SAMPLE QUESTION PAPER

BLUE PRINT

Time Allowed : 3 hours **Maximum Marks :** 70

S. No.		Chapter	VSA /Case based/ AR (1 mark)	SA-I (2 marks)	SA-II (3 marks)	LA (5 marks)	Total	
1.	Unit-VI	Sexual Reproduction in Flowering Plants	3(3)	–	–	1+1*(5)	**4(8)**	**14**
2.		Human Reproduction	1(1)	1(2)	–	–	**2(3)**	
3.		Reproductive Health	–	–	1(3)	–	**1(3)**	
4.	Unit-VII	Principles of Inheritance and Variation	2(2)	1(2)	1(3)	1*	**4(7)**	**18**
5.		Molecular Basis of Inheritance	3(6)	–	–	1(5)	**4(11)**	
6.	Unit-VIII	Human Health and Diseases	–	2(4)	1+1*(3)	1(5)	**4(12)**	**14**
7.		Microbes in Human Welfare	–	1+1*(2)	–	1*	**1(2)**	
8.	Unit-IX	Biotechnology : Principles and Processes	2+1*(2)	3+1*(6)	–	–	**5(8)**	**12**
9.		Biotechnology and Its Applications	1(1)	–	1(3)	–	**2(4)**	
10.	Unit-X	Organisms and Populations	2(5)	1(2)	1(3)	–	**4(10)**	**12**
11.		Biodiversity and Conservation	2(2)	–	–	–	**2(2)**	
		Total	**16(22)**	**9(18)**	**5(15)**	**3(15)**	**33(70)**	

*It is a choice based question.

Subject Code : 044

BIOLOGY

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

General Instructions :

(i) All questions are compulsory.

(ii) The question paper has four sections: Section A, Section B, Section C and Section D. There are 33 questions in the question paper.

(iii) Section-A has 14 questions of 1 mark each and 02 case-based questions. Section-B has 9 questions of 2 marks each. Section-C has 5 questions of 3 marks each and Section-D has 3 questions of 5 marks each.

(iv) There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.

(v) Wherever necessary, neat and properly labeled diagrams should be drawn.

SECTION - A

1. Name the part of the flower which the tassels of the corn-cob represent.

2. Differentiate between parthenogenesis and parthenocarpy.

3. Hybrid seeds have to be produced year after year. Give reason.

4. Write the location and function of Sertoli cells in humans.

5. Name the contrasting pod-related traits studied by Mendel in pea plant experiment.

6. Write the level of biodiversity represented by a mangrove. Give another example falling in the same level.

7. Give an example of a human disorder that is caused due to a single gene mutation.

8. Give two examples of potent bioweapon agents.

9. Which enzymes are used during the breakdown of fungal cell and plant cell respectively in rDNA technology?

10. Name the specific components and the linkages between them that form deoxyguanosine.

11. **Assertion :** Selectable marker is meant for distinguishing a recombinant from non-recombinant.
Reason : The recombinants can flourish in medium having both ampicillin and tetracycline, while the non-recombinants cannot.
(a) Both assertion and reason are true, and reason is the correct explanation of assertion.
(b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Both assertion and reason are false.

OR

Assertion : Restriction enzymes cut the strand of DNA to produce sticky ends.
Reason : Stickiness of the ends facilitates the action of the enzyme DNA polymerase.

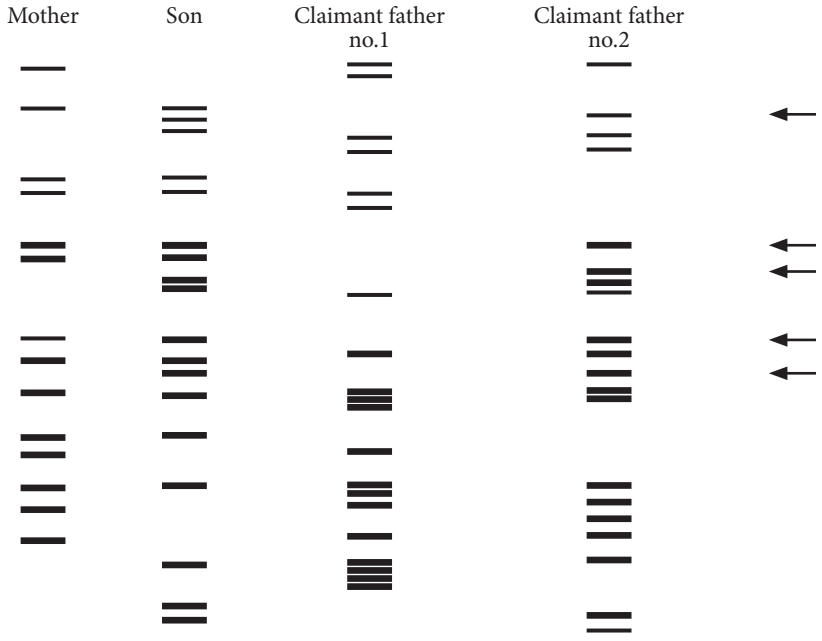
(a) Both assertion and reason are true, and reason is the correct explanation of assertion.
(b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Both assertion and reason are false.

12. Assertion : The polynucleotide chains show polarity.
Reason : In a nucleotide, N-base is attached to deoxyribose sugar at C-1 and phosphoric acid is attached at C-5 of sugar.
(a) Both assertion and reason are true, and reason is the correct explanation of assertion.
(b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Both assertion and reason are false.

13. Assertion : Dodo, Passenger pigeon, Steller's sea cow have become extinct.
Reason : Excessive exploitation of a species, whether animal or plants reduces size of its population so that it becomes vulnerable to extinction.
(a) Both assertion and reason are true, and reason is the correct explanation of assertion.
(b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Both assertion and reason are false.

14. Assertion : Very small animals are rarely found in polar areas.
Reason : Small animals have a larger surface area relative to their volume, so they tend to lose body heat very fast in cold areas.
(a) Both assertion and reason are true, and reason is the correct explanation of assertion.
(b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Both assertion and reason are false.

15. Read the following and answer any four questions from 15(i) to 15(v) given below:
A 5 year old son lives with his mother. Suddenly 2 persons claimed to be his father and filed a case. Police had ordered an investigation to solve the issue and to provide custody to right person. Forensic lab performed DNA fingerprinting and following pattern of bands is obtained.



(i) How are DNA fragments separated?
(a) By gel electrophoresis according to size
(b) By gel electrophoresis according to charge
(c) By PCR according to size
(d) By Southern blotting according to speed

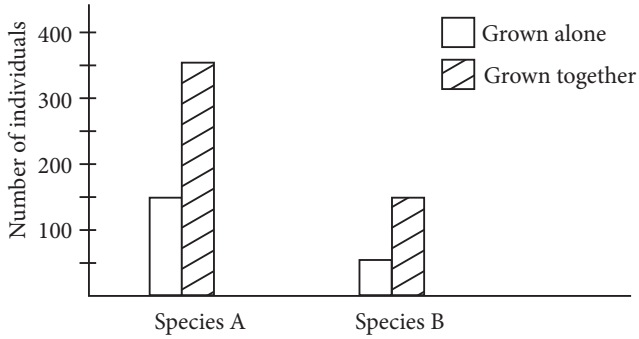
(ii) The method of hybridisation of DNA with radioactive probe is
(a) Northern blotting (b) Western blotting
(c) Southern blotting (d) none of these.

(iii) Identify the correct sequence of various steps of DNA fingerprinting.
A. Restricted DNA fragments are separated by electrophoresis
B. DNA band pattern is transferred to nylon membrane
C. DNA probe binds to radioactive probe
D. The X-ray film is developed to visualise the bands
(a) D → C → B → A (b) A → D → C → B
(c) D → A → C → B (d) A → D → B → C

(iv) **Assertion :** Claimant father 2 is the biological father of the child.
Reason : DNA bands of claimant father 2 are mere similar to DNA bands of mother.
(a) Both assertion and reason are true, and reason is the correct explanation of assertion.
(b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Both assertion and reason are false.

(v) DNA fingerprinting is useful in
(a) solving paternity/maternity disputes
(b) identifying genes connected with heredity disorders
(c) to detect crime and legal pursuits
(d) all of these

16. Read the following and answer any four questions from 16(i) to 16(v) given below:
Two insect species were used in laboratory experiment. For one treatment, both species were grown by themselves (in separate chambers) on a suitable food source. For the second treatment the two species were grown together (in the same chamber) on the same type of amount of food as in the first treatment. The given graph shown the results (the number of individuals of each species in the two treatments) at the end of the experiment.



(i) The two species A and B should be classified as
(a) competitors (b) mutualist
(c) predators of pathogens (d) commensals.

(ii) Which of the following is correct regarding the experiment result?
(a) Species A grown more if it is grown alone.
(b) Species B grown more if it is grown alone.
(c) Species B grown more than the species A.
(d) Both species A and B grown more when they are grown together.

(iii) Which of the following could be another example of the given interaction?
(a) Interaction between alga and fungus
(b) Interaction between sea anemone and clown fish
(c) Interaction between tick bird with rhinoceros
(d) Interaction between crocodile with bird

(iv) The association between two species A and B is a type of association where
(a) both species are harmed
(b) both species are benefitted
(c) one species is harmed and other is benefitted
(d) one species is harmed and other is unaffected.

(v) **Assertion :** Interaction between two species A and B represent commensalism.
Reason : Interaction between species A and B results negative effects on growth and survival of both the population.
(a) Both assertion and reason are true, and reason is the correct explanation of assertion.
(b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Both assertion and reason are false.

SECTION - B

17. Draw and label the parts of the head region only of a human sperm.

18. Mention how the various factors affect linkage.

19. Write the names of the microbes from which the following enzymes are obtained.

(i) Protease	(ii) Amylase	(iii) Rennet
(iv) Lactase	(v) Streptokinase	(vi) Lipase

OR

(a) Name the two microbes used as biocontrol agents.
(b) Explain how the two microbes act as biocontrol agents. Describe why biopesticides are preferred over chemical pesticides.

20. What are the basic requirements of a polymerase chain reaction?

OR

How *Agrobacterium tumefaciens* has been made a useful cloning vector to transfer DNA to plant cells?

21. What are bioreactors? List five growth conditions that a bioreactor provides for obtaining the desired product.

22. Differentiate between type I, II and III restriction endonucleases.

23. Name the two types of immune systems in a human body. Why are cell mediated and humoral immunities so called?

24. Name an allergen and write the response of the human body when exposed to it.

25. Name the type of interaction in each of the following.

(i) Clown fish living among the tentacles of sea anemone

(ii) *Nepenthes* capturing an insect

(iii) Mycorrhizae living on the roots of higher plants

(iv) Lice living on skin of humans

(v) Superior barnacle (*Balanus*) dominating the rocky sea coasts of Scotland and excluding the smaller barnacle *Chathamalus*

SECTION - C

26. A woman has certain queries as listed below, before starting with contraceptive pills. Answer them :

(i) What do contraceptive pills contain and how do they act as contraceptives?

(ii) What schedule should be followed for taking these pills?

27. 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.

(i) Represent this cross in the form of a pedigree chart. Give the genotypes of the daughter and her husband.

(ii) Write the conclusion you draw form the inheritance pattern of this disease.

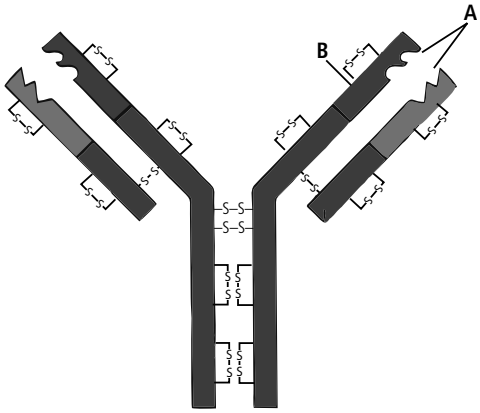
28. **(a)** Plot a logistic growth curve.

(b) Briefly describe nature's carrying capacity for a species in a particular habitat.

29. **(a)** What do you mean by the term biopiracy?

(b) What measures are being taken by the Indian Government to prevent biopiracy?

30.



(a) Identify the labelled part 'A' and 'B'.

(b) What does the diagram illustrate?

(c) Mention the type of immune response provided by the given structure.

OR

(a) Write the scientific name of the source plant of following drugs:

(i) Marijuana (ii) Opium (iii) Cocaine (iv) LSD

(b) Name any two natural hallucinogens and mention their effects on human body.

SECTION - D

31. **(a)** Spleen acts as a lymphoid organ. Justify the statement.

(b) Differentiate between the following:

(i) Innate and acquired immunity

(ii) B - lymphocytes and T - lymphocytes

(c) What are antigen presenting cells? Mention its types.

OR

How sewage water is treated before it could be discharged into natural water bodies?

32. **(a)** Draw a diagram of an enlarged view of T.S. of one microsporangium of an angiosperm and label the following parts:

(i) Tapetum (ii) Middle layer

(iii) Endothecium (iv) Microspore mother cells

(b) Mention the characteristic features and function of tapetum.

(c) Explain the following with reasons:

(i) Pollen grains are well preserved as fossils.

(ii) Pollen tablets are in use by people these days.

OR

(a) Explain any three outbreeding devices in flowering plants.

(b) Suggest the advantages to a farmer of using apomictic seeds of hybrid varieties.

33. Explain the process of protein synthesis.

OR

State three principles of Mendel's law of inheritance. Using Punnett square demonstrate the law of independent assortment in a dihybrid cross involving two heterozygous parents.

SOLUTIONS

1. The tassels of corn-cob represents stigma and style which wave in the wind to trap pollen grains.

2. Differences between parthenogenesis and parthenocarpy are as follows:

S.No.	Parthenogenesis	Parthenocarpy
(i)	It is the development of unfertilised egg into a complete individual without fertilisation.	It is the production and development of seedless fruits without pollination and fertilisation.
(ii)	It occurs in both plants and animals.	It occurs in plants only.
(iii)	Examples: Plants such as *Solanum nigrum, Nicotiana, Datura, Oenothera*, etc. and animals like, drones of honey bees, *Lacerta saxicola, Typhlina brahmina*, etc.	Examples: Banana, pineapple, guava, grapes, apple, tomato, papaya, etc.

3. Hybrid seeds have to be produced year after year because seeds collected from hybrid plants, if sown subsequently, do not maintain hybrid characters due to segregation of traits.

4. The cells that nourish the germ cells in the testes are called Sertoli cells. Sertoli cells are located in the germinal epithelium of the seminiferous tubules.

5. Traits related to pod studied by Mendel were pod shape and pod colour. Inflated (I) shaped and green coloured (G) pod were dominant traits while constricted (i) pod and yellow coloured (g) pod were recessive traits.

6. Ecological diversity is found in mangrove. Rainforests also show same level of biodiversity.

7. Sickle cell anaemia is due to inheritance of a defective allele coding for β-globin. It results in the transformation of HbA into HbS in which glutamic acid is replaced by valine at sixth position in each of two β-chains of haemoglobin.

8. (i) *Bacillus anthracis* causing anthrax disease.
(ii) *Yersinia pestis* causing plague.

9. Fungal cells are treated with chitinase enzyme and plant cells are treated with cellulase enzyme.

10. The specific components that form deoxyguanosine are guanine (nitrogenous base) and deoxyribose (pentose sugar) linked together by glycosidic bond.

11. (c) : The non-recombinants can flourish in medium having both ampicillin and tetracycline, while the recombinants cannot.

OR

(c) : Restriction enzyme, a type of endonuclease, functions by "inspecting" the length of a DNA sequence. Once it finds a recognition sequence, it binds and cuts each of the two strands of the double helix at specific point leaving single stranded portions at the ends. This results in overhanging stretches called sticky ends. This stickiness of the ends facilitates the action of the enzyme DNA ligase, not DNA polymerase.

12. (b) : The polynucleotide chains show polarity as one end of the chain has a sugar residue with C-3 not linked to another nucleotide having free 3′-OH group and the other end has sugar residue with C-5 linked to a phosphate group (not linked to another nucleotide). These are named as 3′ and 5′ ends (three and five prime ends) of polynucleotide chain, respectively.

13. (a)

14. (a)

15. (i) (a) : DNA fragments separate according to size through the pores of agarose gel.

(ii) (c) : A southern blot is a method used in molecular biology for detection of a specific DNA sequence in DNA samples. Southern blotting combines transfer of electrophoresis-separated DNA fragments to a filter membrane and subsequent fragment detection by probe hybridisation.

(iii) (d) : The major steps in DNA fingerprinting are as follows :

– DNA is extracted from the cells. DNA can be amplified by PCR or polymerase chain reaction.
– DNA is cut into fragments with restriction enzymes.

– Chopped DNA fragments are passed through electrophoresis. The separated fragments can be visualised by staining them with a dye.
– Double-stranded DNA is then split into single-stranded DNA using alkaline chemicals.
– Separated DNA sequences are transferred from gel onto a nitrocellulose or nylon membrane.
– The nylon sheet is then immersed in a bath, where probes or markers radioactive synthetic DNA segments of known sequences are added. The probe hybridises VNTR (Southern blotting).
– X-ray film is exposed to the nylon sheet gives dark bands at the probe sites. Thus hybridised fragments are detected by autoradiography.

(iv) (c)

(v) (d)

16. (i) (a) : The given data shows that the insect species A and B are mutualists. Mutualism is an interaction between two organisms of different species where both the partners are benefitted from each other. Species A when grown alone showed less number of individuals, however, its population increased when grown along with species B. Similar observations were made for species B. Hence, it can be concluded that they exhibit mutualism.

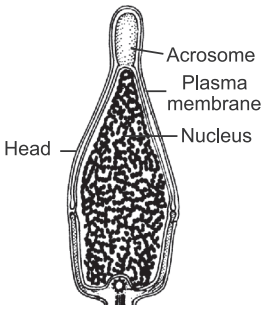
(ii) (d) : *Refer to answer 16(i).*

(iii) (a) : Interaction between alga and fungus is mutualistic. Interaction between sea anemone and clown fish is commensalism. Interaction between tick bird with rhinoceros and crocodile with bird are proto-cooperation.

(iv) (b) : *Refer to answer* 16*(i).*

(v) (d) : *Refer to answer* 16*(i).*

17. The head region of human sperm is as follows:



18. Linkage is affected by the following factors:
(i) The strength of linkage increases with the increase in age.
(ii) A rise in temperature decreases the strength of linkage.
(iii) Radiations like UV rays and X rays decrease the strength of linkage.
(iv) Distance between two genes if increased, then the linkage strength decreases.

19. (i) *Aspergillus* (ii) *Rhizopus*
(iii) *Mucor* (iv) *Saccharomyces fragilis*
(v) *Streptococcus* (vi) *Candida lipolytica*

OR

(a) (i) *Nucleopolyhedrovirus*
(ii) *Bacillus thuringiensis*
(b) *Nucleopolyhedrovirus* a genus of baculoviruses are useful in controlling many insects and other arthropods. They are species specific narrow spectrum bioinsecticides with no side effects on plants, mammals, birds, fish and non-target insects. *Bacillus thuringiensis* is a soil bacterium. The spores of this bacterium possess insecticidal cry protein, hence, kill larvae of certain insects. This bacterium was first biopesticide to be used on commercial scale. The commercial preparations of *B. thuringiensis* contain a mixture of spores, cry protein and inert carrier.
Chemical pesticides used in agricultural fields are toxic and biocides. They kill even useful organisms along with harmful ones, harm human beings and animals, pollute soil and water and crop plants. It is estimated that despite the use of chemical pesticides 30% of the agricultural produce is lost to pathogens and pests because these continue to develop resistance against various pesticides. On the other hand biopesticides are the biological agents that control the growth of weeds, insects and pathogens in an agricultural field. They have targeted actions and are harmless to the crop plants, other beneficial field animals and humans. Therefore, nowadays biopesticides are preferred over chemical pesticides.

20. The basic requirements of a polymerase chain reaction are:
(i) DNA template – The desired segment of target DNA molecule that is to be amplified.
(ii) Primers – Two nucleotide primers, usually 10-18 nucleotides long and complementary to the sequences present at the 3′ end of the target DNA segment.
(iii) Enzyme – *Taq* DNA polymerase which is stable at high temperature is required to carry out synthesis of new DNA.

OR

Agrobacterium tumefaciens is a soil-inhabiting bacterium that may invade growing plants at the junction of root and stem, where it can cause a cancerous growth known as a crown gall. The bacterium, which infects dicotyledonous plants only, contains plasmid (known as a Ti plasmid) that carries the genes for tumour formation. When the bacterium invades the host cells, the Ti plasmid enters the host nuclei. Part of the Ti plasmid become inserted into the chromosome, where it produces copies of itself. For using Ti plasmid as a vector, researchers have eliminated its tumour causing properties while keeping its ability to transfer DNA into plant cells. This bacterium is called natural genetic engineer because genes carried by Ti plasmid produce effect in several parts of the plant.

21. A bioreactor is a vessel in which raw materials are biologically converted into specific products by microbes, plant and animal cells and their enzymes. These are used for food processing, fermentation, waste treatment, etc.

Growth conditions that a bioreactor provides for obtaining the desired products are as follows:

(i) Controlled environment for optimum product yield

(ii) Aseptic fermentation for number of days and prevention of escape of viable cells

(iii) Adequate mixing and aeration for optimum growth and production, without damaging the microorganism

(iv) Easy and dependable temperature control

(v) Facility of sampling

22. Differences between type I, type II and type III restriction endonucleases are as follows:

S.No.	Type I	Type II	Type III
(i)	Enzyme structure consists of three different subunits.	Enzyme structure is simple.	Enzyme structure consists of two different subunits.
(ii)	They require ATP, Mg^{2+} and S-adenosyl-methionine for restriction.	They require Mg^{2+} for restriction.	They require ATP, Mg^{2+} and S-adenosyl-methionine for restriction.
(iii)	They recognise specific sites within the DNA but do not cut these sites.	They recognise specific sites within the DNA and cut these sites.	They recognise specific sites within the DNA but do not cut these sites.
(iv)	They are not used in recombinant DNA technology.	They are used in recombinant DNA technology.	They are not used in recombinant DNA technology.

23. Two types of immune systems in human body are : Antibody Mediated Immune System (AMIS) and Cell Mediated Immune System (CMIS). Antibody-mediated (or humoral) immunity is associated with the appearance of antibodies, secreted by B-lymphocytes, in the extracellular fluids such as plasma, lymph and external secretions. Cell-mediated immunity is mediated by T-lymphocytes that defend against pathogens including protists and fungi that enter the cells.

24. Pollen grain is an allergen. Exposure to pollen causes hay fever. It is the form of allergy due to pollen of grasses, trees and other plants. It is characterised by inflammation of the membrane lining the nose and sometimes of the conjunctiva. The symptoms are sneezing, running nose and watering eyes due to histamine release.

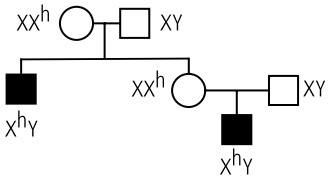
25. (i) Commensalism (ii) Predation
(iii) Mutualism (iv) Parasitism
(v) Competition

26. (i) Contraceptive pills may contain either hormone progestogen or a combination of both progestogen and estrogen hormones.

Oral (contraceptive) pills help to prevent pregnancy by inhibiting body's natural cyclical hormones. They usually stop the body from ovulating, change cervical mucus to make it difficult for sperm to go through cervix and prevent implantation of the fertilised egg.

(ii) Contraceptive pills have to be taken daily for 21 days starting within the first five days of menstrual cycle and this has to be repeated after a gap of 7 days in the same pattern till the female desires to prevent conception.

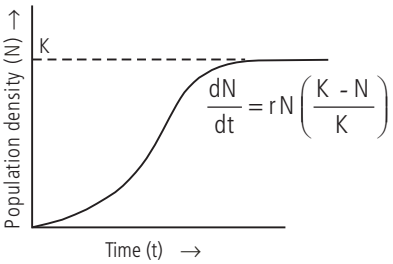
27. (i) The pedigree chart of the cross is represented as:



Thus, from the above pedigree, the genotypes of daughter and her husband can be deduced as XX^h and XY respectively.

(ii) From this, it can be concluded that haemophilia is a sex-linked disease showing criss-cross pattern of inheritance where a parent passes the traits to the grandson. Here , the female is the carrier of the disease haemophilia.

28. (a)



(b) In nature, a given habitat has resources to support a certain number of individuals of a population, beyond which no further growth is possible. This limit is called nature's carrying capacity (K) for that species in that habitat. Nature's limited resources limit the carrying capacity for a species in a particular habitat.

29. (a) When bioresources of one country are exploited or patented by some multinational companies or organisations of other countries without proper authorisation from concerned country and compensation is referred to as biopiracy.

(b) To prevent unauthorised exploitation of bio-resources and traditional knowledge, the Indian Parliament has recently cleared the second amendment of the Indian Patents Bill, that takes biopiracy issues into consideration, including patent terms, emergency provisions, research and development initiatives.

30. (a) 'A' – Antigen binding site
'B' – Variable region of heavy chain

(b) This diagram illustrates the structure of an antibody molecule.

(c) Humoral immune response is an antibody mediated immune response, which is regulated by antibodies in body fluids.

OR

(a) (i) *Cannabis sativa*
(ii) *Papaver somniferum*
(iii) *Erythroxylum coca*
(iv) *Claviceps purpurea*

(b) The two natural hallucinogens are:

(i) LSD (Lysergic acid diethylamide): It causes horrible dreams, emotional outbursts, hallucination, chronic psychosis. It also brings about chromosomal and fetal abnormalities.

(ii) Cannabinoids: These raise the blood sugar level and increase the frequency of urination. They bring about a state of well being, excitement, sometimes uncontrolled laughter and dilation of pupil of eyes.

31. (a) Spleen acts as a secondary lymphoid organ where mature B and T lymphocytes undergo proliferation and differentiation. In spleen, lymphocytes develop immune response and become effector cells.

(b) (i) Differences between innate and acquired immunity are as follows:

S.No.	Innate Immunity	Acquired Immunity
(i)	This includes all the defence elements with which an individual is born.	This immunity is acquired after the birth.
(ii)	It consists of various types of barriers that prevent the entry of foreign agents.	It consists of specialised cells (T-cells and B-cells) and antibodies that circulate in the body fluid.
(iii)	It remains throughout life.	It can be short lived or long - lived.

(ii) Differences between the B-lymphocytes (B-cells) and T-lymphocytes (T-cells) are :

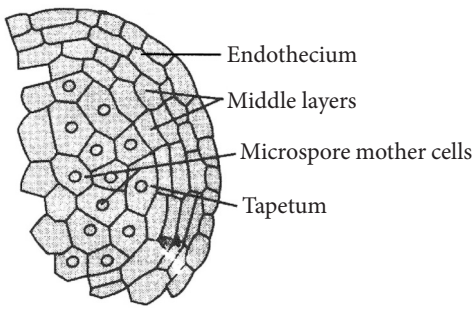
S.No.	B-lymphocytes (B-cells)	T-lymphocytes (T-cells)
(i)	B-cells form humoral or antibody mediated immune system(AMIS).	T-cells form cell-mediated immune system (CMIS).
(ii)	They defend against viruses and bacteria that enter the blood and lymph.	They defend against pathogens including protists and fungi that enter the cells.
(iii)	Plasma cells formed by division of B-cells produce antibodies and provide immunity against foreign substances.	T-lymphocytes produce different types of T-cells, *e.g.*, killer T-cells react against cancer cells, suppressor cells inhibit immune system.

(c) The cells that engulf antigens and present their fragments to T-cells are called antigen presenting cells (APCs). There are three types of APCs found in the body :
(i) Macrophages, (ii) Dendritic cells, (iii) B-cells.

OR

Sewage water can be purified by passing it through sewage treatment plants with the action of microorganisms. A sewage treatment plant separates solids from liquids by physical processes and purifies the liquid by biological processes. There are three stages of this treatment; primary, secondary and tertiary. Primary treatment is physical, secondary biological and tertiary chemical.
Primary treatment phase of sewage treatment removes floating and suspended solids from sewage through two processes of filtration and sedimentation. First floating matter is removed through sequential filtration. The filtrate is kept in large open settling tanks where grit settles down. Aluminium or iron sulphate is added in certain places to flocculation and settling down of solids. The sediment is called primary sludge while the supernatant is called effluent. The primary sludge traps a lot of microbes and debris. It is subjected to composting or land fill where anaerobic digestion removes the organic matter.
During secondary treatment, the primary effluent is taken to aeration tanks. A large number of aerobic heterotrophic microbes grow in the aeration tank. They form flocs are masses of bacteria held together by slime and fungal filaments to form mesh-like structures. The microbes digest a lot of organic matter, converting it into microbial biomass and releasing a lot of minerals. As a result the BOD of the waste matter is reduced to 10-15% of raw sewage, it is passed into settling tank. In settling tank, the bacterial flocs are allowed to undergo sedimentation. The effluent or supernatant is generally passed into natural water bodies and sediment of settling tank is called activated sludge.

32. (a) Sectional view of microsporangium of an angiosperm is as follows:



(b) The characteristics of tapetum are as follows:
(i) Tapetal cells are filled with protoplasmic contents as well as nutrients.
(ii) They are either multinucleate or their nucleus becomes polyploid due to endoploidy.
(iii) Tapetum is of two types – amoeboid and secretory.
(iv) In amoeboid type, the tapetal cells fuse to form a plasmodium or periplasmodium because it passes in between the sporogenous cells to nourish them.
(v) The cells of secretory tapetum pass out substances over the sporogenous cells for their growth and differentiation.
Tapetum has a number of functions:
(i) Nourishment of the developing microspore mother cells and pollen grains.
(ii) It produces lipid rich ubisch granules containing sporopollenin for exine formation, pollenkitt, special proteins for the pollen grains which recognise compatibility and hormone IAA.
(iii) It secretes enzyme callase responsible for the degradation of callose wall around pollen tetrad.
(c) (i) Sporopollenin is present in exine layer of pollen grains. Sporopollenin is highly resistant fatty substance not degraded by any enzyme and not affected by high temperature, strong acid or strong alkali therefore, pollen grains can be well preserved as microfossils.
(ii) Pollen tablets are used as food supplement by people to improve health.

OR

(a) The three outbreeding devices that flowering plants have developed are as follows:
(i) Dicliny (Unisexuality) : Flowers are unisexual so that self pollination is not possible. The plants may be monoecious (bearing both male and female flowers, *e.g.*, maize) or dioecious (bearing male and female flowers on different plants, *e.g.*, mulberry, papaya).
(ii) Dichogamy : Anthers and stigmas mature at different times in a bisexual flower so as to prevent self pollination. (a) Protandry : Anthers mature earlier than stigma of the same flower. Their pollen grains become available to stigmas of the older flowers, *e.g.*, sunflower, *Salvia.*
(b) Protogyny : Stigmas mature earlier so that they get pollinated before the anthers of the same flower develop pollen grains, *e.g.*, *Mirabilis jalapa, Gloriosa, Plantago*.
(iii) Heterostyly : There are 2 or 3 types of flowers with different heights of styles (and stamens), *e.g.*, in diheterostyly (dimorphic heterostyly), there are two types of flowers, pin eyed (long style and

short stamens) and thrum eyed (short style and long stamens), *e.g.*, *Primula* (primrose), jasmine. Pollination occurs between anthers and stigmas of the same height present in different flowers.

(b) Advantages of using apomictic seeds of hybrid varieties are as follows:

(i) Apomixis can be used to preserve desired characters.

(ii) It will reduce the cost of purchasing hybrid seeds every year.

(iii) Embryos formed through apomixis are generally free from infections.

33. The process of decoding of the message from *m*RNA to protein with the help of *t*RNA, ribosome and enzymes is called protein synthesis or translation. Protein synthesis occurs over ribosomes. The 4 main steps in protein synthesis are: activation, initiation, elongation and termination of polypeptide chain.

The newly synthesised *m*RNA joins the smaller subunit of ribosome at 5′ end. *m*RNAs carry the codon and *t*RNAs carry the anticodon for the same codon. Activation of amino acid is catalysed by the enzyme aminoacyl *t*RNA synthetase in the presence of ATP. In presence of ATP an amino acid combines with its specific aminoacyl-*t*RNA synthetase to produce aminoacyl adenylate enzyme complex. This reacts with *t*RNA to form aminoacyl-*t*RNA complex. Activated *t*RNA is taken to ribosome *m*RNA complex for initiation of protein synthesis.

Initiation of protein synthesis is accomplished with the help of 3 initiation factors (IF3, IF2, IF1) in prokaryotes and 9 in eukaryotes (eIF2, eIF3, eIF1, eIF4A, eIF4B, eIF4C, eIF4D, eIF5, eIF6). The ribosome binds to the *m*RNA at the start codon (AUG) that is recognised only by the initiator *t*RNA. A polypeptide chain forms as *t*RNAs deliver amino acids to the ribosome. Large ribosomal subunit binds the initiation complex forming two (A and P) binding sites for *t*RNA molecules. The first site is P site or peptidyl site which is occupied by $tRNA^{met}$. The second site is A or aminoacyl site and is positioned over the second codon. Now, the ribosome proceeds to the elongation phase of protein synthesis. During this stage, complexes composed of an amino acid linked to *t*RNA, sequentially bind to the appropriate codon in *m*RNA by forming complementary base pairs with the *t*RNA anticodon. The ribosome moves from codon to codon along the *m*RNA. Amino acids are added one by one, translated into polypeptide sequences dictated by DNA and represented by *m*RNA. The enzyme peptidyl synthetase catalyses the formation of peptide bond between the carboxylic group of amino acid at P site and amino group of amino acid at A site. Enzyme translocase brings about the movement of *m*RNA by one codon. The termination of protein synthesis occur when a non-sense codon reaches at A site of ribosome. The chain detaches from the ribosome. A release factor binds to the stop codon, terminating translation and releasing the complete polypeptide from the ribosome. Two subunits of ribosomes dissociate with the help of dissociation factor.

OR

The three principles of Mendel's law of inheritance are :

(i) Law of dominance : This law explains that when two individuals of a species, differing in a pair of contrasting forms of a trait are crossed, the form of the trait that appears in the F_1 hybrid is dominant and the alternate form that remains hidden, is called recessive.

(ii) Law of segregation : This law states that the members of the allelic pair that remained together in the parent, segregate during gamete formation and only one factor enters a gamete.

(iii) Law of independent assortment : This states that in the inheritance of two pairs of contrasting characters, the factors of each pair of characters segregate independently of the factors of the other pair of characters.

The principle or law of independent assortment can be studied by means of dihybrid cross between heterozygous parents having YyRr genotype. This can be demonstrated through Punnett square as follows:

Parents: ♀ YyRr Yellow Round × ♂ YyRr Yellow Round

♀ \ ♂	YR	Yr	yR	yr
YR	YYRR	YYRr	YyRR	YyRr
Yr	YYRr	YYrr	YyRr	Yyrr
yR	YyRR	YyRr	yyRR	yyRr
yr	YyRr	Yyrr	yyRr	yyrr

Phenotypic ratio obtained is:

Yellow round	:	9
Yellow wrinkled	:	3
Green round	:	3
Green wrinkled	:	1

Thus, the phenotypic ratio of a dihybrid cross is 9 : 3 : 3 : 1. The occurrence of four types of plants (parental types) in the F_2 generation of dihybrid cross shows that the factors of each of the two characters assort independently of the other as if the other pair of factor are not present.

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