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

2. Mention any one application of a pollen bank.

3. When do the oogenesis and the spermatogenesis initiate in human females and males respectively?

4. Mention the function of trophoblast in human embryo.

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

6. Write the conclusions Mendel arrived at on dominance of traits on the basis of monohybrid crosses that he carried out in pea plants.

7. What will happen if DNA replication is not followed by cell division in a eukaryotic cell?

8. How is gene therapy carried out to treat the patients suffering from ADA deficiency disease?

9. Mention the type of host cells suitable for the gene guns to introduce an alien DNA.

10. Mention the kind of biodiversity more than a thousand varieties of mangoes in India represent. How is it possible?

11. **Assertion :** In monohybrid cross, in F_2 generation, two traits of character are expressed in the proportion of 3 : 1.
Reason : 3 : 1 ratio of F_2 generation is due to segregation of factors present in F_1 plants during gamete formation.

(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 F_1 generation of Andalusian fowls comprises of blue coloured fowls.

Reason : Blue colour is due to epistatic suppression of black colour in one of parental fowls by alleles of white colour.

(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 : A piece of DNA inserted into an alien organism generally does not replicate if not inserted into a chromosome.

Reason : Chromosomes have specific sequences called 'ori' region where DNA replication is initiated.

(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 : Critically endangered category includes the species which have sufficient population at present but is undergoing depletion due to some factors.

Reason : Vulnerable category includes the species which are facing very high risk of extinction in the wild and can become extinct any moment.

(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.

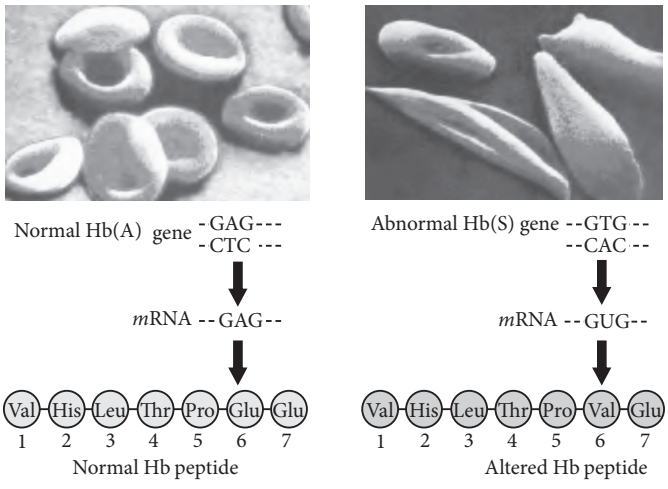
14. Assertion : Elimination of a competitively inferior species in a closely related or otherwise similar group is known as competitive exclusion principle.

Reason : If two species compete for the same resource, they could avoid competition by choosing different times for feeding or different foraging patterns.

(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:

An individual is suffering an autosomal hereditary disorder in which erythrocytes change their shape under oxygen deficiency such as during strenuous exercise and at high altitudes. His haemoglobin is different from normal haemoglobin, as shown below:



(i) From which disorder is an individual suffering?
(a) Cystic fibrosis (b) Sickle cell anaemia
(c) Beta-thalassemia (d) Alkaptanuria

(ii) Identify the type of chromosomal aberration leading to this condition.
(a) Substitution (b) Deletion (c) Inversion (d) Duplication

(iii) What is the genotype of carrier of this disease?
(a) Hb^sHb^s (b) Hb^AHb^A (c) Hb^AHb^s (d) Both (a) and (c)

(iv) How is abnormal haemoglobin peptide different from normal haemoglobin peptide?
(a) Glutamic acid instead of valine (b) Valine is present instead of glutamic acid
(c) Proline is substituted by valine (d) Glutamic acid is replaced by proline

(v) **Assertion :** Sickle shaped erythrocytes can cause anaemia.
Reason : Sickle shaped erythrocytes cannot pass through narrow capillaries and have tendency to clot and degenerate.
(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:
A 35 year old Sudha was suffering from diabetes mellitus type I, causing high levels of blood sugar and undersecretion of insulin. On diagnosis, it was found that her immune system has started destroying body's own protein. Pedigree analysis revealed that disease run in the family.

(i) What type of disease is diabetes mellitus?
(a) Allergy (b) Autoimmune disease
(c) Immunodeficiency disease (d) None of these

(ii) How is T-cell population affected in such disease?
(a) Helper T cells increase and suppressor T cells decrease
(b) Helper T cells decrease and suppressor T cells increase
(c) Killer T cells increase and Helper T cells decrease
(d) T cells decrease and B cells increase

(iii) Which of the following organs or tissues gets affected in diabetes mellitus?
(a) α-cells of pancreas (b) Red blood cells (c) β-cells of pancreas (d) Both (a) and (c)

(iv) Find the odd one out.
(a) Rheumatic fever (b) Rheumatoid arthritis
(c) Systemic lupus erythematosus (d) SCID

(v) What could be the possible treatment for such diseases?
(a) Use of stem cells (b) Use of MAb (c) T cell vaccination (d) None of these

SECTION - B

17. List any four characteristics of an ideal contraceptive.

OR

Mention the problems that are taken care of by Reproduction and Child Health Care Programme.

18. A template strand is given below. Write down the corresponding coding strand and the *m*RNA strand that can be formed, along with their polarity.
3′ ATGCATGCATGCATGCATGCATGC 5′

19. Name the cells that act as HIV factory in humans when infected by HIV. Explain the events that occur in the infected cell.

20. How 'origin of replication' (ori) is responsible for controlling the copy number of the linked DNA?

21. With the help of a diagrammatic representation show the steps of gene therapy.

22. Shark is eurythermal while polar bear is stenothermal. What is the advantage the former has and what is the constraint the later has?

23. **(a)** Pollinating species of wasps show mutualism with specific fig plants. Mention the benefits the female wasps derive from the fig trees from such an interaction.
(b) Why are cattle and goats not seen browsing on *Calotropis* growing in the fields?

24. If 8 individuals in a population of 80 butterflies die in a week, calculate the death rate of population of butterflies during that period.

25. A bioreactor is more advantageous than shake flasks. Explain how.

OR

How "Rosie" considered different from a normal cow?

SECTION - C

26. **(a)** Explain the phenomena of multiple allelism and co-dominance taking ABO blood group as an example.
(b) What is the phenotype of the following?
(i) $I^A\, i$
(ii) ii

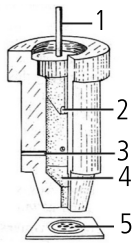
27. **(a)** Name the causative organisms for the following diseases:
(i) Elephantiasis, (ii) Ringworm, (iii) Amoebiasis
(b) How can public hygiene help to control such diseases?

28. Explain three different modes of pollination that can occur in a chasmogamous flower.

OR

Differentiate between geitonogamy and xenogamy in plants. Which one between the two will lead to inbreeding depression and why?

29. **(a)** Which instrument is shown in the given figure?



(b) Identify the parts labelled 1, 2, 3, 4 and 5.
(c) What is its use in gene transfer methods?

30. How do snails, seeds, bears, zooplanktons, fungi and bacteria adapt to conditions unfavourable for their survival?

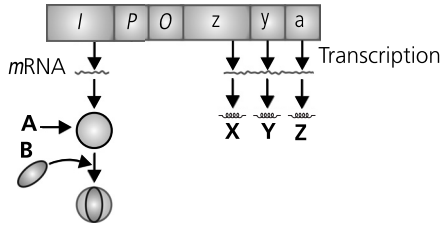
SECTION - D

31. Describe the roles of pituitary and ovarian hormones during the menstrual cycle in a human female.

OR

Draw a labelled diagram of the microscopic structure of a human sperm. Explain the functions of each part.

32. Refer to the given figure and answer the following questions.



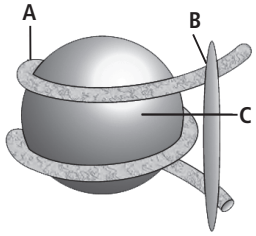
(i) Identify A, B, X, Y and Z in the given figure.

(ii) Briefly describe the function of A.

(iii) Which labelled part is involved in hydrolysing the lactose?

OR

Refer to the given figure and answer the following questions.



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

(ii) Write down the composition of labelled part C.

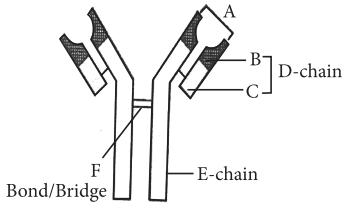
(iii) Briefly describe two functions of the labelled part A.

33. **(a)** State the functions of primary and secondary lymphoid organs in humans.

(b) Write the events that take place when a vaccine for any disease is introduced into the human body.

OR

(a) Identify A, B,C, D, E and F in the diagram of an antibody molecule given below:



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

SOLUTIONS

1. In the most common type of endosperm development of coconut the PEN undergoes successive nuclear divisions to give rise to free nuclei. This stage of endosperm development is called free-nuclear endosperm. Subsequently cell wall formation occurs and the endosperm becomes cellular. The number of free nuclei formed before cellularisation varies greatly. The coconut water from tender coconut is free-nuclear endosperm (made up of thousands of nuclei) and the surrounding white kernel is the cellular endosperm.

2. Pollen banks are used to store pollen grains for long time, which can be used in plant breeding programmes. In pollen banks, pollens are stored in liquid nitrogen at a temperature of –196°C.

3. Oogenesis begins during embryonic development stage while spermatogenesis begins during puberty.

4. Trophoblast helps to provide nutrition to the embryo.

5. 50% of heterozygous tall pea plant is obtained in F_2 generation. 25% of homozygous recessive is obtained in F_2 generation. It can be illustrated as :

Tt (Heterozygous tall)
↓ Selfing

♀ \ ♂	T	t
T	TT	Tt
t	Tt	tt

TT : Tt : tt
25% 50% 25%

6. Whenever Mendel carried out a cross between plants for a contrasting trait he found that only one trait out of the two appears in the F_1 generation. He concluded that the trait which is expressed in F_1 is dominant while the one which remains hidden is recessive. He also said that characters are controlled by discrete unit called factors which occur in pair.

7. DNA replication doubles the amount of DNA in a cell and cell division again halves the amount of DNA, *i.e.*, maintains the normal amount of DNA in the daughter nuclei. Thus, if DNA replication is not followed by cell division in a eukaryotic cell, then amount of DNA will increase than normal, resulting in abnormal conditions such as polyploidy.

8. In gene therapy, lymphocytes are extracted from the bone marrow of the patient and are grown in a culture outside the body. A functional ADA cDNA (using a retrovirals vector) is then introduced into these lymphocytes, which are reinjected to the patient's bone marrow. But these cells do not remain alive always and the patient requires periodic infusion of such genetically engineered lymphocytes.

9. Undifferentiated plant cells are the most suitable host cells for the gene gun to introduce an alien DNA. It is because plant cells have rigid cell wall which can be easily broken down by bombarding them with high velocity micro-particles of gold or tungsten coated with DNA.

10. More than a thousand varieties of mango in India exhibit genetic diversity. Genetic diversity represents the diversity in number and types of genes as well as chromosomes and variations in the genes and their alleles in the same species.
The reason for this genetic diversity is the occurrence of variations in environmental parameters and use of horticulture techniques like grafting, breeding, etc.

11. (a) : In monohybrid cross, at the time of gamete formation, the two factors separate or segregate and pass into different gametes. A gamete come to have one factor of a pair. The gametes fuse randomly during fertilisation so that factors come together in new generation and express themselves freely. The two traits of the character appear in F_2 generation in ratio of three dominant to one recessive, 3 : 1.

OR

(c) : Andalusian fowls have two pure forms, black and white. If the two forms are crossed, F_1 individuals appear blue coloured due to occurrence of fine alternate black and white strips on the feathers. Hence blue colour in fowls is due to incomplete dominance where none of the two contrasting alleles or factors is dominant. The expression of the character in a hybrid or F_1 individual is intermediate or a fine mixture of the expression of the two factors.

12. (a) : 'Origin of replication' is a sequence from where replication starts by binding of polymerase

enzyme. An isolated piece of DNA without origin of replication or 'ori' site cannot replicate and is gradually lost during nuclear divisions. But if it is inserted within a chromosome it is replicated along with the chromosome.

13. (d) : Critically endangered is the highest risk category assigned by the IUCN red list for wild species. Critically endangered species are those that are facing a very high risk of extinction in the wild and can become extinct any moment in the immediate future. 'Vulnerable' species are those whose population is sufficient at present but is undergoing depletion due to some factors so that it is facing the risk of becoming extinct in medium term future. In other words, a taxon is vulnerable when it is not critically endangered or endangered but is facing a high risk of extinction in the wild in the medium-term future.

14. (b) : Gause's 'competitive exclusion principle' states that two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior one is eliminated eventually. This may be true if resources are limiting, but not otherwise. Mechanism of 'Resource partitioning' states that if two species compete for the same resource, they could avoid competition by choosing, for instance, different times for feeding or different foraging patterns.

15. (i) (b) : Sickle cell anaemia is an autosomal disorder in which erythrocytes become sickle shaped under oxygen deficiency.

(ii) (a) : In Hb^s, glutamic acid is replaced by valine due to substitution of T by A.

(iii) (c) : Genotype of heterozygous carrier is Hb^AHb^s. Homozygous sickle called individual (Hb^sHb^s) die in childhood.

(iv) (b) : *Refer to answer 15(ii).*

(v) (a)

16. (i) (b) : Diabetes mellitus type I is an autoimmune disease where immune system fails to recognise self from non-self and starts destroying the body's own proteins, leads to some malfunctions.

(ii) (a) : Increased helper T-cell and decreased suppressor. T-cells functions have been suggested as causes of autoimmunity.

(iii) (c)

(iv) (d) : Rheumatic fever, Rheumatoid arthritis and systemic lupus erythematosus are all autoimmune diseases.

(v) (d)

17. An ideal contraceptive must have the following four characteristics :

(i) It must be safe and user friendly.

(ii) It must be easily available.

(iii) It must be reversible with little or no side effects.

(iv) It must in no way interfere with the sexual drive, desire or sexual act of the user.

OR

Reproductive and Child Health Care (RCH) programmes cover wide range of reproduction-related areas. Creating awareness among people about various reproduction related aspects and providing facilities and support for building up a reproductively healthy society are the major tasks under these programmes.

18. The corresponding coding strand is :

5′ TACGTACGTACGTACGTACGTACG 3′

The corresponding *m*RNA strand is :

5′ UACGUACGUACGUACGUACGUACG 3′

19. Macrophages act as HIV factory in humans. Events that occur in infected cells are:

(i) After the entrance of the virus into the body of the person, the virus enters into macrophages where RNA genome of the virus replicates to form viral DNA with the help of reverse transcriptase enzyme.

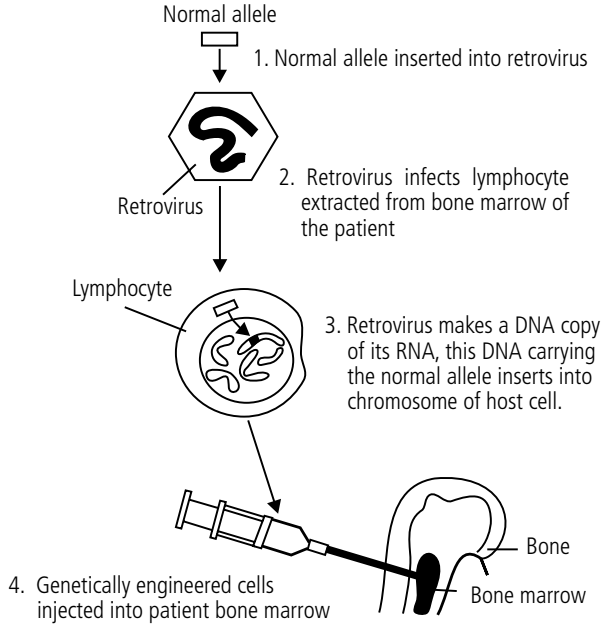
(ii) Viral DNA gets incorporated into the host cell's DNA and directs the infected cells to produce viruses.

(iii) Simultaneously, HIV virus enters into helper T lymphocytes where it replicates and produces more viruses. This is repeated so that the number of helper T lymphocytes decreases in the body of the infected person.

(iv) Due to decrease in the number of helper T lymphocytes in the body, the person starts suffering from infections and gets immune deficiency and he/she is unable to protect himself/herself against these infections.

20. Any piece of DNA when linked to the 'ori' sequence, can be made to replicate within the host cells. This property of 'ori' is used to make a number of copies of the linked DNA. If we want to obtain many copies of the target DNA, then it should be cloned in such a vector whose 'ori' supports high copy number.

21. Steps of gene therapy can be summarised in the given diagram:



22. Sharks being eurythermal can tolerate wide range of temperature variations and thus have wider distribution on earth, on the other hand, polar bear being stenothermal can tolerate only narrow range of temperature and is restricted to specific regions only.

23. (a) Many species of fig trees have mutual relationship with the pollinator species of wasp. A given fig species can be pollinated only by its partner wasp species and not by other species. The female wasp uses the fruit not only as an oviposition (egg laying) site but also uses the developing seeds within the fruit for nourishing its larvae. The wasp pollinates the fig inflorescence while searching for suitable egg-laying sites. In return the fig offers the wasp some of its developing seeds as food for the developing wasp larvae.

(b) Cattle and goats are never seen grazing on *Calotropis*, because *Calotropis* is a weed that produces highly poisonous cardiac glycosides. It is a harmful chemical that makes herbivores sick, inhibits feeding or digestion, disrupts reproduction or even kills them.

24. Death rate is defined as the number of deaths per 1000 individuals of a population. Since, total number of butterflies = 80,

Number of butterflies that died = 8

Death rate $= \frac{8}{80} = 0.1$ butterflies per week

25. A bioreactor is more advantageous than shake flasks. It has an agitator system to mix the contents properly, an oxygen delivery system to make availability of oxygen, a foam control system, a temperature control system, a pH control system and a sampling port to withdraw the small volumes of the culture periodically.

OR

Rosie is the first transgenic cow which contains human gene coding for protein alpha-lactalbumin. The gene is expressed in mammary tissues and the protein is secreted in milk. This milk is nutritionally a more balanced product for human babies than natural cow milk.

26. (a) In the ABO system, there are four blood groups A, B, AB and O. ABO blood groups are controlled by gene *I*. The gene *I* has three alleles I^A, I^B and *i*. This phenomenon is known as multiple allelism. I^A and I^B are completely dominant over *i*. When I^A and I^B are present together they both express themselves and produce blood group AB. This phenomenon is known as co-dominance.

(b) (i) $I^A i$ – Blood group A,
(ii) *ii* – Blood group O

27. (a) (i) Elephantiasis – *Wuchereria bancrofti*
(ii) Ringworm – *Microsporum*
(iii) Amoebiasis – *Entamoeba histolytica*

(b) Maintenance of public hygiene is very important for prevention and control of many infectious diseases. Public hygiene includes proper disposal of waste and excreta, periodic cleaning and disinfection of water reservoirs, pools and tanks and observing standard practices of hygiene in public catering. These measures are particularly essential where the infectious agents are transmitted through food and water such as typhoid, amoebiasis and ascariasis.

28. A chasmogamous flower can undergo
(i) Self pollination or autogamy : Here pollens of a flower fertilise the stigma of the same flower.
(ii) Geitonogamy : Here pollens of one flower fertilise the stigma of another flower present on the same plant.
(iii) Xenogamy or cross pollination : Here pollens of one flower fertilise the stigma of another flower present on different plant of same species.

OR

Differences between xenogamy and geitonogamy are as follows:

S.No.	Xenogamy	Geitonogamy
(i)	It is pollination between two flowers of different plants.	It is pollination between two flowers of the same plant.
(ii)	The flowers are genetically different.	The flowers are genetically similar.
(iii)	It is genetically cross pollination.	It is genetically self pollination.

Geitonogamy will lead to inbreeding depression because it is a type of pollination in which pollen grains are transferred from anther to stigma of different flowers belonging to the same plant.

29. (a) The instrument is gene gun.

(b) (1) Firing pin, (2) DNA coated pellets (3) Vent, (4) Stopping plate and (5) Target cells.

(c) Gene gun (or biolistic) method is a vectorless method of gene transfer in which tungsten or gold particles, coated with foreign DNA are bombarded into target cells at a very high velocity.

30. Ecological adaptations are special characteristics evolved or developed by organisms in order to live comfortably and successfully under a prevailing set of environmental conditions. Adaptations may be morphological, physiological or behavioural or a combination of them. The ultimate aim of all adaptations is to make the individual fit to obtain food and space for its survival, opportunities for its reproduction and rearing of young ones.

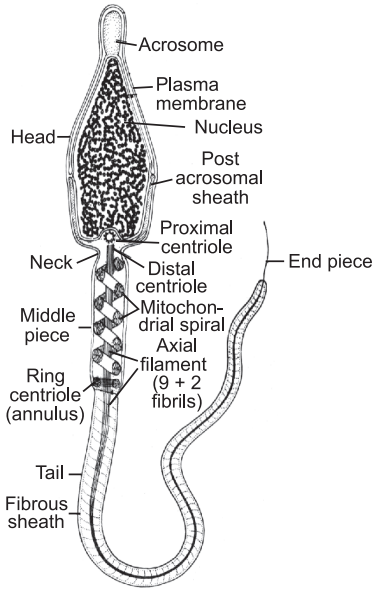
Various kinds of thick walled spores are formed in bacteria, fungi and lower plants which help them survive under unfavourable conditions. These germinate on return of suitable conditions. Some organisms retard their metabolic activities under stress conditions and undergo hibernation or aestivation. For example, polar bears go into hibernation during winter season to escape extreme cold. Some snails and fish undergo aestivation to avoid summer-related problems like heat and dessication. Under unfavourable conditions many zooplanktons in lakes and ponds are known to enter diapause, *i.e.*, a stage of suspended growth and development. Seeds remain dormant in unfavourable conditions. They break dormancy and germinate in favourable environmental conditions.

31. Menstrual cycle in a human female consists of menstrual phase, proliferative phase (follicular phase), ovulatory phase and secretory phase (luteal phase). Days 1-5 of the cycle are known as the menstrual phase. During this phase, menstruation occurs. At the beginning of this stage, levels of progesterone and estrogen have dropped dramatically because of the degeneration of the last cycle's corpus luteum. This triggers the shedding of endometrium. The detached portion of the endometrium as well as blood will pass through the vagina as the menstrual flow. Days 5-14 are known as the proliferative phase. Proliferative phase consists of growth of endometrium of uterus, Fallopian tube and vagina. In ovary, a Graafian follicle grows, matures and secretes estrogen during this phase. The endometrium grows thicker and becomes more vascularised and glandular. Changes in the level of pituitary and ovarian hormones bring about these changes in the ovary and uterus. The level of LH and FSH increase gradually during the follicular phase and stimulate follicular development as well as secretion of estrogens by the growing follicles. In ovulatory phase, both LH and FSH attain a peak level in the middle of cycle (about 14^{th} day). Rapid secretion of LH leading to its maximum level during the mid-cycle called LH surge induces rupture of Graafian follicle and thereby the release of ovum (ovulation).

Days 15-28 are known as luteal phase or secretory phase. After ovulation and in response to luteinising hormone, the portion of the Graafian follicle that remains in the ovary enlarges and is transformed into a corpus luteum containing yellow substance (called lutein) and the luteal phase begins. The corpus luteum secretes large amounts of progesterone which is essential for maintenance of endometrium. Such an endometrium is necessary for implantation of the fertilised ovum and other events of pregnancy. In the absence of fertilisation, the corpus luteum degenerates. This causes disintegration of the endometrium leading to menstruation, marking a new cycle.

OR

Labelled diagram of a human sperm is as follows:



Sperm is a microscopic structure consisting of four parts: head, neck, middle piece and tail. A plasma membrane envelops the whole body of sperm. Head consists of large posterior haploid nucleus and a small anterior cap-like acrosome. Acrosome contains proteolytic and lysosomal enzymes popularly called sperm lysins, required to penetrate the egg at the time of fertilisation. Neck is present between the head and middle piece. It contains the proximal centriole towards the nucleus which plays a role in the first cleavage of the zygote and the distal centriole which gives rise to the axial filament of the sperm. Middle piece is a long cylindrical part of sperm which lies between the neck and tail. Axoneme or axial filament of microtubules runs through it. The same is covered by a mitochondrial spiral (nebenkern) of 10-14 turns. Mitochondrial activity helps in providing energy. The distal end bears a ring centriole or annulus of uncertain role. Tail is very long slender and tapering, and is formed of cytoplasm. Tail is vibratile part of sperm.

32. (i) A – Repressor protein; B – Inducer;
X – β-galactosidase; Y – Permease
Z – Transacetylase

(ii) The given figure is of the *lac* operon in the presence of an inducer. 'A' represents the repressor protein. It is meant for blocking the operator gene so that the structural genes are unable to form *m*RNAs (transcribe). It has two allosteric sites, one for attaching to operator gene and other for binding to the inducer. After coming in contact with inducer the repressor undergoes conformational change and is unable to combine with operator, which allows the transcription of *z*, *y* and *a* gene.

(iii) β–galactosidase (labelled part X) is involved in hydrolysing lactose. It breaks lactose into glucose and galactose.

OR

(i) A – DNA, B – H_1 Histone, C – Histone octamer

(ii) The given figure is of a nucleosome and the labelled part C represents histone octamer. It is composed of four type of histone proteins, *i.e.*, H_2A, H_2B, H_3 and H_4. Each of these histones occur in pairs.

(iii) Labelled part A represents DNA. Two functions of DNA are as follows :

(1) Genetic information (Genetic Blue Print) : DNA is the genetic material which carries all the hereditary information. The genetic information is coded in the arrangement of its nitrogen bases.

(2) Replication: DNA has unique property of replication or production of carbon copies. This is essential for transfer of genetic information from one cell to its daughters and from one generation to the next.

33. (a) There are two types of lymphoid organs : primary lymphoid organs and secondary lymphoid organs. The primary lymphoid organs, *e.g.*, bone marrow and thymus where T lymphocytes and B lymphocytes, mature and acquire their antigen-specific receptors. After maturation, the lymphocytes migrate to secondary lymphoid organs, *e.g.,* spleen and lymph nodes where they undergo proliferation and differentiation. The acquired immune response to antigens usually develops in these organs and become effector cells.

(b) In vaccination, a preparation of antigenic proteins of pathogens or weakened pathogen is introduced into the body. These antigens generate the primary immune response and the memory B and T cells. When the vaccinated person is attacked by the same pathogen again, the existing memory T or B cells recognise the antigen quickly and attack the invaders with massive production of lymphocytes and antibodies.

OR

(a) A – Antigen binding site
B – Variable region
C – Constant region
D – Light chain
E – Constant region of heavy chain
F – Disulphide bond

(b) A person with cuts and bruises following an accident has chances of getting infected from tetanus. So, in this case quick immune response is required which is provided by giving the patient tetanus antitoxin which is a preparation containing preformed antibodies to the toxin.

☺ ☺ ☺