

**CBSE**  
**Class XII Biology (Theory)**  
**Board Paper 2012 – Delhi (Set 2)**

**Time: 3 hour**

**Total Marks: 70**

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**General Instructions:**

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 weightage. 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.
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**SECTION A**

1. Cucurbits and papaya plants bear staminate and pistillate flowers. Mention the categories they are put under separately on the basis of the type of flowers they bear. [1]
2. A garden pea plant (A) produced inflated yellow pod, and another plant (B) of the same species produced constricted green pods. Identify the dominant traits. [1]
3. Write what do phytophagous insects feed on. [1]
4. What is the interaction called between *Cuscuta* and shoe flower bush? [1]
5. When do the oogenesis and the spermatogenesis initiate in human females and males respectively? [1]
6. How does smoking tobacco in human lead to oxygen deficiency in their body? [1]
7. State the significance of the study of fossils in evolution. [1]
8. Name the following: [1]
  - (a) The semi-dwarf variety of wheat is high-yielding and disease-resistant.
  - (b) Anyone inter-specific hybrid mammal.

## SECTION B

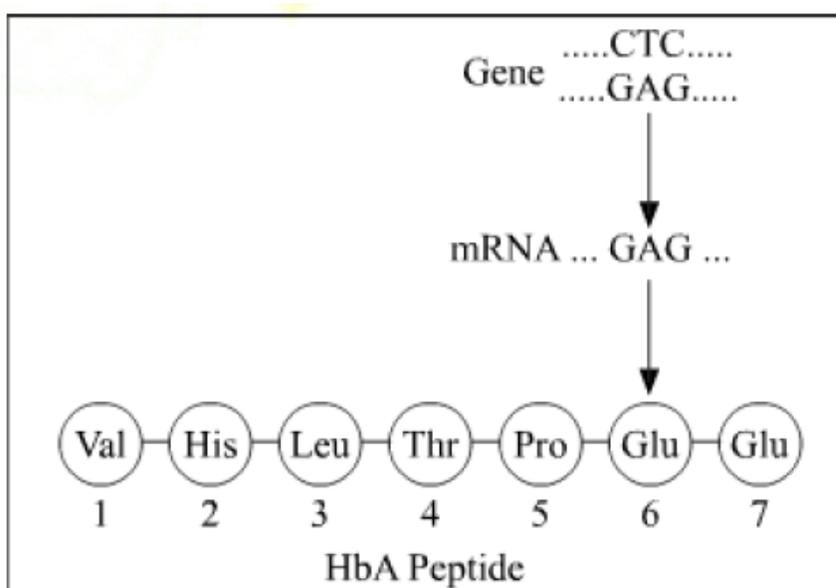
9. [2]  
(a) Highlight the role of thymus as a lymphoid organ.  
(b) Name the cells that are released from the above mentioned gland. Mention how they help in immunity.
10. Why do clown fish and sea anemone pair up? What is this relationship called? [2]
11. Some organisms suspend their metabolic activities to survive in unfavourable conditions. Explain with the help of any four examples. [2]
12. [2]  
(a) State the role of DNA ligase in biotechnology.  
(b) What happens when *Meloidegryne incognitia* consumes cells with RNAi gene?
13. Draw a schematic diagram of a part of double stranded dinucleotide DNA chain having all the four nitrogenous bases and showing the correct polarity. [2]
14. Name of parasite that causes filariasis in humans. Mention its two diagnostic symptoms. How is this transmitted to others? [2]
15. Name the source of streptokinase. How does this bioreactor molecule function in our body? [2]
- OR**
- How do *Mycorrhizae* act as biofertilizers? Explain. Name a genus of fungi that forms a mycorrhizal association with plants.
16. [2]  
(a) State the difference between meiocyte and gamete with respect to chromosome number.  
(b) Why is a whiptail lizard referred to as parthenogenetic?
17. Explain the work carried out by Cohen and Boyer that contributed immensely in biotechnology. [2]
18. Where is sporopollenin present in plants? State its significance with reference to its chemical nature. [2]

### SECTION C

19. Write the function of each of the following: [3]

- (a) Middle piece in human sperm.
- (b) Tapetum in anthers.
- (c) Luteinizing hormone in human males.

20. Given below is the representation of amino acid composition of the relevant translated portion of  $\beta$  - chain of haemoglobin, related to the shape of human red blood cells. [3]



- (a) Is this representation indicating a normal human or a sufferer from certain related genetic disease? Give reason in support of your answer.
- (b) What difference would be noticed in the phenotype of the normal and the sufferer related to this gene?
- (c) Who are likely to suffer more from the defect related to the gene represented the males, the females or both males and females equally? And why?

21. Draw a schematic sketch of pBR 322 plasmid and label the following in it: [3]

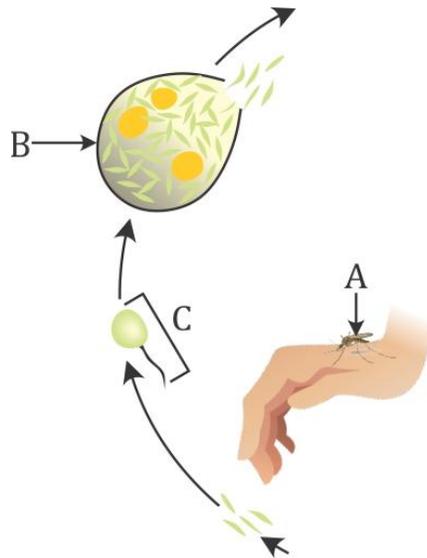
- (a) Any two restriction sites.
- (b) Ori and rop genes.
- (c) An antibiotic resistant gene.

22. It is established that RNA is the first genetic material. Explain giving three reasons. [3]

**OR**

- (a) Name the enzyme responsible for the transcription of tRNA and the amino acid the initiator tRNA gets linked with.
- (b) Explain the role of initiator tRNA in initiation of protein synthesis.

23. Study a part of the life cycle of malarial parasite given below. Answer the questions that follows: [3]



- (a) Mention the roles of, 'A' in the life cycle of the malarial parasite.
- (b) Name the event 'C' and the organ where this event occurs.
- (c) Identify the organ 'B' and name the cells being released from it.

24. State the theory of Biogenesis. How does Miller's experiment support this theory? [3]

25. Name the genes responsible for making Bt cotton plants resistant to bollworm attack. How do such plants attain resistance against bollworm attacks? Explain [3]

26. How does an algal bloom cause eutrophication of a water body? Name the weed that can grow in such a eutrophic lake. [3]

27. Name the two different categories of microbes naturally occurring in sewage water. Explain their role in cleaning sewage water into usable water. [3]

**SECTION D**

28. [5]
- (a) Draw a 'pyramid of numbers' of a situation where a large population of insects feed upon a very big tree. The insects in turn, are eaten by small birds which in turn are fed upon by big birds.
- (b) Differentiate giving reason, between the pyramid of biomass of the above situation and the pyramid of numbers that you have drawn.

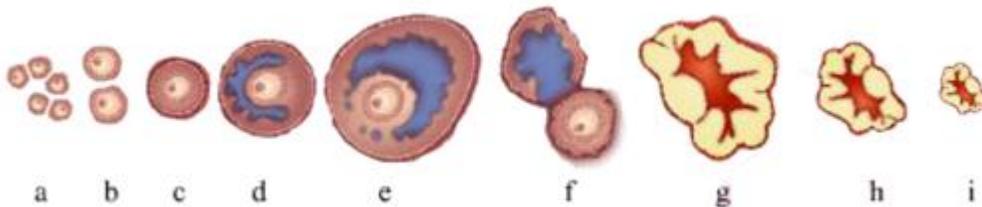
**OR**

- (a) What are the two types of desirable approaches to conserve biodiversity? Explain with examples bringing out the difference between the two types.
- (b) What is the association between the bumble bee and its favourite orchid *Ophrys*? How would extinction or change of one affect the other?
29. What is the inheritance pattern observed in the size of starch grains and seed shape of *Pisum sativum*? Work out the monohybrid cross showing the above traits. How does this pattern of inheritance deviate from that of Mendelian law of dominance? [5]

**OR**

State the aim and describe Messelson and Stahl's experiment.

30. The following is the illustration of the sequence of ovarian events (a - i) in a human female. [5]



- (i) Identify the figure that illustrates ovulation and mention the stage of oogenesis it represents.
- (ii) Name the ovarian hormone and the pituitary hormone that have caused the above mentioned event.
- (iii) Explain the changes that occur in the uterus simultaneously in anticipation.
- (iv) Write the difference between 'c' and 'h'.
- (v) Draw a labeled sketch of the structure of a human ovum prior to fertilization.

**OR**

How does the megaspore mother cell develop into 7-celled, 8 nucleate embryo sac in an angiosperm? Draw a labeled diagram of a mature embryo sac.

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**Solution**

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**SECTION A**

1. **Ans.** Cucurbits are monoecious as they bear both staminate and pistillate flowers on the same plant, while papaya plants are dioecious as the staminate and pistillate flowers are borne on two different plants.
2. **Ans.** Inflated yellow seeds are dominant over constricted green seeds.
3. **Ans.** Phytophagous insects feed on plant sap and other parts of the plant.
4. **Ans.** The interaction between Cuscuta and shoe flower bush is called parasitism. Cuscuta coils around the host plant and sends its haustoria into the host tissue for the absorption of food.
5. **Ans.** Oogenesis starts during the period of foetal development and completes only after the onset of puberty. Spermatogenesis begins at puberty.
6. **Ans.** Smoking of tobacco releases carbon monoxide in the body, thereby depleting the oxygen content which is bound to the haemoglobin.
7. **Ans.** The study of fossils is significant in evolution as
  - (i) Fossil records provide missing links between two groups of organisms.
  - (ii) The fossils occur in various strata of rock. The lowest strata carry the fossils of primitive groups, whereas the upper strata contain the complex group of organisms.
8. **Ans.**
  - (a) Sonalika is the semi-dwarf variety of wheat which is high-yielding and disease resistant.
  - (b) Zonkey is an interspecific hybrid mammal which is a cross between zebra and donkey.

## SECTION B

### 9. Ans.

- (a) In the thymus, immature lymphocytes differentiate into antigen-sensitive lymphocytes. After maturation in the thymus, they migrate to secondary lymphoid organs.
- (b) The cells released from the thymus are called T-lymphocytes. These lymphocytes are responsible for cell-mediated immunity which defends the body against virus, fungi and some bacteria which have entered the host cells. Helper T-cells stimulate B-cells to produce antibodies and killer T-cells migrate to the site of infection.

**10. Ans.** The clown fish protects itself from predators by attaching itself to the body of sea anemone which possesses stinging tentacles. The sea anemone does not get any benefit from the clown fish. This interaction is called commensalism as one species is benefited, whereas the other species is neither harmed nor benefited.

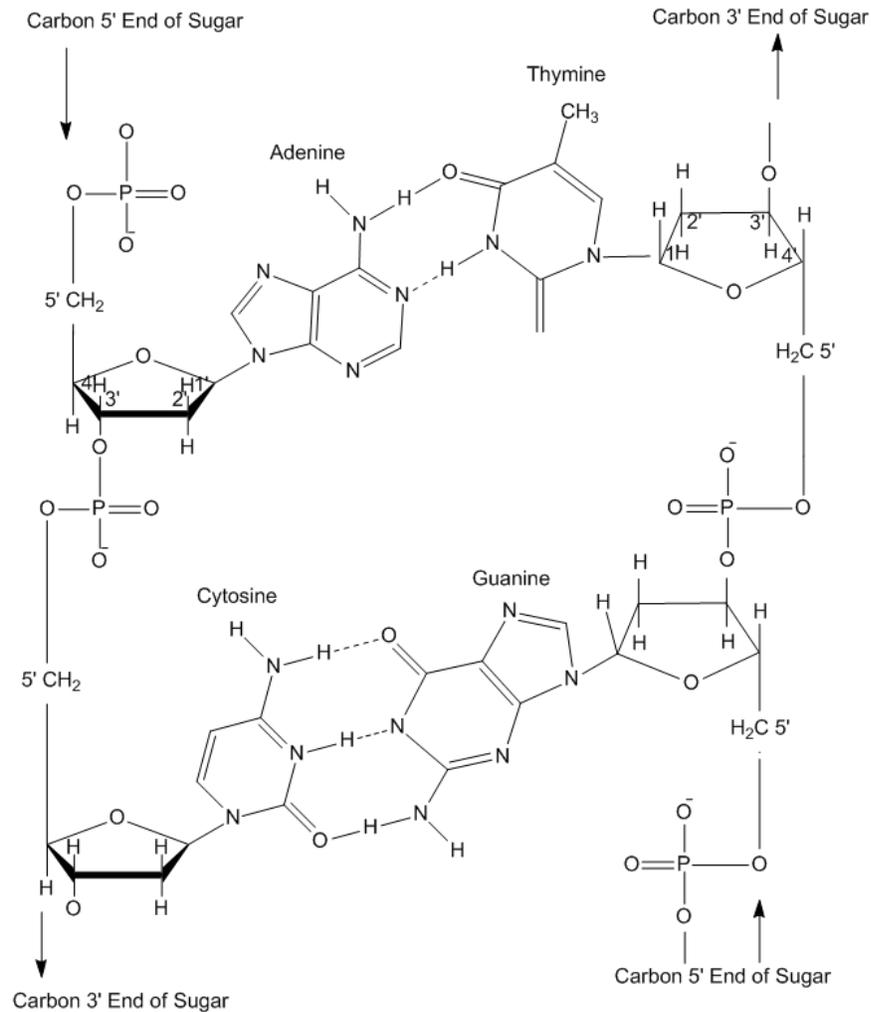
### 11. Ans.

- (a) Cysts formed in bacteria and fungi help them to survive in unfavourable conditions and germinate in favourable conditions.
- (b) Higher plants, seeds and vegetative structures germinate to form new plants under favourable temperature and moisture conditions, thereby reducing metabolic activity.
- (c) Animals stay at favourable conditions by going into hibernation during winter and aestivation during summer. For example, bears go into hibernation and snails go into aestivation.
- (d) Many zooplankton are known to enter diapause, a stage of suspended development under unfavourable conditions.

### 12. Ans.

- (a) DNA ligase enzyme helps in joining the two ends of fragments, having the same kind of sticky ends.
- (b) *Meloidogyne incognita* is a nematode which infects the roots of tobacco plant. If *Meloidogyne incognita* consumes cells with the RNAi gene, the DNA forms sense and antisense RNA in the host cells. These two RNAs, being complementary to each other, form double-stranded RNA which binds to and prevents translation of the mRNA of the nematode. The parasite could not survive in a transgenic host expressing specific interfering RNA and dies. The transgenic plant therefore gets protected from the parasite.

**13. Ans.**



**14.** Filariasis is caused by *Wuchereria bancrofti* and *Wuchereria malayi*.

Symptoms:

(i) Fever

(ii) Legs may become swollen resembling those of an elephant.

It is transmitted to a healthy person through the bite of female mosquito vectors.

**15. Ans.** Streptococcus is used in the production of streptokinase which is used as a clot buster for removing clots from blood vessels of heart attack patients.

**OR**

Mycorrhiza is the symbiotic association between fungal hypha and roots of seed-bearing plants. The fungal symbiont in these associations absorbs phosphorus from soil and passes it to the plant. Thus, mycorrhizae act as a biofertiliser. The genus of fungi *Glomus* forms a mycorrhizal association with plants.

**16. Ans.**

(a) The chromosome number is haploid in gametes, whereas there is a diploid set of chromosomes in the meiocyte (gamete mother cell).

(b) Whiptail lizard is said to be parthenogenetic because the female gamete undergoes development to form new organisms without fertilisation.

**17. Ans.** In 1972, Stanley Cohen and Herbert Boyer introduced a piece of gene containing foreign DNA into the plasmid of *E. coli*. They invented the technique of DNA cloning which allowed genes to be transplanted between different biological species. Boyer had discovered a restriction enzyme which cut DNA strands at specific positions, allowing them to be connected to other DNA. Combining these techniques allowed them to invent genetic engineering, to choose the genes to transplant and to choose the position to clone them.

**18. Ans.** Sporopollenin is found in the cell walls of plant spores and the exines of pollen grains. It is a complex substance of an oxidative polymer of carotenoids. It is the most resistant to biological materials which helps in the fossilisation of pollen grains.

## SECTION C

### 19.Ans.

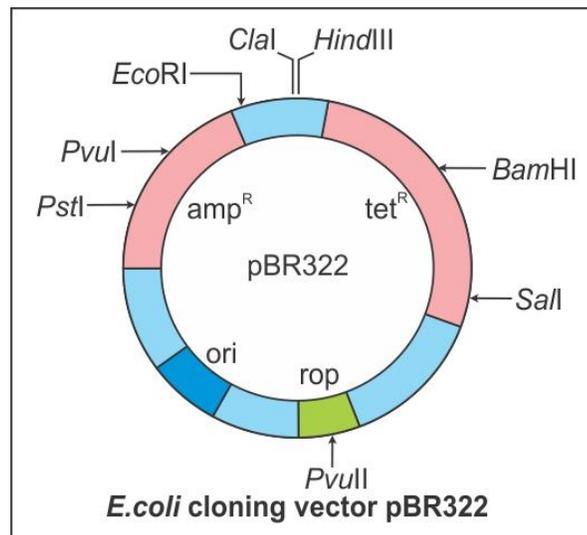
- (a) The middle piece in human sperm possesses numerous mitochondria which produces energy for the movement of the tail that facilitates sperm motility essential for fertilisation.
- (b) Tapetum in anthers is the innermost layer and provides nourishment to the developing pollen grains.
- (c) Luteinising hormones in males stimulate the Leydig cells to produce testosterone.

### 20.Ans.

- (a) This representation indicates a normal human because glutamic acid is present at the sixth position in the respective amino acid chain.
- (b) In the sufferer who exhibits the sickle cell trait, the defect is caused by the substitution of glutamic acid (Glu) by valine (Val) at the sixth position of the  $\beta$ -chain of haemoglobin.
- (c) Both males and females suffer equally because sickle cell anaemia is not a sex-linked disease. It is an autosomal disease and sickle-shaped RBCs will cause equal deficiency of oxygen in both males and females.

### 21.Ans.

- (a) Two restriction sites – BamHI and PvuII
- (b) *Ori* and *rop* genes – *Ori* is the site of origin of replication. *Rop* codes for the proteins involved in the replication of the plasmid.
- (c) Antibiotic-resistant genes –  $\text{amp}^R$  and  $\text{tet}^R$



Schematic sketch of plasmid pBR322

**22.Ans.** RNA is the first genetic material because

- (i) RNA can store genetic information like DNA and acts as an enzyme to catalyse reactions.
- (ii) RNA is involved in metabolism, genetic translation and transcription.
- (iii) RNA is capable of self-replication.

**OR**

- (a) RNA polymerase in prokaryotes and RNA polymerase III in eukaryotes are responsible for transcription of tRNA. Initiator tRNA gets linked with formulated methionine in prokaryotes and methionine in eukaryotes.
- (b) Initiator tRNA combines with methionine in the presence of amino acyl-tRNA enzyme resulting in the formation of charged tRNA. This initiator tRNA combines with two subunits of ribosomes and mRNA forming a translation initiation complex. First, mRNA attaches to the small subunit of ribosome and charged initiator tRNA. The initiator tRNA joins the initiation codon AUG and signals the start of translation. Now, the large subunit of the ribosome combines with the small subunit. Initiator tRNA lies at the P site of the ribosome.

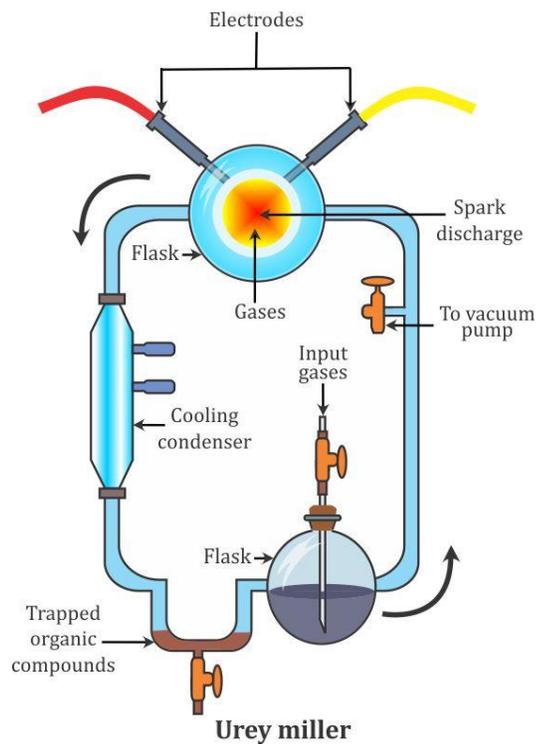
**23.Ans.**

- (a) A represents a female Anopheles mosquito which acts as a vector for plasmodium.
- (b) Event C represents the process of fertilisation which occurs inside the intestine of the mosquito.
- (c) Organ B is the salivary gland of the mosquito and the cells removed are sporozoites.

**24.Ans.** The theory of biogenesis was proposed by Louis Pasteur. He proposed that all living things arise from pre-existing life. These cells further originated from organic compounds. So, life could have come from non-living matter and these were formed from inorganic constituents.

Urey and Miller in 1953 demonstrated that the electrical discharges or heat energy can form the complex organic substances from the mixture of water (H<sub>2</sub>O), methane (CH<sub>4</sub>), ammonia (NH<sub>3</sub>) and hydrogen (H<sub>2</sub>). The chemicals were all sealed inside a sterile array of glass flasks and flasks connected in a loop, with one flask half-full of liquid water and another flask containing a pair of electrodes. The liquid water was heated to induce evaporation, sparks were fired between the electrodes to simulate lightning through the atmosphere and water vapour, and then the atmosphere was cooled again so that the water could condense and trickle back into the first flask in a continuous cycle. They observed production of acetic acid, urea, fatty acids, lactic acid and amino acids such as glycine, alanine and aspartic acid. Other investigators observed the formation of sugars and nitrogen bases by using ultraviolet light. Hence, this

experiment supported that life has evolved from pre-existing non-living organic molecules.



**25.Ans.** The genes responsible for making the Bt cotton plant resistant to bollworms are *cryIAC* and *cryIIAB*. These genes are secreted in the form of protein crystals during a particular phase of their growth which contains insecticidal proteins which exist in the inactive form. When an insect ingests the inactive toxin, it gets converted to the active form in the gut under alkaline conditions. This solubilises the crystals and the active toxin binds to the surface of epithelial cells and creates pores which cause cell swelling, lysis and death of the insect.

**26.Ans.** The excessive use of fertilisers is washed out with rainwater from the fields into the rivers, lakes and ponds and promotes the profuse growth of algae called algal bloom. Such algal bloom may totally cover the water surface and consume excess quantity of dissolved oxygen, causing depletion of oxygen in water for other organisms. Algae also release toxins in water to inhibit the growth of other algae and aquatic animals (fish). Thus, reduction of oxygen and toxin released in water affect the fish population and other aquatic life. The process of nutrient enrichment of water and consequent loss of species diversity is called eutrophication.

The weed water hyacinth can grow in such a eutrophic lake.

**27.Ans.** Different microbes occurring in sewage water are aerobic and anaerobic bacteria, protozoans and filamentous fungi.

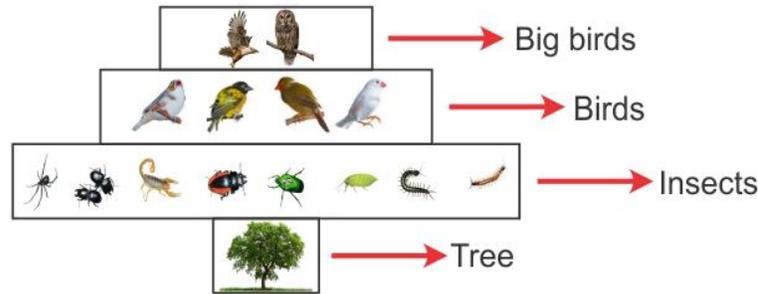
The primary effluent is passed into large aeration tanks where it is constantly agitated. This allows abundant growth of aerobic microbes (bacteria and filamentous fungi) into flocs, mesh-like structure. The growth of these microbes reduces the BOD of effluents. When the BOD is reduced, the effluent is passed into settling tanks where the bacterial flocs are allowed to sediment. This sediment is called activated sludge. A small part of activated sludge is introduced into large tanks called anaerobic sludge digesters where anaerobic bacteria digest bacteria and fungi in the sludge and produce methane, H<sub>2</sub>S and CO<sub>2</sub>. The effluent from secondary treatment is then released into natural water bodies.

## SECTION D

28. Ans.

- (a) The pyramid of numbers is the graphic representation depicting the arrangement of the number of individuals of different trophic levels in a food chain in an ecosystem.

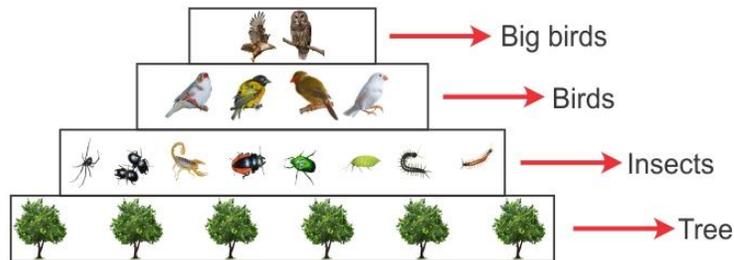
Pyramid of numbers showing interaction between trees, insects, small birds and big birds:



**Pyramid of numbers**

This is a spindle-shaped pyramid.

- (b) Pyramid of biomass is a graphic representation of biomass present per unit area in different trophic levels.



**Pyramid of Biomass**

Differences between the pyramid of biomass of the above situation and the pyramid of numbers:

- (i) The pyramid of numbers is spindle-shaped, whereas the pyramid of biomass in this ecosystem is straight.
- (ii) In the pyramid of numbers, the number of trees and birds is less than insects, whereas in the pyramid of biomass, the biomass decreases at each trophic level.

**OR**

- (a) The two types of desirable approaches to conserve biodiversity are

- (i) *In situ* conservation: *In situ* conservation is the most appropriate method to maintain the species of wild animals and plants in their natural habitats. This approach includes protection of the total ecosystem through a network of protected areas. These are the biogeographical areas where biological diversity along with natural/cultural resources are

protected, maintained and managed. The common natural habitats which have been set for *in situ* conservation of wild animals and plants include

- National parks
- Biosphere reserves
- Wildlife sanctuaries
- Sacred grooves and lakes
- Several wetlands, mangroves and coral reefs

(ii) *Ex situ* conservation: This conservation strategy includes botanical gardens, zoos and gene, pollen, seed, seedling, tissue culture and DNA banks.

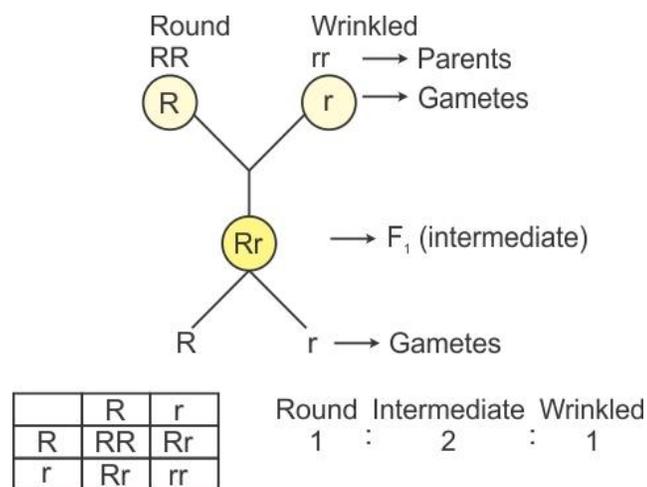
All these approaches help conserve species and population diversity outside the natural habitats.

(b) Association between the bumble bee and its favourite orchid *Ophrys* is mutualism. Orchids show a bewildering diversity of floral patterns many of which have evolved to attract the right pollinator insect (bees and bumble bees) and ensure guaranteed pollination by it.

If the female bee's colour pattern changes even slightly for any reason during evolution, pollination success will be reduced unless the orchid flower co-evolves to maintain the resemblance of its petal to the female bee.

**29. Ans.** A cross between round seed which has well-developed starch grains and wrinkled seeds which do not have starch grains will give an intermediate situation. Such a cross is a monohybrid cross.

Suppose R is the allele for round seed and r is the allele for wrinkled seed.



This is an example of incomplete dominance, whereas Mendelian inheritance shows complete dominance. In Mendel's pea plant experiment, dominance was essentially complete. There was no difference between homozygous and heterozygous plants in the expression of a dominant character. However, this is

not true for all characters or organisms. There are characters or alleles which are neither dominant nor recessive. In such cases, both alleles of contrasting conditions of a character express as a blend or mixture. As a result, the hybrid produced by crossing two pure individuals does not resemble either of them but is midway.

The expression of the traits of two pure parents as an intermediate condition or fine mixture in the  $F_1$  hybrids is known as incomplete, partial or blended dominance.

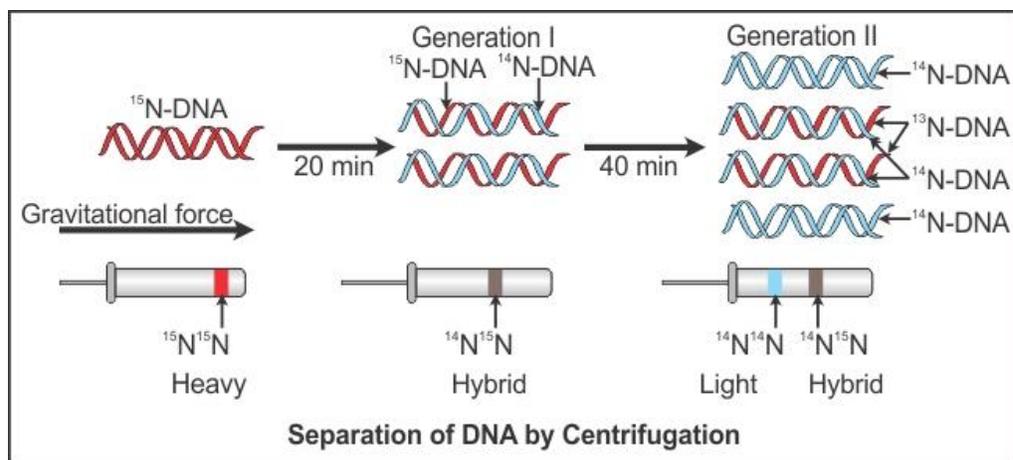
Blended inheritance is an exception to the outcome of Mendel's crosses.

**OR**

In 1958, the aim of Matthew Meselson and Franklin Stahl was to prove that DNA replicates in a semi-conservative way. The DNA consists of two helices which are combined. When the two helices are copied, each will have one part coming from the original cell (parental). The other part will be newly made.

Experimental Procedure:

- (i) *E. coli* was grown for several generations in a medium with  $^{15}\text{NH}_4\text{Cl}$ . As a result,  $^{15}\text{N}$  was incorporated into newly synthesised DNA. This DNA could be distinguished by centrifugation in  $\text{CsCl}$  density gradient.
- (ii) These *E. coli* cells are then transferred to normal  $^{14}\text{NH}_4\text{Cl}$  medium and the DNA was extracted as a double-stranded helix. The various samples were separated independently on  $\text{CsCl}$  gradients to measure the density of DNA.
- (iii) DNA extracted from the culture after another generation (second generation) was composed of equal amounts of hybrid and light DNA.



**30. Ans.** Figure 'f' illustrates ovulation and it is the ovulatory stage of oogenesis.

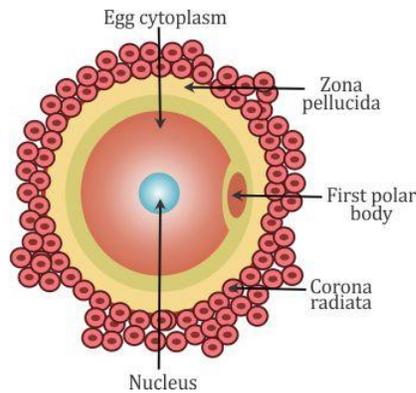
- (i) The ovarian hormone is progesterone which is released during ovulation. The pituitary hormones are the follicle-stimulating hormone (FSH) and luteinising hormone (LSH) which are released during ovulation.
- (ii) The endometrium of the uterus gets thickened and blood supply to the endometrium increases.

(iii) Figure 'c' represents the secondary follicle and figure 'h' represents the degenerating corpus luteum.

(iv)

Secondary Follicle	Corpus Luteum
1. It is surrounded by layers of granulosa cells.	1. Absence of granulosa cells.
2. Theca layer is present.	2. Theca layer is absent.

(v) Human ovum before fertilisation:



**OR**

- (i) The functional megaspore enlarges and undergoes three free nuclear mitotic divisions. The first division produces the binucleate embryo sac.
- (ii) The two nuclei shift to the two ends and divide there twice forming four-nucleate and then eight-nucleate structure.
- (iii) One nucleus from each side moves to the middle. They are called polar nuclei. The remaining three nuclei form cells at the two ends—3-celled egg apparatus at the micropylar end and three antipodal cells at the chalazal end.
- (iv) The egg apparatus consists of two synergids and one egg cell.
- (v) The synergids have special cellular thickenings at the micropylar tip called the filiform apparatus which plays an important role in guiding the pollen tubes into the synergid.
- (vi) Thus, at maturity, a typical angiosperm embryo sac is 8-nucleate but 7-celled.

