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	2(2)	–	–	1+1*(5)	**3(7)**	**14**
2.		Human Reproduction	2(2)	1*	1(3)	–	**3(5)**	
3.		Reproductive Health	–	1(2)	–	–	**1(2)**	
4.	Unit-VII	Principles of Inheritance and Variation	2(5)	–	1(3)	–	**3(8)**	**18**
5.		Molecular Basis of Inheritance	3 +1*(3)	1+1*(2)	–	1+1*(5)	**5(10)**	
6.	Unit-VIII	Human Health and Diseases	1(4)	1(2)	–	–	**2(6)**	**14**
7.		Microbes in Human Welfare	–	–	1 +1*(3)	1+1*(5)	**2(8)**	
8.	Unit-IX	Biotechnology : Principles and Processes	3(3)	2(4)	1(3)	–	**6(10)**	**12**
9.		Biotechnology and Its Applications	–	1(2)	–	–	**1(2)**	
10.	Unit-X	Organisms and Populations	1(1)	2(4)	1(3)	–	**4(8)**	**12**
11.		Biodiversity and Conservation	2(2)	1(2)	–	–	**3(4)**	
		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. Write the function of scutellum.

2. Explain the events after pollination leading to the formation of a seed in angiosperms.

3. Mention the difference between spermatogenesis and spermiation.

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

5. Write the percentage of the pea plants that would be homozygous recessive in F_2 generation when tall F_1 heterozygous pea plants are selfed.

6. Write the basis on which Alfred Sturtevant explained gene mapping.

7. Write the specific features of the genetic code AUG.

8. In the year 1963, two enzymes responsible for restricting the growth of bacteriophage in *E. coli* were isolated. How did the enzymes act to restrict the growth of the bacteriophage?

9. Why do DNA fragments move towards the anode during gel-electrophoresis?

10. Who is mainly responsible for the 'Sixth Extinction'?

11. **Assertion :** Histone proteins are synthesised during S-phase.

Reason : Histone proteins are found associated with DNA to form bead-like nucleosomes.

(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 : One gene one enzyme hypothesis was changed into one gene one polypeptide hypothesis.

Reason : The synthesis of the two types of polypeptides is controlled by two different genes situated on same chromosome.

(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 : Genetic engineering requires both nucleases and ligases.

Reason : Ligases produce the nick in the recombinant DNA molecule.

(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 : Threatened species are those living species which have been greatly reduced in their number and are liable to become extinct if the causative factors continue.

Reason : IUCN is an international organisation which maintains the IUCN red list of threatened species, to assess the conservation status of different species.

(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.

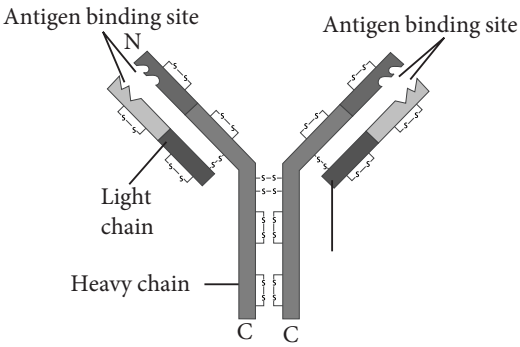
14. Assertion : Predators maintain prey population under control.

Reason : Predators reduce the intensity of competition among competing prey species.

(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:

These molecules are produces in the body in response to the foreign bodies. These molecules are produced by type of antigen presenting cells (APCs). They direct humoral immunity. A 10 year old boy fell down while climbing stairs of foot over bridge. His parents took him to the hospital where he was injected anti-tetanus serum containing the given molecule X.



Molecule X

(i) Identify the molecule X.

(a) Antigen (b) Antibody (c) Dendritic cell (d) Macrophage

(ii) What type of immunity is provided to boy after injury?

(a) Natural active immunity (b) Natural passive immunity

(c) Artificial active immunity (d) Artificial passive immunity

(iii) The given molecule is produced by_____

(a) B-cells (b) T-cells

(c) Plasma cells (d) Both (a) and (c)

(iv) Which class of given molecule is mainly responsible for secondary immune response.

(a) IgM (b) IgA

(c) IgG (d) IgD

(v) Two heavy chains of the given molecule are joined by

(a) H-bonds (b) disulphide bonds

(c) glycosidic linkage (d) covalent bonds.

16. Read the following and answer any four questions from 16(i) to 16(v) given below:

Incomplete dominance

Nishant studied the Mendel's principle of inheritance in his class and teacher practically demonstrated the process though the emascation and cross breeding experiment. In his garden, he saw Snapdragon plant and he got curious about the colours of Snapdragon flowers. He discussed it with his biology teacher and then the teacher explained him the phenomenon of incomplete dominance which is an exception to law of dominance. Incomplete dominance is when a dominant allele, or form of a gene, does not completely mask the effects of a recessive allele, and the organism's resulting physical appearance shows a blending of both alleles. In case of dog flower, the cross breeding of red and flowered plants lead to the production of all intermediate pink coloured flowers in F_1 generation. The F_1 generation selfing results in red, pink and white flowered plants in the ratio of 1:2:1 as the dominant and recessive alleles come in homozygous condition and the dominant, *i.e.*, red flower and recessive trait, *i.e.*, white flower appears in F_2 generation. Similar case of incomplete dominance is also seen in 4 o' clock plant. Incomplete dominance was first recorded in plants. The German scientist Josef Kolreuter bred red and white carnations, expecting to get offspring with the dominant red coloration. Instead, many came up pink! Kolreuter found that neither allele was fully dominant in his flowers and identified the concept of incomplete dominance.

(i) Incomplete dominance is not seen in

(a) *Mirabilis jalapa* (b) Carnations

(c) Snapdragon (d) garden pea.

(ii) In incomplete dominance, intermediate colour appears in _____.

(a) homozygous recessive plant (b) homozygous dominant plant

(c) hetrozygous dominant plant (b) pureline dominant plant.

(iii) Incomplete dominance is an exception to_____.

(a) law of dominance (b) co-dominance

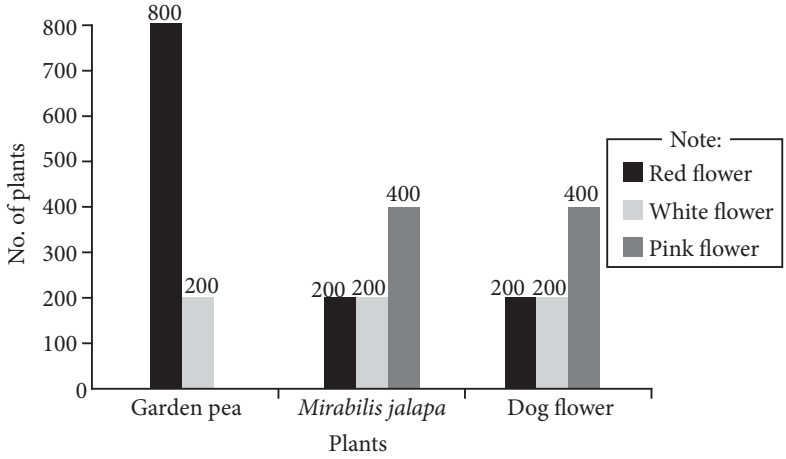
(c) law of segregation (d) law of independent assortment

(iv) The plant in which flower colour did not follow law of dominance is

(a) *Antirrhinum majus* (b) *Pisum*

(c) 4'o clock plant (d) both (a) and (b).

(v) Refer to the given graph regarding results F_2 generation.



The following statements are drawn as conclusions from the above figure .

I. *Mirabilis jalapa* clearly follow law of dominance

II. Dogflower and *Mirabilis jalapa* represent same phenotypic ratio.

III. Garden pea show deviation from Mendel law of inheritance

Choose the correct option.

(a) Only I is true (b) Only II is true

(c) Only III is true (d) I, II and III are true.

SECTION - B

17. What do oral pills contain and how do they act as effective contraceptives?

OR

What is an acrosome in human sperm? Write its function.

18. Explain the structure of a *t*RNA and state why it is known as an adapter molecule.

OR

Differentiate between introns and exons.

19. How does over-exploitation of beneficial species affect biodiversity? Explain with the help of one example.

20. How a probe is used in molecular diagnosis? Explain.

21. A disease can be detected before its symptoms appear. Explain the principle that works behind this.

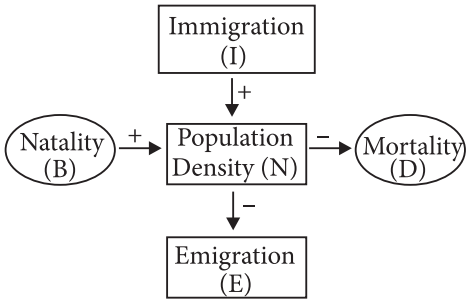
22. List any two molecular diagnostic techniques and write one application of each of them.

23. **(a)** Define the term 'health'. When is "World Health Day" celebrated?

(b) Describe the factors which affect our health.

24. How does a desert plant adapt to the dry, warmer environmental conditions?

25. Study the given flow chart and complete the equation that follows by identifying 1, 2, 3 and 4.



$N_{t+1} = N_t + \{(1 + 2) - (3 + 4)\}$

SECTION - C

26. Why has a bacterium to first become 'competent' to be able to take up DNA? Explain how it become 'competent' and takes in the recombinant DNA.

27. In pea plantlet, symbol Y represents dominant yellow; symbol y, the recessive green; symbol R, the round seed shape and symbol r, the wrinkle seed shape. A typical Mendelian dihybrid cross was carried out in pea plants. Write the genotypes of

(i) Homozygous dominant and recessive parents

(ii) Gametes produced by both the parents

(iii) F_1 offspring

(iv) Gametes produced by F_1 offspring.

28. Name the stage of human embryo at which it gets implanted. Explain the process of implantation.

29. Explain why do lepidopterans die when they feed on Bt cotton.

OR

Give reason how transgenic animals have proved to be beneficial in:

(i) Production of biological products

(ii) Testing vaccine safety

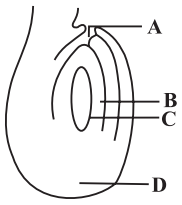
(iii) Study of physiology and development

(iv) Study of diseases

30. List three symptoms of high altitude sickness and three adaptations to overcome it.

SECTION - D

31. Consider the given figure and answer the following questions.



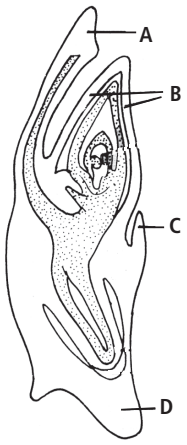
(i) Identify the parts labelled A, B, C and D in the given figure.

(ii) Define the given structure.

(iii) Give examples of plants which bear such kind of structure.

OR

Refer to the given figure and answer the following questions.



(i) Identify A, B, C and D in the given figure.
(ii) Briefly describe part B and D.
(iii) Which labelled part represents rudiments of second cotyledon?

32. **(a)** What is a genetic code?
(b) Explain the following :
Stop codon; Degenerate code; Unambiguous code; Universal codon; Initiator codon

OR

(a) Name the major types of RNAs and explain role of any two types of RNA in the process of protein synthesis in a prokaryote.
(b) Explain the protein factories regarding protein synthesis.

33. **(a)** Explain the process of sewage water treatment before it can be discharged into natural water bodies.
(b) Why is this treatment essential?

OR

What are biofertilisers? Describe their role in agriculture. Why are they preferred to chemical fertilisers?

SOLUTIONS

1. Scutellum is the tissue in a monocot seed that lies between the embryonic axis and the endosperm. It is the modified cotyledon of grasses. It is very thin with high surface area and serves to absorb nutrients from the endosperm during germination.

2. Endosperm is food storing tissue formed during the development of angiospermous seed which provides essential nutrients to the growing embryo and also young seedling at the time of seed germination.

3. The process of formation of sperms is called spermatogenesis while release of sperms from the seminiferous tubules is called spermiation.

4. Depolarisation of the egg plasma membrane by binding of sperm to it, checks additional sperms from entering into ovum.

5. 25% of homozygous recessive is obtained in F_2 generation. It can be illustrated as :

Tt × Tt

↓ Selfing

♀ / ♂	T	t
T	TT	Tt
t	Tt	tt

F_2 generation :

TT : Tt : tt

25% 50% 25%

6. Sturtevant used the frequency of recombination between the gene pairs on the same chromosome as a measure of the distance between genes and mapped their position on the chromosome. This resulted in a chromosome map which was a linear graphic representation of the sequence and relative distances of the various genes present in that chromosome. This relative distance between genes was indicated by the percentage of their recombination or crossing over. A 100% cross over was termed as Morgan (M), 10% as deciMorgan (dM) and 1% as centiMorgan (cM) or 1 map unit. Today genetic maps are extensively used as a starting point in the sequencing of whole genomes.

7. AUG codon has dual functions. It codes for methionine (met) and also acts as an initiation codon for polypeptide synthesis.

8. In 1963, the two enzymes responsible for restricting the growth of bacteriophage in *Escherichia coli* were isolated. One of these added methyl groups to DNA while the other cut DNA at specific sequences, *i.e.*, restriction endonuclease. To restrict the growth of bacteriophage, the *E. coli* recognises and cut foreign DNA into pieces by restriction endonucleases. And in order to prevent cleavage of its own DNA by these enzymes, it modifies its DNA by adding methyl groups, And thus remain unrecognised.

9. DNA is a negatively charged molecule hence during gel electrophoresis it moves towards anode (positive electrode) under the influence of electrical field.

10. Human activities like settlements, hunting, over-exploitation and habitat destruction are mainly responsible for 'Sixth extinction'.

11. (b)

OR

(c) : The synthesis of the two types of polypeptides is controlled by two different genes situated on different chromosomes.

12. (c) : Nucleases are the enzymes that remove nucleotides or produce nick in the DNA strand. Ligases are called molecular glue as they join together two DNA strands by forming phosphodiester bonds between adjacent nucleotides.

13. (b)

14. (a) : Predation is an interaction between members of two species in which members of one species capture, kill and eat up members of other species. The former are called predators while the latter are termed as preys. Predators also help in maintaining prey population under control by reducing the intensity of competition among competing prey species.

15. (i) (b)

(ii) (d) : Antibodies are immunoglobulins which produce in response to pathogens into our body to fight with them. When readymade antibodies are directly given to protect the body against foreign agents, it is called passive immunity.

(iii) (d)

(iv) (d)

(v) (b) : A disulphide bond joins a light chain with heavy chains and also two heavy chains together.

16. (i) (d) : Garden pea plant follows Mendelian inheritance. Only the dominant flower colour appears when pure line dominant flower coloured plant is cross bred with recessive flower coloured plant.

(ii) (c) : Incomplete dominance is when a dominant allele, or form of a gene, does not completely mask the effects of a recessive allele, and the organism's resulting physical appearance shows a blending of both alleles. Therefore, the heterozygous dominant plant would have intermediate colour.

(iii) (a) : It is an exception to law of dominance. According to this law, when the individuals with one or more sets of contrasting characters (now known as phenotypes) are crossed, then only dominant characters appear in F_1 generation, and the recessive characters remain hidden.

(iv) (d)

(v) (b) : In the given graph, the bars showing number of plants with red and white flowers in garden pea are in 3:1 ratio which is a Mendelian ratio whereas the bars showing number of plants with red, pink and white flowers in *Mirabilis jalapa* and dogflower show a phenotypic ratio of 1:2:1. This ratio is achieved in case of incomplete dominance.

17. Oral pills contain either progestin (progestogen) alone or a combination of progestogen and estrogen both. Oral pills inhibit ovulation, motility and secretory activity of oviducts and changes the cervical mucus that impairs transport of sperms and also alter the uterine endometrium and makes it unsuitable for implantation. Hence, they act as effective contraceptives for human females.

OR

Acrosome is the anterior part of head of sperm. It is formed from Golgi body of the spermatid. Acrosome contains hyaluronidase proteolytic enzymes called spermlysins that are used to contact and penetrate the ovum at the time of fertilisation.

18. Structure of *t*RNA can be explained by means of L-form model (Given by Klug 1974) and by means of clover leaf model (given by Holley 1965).

In *t*RNA molecule, about half of the nucleotides are base paired to produce paired stems. Five regions are unpaired or single stranded - AA-binding site, T ψ C loop, DHU loop, extra arm and anticodon loop.

(i) Anticodon Loop : It has 7 bases out of which three bases form anticodon (nodoc) for recognising and attaching to the codon of *m*RNA.

(ii) AA-Binding Site : It is amino acid binding site. The site lies at the 3′ end opposite the anticodon and has CCA – OH group. The 5′ end bears G. Amino acid or AA binding site and anticodon are the two recognition sites of *t*RNA.

(iii) T ψ C Loop : It has 7 bases out of which ψ (pseudouridine) and rT (ribothymidine) are unusual bases. The loop is the site for attaching to ribosome.

(iv) DHU Loop : The loop contain 8–12 bases. It is largest loop and has dihydrouridine. It is binding site for aminoacyl synthetase enzyme.

(v) Extra Arm : It is a variable side arm or loop which lies between T ψ C loop and anticodon. It is not present in all *t*RNAs.

*t*RNA is known as an adapter molecule because it transfers amino acids to ribosomes during protein synthesis for synthesis of polypeptides.

OR

Differences between introns and exons are:

S. No.	Introns	Exons
(i)	Regions of a gene which do not form part of *m*RNA.	Regions of a gene which become part of *m*RNA.
(ii)	Removed during the processing of *m*RNA.	Code for the different proteins.

19. Excessive exploitation of a species, whether a plant or animal, reduces size of its population so that it becomes vulnerable to extinction. For example, presently many marine fish population around the world are declining due to over harvesting results in endangering the continued existence of some commercially important species.

20. The molecular probes are usually pieces of ssDNA (or RNA) labelled with radio isotopes such as ^{32}P. These are used for molecular diagnosis of various diseases such as Duchenne muscular dystrophy, cystic fibrosis, Tay-Sachs disease, etc. In molecular diagnosis, a single stranded DNA or RNA joined with a radioactive molecule (probe) is allowed to hybridise with its complementary strand followed by detection using autoradiography.

21. A disease can be detected when symptoms are not yet visible due to very low count of pathogens, by the technique called Polymerase Chain Reaction (PCR). PCR multiplies pathogen nucleic acids and by analysing them, disease can be diagnosed. By PCR, even very low amounts of DNA can be detected and amplified. It is used to detect HIV and many other genetic disorders.

22. (i) PCR is polymerase chain reaction. It is used to detect HIV infection and mutations in genes in suspected cancer patient.
(ii) ELISA is Enzyme- Linked Immunosorbent Assay. It is used to detect infections by pathogens.

23. (a) Health does not mean "absence of disease or physical fitness". It may be defined as state of complete physical, mental and social well being and not only absence of disease.
World Health Day is celebrated on 7^{th} April.
(b) Our health is affected by different factors such as:
(i) genetic disorders - deficiencies with which a child is born and deficiencies/defects which the child inherits from parents during birth;
(ii) infections and
(iii) life style including food and water we take, rest and exercise we give to our bodies, habits that we have or lack, etc.

24. Desert plants or xerophytes have various adaptations to cope with dry, hot environmental conditions such as leaves with thick waxy, hairy coating to reduce transpiration, leaves reduced to spines and photosynthetic stems, fleshy organs to store water, sunken stomata that open only during night and deep penetrating roots that reach water table.

25. In the given equation, 1, 2, 3 and 4 respectively are B, I, D and E. Therefore, the equation will be

$$N_{t+1} = N_t + [(B + I) - (D + E)$$

26. Competent host is essential for biotechnology experiment. Since DNA is a hydrophilic molecule, it cannot pass through membranes, so the bacterial cells must be made capable to take up DNA, *i.e.*, made competent.
This can be achieved by :
(i) Treatment of DNA with divalent cation of $CaCl_2$ or rubidium chloride : Treating them with a specific concentration of a divalent cation, increases the efficiency with which DNA enters the bacterium through pores in its cell wall.
(ii) Heat shock treatment of DNA : Recombinant DNA (rDNA) can then be forced into such cells by incubating the cells with recombinant DNA on ice, followed by placing them briefly at 42°C (heat shock) and then putting them back on ice. This enables the bacteria to take up the recombinant DNA.

27. (i) Homozygous dominant = YYRR
Homozygous recessive = yyrr
(ii) Gametes produced by both the parents = YR and yr
(iii) F_1 = YyRr
(iv) Gametes produced by F_1 offspring
= YR, Yr, yR and yr.

28. The events of implantation are discussed as follows: Implantation is the attachment of blastocyst to the uterine wall. It occurs after 7 days of fertilisation. As zygote moves towards the uterus, it undergoes series of mitotic divisions known as cleavage and forms 2,4,8,16 daughter cells called blastomeres. The embryo with 8 blastomeres is called morula. The morula transforms into blastocyst. In a blastocyst, the blastomeres are arranged into an outer layer called trophoblast and an inner group of cells called the inner cell mass. The trophoblast then gets attached to the endometrium and the inner cell mass gets differentiated as the embryo. After attachment the uterine cells divide rapidly and cover the blastocyst. As a result, the blastocyst becomes embedded in the endometrium of the uterus. This whole phenomenon is called implantation and it leads to pregnancy.

29. The soil bacterium *Bacillus thuringiensis* produces Bt toxin proteins in mature form. This protein kills certain insects like lepidopterans (tobacco budworm, armyworm), coleopterans (beetles) and dipterans (flies, mosquitoes), etc. These crystals contain a toxic insecticidal protein. When the insect larvae ingest any plant part, toxin becomes active in the alkaline pH of the alimentary canal that solubilies the crystals. The activated toxin binds to the surface of midgut epithelial cells which cause cell swelling and lysis and finally cause death of the lepidopterans (insects).

OR

(i) Production of biological products : Transgenic animals that produce useful biological products can be created by the introduction of the portion of DNA (or genes) which codes for a particular product. Such as human protein (α-1-antitrypsin) used to treat emphysema, tissue plasmogen activator (goat), blood clotting factors VIII and IX (sheep) and lactoferrin (cow).
(ii) Testing vaccine safety : Before being used on humans, transgenic mice are used to test safety of newly developed vaccines. Transgenic mice are being used to test the safety of polio vaccine.
(iii) Study of physiology and development : Transgenic animals are developed to study how genes are regulated and how they affect normal functions of body and its development.

(iv) Study of diseases : Transgenic animals act as models for study and understanding of causes and possible treatments of disease in concern, *e.g.*, cancer, cystic fibrosis, Alzheimer's disease, etc.

30. Atmospheric pressure is low at higher altitudes as compared to plains. When we go for a trek/trip on high altitude, then due to low atmospheric pressure our body does not get enough oxygen, as a result of which we experience nausea, fatigue and heart palpitation (altitude sickness). But by taking rest for first two days, body gets acclimatised to high altitude conditions. The body compensates low oxygen availability by increasing red blood cell production, decreasing binding capacity of haemoglobin and increasing breathing rate. Hence, we will automatically stop experiencing altitude sickness.

31. (i) In the given figure of anatropous ovule, A represents micropyle, B represents nucellus, C represents embryo sac and D represents chalaza.
(ii) The given figure is of an anatropous ovule. In this case, the ovules become completely inverted during development so that the micropyle lies close to the hilum. The hilum is a scar that marks the point where the seed was attached to the fruit wall by the funicle.
(iii) Anatropous ovule is found in maximum flowering plants, *e.g.*, *Helianthus, Tridax*, etc.

OR

(i) A – Scutellum B – Coleoptile
C – Epiblast D – Coleorrhiza
(ii) The given figure is L.S. of an embryo of a plant belonging to grass family. B represents coleoptile and D-represents coleorrhiza. Coleoptile is a foliar structure that encloses the epicotyl bearing shoot apex and leaf primordia. It protects the plumule during emergence from soil. Coleorrhiza is a sheath encapsulating both radicle and root cap. It does not protect the radicle during its passage into the soil.
(iii) Epiblast (labelled as C), represents rudiments of second cotyledon.

32. (a) The relationship between the sequence of amino acids in a polypeptide and nucleotide sequence of DNA or *m*RNA is called genetic code.
(b) (i) Stop codon : Codons that do not code for any amino acids and signal polypeptide chain termination. *E.g.*, UAA, UAG, UGA.
(ii) Unambiguous codon : Codons that specify only one amino acid and not any other. *E.g.*, AUG codes for methionine.
(iii) Degenerate codon : More than one codons codes for a single amino acid. In degenerate codons, generally the first two nitrogen bases are similar while the third one is different. *E.g.*, UUU and UUC codes for phenylalanine.
(iv) Universal codon : A codon that is applicable universally, *i.e.,* specifies the same amino acid from a virus to a tree or human being.
(v) Initiator codons : Codons that initiate the process of translation, *i.e.*, polypeptide synthesis. These are AUG and rarely GUG, which code respectively for methionine and valine.

OR

(a) The three type of RNA are ribosomal RNA, messenger RNA and transfer RNA.
(i) *m*RNA - Messenger RNA bring coded information from DNA and takes part in its translation by bringing amino acids in a particular sequence during the synthesis of polypeptide. However, the codons of *m*RNA are not recognised by amino acids but by anticodons of their adapter molecules (*t*RNAs $\rightarrow$ aa-*t*RNAs). Translation occurs over the ribosomes. The same *m*RNA may be reused time and again. In the form of polysome, it can help synthesise a number of copies simultaneously.
(ii) *t*RNAs -They are transfer or soluble RNAs which pick up particular amino acids (at CCA or 3′ end) in the process called charging. The charged *t*RNAs take the same to *m*RNA over particular codons corresponding to their anticodons. A *t*RNA can pickup only a specific amino acid though an amino acid can be specified by 2-6 *t*RNAs. Each *t*RNA has an area for coming in contact with ribosome (T ψ C) and the enzyme amino acyl *t*RNA synthetase (DHU).
(b) Protein synthesis occurs over the ribosomes. Ribosomes are, therefore, also called protein factories. Each ribosome has two unequal parts, small and large. The larger subunit of ribosome has a groove for pushing out newly formed polypeptide and protecting the same from cellular enzymes. The smaller subunit fits over the larger one like a cap but leaves a tunnel for *m*RNA. The two subunits come together only at the time of protein formation. Mg^{2+} is essential for it. Soon after the completion of protein synthesis, the subunits separate.

33. (a) 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, the 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.

(b) This treatment prevents water pollution and water borne diseases. So, it is essential in order to protect the natural water bodies from sewage pollution.

OR

Biofertilisers are microorganisms which bring about nutrient enrichment of soil by enhancing the availability of nutrients like nitrogen (N) and phosphorus (P) to crops. Biofertilisers include–nitrogen fixing bacteria, nitrogen fixing cyanobacteria and mycorrhiza. *Azotobacter* occurring in fields of cotton, maize, jowar and rice, not only increases yield but also saves nitrogen fertiliser upto 10–25 kg/ha.

A number of free living cyanobacteria or blue-green algae have the property of nitrogen fixation, *e.g., Anabaena, Nostoc, Oscillatoria, Aulosira, Tolypothrix, Cylindrospermum, Stigonema*. Cyanobacteria are extremely low cost biofertilisers.

The most important of the symbiotic nitrogen fixing bacteria is *Rhizobium*. It forms nodules on the roots of legume plants. There are about a dozen species of *Rhizobium* which form association with different legume roots, *e.g., R. leguminosarum, R. lupini, R. trifolii, R. meliloti, R. phaseoli*.

Nitrogen fixing cyanobacteria (blue–green algae) form symbiotic association with several plants, *e.g.*, cycad roots, lichens, liverworts, *Azolla* (fern). *Azolla–Anabaena* association is of great importance to agriculture. *Azolla pinnata* is a free floating fresh water fern which multiplies rapidly, doubling every 5–7 days. The fern can co-exist with rice plants because it does not interfere with their growth. In some South-East Asian countries, especially China, the rice fields are regularly provided with *Azolla*.

Chemical fertilisers cause pollution of water bodies as well as groundwater, besides getting stored in crop plants. Therefore, farmers are pressing for switch over to organic farming which includes the use of manures biofertilisers, biopesticides. Biofertilisers are microorganisms which bring about nutrient enrichment of soil by enhancing the availability of nutrients to crops. The microorganisms which act as biofertilisers are bacteria, cyanobacteria (blue green algae) and mycorrhizal fungi. Bacteria and cyanobacteria have the property of nitrogen fixation while mycorrhizal fungi preferentially withdraw minerals from organic matter for the plant with which they are associated. Phosphate is also solubilised by some bacteria and by some fungi that form association with plant roots.