protein.

27. **(a) What is "population" according to you as biology student ?**

(b) "The size of a population for any species is not a steatic parameter." Justify the statment with specific reference to flutctuatio in the population density of a region in a given period of time. [4+1=5]

OR

(a) What is hydrarch succession ?

(b) Compare the pioneer species and climax communities of hydrarch and xerarch succession respectively.

(c) List the factors upon which the type of invading pioneer species depend in secondary hydrarch succession. Why is the rate this succession faster than that of primary succession ? [1 + 2 + 2 = 5]

Answer :

(a) **Population :** Total number of organisms of a species in a particular area at a particular time.

(b) The size of a population for any species is not a static parameter because of factors like :

1. **Birth Rate or Natality :** Number of births during a given period.
2. **Death Rate or Mortality :** Number of deaths during a given period
3. **Immigration :** Number of individuals of the same species that have come into the habitat from elsewhere during the time period under consideration.
4. **Emigration :** Number of individuals of the population who left the habitat and gone elsewhere during the time period under consideration.

OR

(a) **Hydrarch succession :** The gradual and fairly predictable changes in the species composition in a water body.

(b) **Hydrarch :** Pioneer species–Phytoplanktons
Climax Community–Forest trees
Xerarch : Pioneer species–Lichen
Climax community–forest trees

(c) Factors on which the type of invading pioneer species depend in the secondary hydrarch succession are :

1. Condition of soil
2. Availability of water
3. Seeds or other propagules

The rate of secondary succession is much faster than primary succession since nutrient soil is already there.

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Biology 2019 (Delhi) SET II

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following questions. All the remaining questions have been asked in previous set.

SECTION–A

2. **How did Charles Darwin express 'fitness'?** [1]

Answer : Charles Darwin expressed fitness as "Reproductive Fitness".

SECTION–B

6. **Express the proces of pollination in *Vallisneria*.** [2]

Answer : In *Vallisneria*, the female flower reaches the surface of water by a long stalk and the male flowers or pollen grains are released on the surface of water. They are carried passively by the water current to the female flower and the stigma.

9. **Why is crossbreeding in animal practiced ? How is a breed Hisardale developed ?** [2]

Answer : Cross breading allows the desirable qualities of two different breeds of animals to combine. Hisardale is developed by cross of Bikaneri ewes with Marino rams.

10. **β galctosidase enzyme is considered a better selectable marker. Justify the statement.** [2]

Answer : The non-recombinants can be differentiated from recombinants on the basis of colour change when β-galactosidase is used as a selectable marker. When grown on a chromogenic substrate the non-recombinants show a colour change from colourless to blue whereas the recombinants are not able to show any colour change due to insertional activation. Moreover, the procedure involving β-galactosidase is single step, easy and non-cumbersome.

SECTION–C

13. **(a) Differentiate between geitonogamy and xenogamy.**

(b) Write the difference in the characteristics of the progeny produced as a result of the two processes. [3]

Answer :

(a) Geitonogamy–Transfer of pollen grains from anther to stigma of another flower of the same plant.

Xenogamy–Transfer of pollen grains from anther to stigma of a different plant of the same species.

(b) The characters of progeny in geitonogamy are the same as their parents. There is no variation and hence in the long run can cause inbreeding depression. The progeny also help to develop pure line (homozygosity). The characters of progeny in Xenogamy are different from their parents. Variaton is observed in them and hence they will not cause any inbreeding depression in the long run.

18. How does the activity of each one of the following help in organic farming found ?

(a) ***Mycorrhiza*** **(b)** ***Cyanobacteria***

(c) ***Rhizobium*** [3]

Answer :

(a) Mycorrhiza : The fungal symbionts in these association absorb phosphorus from the soil and pass it to the plant. The plants also show resistance to root borne pathogens, tolerance to salinity and drought, and an overall increase in plant growth and development.

(b) Cyanobacteria : Serves as an important biofertiliser by fixing atmospheric N_2. They also add organic matter to the soil and increases its fertility.

(c) Rhizobium : They fix atmospheric nitrogen into organic forms which is used by plants as nutrients. They form a symbiotic association in root nodules of leguminous plants.

23. Mention the special adaptation evolved in parasites and why ? [3]

Answer :

1. Loss of unncecessary sense organs.
2. Presence of adhesive organs or suckers to cling to the host.
3. Loss of digestive system
4. High reproductive capacity.
5. If the host evolves special mechanism for resisting the parasite, the parasite also evolves mechanism to counteract or neutralise them.
6. Presence of more than one host.

Reason for the evolution of special adaptations in parasites :

1. To cling to the host.
2. To prevent being eliminated by the host.
3. In endoparasites, sense of organs of sight, smell, touch ete, are not required.

SECTION–D

25. Where does the process of megasporogenis start in an angiosperm ? Describe the process upto the formation of embryo sac. [5]

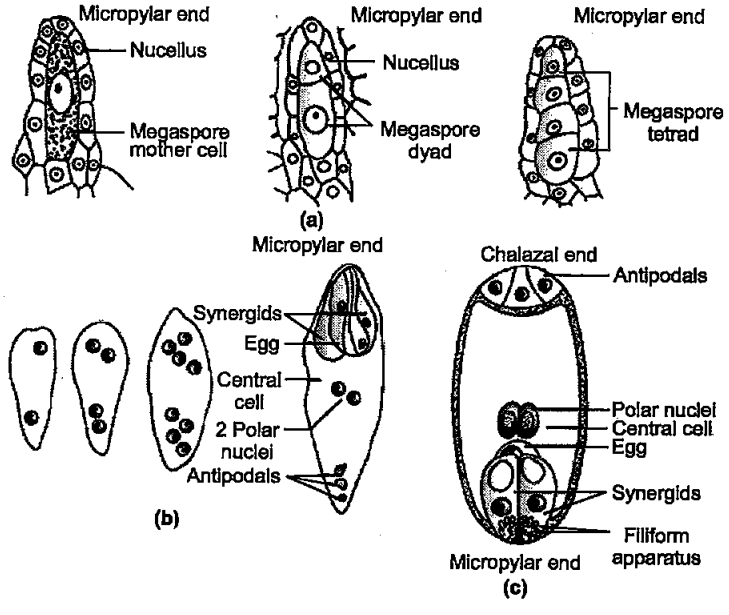
OR

(a) Explain the process of fertilization in human.

(b) Name the embyonic stage that gets implanted in human females. Explain the process of implantation.

Answer : Megasporogenesis begins in the nucleus in an ovule.

A single megaspore mother cell or MMC dfferentiates in the micropylar region of the nucellus. The MMC undergoes meiosis to produce four haploid megaspores out of which three die. The remaining functional megaspore undergoes free nuclear division to form 2-4 and 8 nucleate embryo sac. Cell wall formation occurs in 6 of the 8 nuclei. Two polar nuclei occur in the large central cell to from 8-nucleated and 7-celled embryo sac.



Answer :

(a) The process of fusion of a sperm with an ovum is called fertilization. When a sperm comes in contact with the zona pellucida layer of the ovum, it induces changes in the membrane that block the entry of additional sperms. The secretions of the acrosome helps the sperm to enter into the cytoplasm of the ovum through the zona pellucida and the plasma membrane. This induces completion of the meiotic division of the secondary oocyte which results in the formation of second polar body and ootid. Soon the haploid nucleus of the sperm fuses with the ovum to form a diploid zygote.

(b) Blastocyst stage is the embryonic stage that gets implanted in the human females.
Process : Cells of the blastocyst are arranged into an outer layer called trophoblast and an inner cell mass. The trophoblast gets attached to the endometrium after which the uterine cells divide rapidly and cover the blastocyst. This is called implantation.

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Biology 2019 (Delhi) SET III

Time allowed : 3 hours **Maximum marks : 70**

Note : Except for the following question all the remaining questions have been asked in the previous sets.

SECTION-A

2. Write the number of chromosomes body cells of honey bee workers and drone have. [1]

Answer :

Honey bee workers – 32 chrososomes

Drones – 16 chrosomes.

SECTION–B

6. It is said apomixis is a type of asexual reproduction. Justify. [2]

Answer : Apomixis is the formation of seeds or embryo without the fusion of gametes. In some species, the diploid egg cell is formed without reduction division and develops into an embryo without fertilisation. In some other species, some nucellar cells protrude into the embryo sac and develop into a embryo.

8. Write the steps in sequence as carried in multiple ovulation embryo transfer technology. [2]

Answer : In this method, a cow is administered with FSH like hormone to induce follicular maturation and super ovulation. Instead of one egg per cycle, they produce 6-8 eggs. The animal is either mated with an elite bull or artificially inseminated. The fertilised eggs at 8-32 cells stage are recovered non-surgically and transferred to surrogate mothers.

9. What is an origin of replication in a chromosome ? State its function. [2]

Answer : This is a point of DNA where replication begins. The function of ORI is to control the copy number of linked DNA.

SECTION–B

13. How does a bisexual flowering plant ensures cross pollination ? Explain. [3]

Answer : The bisexual flowering plant ensures cross pollination by the following ways :

1. Pollen release and stigma receptivity are not synchronised.
2. Anther and stigma are placed at different heights.
3. Self incompatibility is a genetic mech-anism which prevents self pollen (from the flowers of the same plant) from fertilising the ovules by inhibiting pollen germination or pollen tube growth in the pistil.

18. Effluent from the primary treatment of sewage is passed for secondary treatment. Explain the process till the water is ready to be releasd into natural water bodies. [3]

Answer : During secondary treatment after adding small amount of inoculum, the primary effluent is constantly agitated mechanically in the aeration tank and air is pumped into it. This allows vigorous growth of useful microbes into 'flocs', which consume major part of organic matter in the effluent. This results in reduction of BOD. The effluent is then passed into settling tank where the bacterial flocs are allowed to sediment. Major part of the activated sludge is pumped into anaerobic sludge digesters. During this digestion, bacteria produce a mixture of gases (biogas) while the remaining water is released into natural water bodies.

24. Explain any two most important levels of biological organisation showing biodiversity with the help of an example each. [3]

Answer :

1. **Genetic diversity :** A high diversity exists at the genetic level over its distributional range.

   e.g., *Rouwolfia vomitoria* growing on different Himalayan ranges might show diversity in terms of potency and concentration of active chemical reserpine.

2. **Species diversity :** Diversity which exists at the species level. *e.g.*, The Western Ghats have a greater amphibian species diversity than the Eastern Ghats.

3. **Ecological diversity :** Diversity which exists at the ecosystem level. *e.g.*, India has a large diversity of deserts, rain forests, mangroves, coral reefs, westlands, estuaries, alpine meadows etc.

SECTION–D

25. (a) Differentiate between spermatogenesis and oogenesis on the basis of :

(i) Time of initiation of the process

(ii) Site of completion of the process

(iii) Nature of meiotic division undergone by gamete mother cells

(b) Name the hormones and state their role invovled in controlling spermatogenesis in humans. [5]

OR

(a) Explain the process of double fertilization in angiosperms.

(b) Why does the development of endosperm preceeds that of embryo ?

(c) List the parts of a typical dicot embryo.

Answer :

(a)

	Basis	Spermato-genesis	Oogenesis
(i)	Time of initiation of the process.	At puberty	During foetal or embryonic stage.
(ii)	Site of completion of the process	Semininferrous tubule.	Ampullery isthmic junction of Fallopian tube
(iii)	Nature of meoitic division undergone by gamate mother cell.	(i) Equal cell division. (ii) Continuous cell division. (iii) Formation of 4 spermatids.	(i) Unequal cell division. (ii) Arrested at early embryonic stage. (iii) Formation of one egg.

(b) GnRH acts on anterior pituitary to secrete LH and FSH. LH acts on Leydig cells and stimulates synthesis and secretion of androgens which stimulate spermatogenesis. FSH acts on sertoli cells which stimulates secretion of some factors which help in the process of spermeiogenesis.

OR

(a) Double fertilisation :

1. One male gamete fuses with the egg cell in the embryo sac to form zygote (2n) by the process of syngamy.
2. The other male gamate fuses with the two polar nuceli to form PEN (Primary Endospern Nucleus) (3n) by the process of triple fusion.
3. Both syngamy and triple fusion together are known as double fertilisation.

(b) The endosperm contains reserve food material which is used for nutrition of developing embryo.

(c) A typical dicot embryo consists of an embryonal axis and two cotyledons. The portion of the embryonal axis above the level of cotyledons is the epicotyl which terminates with the plumule. The portion below the level of the cotyledons is the hypocotyl that terminates at its lower end with the radical which is covered by a root cap.

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