

CBSE
Class XII Biology (Theory)
Board Paper 2010 - Delhi (Set 1)

Time: 3 hrs

Total Marks: 70

General Instruction:

1. All questions are compulsory.
2. This question paper consists of four Sections A, B C and D. Section A contains 8 questions of one mark each, Section B is of 10 questions of two marks each, Section C is of 9 questions of three marks each, and Section D is of 3 questions of five marks each.
3. There is no overall choice. However an internal choice has been provided in one question of 2 marks, one question of 3 marks and all the three questions of 5 marks weight age. A student has to attempt only one of the alternatives in such questions.
4. Wherever necessary, the diagrams drawn should be neat and properly labelled.

SECTION A

1. A bilobed, dithecous anther has 100 microspore mother cells per microsporangium how many male gametophytes this anther can produce? [1]
2. Mention two functions of the codon AUG. [1]
3. Name the scientist who disproved spontaneous generation theory. [1]
4. What is it that prevents a child to suffer from a disease he/she is vaccinated against? Give one reason. [1]
5. Why is the enzyme cellulase used for isolating genetic material from plant cells but not for animal cells? [1]
6. Name a molecular diagnostic technique to detect the presence of a pathogen in its early stage of infection. [1]
7. If 8 individuals in a laboratory population of 80 fruitflies died in a week then what would be the death rate of population for the said period? [1]
8. Why is reproduction essential for organism? [1]

SECTION B

9. A moss plant produces a large number of antherozoids but relatively only few egg cells. Why? [2]
10. Mention the reasons for difference in ploidy of zygote and primary endosperm nucleus in an angiosperm. [2]
11. How does an electrostatic precipitator work to remove particulate pollutants released from the thermal power plants? [2]
12. Name the type of food chains responsible for the flow of larger fraction of energy in an aquatic and a terrestrial ecosystem respectively. Mention one difference between the two food chains. [2]
13. How does a test-cross help in identifying the genotype of the organism? Explain. [2]
14. Name the host and the site where the following occur in the life-cycle of a malarial parasite. [2]
- (a) Formation of gametocytes
 - (b) Fusion of gametocytes
15. Honey collection improves when beehives are kept in crop-fields during flowering season. Explain. [2]
- OR**
- How does addition of small amount of curd to fresh milk help formation of curd? Mention a nutritional quality that gets added to the curd.
16. Why is the introduction of genetically engineered lymphocytes into a ADA deficiency patient not a permanent cure? Suggest a possible permanent cure. [2]
17. How does the floral pattern on Mediterranean orchid *Ophrys* guarantee cross pollination? [2]
18. In the biosphere immense biological diversity exists at all levels of biological organization. Explain any two levels of biodiversity. [2]

SECTION C

19. Draw a longitudinal section of a post-pollinated pistil showing entry of pollen tube into mature embryo-sac. Label filiform apparatus, chalazal end, Hilum antipodals, male gametes and secondary nucleus.

OR

Draw a labelled sectional view of seminiferous tubule of a human male. [3]

20. During the studies on genes in *Drosophila* that were sex-linked T.H. Morgan found F_2 – population phenotypic ratios deviated from expected 9:3:3:1. Explain the conclusion he arrived at. [3]

21. Describe the initiation process of transcription in Bacteria. [3]

22. Explain convergent and divergent evolution with the help of one example of each. [3]

23. Name the type of human cell HIV attacks on its entry into the body. Explain the events that occur in the cell which further lead to cause immunodeficiency syndrome. [3]

24. Explain the efforts which must be put in to improve health, hygiene and milk yield of cattle in a dairy farm. [3]

25. Identify a, b, c, d, e and f in the table given below. [3]

Organism	Bioactive molecule	Use
1. <i>Monascus purpureus</i> (Yeast)	a _____	b _____
2. c _____	d _____	antibiotic
3. e _____	Cyclosporin A	f _____

26. Eco RI is used to cut a segment of foreign DNA and that of a vector DNA to form a recombinant DNA. Show with the help of schematic diagrams. [3]

(i) The set of palindromic nucleotide sequence of bases pairs the Eco RI will recognize in both the DNA segments. Mark the site at which ECO RI will act and cut both the segments.

(ii) Sticky ends are formed on both the segments where the two DNA segments will join later to form a recombinant DNA.

27. How does RNA interference help in developing resistance in tobacco plant against nematode in infection? [3]

SECTION D

- 28.** [5]
- (a) How does a chromosomal disorder differ from a Mendelian disorder?
 - (b) Name any two chromosomal aberration associated disorders.
 - (c) List the characteristics of the disorders mentioned above that help in their diagnosis.

OR

Fitness is the end result of the ability to adapt and get selected by nature. Explain with suitable example.

- 29.** When and where are primary oocytes formed in a human female? Trace the development of these oocytes till ovulation (in menstrual cycle). How do gonadotropins influence this development process? [5]

OR

- (a) Explain the events taking place at the time of fertilization of an ovum in a human female.
- (b) Trace the development of the zygote up to the implantation in the uterus.
- (c) Name and draw a labelled sectional view of the embryonic stage that gets implanted.

- 30.** Draw and explain a logistic curve for a population of density (N) at time (t) whose intrinsic rate of natural increase is (r) and carrying capacity is (k). [5]

OR

Describe the process of decomposition of detritus under the following heads:
Fragmentational leaching; catabolism; humification and mineralization.

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SOLUTION

Time: 3 hrs

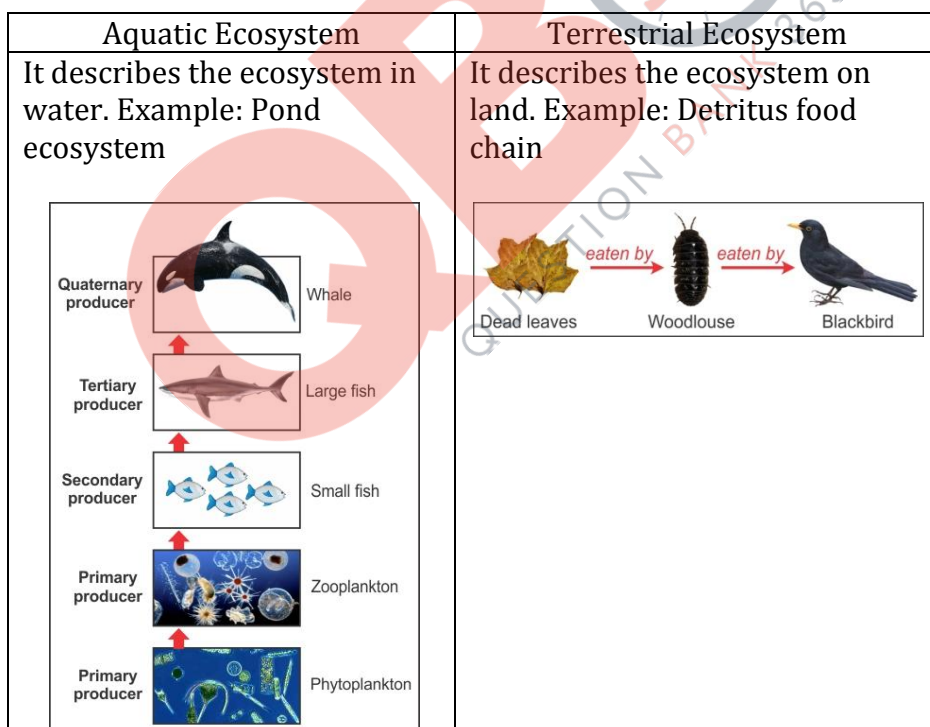
Total Marks: 70

SECTION A

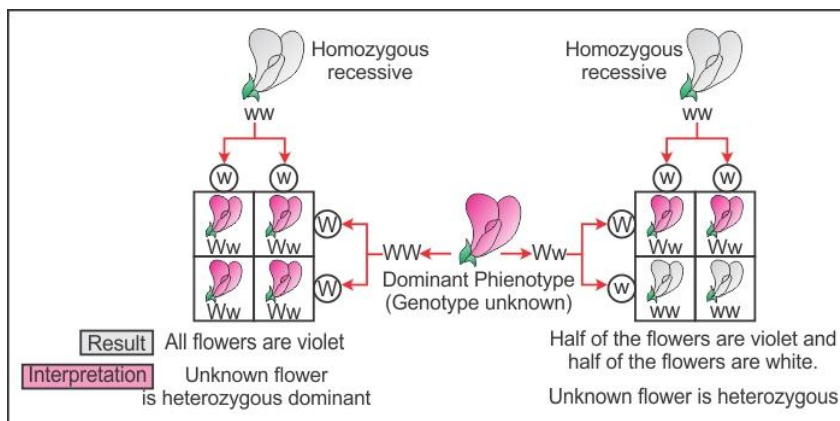
1. **Ans.** There are four microsporangia or pollen sacs in an anther. In this case, the anther will have 400 microspore mother cells. As each microspore mother cell forms four pollen grains, 400 microspore mother cells will form 1600 pollen grains or male gametophytes.
2. **Ans.** AUG has dual function.
(i) It codes for Methionine (Met).
(ii) It also acts as the initiator codon.
3. **Ans.** Louis Pasteur disproved the spontaneous generation theory. According to this theory, life originated repeatedly from non-living materials spontaneously. However, according to Louis Pasteur, life originated from pre-existing organisms of their own kind.
4. **Ans.** On exposure to antigens or vaccines, the antibodies produced in the body neutralise the pathogenic agent during infection. The vaccines generate memory B cells and T cells during primary response. When the vaccinated person is attacked by the same pathogen, the existing memory T or B cells recognise the antigen quickly and attack the invaders with a massive production of lymphocytes and antibodies.
5. **Ans.** Cellulase is used for isolating genetic material from plant cells because the cell wall of plants is made of cellulose. Animal cells do not have a cell wall or cellulose, so cellulase is not required for isolating genetic material from animal cells.
6. **Ans.** Different viral and bacterial DNA in a host body can be detected by polymerase chain reaction (PCR). PCR can detect very low amounts of DNA. PCR is now usually used to detect HIV in suspected AIDS patients. It is a good technique to identify many other genetic disorders.
7. **Ans.** If 8 individuals in a laboratory population of 80 fruit flies died during a specified time interval (suppose a week), the death rate in the population during that period is $8/80 = 0.1$ individuals per fruit fly per week.
8. **Ans.** Reproduction is essential because it enables the continuity of species generation after generation and introduces variations in the organisms essential for adaptations and evolution.

SECTION B

9. **Ans.** The eggs are located in the archegonium in moss. For fertilisation to occur, antherozoids swim in water to reach the eggs. Moss produces a large number of antherozoids to increase the chances of fertilisation.
10. **Ans.** The zygote is formed because of fusion of two haploid gametes; hence, it is diploid ($2n$). An endosperm develops from a triploid ($3n$) primary endosperm nucleus formed because of fusion of male gamete (n) and two polar nuclei (n).
11. **Ans.** Electrostatic precipitators are the most efficient devices where the particles present in the dirty air are charged electrically to form a corona of negative charges around them. The charged dust particles are passed over collection plates connected electrically with the earth. Dust particles lose their charge and settle.
12. **Ans.** Aquatic ecosystem: Pond ecosystem
Terrestrial ecosystem: Detritus food chain



13. **Ans.** Test cross is a cross between F_1 hybrid and the recessive parent. To know the genotypic composition from the phenotype of a dominant trait, a cross is made between the unknown genotype of the F_1 generation with the homozygous recessive. If the result shows 100% dominant trait, this means that the unknown genotype of the F_1 generation is homozygous dominant. If the test cross yields offspring of 50% dominant and 50% recessive character, then the F_1 hybrid is heterozygous. It shows (1:1) test ratio for the monohybrid cross and (1:1:1:1) for the dihybrid cross.



14.Ans.

- (a) Formation of gametocytes occurs in the red blood cells of human host.
- (b) Fertilisation of gametocytes occurs in the mosquito's stomach.

15.Ans. Bee farms or apiaries are established in an area where abundance of wild shrubs, fruit orchards and cultivated crops is available in 1–2 km radius. Availability of flowering plants for the collection of nectar and pollen is called pasturage. It plays an important role in the quality and quantity of honey. The beehives when kept in the fields of sunflower, *Brassica*, apple and pear increase the pollination efficiency of flowering plants and improve the yields.

OR

When a small amount of curd is added to milk, the fermentation process begins. During this process, the lactose sugar of milk is converted to lactic acid which acidifies the fermenting media. The acidic medium helps in coagulating milk protein by partially digesting it so that a thick concentrated curd is prepared.

Lactic acid bacteria improve its nutritional quality by increasing vitamin B₁₂.

16.Ans. Adenosine deaminase deficiency can be cured by enzyme replacement therapy but the cure is not permanent even after infusion of genetically engineered lymphocytes into the patient as cells are not immortal. The patient does not have functional T-lymphocytes, so they cannot provide immune responses against invading pathogens. The patient requires periodic infusion of such genetically engineered lymphocytes. However, if the gene isolated from bone marrow cells producing ADA is introduced into cells at early embryonic stages, it could prove to be a permanent cure.

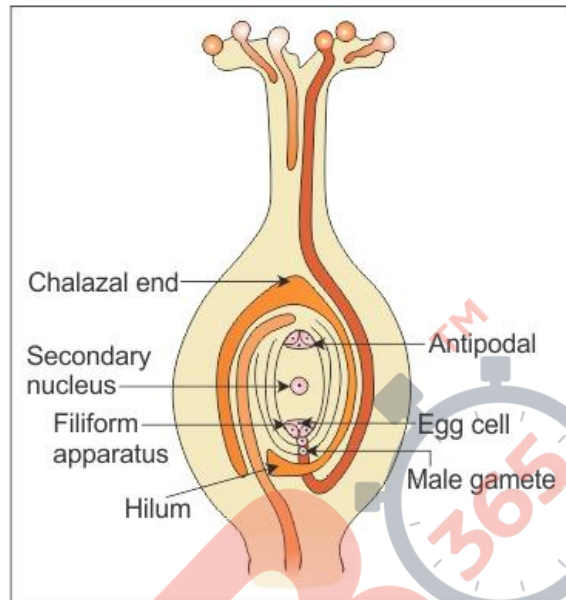
17.Ans. The Mediterranean orchid *Ophrys* has a very strange relationship with its insect pollinator *Colpa aurea* (a hairy wasp). The orchid bears flowers which resemble the female wasp in colour, odour and appearance. The male wasp matures first and leaves the burrow about four weeks before the females come out for open air mating. The inexperienced males try to pseudocopulate the orchid flowers presuming them as their female partners and bring about pollination.

18.Ans. In the biosphere, immense biodiversity exists at all levels of biological organisation ranging from macromolecules within cells to biomes. The most important levels of biological diversity are genetic diversity, species diversity and ecological diversity.

- i. Genetic diversity: It is related to the variations of genes within species. The variations may be in different variants of the same genes (alleles), in entire genes or in chromosomal structures. On account of genetic differences, all the individuals of the same species become different from one another in the details of the body structure giving rise to multitude of intraspecific categories such as sub-species, varieties, races and strains, all of these show variations of one kind or the other. For example, there are various varieties of mangoes.
- ii. Species diversity: It is related to the variety in the number and richness of the species within a region and is measured at the level of 'species'. For example, big cats such as tiger, lion and snow leopard belong to the same genus but all differ at the species level.

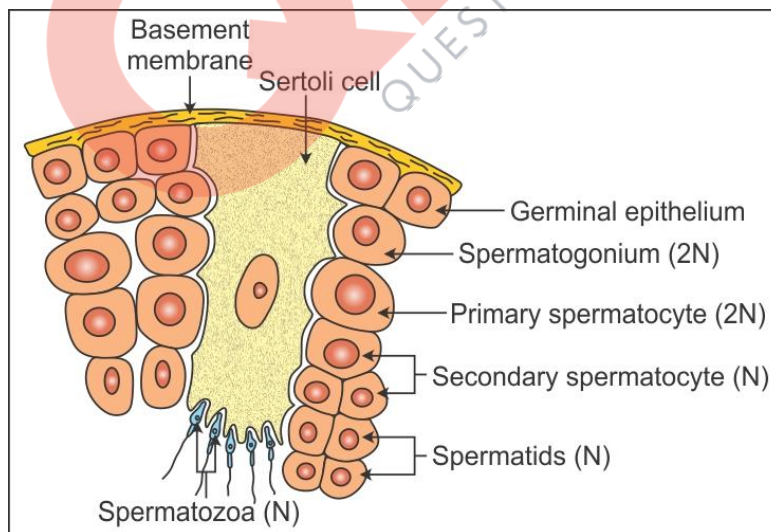
SECTION C

19.Ans. Longitudinal section of a post-pollinated pistil:



OR

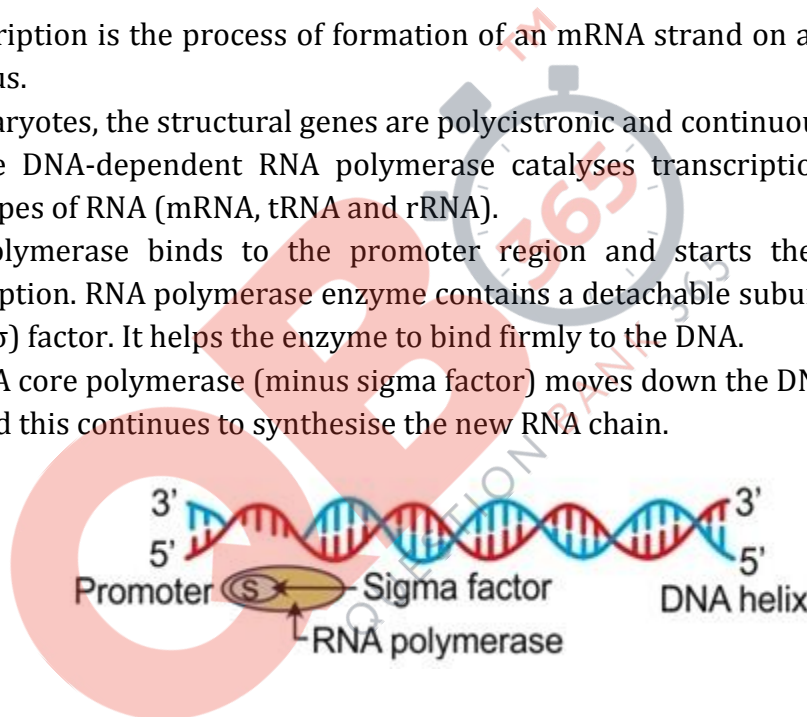
Sectional view of the seminiferous tubule of a human male:



20.Ans. Morgan attributed this to the physical association or linkage of the two genes and coined the term linkage to describe the physical association of genes on a chromosome and the term recombination to describe the generation of non-parental gene combinations. Morgan and his co-workers also found that even when genes were grouped on the same chromosomes, some genes were very tightly linked and showed very low recombination, while others were loosely linked and showed higher recombination. For example, he found that genes for white and yellow body colour were tightly linked and showed only 1.3% recombination, while white and miniature wing showed 37.2% recombination.

21.Ans. Transcription is the process of formation of an mRNA strand on a DNA strand in the nucleus.

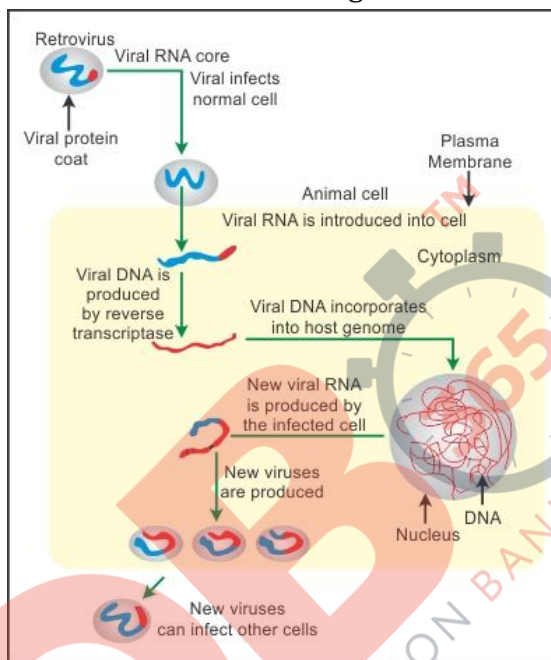
- (i) In prokaryotes, the structural genes are polycistronic and continuous.
- (ii) A single DNA-dependent RNA polymerase catalyses transcription of all the three types of RNA (mRNA, tRNA and rRNA).
- (iii) RNA polymerase binds to the promoter region and starts the process of transcription. RNA polymerase enzyme contains a detachable subunit called the sigma (σ) factor. It helps the enzyme to bind firmly to the DNA.
- (iv) The RNA core polymerase (minus sigma factor) moves down the DNA at a faster pace and this continues to synthesise the new RNA chain.



22.Ans.

- (i) Convergent evolution: The organs which have arisen in the evolutionary process through adaptation of quite different organisms to a similar mode of life is called convergent evolution. Analogous organs are the result of convergent evolution. Example: The wing of an insect and the wing of a bird are analogous organs. Both these organs are used for flying in the air but are different in structure.
- (ii) Divergent evolution: The homologous structures seen in successive generations indicate actual relationship and the possessors are the diverse descendants of common ancestry is called divergent evolution. Homologous organs are the result of divergent evolution. Example: The forelimbs of vertebrates such as man, cheetah, whale and bat are homologous organs as they are built on the same plane but perform different functions.

- 23. Ans.** Viral DNA enters the helper T-lymphocytes. HIV is a retrovirus. Its genetic material is RNA which can make a DNA copy of itself using the reverse transcriptase enzyme. The virus binds specifically to a surface receptor on a helper T-cell and introduces its RNA and reverse transcriptase enzyme into the cells where it multiplies and releases new viruses. These new viruses destroy the cell. AIDS occurs when several helper T-cells fall too low to fight the disease.



- 24. Ans.** Efforts to improve health, hygiene and milk yield of cattle in a dairy farm are
- (i) Selection of good breeds of dairy farm animals having high-yielding potential.
 - (ii) Selection of disease-resistant breeds.
 - (iii) Sufficient water and feed is to be provided so that animals are properly nourished.
 - (iv) Animals should be kept in a clean place under a shadow or in an open area free from dirt and pollution.
 - (v) Regular inspections with proper record keeping.
 - (vi) Regular visits by a veterinary doctor should be mandatory.

25. Ans.

a = Statins

c = *Penicillium notatum*

e = *Trichoderma polysporum*

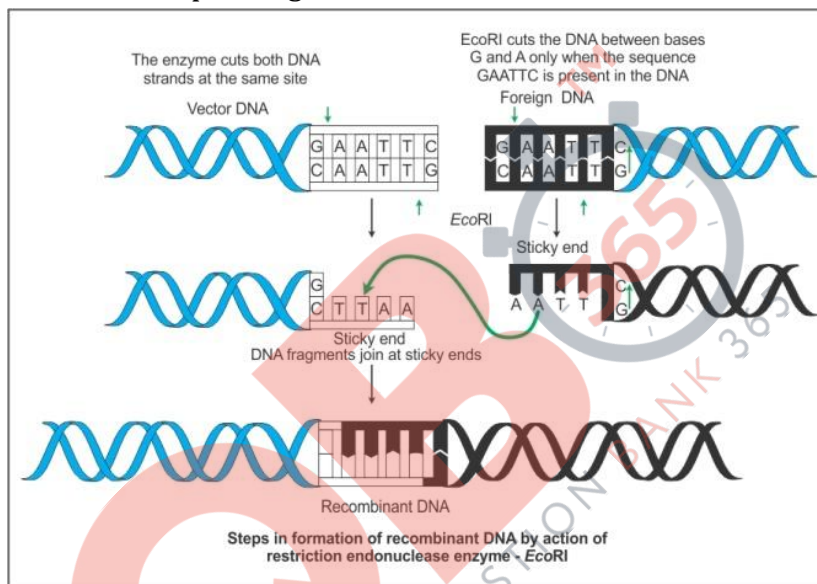
b = Blood cholesterol lowering agents

d = Penicillin

f = Immunosuppressant drug

26.Ans.

- (i) Restriction endonuclease functions by recognising its specific sequence. It binds to the DNA and cuts each of the two strands of the double helix at specific points in their sugar phosphate backbones. Each restriction endonuclease recognises a specific palindromic nucleotide sequence in the DNA.
- (ii) Restriction enzymes cut the strand of DNA between the same two bases on the opposite strands leaving a single-stranded portion at their ends. These overhanging stretches are called sticky ends on each strand. The enzyme DNA ligase functions depending on the stickiness of these ends.



27.Ans. A nematode (*Meloidogyne incognita*) infects the roots of tobacco plants and reduces its yield. A method of cellular defence, RNA interference (RNAi) takes place in all eukaryotic organisms which involves silencing of a specific mRNA. Agrobacterium vectors were used for introducing nematode-specific genes into the host plant. The introduction of DNA produces both sense and antisense RNA in the host cells. These two RNA molecules, being complementary to each other, form double-stranded RNA which binds to and prevents the translation of mRNA (silencing) of the nematode. The parasite does not survive in a transgenic host expressing specific interfering RNA. The transgenic plant therefore gets protected from the parasite.

SECTION D

28.Ans.

(a)

Chromosomal disorders	Mendelian disorders
i. These genetic disorders are caused by the absence or excess or abnormal arrangement of one or more chromosomes.	i. These disorders are determined by mutations in single genes.
ii. These are non-heritable and pedigree analysis of a family does not help in tracing the pattern of inheritance of such chromosomal disorders.	ii. They are transmitted to offspring according to Mendelian principles. The pattern of inheritance of such Mendelian disorders can be traced in a family by pedigree analysis.

(b) Down's syndrome and Turner's syndrome.

(c) Symptoms of Down's syndrome:

- (i) Mental retardation
- (ii) Short statured with small round face and broad forehead
- (iii) Partially open mouth with protruding furrowed tongue
- (iv) Flat hands and stubby fingers

Symptoms of Turner's syndrome:

- (i) Sterile females with rudimentary ovaries
- (ii) Undeveloped breasts
- (iii) Small uterus
- (iv) Puffy fingers
- (v) Short stature

OR

The essence of Darwinian Theory about evolution is natural selection. The organisms which are provided with favourable variations would survive because they are the fittest to face their surroundings, while the unfit are destroyed.

It is to be noted that only survival of the fittest is not enough. Organisms should also adapt or change themselves according to the changed conditions of the environment as the environment is always changing. The extinct reptiles can be cited as an example to explain the phenomenon of survival of the fittest. During the evolution of reptiles, giant reptiles and dinosaurs appeared. Majority of them were herbivorous but due to certain climatic changes, the vegetation disappeared and therefore most of them became extinct. Small animals who could change their feeding habits from a herbivorous to a carnivorous diet survived because they could easily adapt to the changed environment. These therefore have a greater chance of survival and hence

are selected by nature. Darwin called it natural selection and implied it as a mechanism of evolution.

Nature selects for fitness based on the characteristics which are inherited. Some organisms are better adapted to survive in a hostile environment and are selected by nature over the others.

29.Ans. Primary oocytes are formed in the female ovary. In the multiplicative phase of oogenesis, certain cells in the germinal epithelium of the ovary divide by mitosis and produce millions of egg mother cells or oogonia in each ovary. These oogonia multiply mitotically to form primary oocytes.

The menstrual cycle consists of the following phases:

- (i) Menstrual phase: It is also called the bleeding phase. The production of luteinising hormone (LH) from the anterior lobe of the pituitary gland is considerably reduced. The withdrawal of this hormone causes degeneration of the corpus luteum and therefore progesterone production is reduced. Production of oestrogens is also reduced in this phase. The endometrium of the uterus breaks down and menstruation begins.
- (ii) Follicular phase: It is also called the proliferative phase. In this phase, the follicle-stimulating hormone (FSH) secreted by the anterior lobe of the pituitary gland stimulates the ovarian follicle to secrete oestrogens which stimulate the proliferation of the endometrium of the uterine wall.
- (iii) Ovulatory phase: In this phase, LH is secreted rapidly which induces rupturing of the Graafian follicle and thereby release of the ovum. This is called ovulation. Thus, LH causes ovulation.
- (iv) Luteal phase: It is also called the secretory phase. The remaining cells of the ovarian follicles are stimulated by the LH to develop the corpus luteum. The corpus luteum secretes a large amount of progesterone.

Hormonal control of the menstrual cycle:

Gonadotropin-releasing hormone (GnRH), also called gonadotropin-releasing factor (GnRF), is secreted by the hypothalamus of the brain, which stimulates the release of FSH and LH.

FSH stimulates the ovarian follicles to produce oestrogen during the proliferative phase. LH causes ovulation during the ovulatory phase and stimulates the corpus luteum of the ovary to secrete progesterone.

OR

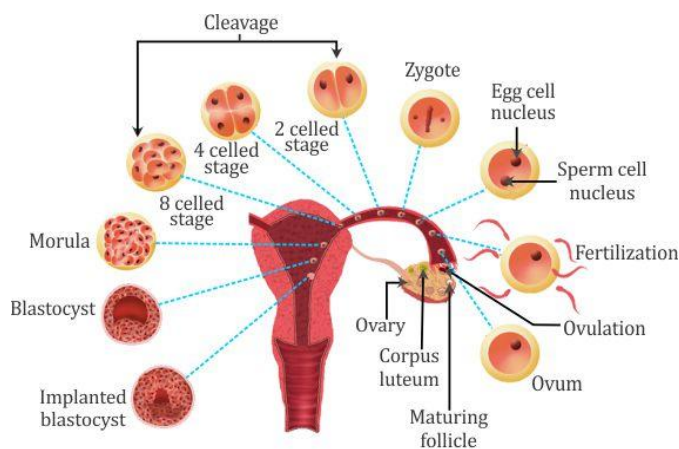
- (a) The process of fusion of a haploid male gamete (sperm) and a haploid female gamete (ovum) to form a diploid zygote is called fertilisation. The male discharges semen in the female's vagina close to the cervix during coitus. This is called insemination. Certain activities of the female reproductive tract help the sperms reach the site of fertilisation. Immediately after the fusion of sperm and egg plasma membrane, the egg shows a cortical reaction to further check the

entry of more sperms. In this reaction, the cortical granules present beneath the egg's plasma membrane fuse with the plasma membrane and release enzymes between the plasma membrane and the zona pellucida. These enzymes harden the zona pellucida which block the entry of additional sperms and prevent polyembryony.

(b) Implantation is the attachment of the blastocyst to the uterine wall.

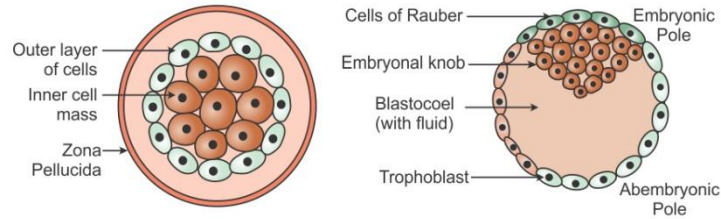
Cleavage in the human zygote occurs during its passage through the fallopian tube to the uterus.

- (i) It divides the zygote and the blastomeres completely into daughter cells. The first cleavage takes about 30 hours after fertilisation and produces two blastomeres, one slightly larger than the other.
- (ii) The second cleavage occurs within 60 hours after fertilisation and divides each blastomere into two by forming a mitotic spindle in each.
- (iii) The third cleavage occurs about 72 hours after fertilisation.
- (iv) Cleavage produces a solid ball of small blastomeres and is called morula. It consists of 16–32 cells but is not larger than the zygote.
- (v) The morula reaches the uterus about 4–6 days after fertilisation and remains surrounded by the zona pellucida to prevent its sticking to the uterine wall.
- (vi) The outer layer of the cells of morula absorbs the nutritive fluid secreted by the uterine mucous membrane and is called trophoblast.
- (vii) The fluid absorbed by a trophoblast collects in a cavity called blastocoel or blastocyst cavity.
- (viii) As the quantity of the fluid increases, the morula enlarges to form a blastocyst. The zona pellucida becomes thinner and finally disappears.
- (ix) The blastocyst sinks into a pit formed in the endometrium which grows around it. Thus, implantation involves the activities of both blastocyst and uterus.

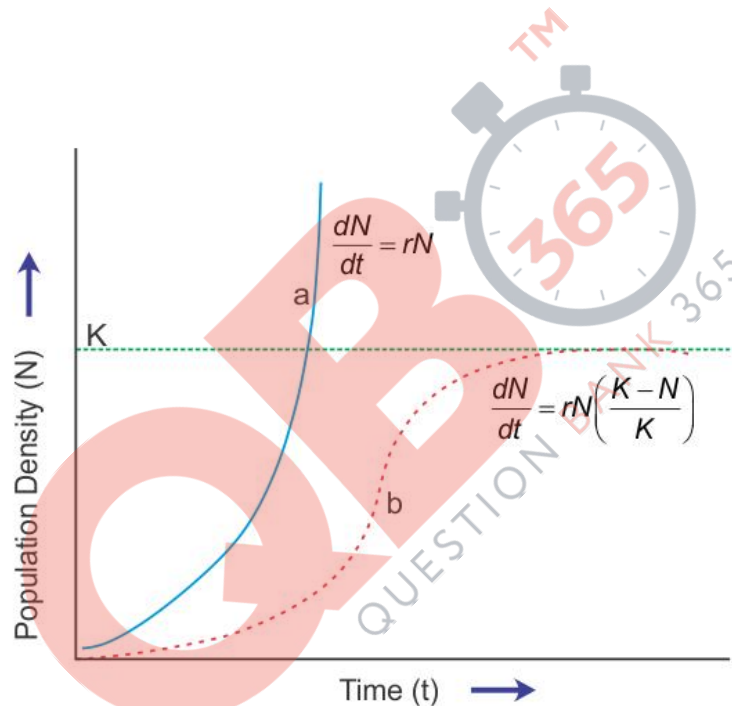


Development of the embryo

(c)



30.Ans.



In nature, a given habitat has resources to support a certain number of individuals of a population beyond which no further growth is possible. This limit is called nature's carrying capacity. A plot of N in relation to time (t) results in a sigmoid curve. This type of population growth is called Verhulst–Pearl logistic growth. It is explained by the following equation:

$$\frac{dN}{dt} = rN \left(\frac{K - N}{K} \right)$$

where N = population density at time t ; r = intrinsic rate of natural increase and K = carrying capacity.

Because resources for growth for most animal populations become limiting sooner or later, the logistic growth model is more realistic. It is also called the S or sigmoid growth curve.

OR

Decomposition is the process of breaking down a substance into its constituent parts. Dead remains of plants and animals are called detritus.

Decomposition is a complex, enzymatic process which involves stepwise degradation of detritus. It involves the following steps:

- (i) Fragmentation: It is the process of breaking of the detritus into smaller particles or fragments by detritivores. Fragmentation increases the surface area of detritus particles for microbial action.
- (ii) Leaching: Soluble substances formed during decomposition pass into soil along with percolating water to be made available to the roots of plants for absorption.
- (iii) Catabolism: This process is carried out by decomposers which release extracellular enzymes to decompose detritus particles to simpler compounds and inorganic substances.
- (iv) Humification: It is the process by which simplified detritus gets converted to a dark coloured amorphous substance called humus in the soil.
- (v) Mineralisation: It is the process resulting in the release of inorganic substances such as carbon dioxide, water and nutrients.