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)	–	–	–	**2(2)**	**14**
2.		Human Reproduction	2(2)	–	1(3)	1+1*(5)	**4(10)**	
3.		Reproductive Health	–	1(2)	–	–	**1(2)**	
4.	Unit-VII	Principles of Inheritance and Variation	3(6)	1+1*(2)	1(3)	–	**5(11)**	**18**
5.		Molecular Basis of Inheritance	2(2)	–	–	1+1*(5)	**3(7)**	
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)	–	–	**3(4)**	**12**
9.		Biotechnology and Its Applications	1+1*(1)	2(4)	1(3)	–	**4(8)**	
10.	Unit-X	Organisms and Populations	2(2)	–	1+1*(3)	–	**3(5)**	**12**
11.		Biodiversity and Conservation	2(5)	1(2)	–	–	**3(7)**	
		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. All papaya plants bear flowers but fruits are seen in some. Explain.

2. Mention an advantage of apomictic seeds to farmers.

3. List the changes the primary oocyte undergoes in the tertiary follicular stage in the human ovary.

4. Name the phase of menstrual cycle when a Graafian follicle transforms into an endocrine structure. Write its action thereafter.

5. Write the chromosomal defect in individuals affected with Klinefelter's syndrome.

6. How many chromosomes do drones of honeybee possess? Name the type of cell division involved in the production of sperms by them.

7. Mention the role of the codons AUG and UGA during protein synthesis.

8. Golden rice is a transgenic variety of rice. What is its characteristic property?

9. Penicillium inhibiting the growth of *Staphylococcus* bacterium shows which type of interaction?

10. What do phytophagous insects feed on?

11. **Assertion :** *Lac* operon is a repressible operon.
Reason : The product of gene activity stops the activity of the said gene.
(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 :** Bacteriophage vectors are more advantageous than plasmid vectors.
Reason : Bacteriophage vectors can be easily detected at the time of cloning experiments.

(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 : Spare parts of pig such as heart, pancreas, etc., for human use can be grown through transgenic animals.

Reason : Transgenic pigs show improved growth and meat production.

(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 :** Coral reefs are found only in temperate forests.

Reason : Minimum diversity of biota are found in the reefs.

(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 :** Lysozyme is usually used to dissolve the bacterial cell wall.

Reason : Cleaving enzymes are used to break DNA molecules.

(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:**

India is one of the biodiversity rich country of the world. Now-a-days world is facing accelerated rates of biodiversity loss due to various anthropogenic reasons. Biodiversity loss describes the decline in the number, genetic variability and variety of species, and the biological communities in a given area. There are four major causes of biodiversity loss that are also known as 'The Evil Quartet' *viz*., habitat loss and fragmentation, over-exploitation, alien species invasion and co-extinction. Habitat loss and fragmentation is the most important factor that is responsible for the extinction of animals and plants. Tropical rainforests once covering more than 14 per cent of the earth's land surface now cover no more than 6 per cent. Similarly the Amazon rainforest also known as the 'lungs of the planet' harbouring probably millions of species is being cut and cleared for cultivating soya beans or for conversion to grasslands for raising beef cattle. In 2019, the forest fires in Amazon forest lead to the destruction of many animal and plant species. Besides total loss, the degradation of many habitats by pollution also threatens the survival of many species. The over-exploitation of resources by humans have lead to the extinction of many species in the last 500 years, *e.g.,* Steller's sea cow, passenger pigeon. Alien species invasions whether intentionally or unintentionally also cause decline or extinction of indigenous species. The best example is the extinction of more than 200 species of Cichlid fish due to introduction of Nile perch into Lake Victoria in East Africa. When a species becomes extinct, the plant and animal species associated with it in an obligatory way also become extinct. Therefore, the co-extinction is also an important factor in biodiversity loss.

(i) Evil quartet of biodiversity loss does not include

(a) habitat destruction
(b) forest fires
(c) invasion by alien species
(d) over exploitation.

(ii) The species lost due to overexploitation is

(a) Steller's sea cow (b) Cichlid fish

(c) common pigeon (d) both (a) and (c).

(iii) Biodiversity of any region includes

(a) only the flora of the region

(b) only the fauna of the region

(c) both the flora and fauna of the region

(d) flora, fauna and microorganism diversity of the region.

(iv) The introduction of Nile perch in lake Victoria of East Africa has lead to the

(a) excessive growth of weeds in water (b) excessive growth of cichlid fish

(c) elimination of cichlid fish (d) none of these.

(v) **Assertion :** Climate change leads to the biodiversity destruction.

Reason : All forms of pollution pose a serious threat to biodiversity.

(a) Both assertion and reason are true, and the reason is the correct explanation of the assertion.

(b) Both assertion and reason are true, but the reason is not the correct explanation of the 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:

According to the genetic sex-determination systems, the sex of an organism is determined by the genome it inherits from parents, *i.e.,* the asymmetrically inherited sex chromosomes that carries the genetic features that influence development of an individual. In most of the cases, the males produce two different types of gametes and females produce single type of gametes. Such type of sex determination mechanism is designated to be the example of male heterogamety. In birds, the sex is determined by two chromosomes *viz*., Z and W. In birds, a different mechanism of sex determination is observed- Females are heterogametic (ZW) and males are homogametic (ZZ). In this case, the total number of chromosomes are same in both males and females but two different types of gametes in terms of the sex chromosomes, are produced by females. The two different sex chromosomes of a female bird has been designated to be the Z and W chromosomes. In birds, the females have one Z and one W chromosome, whereas males have a pair of Z-chromosomes besides the autosomes. The ZZ-ZW mechanism of sex determination is not restricted to birds. Within the vertebrates, a similar system of sex determination has been identified in reptiles, as well as in some fishes and amphibians.

(i) Sex determination in humans is because of _____.

(a) female heterogamety (b) male heterogamety

(c) male isogamety (d) both (b) and (c).

(ii) Sex determination in birds is different from humans in having _____.

(a) male heterogamety (b) female heterogamety

(c) female homogamety (d) none of these.

(iii) ZZ/ZW type of sex determination is seen in _____.

(a) reptiles (b) cats

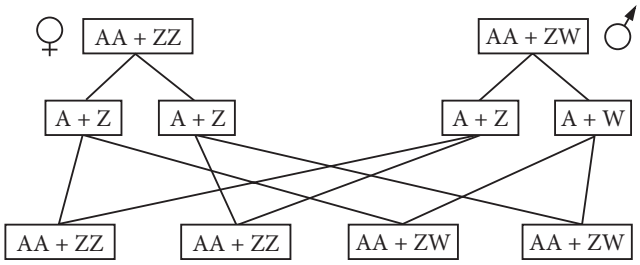
(c) humans (d) dogs

(iv) What type of sex mechanism does grasshopper have?

(a) XY type (b) ZW type

(c) XO type (d) XX type

(v) Study the given cross.



Which of the following statements are correct for the above cross?

I. There is an equal chance of production of male or female.

II. This type of sex determination is seen in humans.

III. This type of sex determination is seen in some amphibians and fishes.

Choose the correct option.

(a) Only I and II are true. (b) Only II and III are true.

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

SECTION - B

17. When surrogacy could be helpful for infertile couples?

18. How linkage and crossing over of genes are different from each other?

OR

With the help of one example, explain the phenomena of co-dominance and multiple allelism in human population.

19. Name the bacterium responsible for the large holes seen in "Swiss Cheese". What are these holes due to?

OR

Explain the role of flocs in sewage treatment.

20. Why a bacterial cell must be made competent to take up DNA? Explain the steps by which a bacterial cell is made competent to take up recombinant DNA.

21. (a) Mice are the most preferred mammals for studies on gene transfer. Justify the statement.

(b) Which human genes encoding valuable proteins have been transferred into transgenic rabbits?

22. (a) Name the *cry* genes that control cotton bollworm and corn borer respectively.

(b) Why Bt toxin do not kill the bacterium that produces it, but kill the insect that ingest it?

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

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

24. Why are sacred groves highly protected?

25. List the events that lead to biogas production from wastewater, whose BOD has been reduced significantly.

SECTION - C

26. Draw a diagram of the microscopic structure of human sperm. Label the following parts in it and write their functions.
(i) Acrosome
(ii) Nucleus
(iii) Middle piece

27. Describe how biogas is generated from activated sludge. List the components of biogas.

28. What are biopatents? Mention their significance.

29. Differentiate between mutualism, parasitism and commensalism. Provide one example for each of them.

OR

Draw and explain expanding age pyramids of human population. Why is it so called?

30. What is a test cross? How can it decipher the heterozygosity of a plant?

SECTION - D

31. **(a)** Name the hormone that initiates spermatogenesis in humans. Describe the process of spermatogenesis in sequence mentioning the ploidy of the cells at each step.
(b) With the diagram show hormonal control of male reproductive system.

OR

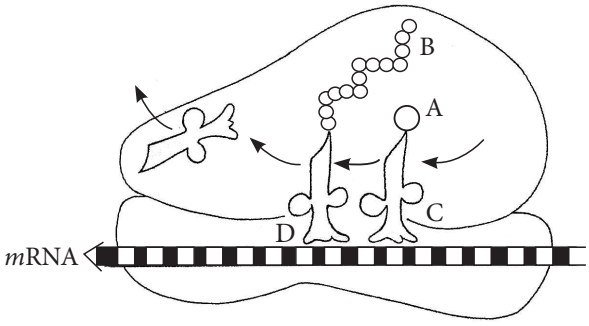
Explain the different phases of menstrual cycle and correlate the phases with the different levels of ovarian hormones in a human female.

32. **(a)** Cancer is one of the most dreaded disease. Explain 'contact inhibition' and 'metastasis' with respect to the disease.
(b) Name the group of genes that have been identified in normal cells that could lead to cancer. How do these genes cause cancer?
(c) Name any two techniques that are useful in detecting cancers of internal organs.
(d) Why are cancer patients often given α-interferon as part of the treatment?

OR

(a) Name and explain any four lymphoid organs present in humans.
(b) Categorise the named lymphoid organs as primary or secondary lymphoid organs, giving reasons.

33. Observe the given figure and answer the following questions.



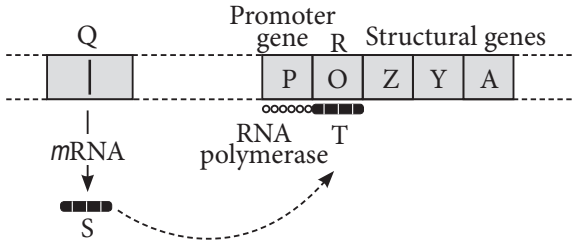
(i) Identify A, B, C and D in the given figure.

(ii) State the function of C and D.

(iii) How does elongation of B occur?

OR

Study the given figure and answer the following questions.



(i) Identify the figure and Q, R, S and T.

(ii) Explain the function of S.

(iii) State the function of Z, Y and A in presence of lactose in the medium.

SOLUTIONS

1. Papaya plant is dioecious plant and bears male and female flowers on different plants, *i.e.*, male plant and female plant. Fruit is formed by the female part of the flower after fertilisation following double fertilisation. As these female structures are found only on female papaya plants hence fruits are present only on female papaya plant whereas male papaya plant only produces gametophytes, *i.e.*, pollen grains which bear male gametes.

2. In hybrid apomicts, there is no segregation of characters in hybrid progeny. So, farmers can keep on using the hybrid seeds to raise new crop year after year and they do not have to buy new hybrid seeds every year.

3. The primary oocyte grows in size and completes its first meiotic division within the tertiary follicle.

4. Graafian follicle changes into an endocrine structure called corpus luteum during luteal phase of menstrual cycle. Corpus luteum secretes progesterone which stimulates the uterine glands to produce increased amount of watery mucus and is also essential for maintenance of the endothelium.

5. Klinefelter's syndrome is caused by union of an abnormal XX egg and a normal Y sperm or normal X egg and abnormal XY sperm. The individual has 47 (44 + XXY) chromosomes.

6. Drones of honeybees are haploid and possess 16 chromosomes. Mitosis is involved in the production of sperms.

7. AUG has dual functions. It functions as initiation codon during protein synthesis and also codes for methionine. UGA does not specify any amino acid hence it functions as terminator codon.

8. Golden rice is a transgenic variety of rice that contains good quantities of β-carotene, a principle source of vitamin A.

9. Amensalism.

10. Phytophagous insects feed on plant sap and other parts of plants.

11. (d) : 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 promoter gene, a regulator gene, a repressor and inducer or corepressor (from outside). *Lac* operon is an inducible operon. An inducible operon system is a regulated unit of genetic material which is switched on in response to the presence of a chemical.

12. (a) : Bacteriophage vectors are more advantageous than plasmid vectors because bacteriophage vectors can be used for large. DNA fragments and can easily be detected at the time of cloning experiments.

OR

(b) : Transgenic pigs expressing human growth hormone do show improved growth and meat production, but they also show several health problems.

13. (d) : Coral reefs have fragile environment and vulnerable habitats so that they have maximum biodiversity despite having little seasonal changes of temperature and moisture.

14. (b)

15. (i) (b) : The Evil Quartet speaks of four factors that have impact on the environment and lead to biodiversity loss. They are habitat destruction and fragmentation, allen species, invasion, over-exploitation and co-extinction.

(ii) (a) : The Steller's sea cow and passenger pigeon got extinct due to over-exploitation. Cichlid fish got extinct due to invasion of exotic species and common pigeon is not extinct.

(iii) (d) : Biodiversity means biological diversity. It refers to every living thing, including plants, bacteria, animals and humans.

(iv) (c) : The introduction of Nile perch into Lake Victoria in East Africa lead to the extinction of more than 200 species of cichlid fish.

(v) (b) : Climate change is already having an impact on biodiversity and is projected to become a progressively more significant threat in the coming decades. All forms of pollution pose a serious threat to biodiversity, but in particular nutrient loading, primarily of nitrogen and phosphorus, is a major and increasing cause of biodiversity loss and ecosystem dysfunction.

16. (i) (b) : In humans, the males produce two different types of gametes and females produce single type of gametes. Such types of sex determination mechanism is designated to be the example of male heterogamety.

(ii) (b) : In humans, the males produce two different types of gametes and females produce single type of gametes, whereas in birds females produce two different types of gametes and males produce single type of gametes

(iii) (a) : In reptiles, the sex is determined by two chromosomes *viz*. Z and W. Males are homogametic (ZZ) and females are heterogametic (ZW).

(iv) (c)

(v) (c) : The given cross presents the sex determination in birds. In birds, the sex is determined by two chromosomes *viz*. Z and W. Females are heterogametic (ZW) and males are homogametic (ZZ). A similar system of sex determination has been seen in reptiles, as well as in some fishes and amphibians. This type of sex determination is different from humans where females are homogametic (XX) and males are heterogametic (XY).

17. When both the partners are producing normal gametes but female is unable to conceive due to some problem with Fallopian tube or uterus or hormonal levels of the female. Then, surrogacy is suggested to the couple. In this method the ova from the wife and sperms from the husband are induced to form zygote in the laboratory. The zygote is then allowed to divide to form embryo. A developing embryo is then implanted in the uterus of another female (surrogate mother). The surrogate mother then gives birth to the child.

18. Linkage is the tendency of two different genes on the same chromosome to remain together during the separation of homologous chromosomes at meiosis. Linked genes do not exhibit the dihybrid ratio of 9:3:3:1. It produces offspring with parental characters. Crossing over is the exchange of genes occurring during meiotic prophase I to break old linkage and establish new ones. It produces recombination resulting in new varieties. Thus, they are alternative of one another, *i.e.*, if linkage is present in between genes, no crossing over occurs between them and if crossing over occurs between the two genes, they are not linked.

OR

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.

19. Bacterium responsible for large holes in Swiss cheese is *Propionibacterium shermanii*. Large holes in Swiss cheese are due to CO_2 gas produced by these bacteria.

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. DNA is a hydrophilic molecule, it cannot pass through membranes, so the bacterial cells must be made capable to take up DNA. This is done by treating them with a specific concentration of a divalent cation, such as calcium which increases the efficiency with which DNA enters the bacterium through pores in its cell wall. 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.

21. (a) Mouse is the most preferred mammal for studies on gene transfer due to its many favourable features like short oestrous cycle and gestation period, relatively short generation time, production of several offspring per pregnancy, convenient *in vitro* fertilisation, successful culture of embryos *in vitro*, etc.
(b) The following human genes encoding valuable proteins have been transferred into rabbits : interleukin 2, growth hormone, tissue plasminogen activator, α_1 antitrypsin, etc. These genes were expressed in the mammary tissues and their proteins were harvested from milk.

22. (a) The proteins encoded by the genes *cry* I *Ac* and *cry* II *Ab* control the cotton bollworms, that of *cry* I *Ab* controls corn borer.

(b) The Bt toxin protein exist as inactive protoxins but once an insect ingest the inactive toxin, it is converted into an active form of toxin due to the alkaline pH of the gut which solubilise the crystals. The activated toxin binds to the surface of midgut epithelial cells and create pores that cause cell swelling and lysis and eventually cause death of the insect.

23. (a) Thymus is a primary lymphoid organ where the maturation of T-lymphocytes takes place. Thymus is quite large in size at the time of birth but it atrophies with age.

(b) T-lymphocytes are released from thymus. T cells provide cell-mediated immunity and defend against pathogens including protists and fungi that enter the cells.

24. Sacred groves are forest patches around places of worship, held in high esteem by tribal communities. They are most undisturbed forest patches which are often surrounded by highly degraded landscapes. Not a single branch is allowed to be cut from these forests and as a result, many endemic species which are rare or have become extinct elsewhere can be seen to flourish here. *E.g.,* Jaintia and Khasi hills in Meghalaya.

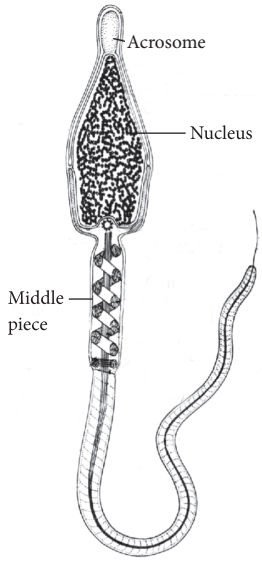
25. Sewage water can be purified by passing it through sewage treatment plants with the action of microorganisms. A sewage treatment plant separates solids from liquids by physical processes and purifies the liquid by biological processes. There are three stages of this treatment; primary, secondary and tertiary. Primary treatment is physical, secondary is biological and tertiary is 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.

A small part of the activated sludge is pumped back into the aeration tank to serve as the inoculum. The remaining major part of the activated sludge is pumped into large tanks called anaerobic sludge digesters. The anaerobic bacteria digest the bacteria and fungi in a sludge and produce mixture of gases like methane, hydrogen sulphide and CO_2 which constitute biogas.

26. The diagram of a human sperm with labelled parts-acrosome, nucleus and middle piece is as follows:



Functions:

(i) Acrosome : It contains hyaluronidase proteolytic enzymes, called spermlysins that are used to contact and penetrate the egg at time of fertilisation.

(ii) Nucleus : It contains chromatin material which will be responsible for the genetic make-up of the future zygote.

(iii) Middle piece : It contains mitochondria that provide energy for the movement of the sperm.

27. A small part of the activated sludge is pumped back into the aeration tank to serve as the inoculum. The remaining major part of the activated sludge is pumped into large tanks called anaerobic sludge digesters. The anaerobic bacteria digest the bacteria and fungi in a sludge and produce mixture of gases like methane, hydrogen sulphide and CO_2 which constitute biogas.

28. When patents are granted for biological entities and for products derived from them, these patents are called biopatents. Biopatents are awarded for (i) strains of microorganisms, (ii) cell lines, (iii) genetically modified strains of plants and animals, (iv) DNA sequences, (v) the proteins encoded by DNA sequences, (vi) various biotechnological procedures, (vii) production processes, (viii) products and its applications.

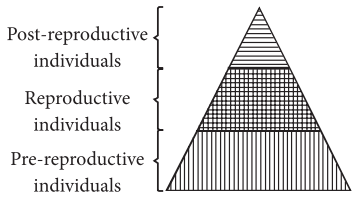
Significance of biopatents : Biopatent system allows private, monopoly rights over cells, genes, animals and plants. The important advantages of biopatents is that they are direct incentive for genetic engineering.

29. Differences between mutualism, commensalism and parasitism are as follows:

S.No.	Mutualism	Commensalism	Parasitism
(i)	It is an association between two organisms in which both are benefitted.	It is an association between two organisms in which only one is benefitted. The second is neither benefitted nor harmed.	It is an interaction between two living organisms of different species in which one organism called parasite obtains its food from another living organism called host, *i.e.,* one is benefitted and other is harmed.
(ii)	Contact between the two organisms is obligatory.	Contact between commensal and its benefactor may be periodic or continuous.	Contact between host and parasite may be temporary or permanent.
(iii)	Nitrogen fixing blue-green alga or cyanobacterium called *Anabaena* is associated with water fern *Azolla* in a mutualistic interaction.	Many epiphytes, *e.g.,* orchids, are found growing on the branches and in the forks of trees. These epiphytes use the trees only for attachment and manufacture their own food by photosynthesis.	*E.g., Cuscuta* is a total stem parasite, malarial parasite can be intracellular (endoparasite), etc.

OR

An age pyramid for expanding human population is as follows:



Pyramid with broad base or triangular shape indicates a rapidly expanding population with a high percentage of pre-reproductive individuals followed by reproductive and then post-reproductive individuals. Thus, in rapidly growing population, birth rate is high and population keeps growing.

30. Test cross is a cross used to identify whether an individual is homozygous or heterozygous for dominant character. The individual is crossed with homozygous recessive parent for the trait being investigated.

Tall plant could have two possible genotypes : TT and Tt

Case I : Tall (homozygous) pea plant crossed with dwarf pea plant :

Parent : TT × tt

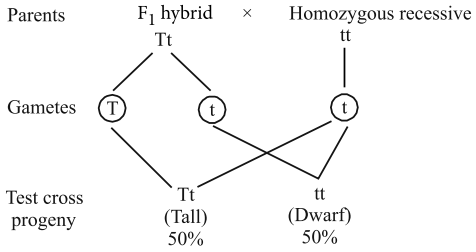
Gametes : (T)(T) (t)(t)

Progeny :

♀ / ♂	t	t
T	Tt Tall	Tt Tall
T	Tt Tall	Tt Tall

If plant produces all tall plants as offspring, then the genotype of plant is TT *i.e.*, homozygous tall plant.

Case II : Tall (heterozygous) pea plant is crossed with dwarf pea plant.



If plant produces both tall and dwarf plants in the ratio of 1 : 1 then genotype of plant is TT, *i.e.*, heterozygous tall pea plant.

31. (a) In humans, follicle stimulating hormone (FSH) initiates the process of spermatogenesis.

Spermatogenesis is the process of formation of haploid spermatozoa from diploid spermatogonia inside the testes of the male. It includes following three phases :

(i) Multiplication phase – At sexual maturity, the undifferentiated primordial germ cells divide several times by mitosis to produce a large number of spermatogonia or sperm mother cells. Spermatogonia (2N) are of two types : type A spermatogonia and type B spermatogonia. Type A spermatogonia serve as the stem cells which divide to form second type of spermatogonia whenever required. Type B spermatogonia are progenitor cells which function as precursors of spermatozoa.

(ii) Growth phase - Each type B spermatogonium actively grows to a larger primary spermatocyte by obtaining nourishment from the nursing cells.

(iii) Maturation phase - Each primary spermatocyte undergoes two successive divisions, called maturation divisions. The first maturation division is reductional or meiotic. Hence, the primary spermatocyte divides into two haploid daughter cells called secondary spermatocytes. Both secondary spermatocytes now undergo second maturation division which is an ordinary mitotic division to form four haploid spermatids, by each primary spermatocyte.

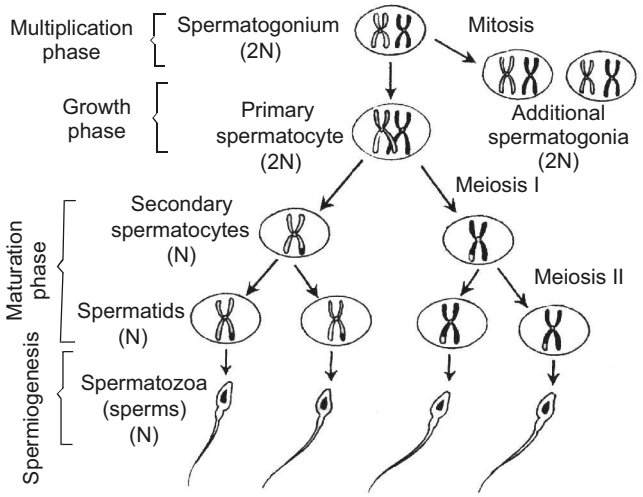
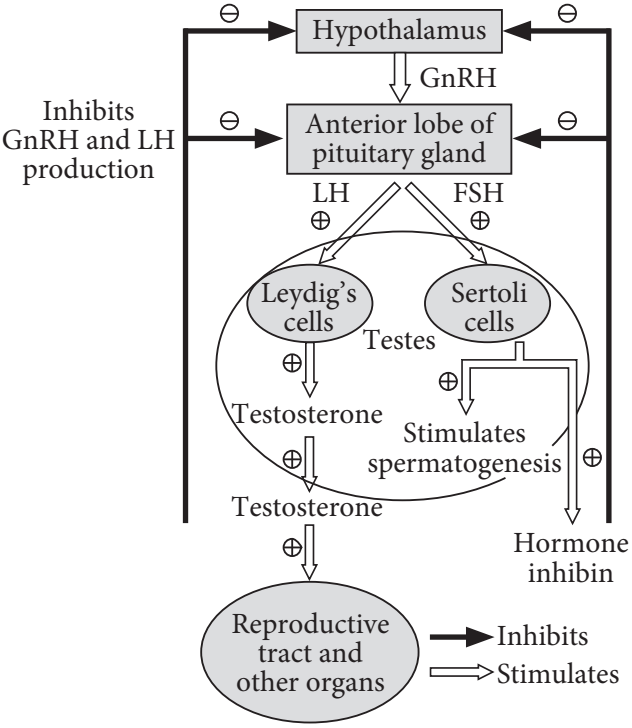


Fig.: Stages in spermatogenesis

(b) Hormonal control of male reproductive system is as follows:



OR

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.

32. (a) The normal cells are characterised by contact inhibition by virtue of which contact with other cells inhibits their uncontrolled growth. Metastasis is a property shown by cancerous cells in which these cells detach from the tumors and move to distant sites through body fluids and develop secondary tumors. Metastasis is fatal because the cancerous cells damage other normal cells, compete with them for vital nutrients and disrupt the normal metabolism.
(b) Several genes called cellular oncogenes (c-onc) or protooncogenes have been identified in normal cells which, when activated under certain conditions, could lead to oncogenic transformation of the cells (cancer).
(c) Radiography (X-rays) and CT (computerised tomography) are useful in detecting cancer of internal organs.
(d) The cancer patients are given substances called biological response modifiers such as α-interferon which activate their immune system and helps in destroying the tumor.

OR

(a) Four lymphoid organs are :
(i) Bone marrow : It is the main lymphoid organ where all blood cells including lymphocytes are formed. Maturation of B-lymphocytes occurs here.
(ii) Thymus : It is the site of T lymphocyte maturation. Thymus is situated near the heart and is quite large in size at the time of birth but keeps reducing with age.
(iii) Lymph nodes: These are small solid structures found at intervals along the lymphatic system. They are composed of lymphoid tissue and act as filters for the lymph, preventing foreign particles from entering the bloodstream. Lymph nodes also produce lymphocytes and plasma cells.
(iv) Spleen: It is a bean shaped organ which is the largest single mass of lymphoid tissue in the body. In fetus, the spleen produces all types of blood cells but in adult it only produces lymphocytes. Macrophages of spleen are phagocytic.
(b) 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.

33. (i) In the given figure, 'A' is amino acid, 'B' is peptide chain, 'C' is A site and 'D' is P-site of ribosome.
(ii) There are three reactive sites— P, A and E in ribosomes. A-site (label C) or aminoacyl or acceptor site is situated on the larger subunit of ribosome. It faces the tunnel between the two subunits. P-site (label D) or peptidyl transfer or donor site is jointly contributed by the two ribosomal subunits. E or exit site is part of larger subunit facing the tunnel site.
(iii) An aminoacyl *t*RNA complex reaches the A-site and attaches to *m*RNA codon next to initiation codon with the help of its anticodon. The step requires GTP and elongation factor. A peptide bond (–CO–NH–) is established between the carboxyl group of amino acid attached to *t*RNA at P-site and amino group of amino acid attached to *t*RNA at A-site. In the process, the connection between *t*RNA and the amino acid at the P-site breaks. The free *t*RNA of the P-site slips to E-site and from there to the outside of ribosome with the help of G-factor. The A-site carries peptidyl *t*RNA complex. After the establishment of first peptide linkage and slipping of the freed *t*RNA, the ribosome rotates slightly, as a result the A-site codon alongwith peptidyl-*t*RNA complex reaches the P-site. A new codon is exposed at the A-site. The process of bond formation and translocation is repeated.

OR

(i) The given figure represents *lac* operon in *E.coli*. 'Q' is regulator gene, 'R' is operator gene, 'S' is repressor and 'T' is repressor operator complex.

(ii) Repressor is a regulator protein meant for blocking the operator gene so that the structural genes are unable to form *m*RNAs. It has two allosteric sites, one for attaching to operator gene and second for binding to inducer. After coming in contact with inducer the repressor undergoes conformational change in such a way that it is unable to combine with operator.

(iii) The lactose or *lac*-operon of *Escherichia coli* contains three structural genes *i.e.*, Z, Y, A. They transcribe a polycistronic *m*RNA molecule that helps in the synthesis of three enzymes— β-galactosidase for hydrolysing lactose or galactoside, lactose or galactoside permease for allowing entry of lactose from outside and thiogalactoside acetylase or transacetylase for metabolising toxic thiogalactosides which are also allowed entry by lactose permease. The three enzymes are produced in different molar concentration.

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