

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.*

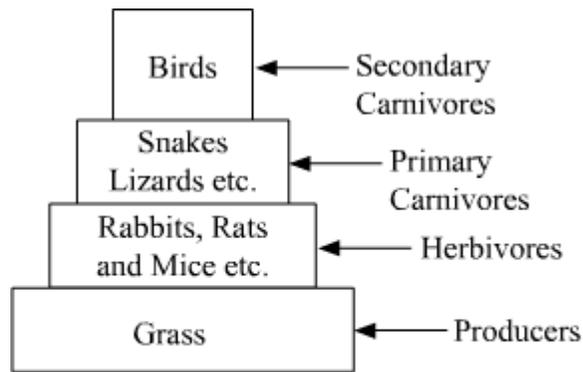
- Q28.** (a) Explain the significance of ecological pyramids with the help of an example.
- (b) Why are the pyramids referred to as 'upright' or 'inverted'? (5)

OR

- (a) Explain giving reasons why the tourists visiting Rohtang Pass or Mansarovar are advised to resume normal 'active life' only after a few days of reaching there.
- (b) It is impossible to find small animals in the polar regions. Give reasons.

- Ans:** (a) Ecological pyramids give the feeding relationships and efficiency of energy transfer through the biotic component of ecosystems. This give an apparently simple and fundamental basis for comparing: different ecosystems, seasonal variation within a particular ecosystem, change in an ecosystem.
- Three types of pyramids have been used:
1. Pyramid of numbers, based on counting the numbers of organisms at each trophic level.
 2. Pyramid of biomass, which note the weight (usually dry weight) of organisms at each trophic level.
 3. Pyramid of energy, which monitor the energy content of the organisms at each trophic level.

Example of pyramid of biomass in grassland ecosystem



Pyramid of biomass in a grassland ecosystem

- (b) The base of most pyramid (pyramids of number, energy and biomass), representing the producers or the first trophic level is broad and it narrows down at the apex. These are **upright pyramids**. It means producers are more in number and in biomass than the herbivores, and herbivores are more in number and biomass than the carnivores. Also energy at a lower trophic level is always more than that at a higher level.

In some pyramids of energy and biomass, the base representing the producers or the first trophic level is narrow and it get broader at the apex. These are **inverted pyramids**.

For example- large number of insects feeding on a big tree give inverted pyramid of number.

The pyramid of biomass in sea is also generally inverted because the biomass of fishes far exceeds that of phytoplankton.

Or

- (a) Tourists visiting high altitude areas such as Rohtang Pass or Mansarovar, experience altitude sickness. Its symptoms include nausea, fatigue and heart palpitations. This is because in the low atmospheric pressure of high altitudes, the body does not get enough oxygen. But, gradually we get acclimatised and stop experiencing altitude sickness. Thus, the visitors are advised to resume their normal active life involving heavy works only after few days because for doing heavy tasks our body needs energy and this energy is obtained by the oxidation of glucose in the presence of oxygen which is a limiting factor in higher altitudes.
- (b) Smaller animals are rarely found in polar regions because small animals have a larger surface area relative to their volume and they tend to lose body heat very fast when it is cold outside; then they have to expend much energy to generate body heat through metabolism.

Q29. Describe Frederick Griffith's experiment on *Streptococcus pneumoniae*. Discuss the conclusion he arrived at. (5)

OR

- (a) Explain a monohybrid cross taking seed coat colour as a trait in *Pisum sativum*. Work out the cross upto F₂ generation.
- (b) State the laws of inheritance that can be derived from such a cross.
- (c) How is the phenotypic ratio of F₂ generation different in a dihybrid cross?

Ans: (a) Griffith worked on *Streptococcus pneumoniae* to find the process of transformation in the bacteria. When *Streptococcus pneumoniae* bacteria were grown on a culture plate, some of the bacteria produced smooth shiny colonies (S) due to the presence of polysaccharide coat while others produced rough colonies (R) as they lacked polysaccharide coat.

Griffith then injected mice with this S strain (polysaccharide coat) as well as with R strain bacteria. He found that mice infected with virulent strain died from pneumonia, but mice infected with R strain did not develop pneumonia.

S strain → Injected into mice → Mice died of pneumonia

R strain → Injected into mice → Mice lived

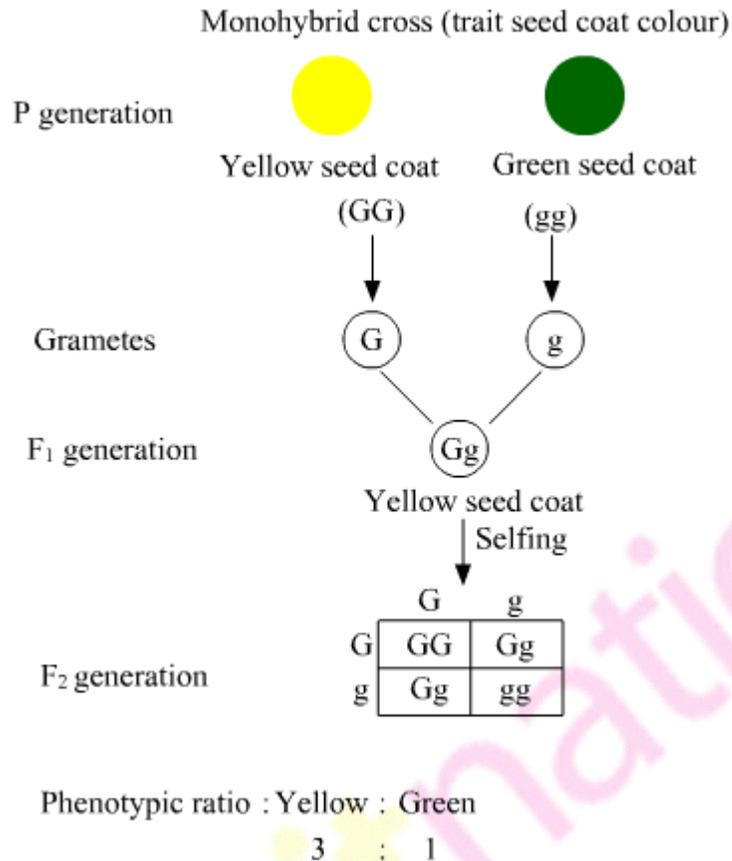
Now Griffith killed the S strain bacteria by heating them and injected these heat-killed bacteria into the mice. He observed that heat-killed S strain bacteria did not kill the mice. But when a mixture of heat-killed S and live R bacteria was injected into mice, the mice died. It was because when the heat-killed S strain bacteria along with live R strain bacteria were injected into mice, the DNA from the heat-killed S strain got transferred into live R strain. This resulted in R strain to become virulent and cause pneumonia in the mice, which led to their death. This process is called transformation.

S strain → injected into mice → Mice lived

S strain (heat-killed) + R strain (live) → Injected into mice → Mice died

Or

(a) **Monohybrid cross** is only one trait, For example, if pea plant with yellow seed coat is crossed with pea plant having green seed coat then in the F₁ generation all the plants produce yellow seeds.



(b) Two laws can be derived from such a cross

Law of Dominance

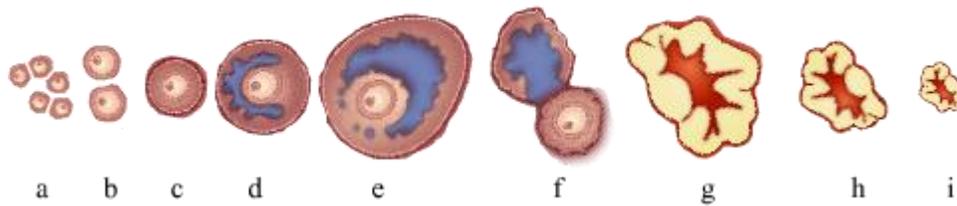
- According to this law, characters are controlled by discrete units called factors, which occur in pairs with one member of the pair dominating over the other in a dissimilar pair.
- This law explains expression of only one of the parental character in F₁ generation and expression of both in F₂ generation.

In the given cross, the trait to produce yellow seeds is dominant over the trait producing green seeds. In F₁ generation all offsprings showed yellow colour of seed (dominant character) and expression of both yellow and green in F₂ generation.

Law of Segregation

- This law states that the two alleles of a pair segregate or separate during gamete formation such that a gamete receives only one of the two factors.
- In homozygous parents, all gametes produced are similar; while in heterozygous parents, two kinds of gametes are produced in equal proportions.

Q30. The following is the illustration of the sequence of ovarian events “a” to “i” in a human female:

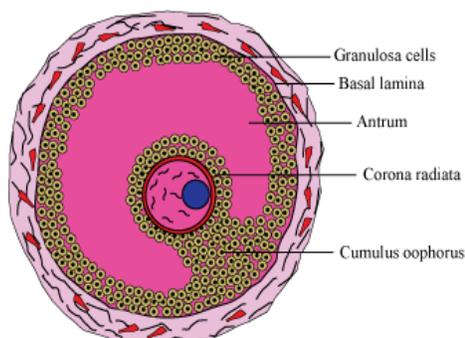


- Identify the figure that illustrates corpus luteum and name the pituitary hormone that influences its formation.
- Specify the endocrine function of corpus luteum. How does it influence the uterus? Why is it essential?
- What is the difference between “d” and “e”?
- Draw a neat labeled sketch of Graafian follicle. (5)

OR

- Why is fertilization in an angiosperm referred to as double fertilisation? Mention the ploidy of the cells involved.
- Draw a neat labeled sketch of L.S. of an endospermous monocot seed.

- Ans:**
- Figure ‘g’ illustrates corpus luteum. Rapid secretion of LH from pituitary gland induces rupture of Graafian follicle and formation of corpus luteum.
 - The corpus luteum secretes large amounts of progesterone and also estrogen which is essential for maintenance of the endometrium. Such an endometrium is necessary for implantation of the fertilised ovum and other events of pregnancy.
 - Figure ‘d’ is **tertiary follicle** which is characterised by a fluid filled cavity called antrum. The theca layer is organised into an inner theca interna and an outer theca externa. It is at this stage the primary oocyte within the tertiary follicle grows in size and completes its first meiotic division. It is an unequal division resulting in the formation of a large haploid secondary oocyte and a tiny first polar body. Figure ‘e’ is mature follicle or Graafian follicle. The secondary oocyte forms a new membrane called zona pellucida surrounding it.
 - Diagram showing mature Graafian follicle**



Structure of the Graafian follicle

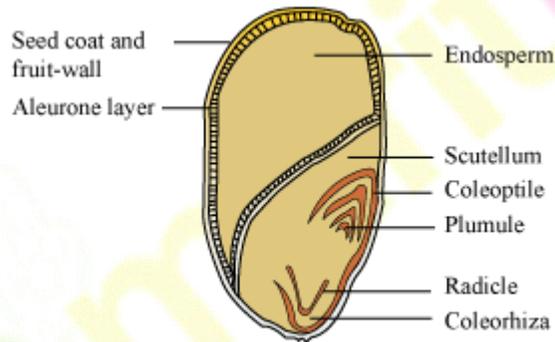
OR

- (a) **Double fertilization** is a characteristic feature of flowering plants or angiosperms. In the process of double fertilization, out of the two sperm nucleus, one sperm nucleus fuses with the egg nucleus to form an embryo (process is called syngamy) and another fuses with polar nuclei to form endosperm (process is called triple fusion). Since two kinds of fusion; syngamy and triple fusion take place, the process is known as double fertilisation.

Ploidy of the cells involved

Cell	Ploidy
Egg cell	Haploid
Both Male nuclei	Haploid
Central cell	Diploid
Zygote	Diploid
Endosperm	Triploid

- (b) **L.S of endospermous monocot seed**



L.S. of an endospermous monocot seed