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+1*(3)	–	–	1*	**3(3)**	**14**
2.		Human Reproduction	1(1)	1*	–	1(5)	**2(6)**	
3.		Reproductive Health	–	1(2)	1(3)	–	**2(5)**	
4.	Unit-VII	Principles of Inheritance and Variation	4(7)	1(2)	1(3)	–	**6(12)**	**18**
5.		Molecular Basis of Inheritance	1(1)	–	–	1+1*(5)	**2(6)**	
6.	Unit-VIII	Human Health and Diseases	–	1(2)	–	1+1*(5)	**2(7)**	**14**
7.		Microbes in Human Welfare	–	2+1*(4)	1(3)	–	**3(7)**	
8.	Unit-IX	Biotechnology : Principles and Processes	2(2)	1(2)	1+1*(3)	–	**4(7)**	**12**
9.		Biotechnology and Its Applications	1(1)	2(4)	–	–	**3(5)**	
10.	Unit-X	Organisms and Populations	2(5)	–	1(3)	–	**3(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. Give an example of a plant which came into India as a contaminant and is a cause of pollen allergy.

2. Explain the function of coleorhiza.

3. Give reasons for the following :
The human testes are located outside the abdominal cavity.

4. In which organism did Morgan carry out dihybrid crosses for studying genes that were sex-linked?

5. A human being suffering from Turner's syndrome shows monosomy. Mention the cause of this chromosomal abnormality.

6. Expand VNTR.

7. Name an autosomal genetic disorder due to a mutation resulting in a single base pair change in DNA.

8. What will be the consequences if a foreign gene is incorporated at *Sal I* site of pBR322 plasmid?

9. What are recombinant therapeutics?

10. Why is tropical environment able to support greater species diversity?

11. **Assertion :** Tapetum helps in formation of exine layer of pollen grain.
Reason : Tapetum produces lipid rich Ubisch granules containing sporopollenin.
(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 : The coconut water is free-nuclear endosperm.

Reason : The white kernel of coconut is cellular endosperm.

(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 : In biolistic method, tungsten or gold particles coated with foreign DNA are bombarded into target cells at a very high velocity.

Reason : Biolistic method is also used to insert genes into animals that promote tissue repair into cells.

(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 : In parasite-host relationship, the stronger organism is benefitted.

Reason : Parasites are commonly prey specific.

(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 : Alpha diversity refers to species diversity present in a given community or habitat.

Reason : Alpha diversity is expressed by species richness and species evenness in a community or habitat.

(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 student conducted an experiment by crossing pure round yellow seeded pea plant with wrinkled green seeded pea plant. Yellow colour is dominant over green and rounded seed shape over wrinkled seed shape. F_1 plants are all round and yellow seeded. F_2 generation is obtained by self-breeding F_1 plants. 4 types of plants were obtained in F_2 generation ; round yellow, round green, wrinkled yellow and wrinkled green.

(i) Which Mendelian law is being discussed in the given passage?

(a) Law of dominance
(b) Law of independent assortment
(c) Law of segregation
(d) All of these

(ii) Identify the correct statement in context of given law.

(a) Only one allele expresses itself in the hybrid.
(b) Offspring do not show parental combination of alleles.
(c) Alleles of two pairs separate independently of each other during gamete formation.
(d) This law is applicable only to closely linked genes, present on same chromosomes.

(iii) F_2 phenotypic ratio obtained is _____ .

(a) 9 : 3 : 3 : 1
(b) 3 : 1
(c) 1 : 2 : 1 : 2 : 4 : 2 : 1 : 2 : 1
(d) 1 : 2 : 1

(iv) Genotype of round green seed is _____ and of wrinkled yellow is _____ .

(a) RRyy, rryy (b) rrYy, RrYy (c) RRyy, RrYy (d) Rryy, rrYy

(v) **Assertion :** F_2 generation shows recombinant traits.

Reason : Alleles of two different characters separate and combine independent of each other.

(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.

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

Living organisms are capable to cope with stressful conditions by various methods. Organisms W are able to maintain constant body temperature and constant osmotic concentration despite changes in external environment, thus have wide range of distribution. Organisms X are ectotherms, *i.e.*, they change their body temperature with surrounding temperature. Organism X have narrow range of distribution. Organisms Y have the ability to regulate body functions to a limited extent, beyond that limit, their body temperature changes with external conditions. Organisms Z suspend development during unfavourable conditions and resume growth on return of suitable conditions.

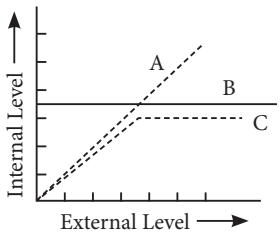
(i) Select the correct example of organisms W, X and Z.

	W	**X**	**Z**
(a)	Pigeon	*Asterias*	Zooplankton
(b)	Dog	Zooplankton	Pigeon
(c)	Zooplankton	Cow	Monkey
(d)	Cow	Zooplankton	*Asterias*

(ii) Stage of suspended development is known as

(a) diapause (b) hibernation (c) aestivation (d) migration.

(iii) Identify the organisms from given graph.



	(A)	**(B)**	**(C)**
(a)	W	Y	Z
(b)	X	W	Y
(c)	X	Y	W
(d)	Y	X	W

(iv) Which statement is correct for organisms X?

(a) They are very active organisms.

(b) They consume lesser amount of energy.

(c) Their body fluids have fixed osmotic concentration.

(d) All of these

(v) **Assertion :** Polar bears undergo hibernation to escape extreme cold.

Reason : Polar bears are ectothermic, thus cannot maintain constant body temperature.

(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. Why are copper containing intrauterine devices considered an ideal contraceptive for human females?

OR

Differentiate between Leydig's cells and Sertoli cells.

18. Differentiate between male and female heterogamety.

19. List the events that reduce the Biological Oxygen Demand (BOD) of a primary effluent during sewage treatment.

OR

Distinguish between the roles of flocs and anaerobic sludge digesters in sewage treatment.

20. **(a)** Define gene therapy.
(b) Why is recombinant human insulin better for diabetic patients than pig or cow insulin?

21. **(a)** Name the key tools used in recombinant DNA technology.
(b) What do you mean by restriction digestion?

22. Which was the first transgenic cow? How did the milk obtained from this transgenic cow was different from a natural cow milk?

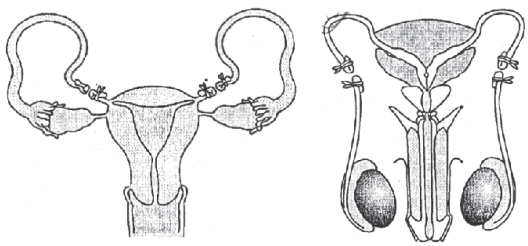
23. Name the microbes that help in production of the following products commercially :
(i) Statin (ii) Citric acid
(iii) Penicillin (iv) Butyric acid

24. Name the parasite that causes filariasis in humans. Mention its two diagnostic symptoms. How is this disease transmitted to others?

25. How does offsite collection helps in conservation of biodiversity? Explain.

SECTION - C

26. Refer to the given figures and answer the following questions.



X **Y**

(i) Which methods of birth control are shown by figure X and Y?
(ii) How do these methods provide contraception? Describe briefly.

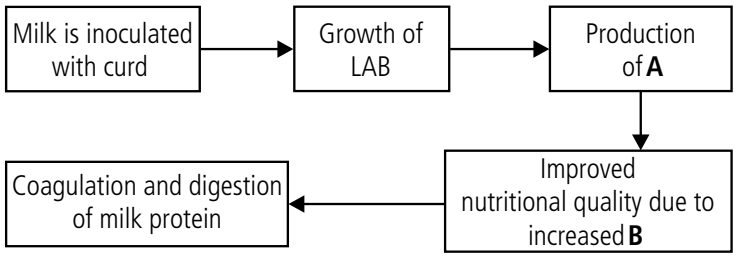
27. What do you mean by mutation and mutagen? Write the significance of mutations.

28. Who invented polymerase chain reaction (PCR)? Explain its working procedure.

OR

(a) What are cloning vectors. What is their function?
(b) State the role of DNA ligase in biotechnology.

29. Refer to the given flow chart and answer the following questions.



(i) Identify the missing parts A and B.
(ii) What is the optimum temperature at which the above mentioned process occur and the role of bacteria in the process?

30. The given table shows population interactions. Study the table and answer the following questions:

Species A	Species B	Name of Interaction
–	0	(P)
+	–	(Q)
–	–	(R)
+	+	(S)

[**Note :** (+) plus = beneficial interaction; (–) minus = detrimental interaction; (0) zero = neutral interaction]
(i) Identify the interactions (P) to (S).
(ii) Explain (Q) and (R).

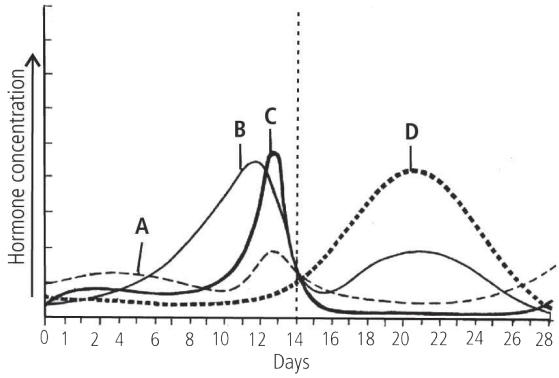
SECTION - D

31. **(a)** Ramesh, a rickshaw puller is in the habit of chewing tobacco throughout the day. Since a few days, he has not been able to eat his food, as there are many ulcers in his mouth, and he is also suffering from high blood pressure. What may be the possible reason for this?
(b) How does morphine, an opioid drug affect the human body?

OR

(a) What happens to a normal cell in a body when oncogenes are activated under certain conditions?
(b) Which techniques are useful to detect cancer of internal organs?
(c) Why are cancer patients often given α-interferon during their treatment?

32. Given graph shows the concentration of pituitary hormones and ovarian hormones during menstrual cycle. Study this graph and answer the following questions based on it.



(i) Which hormones are represented by A, B, C and D?

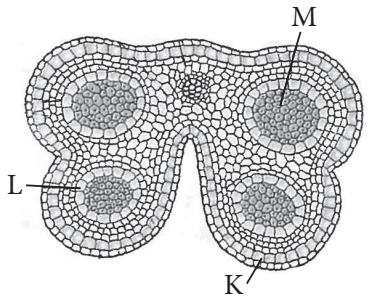
(ii) State the events that occur due to peak level of B and C.

(iii) Why the level of hormone D increases after ovulation?

(iv) Which phase is caused by increased production of B and D?

OR

Refer to the given figure showing T.S. of an anther and answer the following questions.



(i) Identify the structures K and L.

(ii) Give the functions of K and L.

(iii) Identify the structure M and describe its role in microsporogenesis.

33. What is an operon? Names its types. In a culture of *E.coli,* what happens when lactose is added? Why does the *lac*-operon switch off after sometime again?

OR

(a) Describe aminoacylation of *t*RNA.
Identify the specific process in which it occurs – transcription or translation.

(b) Elaborate the steps of translation.

SOLUTIONS

1. *Parthenium* or carrot grass is an example of a plant which came to India as a contaminant and is a major contributor to pollen allergy.

2. Coleorhiza is a protective sheath that covers the young root of the embryo in plants of the grass family.

3. The human testes are located outside the abdominal cavity within a pouch called scrotum. The scrotum helps in maintaining the low temperature of the testes (2- 2.5°C) lower than the normal internal body temperature, necessary for spermatogenesis.

4. Morgan carried out several dihybrid crosses in *Drosophila,* to study genes that were sex-linked.

5. Turner's syndrome is a chromosomal disorder, which is caused due to the absence of one of the X chromosomes (XO). Thus, the number of chromosomes is 45. Such females are sterile.

6. VNTR → Variable Number of Tandem Repeats.

7. Sickle-cell anaemia is a disease that occurs as a result of point mutation.

8. When an alien gene is ligated at *Sal I* site of pBR322, the gene tet^r becomes non-functional and plasmid loses its tetracycline resistance. Hence, the cell possessing such recombinant pBR322 will not be able to grow on tetracycline.

9. Therapeutic proteins produced by recombinant DNA technology are called recombinant therapeutics.

10. Continuous favourable environment with little seasonal changes of temperature and moisture supports greater species diversity in tropical areas. Also, more solar energy is available in tropics, which promotes higher productivity and increased biodiversity.

11. (a) : Secretory or glandular tapetum produces lipid rich Ubisch granules containing sporopollenin for increasing thickness of exine of pollen grains.

OR

(b) Endosperm is the name of food laden tissue which is meant for nourishing the embryo in seed plants. Depending upon the mode of its formation, angiospermic endosperm is of three types : nuclear, cellular and helobial. The coconut water from tender coconut is nothing but free nuclear endosperm, *i.e.*, made up of thousands of nuclei and the surrounding white kernel is the cellular endosperm.

12. (b)

13. (d) : In parasite-host relationship a weaker organism is benefitted. Parasites are commonly host specific.

14. (b)

15. (i) (b) : According to this law the two factors of each character assort or separate independent of the factors of other characters at the time of gamete formation and randomly re-arranged in the offspring producing both parental and new combinations of traits.

(ii) (c) : *Refer to answer 15(i).*

(iii) (a) : In the dihybrid cross as mentioned in the passage, the phenotypes round yellow, wrinkled yellow, round green, wrinkled green appeared in the ratio 9 : 3 : 3 : 1.

(iv) (d)

(v) (a)

16. (i) (a)

(ii) (a) : Under unfavourable conditions many organisms are known to enter diapause, *i.e.*, a stage of suspended development.

(iii) (b) : In the given figure, A, B and C are conformers (X), regulators (W) and partial regulators (Y) respectively.

(iv) (b) : Regulators (W) are very active organisms and their body fluids have fixed osmotic concentration.

(v) (c)

17. Copper containing intrauterine devices (CuT, Cu7, etc.) are considered an effective contraceptives for human females as the Cu ions released by them suppress sperm motility and fertilising capacity of the sperms. Hence, they act as effective birth control method.

OR

Leydig's cells or interstitial cells are present in the spaces between adjacent seminiferous tubules and are involved in secretion of testosterone, whereas sertoli cells are present inside the seminiferous tubules and are involved in formation of sperms, providing nutrition in supporting spermatogenesis, secretion of androgen binding protein (ABP) and secretion of inhibin to check the effects of testosterone and FSH.

18. The type of sex determination mechanism shown in female XX with male XY is called male heterogamety because male produces two different types of gametes, *e.g., Drosophila*.
The type of sex determination mechanism shown in female ZW with male ZZ is female heterogamety because female produces two different types of gametes, *e.g.*, birds.

19. Secondary treatment or biological treatment of sewage considerably reduces the biological oxygen demand (BOD) of primary effluent during sewage treatment. The organic matter present in the effluent is decomposed with the help of microbial flora called as sewage fungus. The effluent is constantly agitated or aerated. This causes the growth of various aerobic microorganisms and sewage fungi. These microbes digest the organic matter thereby reducing the BOD of original sewage by 10-15%.

OR

Flocs are masses of aerobic bacteria held together by slime and fungal filaments to form mesh like structures. These microbes digest a lot of organic matter converting it into microbial biomass and releasing a lot of minerals. This reduces biochemical oxygen demand or BOD.
In anaerobic sludge digesters, aerobic microbes present in the sludge get killed. Anaerobic microbes digest the organic mass as well as aerobic microbes of the sludge. During this digestion, bacteria produce a mixture of gases such as methane, hydrogen sulphide and carbon dioxide. These gases form biogas which can be used as source of energy as it is inflammable. The spent sludge of anaerobic sludge digester can be used as manure or part of compost.

20. (a) Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child/embryo.
(b) Insulin from an animal source causes some patients to develop allergy or other types of reactions to the foreign protein, whereas recombinant human insulin is identical with human insulin.

21. (a) Restriction enzymes, polymerase enzymes, ligases, vectors and the host organisms.
(b) The process of cutting DNA by restriction enzymes is called restriction digestion.

22. The first transgenic cow was Rosie.
Its milk contained the human alpha-lactalbumin and was nutritionally a more balanced product for human babies than natural cow milk.

23. (i) Statin – *Monascus purpureus*
(ii) Citric acid – *Aspergillus niger*, *Mucor*, *Candida lipolytica*
(iii) Penicillin – *Penicillium chrysogenum*, *P. notatum*
(iv) Butyric acid – *Clostridium acetobutylicum*

24. Filariasis is a helminthic disease caused by *Wuchereria* (*W. bancrofti* and *W. malayi*). It causes swelling of lymphatic vessels of lower limbs resulting in swelling of feet, legs, scrotal sacs and thighs. It spreads from one human being to other through the bite of female mosquito, *Culex*.

25. Offsite collections are live collections of wild and domesticated species in botanical gardens, zoological parks, wildlife safari parks and arboreta, etc. Many botanical gardens and arboreta have seed banks, tissue culture facilities and other *ex-situ* conservation technologies. Zoological parks have well managed captive breeding programmes due to which many animals that have become extinct in the wild continue to be maintained in zoological parks. Therefore, offsite collections can be used to conserve biodiversity.

26. (i) Figure X and Y show permanent method of birth control in female and male respectively. This is called sterilisation. Sterilisation in female is called tubectomy (X) and in male it is called vasectomy (Y).
(ii) In tubectomy, a small part of fallopian tube is removed or tied up through small cut in the abdomen or through vagina, while in vasectomy, a small part of vas deferens is removed or tied up through small cut on the scrotum. These methods prevent pregnancy by blocking gamete transport. Both methods are very effective but reversibility is poor.

27. Mutation is a phenomenon which results in alteration of DNA sequences, and consequently results in changes in the genotype, and the phenotype of an organism. In addition to recombination, mutation is another phenomenon that leads to variation in DNA.
Any extracellular physical or chemical factor, which can cause mutations or increase the frequency of mutations in organisms is called mutagen. *e.g.* temperature and high energy radiations.
Significance of mutations:
(i) Mutations are the sources of all variability in a population.
(ii) Mutations have also occurred for higher milk yield, lactation period, egg production, meat content, wool yield, adaptability to diverse environments.
The domestication of several plants was made possible due to sudden mutations appearing in them, *e.g.*, stiff hairs in wheat, rice and other cereals, lint in cotton, etc.

28. The polymerase chain reaction (PCR) was invented by Kary Mullis in 1985.
The working procedure of PCR is given as :
A single PCR amplification cycle involves three basic steps; denaturation, annealing and extension (polymerisation).
(i) Denaturation : In this step, the target DNA is heated to a high temperature (usually 94° to 96°C), resulting in the separation of the two strands. Each single strand of the target DNA then acts as a template for DNA synthesis.
(ii) Annealing : In this step, the two oligonucleotide primers hybridise to each of the single stranded template DNA since the sequence of the primers is complementary to the 3' ends of the template DNA. This step is carried out at a lower temperature (usually 40° to 60°C) depending on the length and sequence of the primers.
(iii) Extension : The final step is extension, wherein *Taq* DNA polymerase (obtained from *Thermus aquaticus*) synthesises the DNA region between the primers, using DNTPs (deoxynucleoside triphosphate) and Mg^{2+}. It means the primers are extended towards each other so that the DNA segment lying between the two primers is copied. The optimum temperature for this polymerisation step is 72°C.

OR

(a) Cloning vectors are those organisms or their DNAs which can multiply independently of the host DNA and increase their copy number along with the foreign DNA attached to them. Cloning vectors may be plasmids, bacteriophages, cosmids, viruses, etc.
Functions :
(i) They help in linking the foreign DNA with that of the host.
(ii) They also help in the selection of recombinants from the non-recombinants.
(b) DNA ligase joins two individual fragments of DNA by the formation of phosphodiester bond between them.

29. (i) A - Lactic acid; B - Vitamin B_{12}
(ii) Indian curd is prepared by inoculating skimmed and cream milk with *Lactobacillus acidophilus* at a temperature of about 40°C or less. Lactic acid bacteria (LAB) like *Lactobacillus* are added to milk. It converts lactose sugar of milk into lactic acid. Lactic acid causes coagulation and partial digestion of milk protein casein and milk is then converted into curd, yoghurt or cheese using different processes.

30. (i) (P) = Amensalism (Q) = Parasitism
(R) = Competition (S) = Mutualism
(ii) Parasitism : It is an association between organisms of different species in which one organism (the parasite) lives on or in the body of another organism (host), from which it obtains its nutrients. It is one sided relationship in which parasite is benefitted and host is harmed.
Competition : It is a rivalry between two or more organisms for obtaining the same resources. It may be between individuals of same species (intraspecific) or of different species (interspecific).

31. (a) Chewing tobacco throughout the day is affecting Ramesh's health day by day, because tobacco contains a large number of harmful chemical substances including nicotine, an alkaloid. Nicotine stimulates adrenal gland to release adrenaline and nor-adrenaline into blood circulation, both of which raise blood pressure and increase heart rate. Tobacco chewing is associated with increased risk of cancer of the oral cavity, and that is the reason for Ramesh's mouth ulcers.
(b) Morphine is the active principle alkaloid of opium, that causes addiction. It depresses respiratory centre, leads to the fall in blood pressure and causes bradycardia (slow heartbeat). Morphine also causes release of ADH, reduces urine output, causes constipation and also mild hyperglycemia. However, morphine is a very effective sedative and painkiller.

OR

(a) When cellular oncogenes or proto-oncogens are activated under certain conditions in normal cells in a body, they could lead to oncogenic transformation of the cells. Transformation of normal cells into cancerous neoplastic cells may be induced by physical, chemical or biological agents also.
(b) Techniques like radiography (use of X-rays), CT (computed tomography) and MRI (magnetic resonance imaging) are very useful to detect cancers of the internal organs. Computed tomography uses X-rays to generate a three-dimensional image of the internals of an object. MRI uses strong magnetic fields and non-ionising radiations to accurately detect pathological and physiological changes in the living tissue.
(c) Cancer patients are often given α-interferon during their treatment, because these biological response modifiers activate the immune system and help in destroying the tumour.

32. (i) A – Follicle stimulating hormone (FSH),
B – Estrogen,
C – Luteinising hormone (LH),
D – Progesterone

(ii) High concentration of estrogen (B) in blood plasma stimulates the proliferation of the uterine endometrium along with increase of uterine glands and blood vessels. High concentration of LH (C) induces rupturing of Graafian follicle and ovulation (release of ovum) occurs.
(iii) After ovulation, the remaining cells of ovarian follicles develop into corpus luteum under the influence of LH. This corpus luteum secretes large amount of hormone progesterone (D) hence, its level increases after ovulation.
(iv) Proliferative and secretory phase is caused by increased production of B and D.

OR

(i) K in the figure represents endothecium while L represents tapetum.
(ii) The function of endothecium (K) is :
1. to protect the young anther
2. help in dehiscence of ripe anther.

On the other hand, tapetum (L) has a number of functions:
1. nourishment of the developing microspore mother cells and microspores,
2. secretion of enzymes for degradation of callose wall around pollen tetrad,
3. production of Ubisch granules and pollenkitt, etc.
4. amoeboid tapetum contributes in the formation of exine.

(iii) The structure M in the figure represents sporogenous cells. The sporogenous cells divide to increase their number with the growth of anther and ultimately get transformed into microspore mother cells, which further undergo meiosis to produce microspores. This process is called microsporogenesis.

33. An operon is a part of genetic material (or DNA), which acts as a single regulated unit having one or more structural genes, an operator gene, a promotor gene, a regulator gene, a repressor and an inducer or corepressor (from external source).
Operons are of two types : Inducible and repressible.
Inducible operon is an operon, which remains switched off normally, but becomes operational in the presence of an inducer (a chemical substance or substrate) *e.g.* lactose as in the case of *lac* operon.
In the culture medium of *E.coli*, when lactose was added, *Lac* operon is switched on, as lactose acts as inducer, and inactivates the repressor. Due to this switching on of the *lac* operon system, β-galactosidase is formed, which converts lactose into glucose and galactose. As soon as the lactose is consumed, the repressor again becomes active and causes switching off, of the system.

OR

(a) Aminoacylation or charging of *t*RNA occurs during translation. In this process, a *t*RNA is specially linked to an amino acid.
Charging is a two-step process : In the first step, an amino acid reacts with ATP, in the presence of a specific aminoacyl *t*RNA synthetase, to produce the activated form or an aminoacyl adenylic acid.

$$\underset{\substack{\text{(Amino}\\\text{acid)}}}{AA} + ATP + E \xrightarrow{Mg^{2+}} \underset{\substack{\text{(Amino-acyl}\\\text{tRNA synthetase)}}}{} \underset{\substack{\text{(Aminoacyl enzyme}\\\text{complex)}}}{AA\sim AMP - E} + \underset{\substack{\text{(Inorganic}\\\text{pyrophosphate)}}}{PPi}$$

In the second step, the complex now reacts with a specific *t*RNA and the amino acid is linked to the 3′-OH-end of *t*RNA through its –COOH group to form aminoacyl-*t*RNA complex. The enzyme and AMP leave the complex. Such a *t*RNA complexed with amino acid is called charged *t*RNA.

$$\underset{\text{(Aminoacyl enzyme complex)}}{AA \sim AMP - E} + tRNA \longrightarrow \underset{\text{(Aminoacyl tRNA)}}{AA \sim tRNA} + E + AMP$$

(b) Translation is the process in which the genetic message, carried by *m*RNA from the DNA, is converted in the form of a polypeptide chain, having a specific sequence of amino acids.
Besides *m*RNA, the three key players in this process are – ribosomes, *t*RNA and amino acids.
Translation occurs in the cytoplasm where the ribosomes are located.
The main steps of translation are:
(i) Initiation : For initiation, the ribosome binds to the *m*RNA at the start codon (AUG), that is recognised only by the initiator *t*RNA.
(ii) Elongation : 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 and peptide bonds are established between the adjacent amino acids. This results in polypeptide sequences dictated by DNA and represented by *m*RNA.
(iii) Termination : At the end, a release factor binds to the stop codon, terminating translation and releasing the complete polypeptide from the ribosome.

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