

BIOLOGY (Theory)

[Time allowed: 3 hours]

[Maximum marks:70]

General Instructions:

- (i) All questions are compulsory.
- (ii) 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.
- (iii) 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.
- (iv) Wherever necessary, the diagrams drawn should be neat and properly labelled.

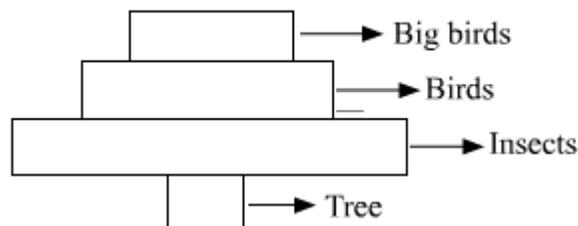
- Q28.** (a) Draw a 'pyramid of numbers' of a situation where a large population of insects feed upon a very big tree. The insects in turn, are eaten by small birds which in turn are fed upon by big birds.
- (b) Differentiate giving reason, between the pyramid of biomass of the above situation and the 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?

Ans:

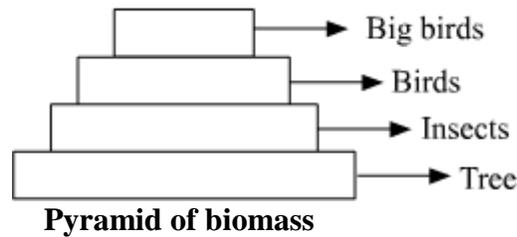
- (a) **Pyramid of numbers** showing interaction between trees, insects, birds and big birds.



Pyramid of numbers

- (b)
- (i) 'Pyramid of number' is spindle shaped as the number of insects is maximum. The number of

trees and birds are less than the insects. The numbers is gradually decreasing at each trophic level.



(ii) The Pyramid of Biomass in this ecosystem is erect because the biomass decreases at each trophic level.

OR

(a) Two approaches to conserve biodiversity are:

- (i) *In situ* conservation
- (ii) *Ex situ* conservation

In situ conservation	Ex situ conservation
It is the “on site” approach for the conservation of endangered species. It involves conservation of endangered species in their natural environment.	It is the “off site” approach for the conservation of endangered species. In this method, the organism is taken out of its natural environment and placed in special settings and given special care.
This method is characterised by the construction of biosphere reserves, national parks and wildlife sanctuaries.	This involves setting up of zoological parks, botanical gardens, etc., and employing modern techniques like cryopreservation of gametes, eggs and seeds.
It is a desirable method for conservation in the long run.	This method is useful especially in cases where urgent attention is required to save an organism from extinction.

(b) Commensalism is the type of association seen between the bumble bee and the orchid *Ophrys*. In this type of association, one species is benefitted and the other is neither harmed nor benefitted. Here, one petal of its flower bears an uncanny resemblance to the female of the bee in size, colour and markings. The male bee is attracted to what it perceives as a female, ‘pseudocopulates’ with the flower, and during that process is dusted with pollen from the flower. When this same bee ‘pseudocopulates’ with another flower, it transfers pollen to it and thus, pollinates the flower.

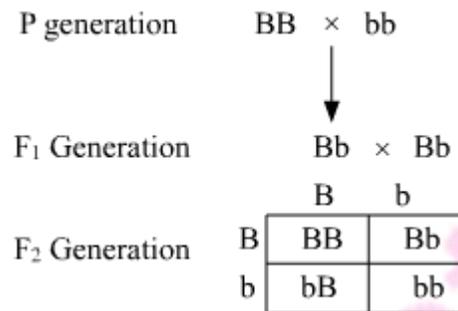
Extinction of bumble bee will definitely affect the orchid flower because these bees are the means of pollination for the flower and if they get extinct then the pollination percentage will be reduced. But the extinction of the orchid will not affect the bumble bee population.

Q29. What is the inheritance pattern observed in the size of starch grains and seed shape of *Pisum sativum*? Workout 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.

Ans: The starch synthesis in pea plants is controlled by a single gene. It has two alleles **B** and **b**. **BB** homozygotes produced large starch grains as compared to that produced by **bb** homozygotes. After maturation it was observed that **BB** seeds were round and **bb** were wrinkled. When they were crossed, the resultant progeny were intermediate-sized **Bb** seeds. The cross involved is



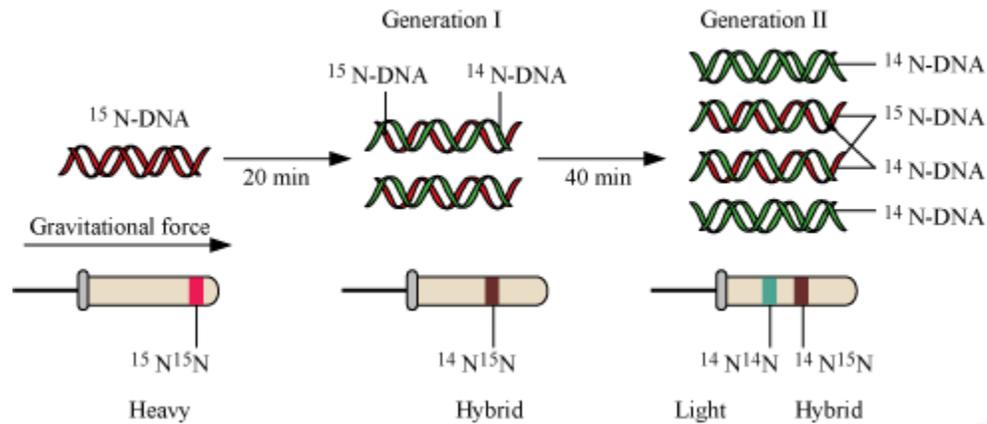
Deviation from Mendel's law of dominance: If starch grain size is considered as the phenotype, then from this angle, the alleles show incomplete dominance. Thus, dominance is not an autonomous feature of a gene, it depends on gene product and production of particular phenotype from this product.

OR

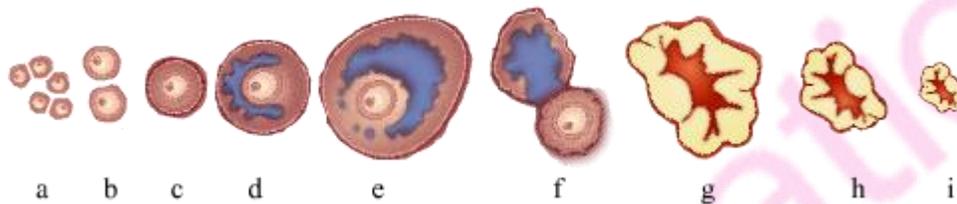
Messelson and Stahl in 1958 aimed at proving that the DNA replicates in a semi-conservative fashion. The semi-conservative DNA replication suggests that after the completion of replication, each DNA molecule will have one parental and one newly-synthesised strand.

Experimental proof

- (1) *E. coli* was grown in a medium containing $^{15}\text{NH}_4\text{Cl}$ (^{15}N is the heavy isotope of nitrogen) as the only nitrogen source for many generations. As a result, ^{15}N was incorporated into the newly-synthesised DNA. This heavy DNA could be distinguished by centrifugations in CsCl density gradient.
- (2) Then, these *E. coli* cells were transferred to a medium with normal $^{14}\text{NH}_4\text{Cl}$ and the DNA was extracted as double-stranded helix. The various samples were separated on CsCl gradients for measuring the density of DNA.
- (3) After 40 minutes, the DNA of the second generation was extracted from the $^{14}\text{NH}_4\text{Cl}$ medium and was found to have equal amounts of hybrid and light DNA.



Q30. The following is the illustration of the sequence of ovarian events (a – i) in a human female. (5)



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

OR

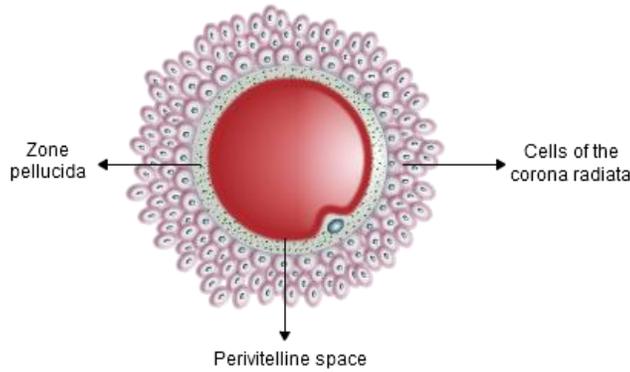
How does the megaspore mother cell develop into 7-celled, 8 nucleate embryo sac in an angiosperm? Draw a labeled diagram of a mature embryo sac.

- Ans:**
- Figure 'f' illustrates ovulation. It represents the ovulatory stage of oogenesis.
 - Progesterone is the ovarian hormone released during ovulation. Follicle stimulating hormone (FSH) and Luteinizing hormone (LH) is the pituitary hormone released during ovulation.
 - In anticipation of receiving the fertilised egg, the endometrium of the uterus gets thickened and also the blood supply to the endometrium increases.
 - In the figure, (c) stage represents the secondary follicle and the (h) stage represents the degenerating corpus luteum.

Secondary follicle	Corpus luteum
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It is Surrounded by layers of granulosa cells	Layers of granulosa cells absent
Presence of theca layer.	Theca layer is absent.

(v)



OR

The megaspore mother cell undergoes mitosis to form two nuclei which migrate to opposite poles, forming a 2-nucleate embryo sac. Further mitotic divisions lead to the formation of 4-nucleate and 8-nucleate stages of the embryo sac. In these mitotic divisions, nuclear division is not followed by cell division. After the 8-nucleate stage, cell walls are laid down and a typical female gametophyte or embryo sac is formed. Among the eight nuclei, six are enclosed by cell walls and organised into cells, while the remaining two nuclei (called polar nuclei) are situated above the egg apparatus in a large central cell. Out of the six cells, three are grouped at the micropylar end, and constitute the egg apparatus made up of two synergids and one egg cell. The other three cells are located at the chalazal end, and are called antipodals. Thus, a typical angiosperm embryo sac after maturity is 8-nucleated and 7-celled.

