

**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, D and E. Section A contains 5 questions of **one** mark each, Section B is of 5 questions of **two** marks each,*
- (iii) *Section C has 12 questions of **three** marks each and Section D is of 1 questions of **four** marks each Section E is of 3 questions of **five** marks each.*
- (iv) *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.*
- (v) *Wherever necessary, the diagrams drawn should be neat and properly labelled.*

**Section A**

1. Failure of testes to descend into scrotal sacs leads to sterility.  
Why? 1
  
2. Each and every coitus does not result in fertilisation and pregnancy. Justify the statement. 1
  
3. Identify the correct statement:
  - a. Female of many birds has a pair of dissimilar ZW chromosomes, while the males possess a pair of similar ZZ

- chromosomes.
- b. Female of many birds has a pair of similar ZZ chromosomes, while the males possess a pair of dissimilar ZW chromosomes. 1
4. Name the base change and the amino acid change, responsible for sickle cell anaemia. 1
5. Name the plant whose sap is used in making Toddy. Mention the process involved in it. 1

### Section B

6. Rearrange the following in increasing order of evolution: Psilophyton; Conifers; *Zosterophyllum*; *Ginkgo* 2
7. Lactational Amenorrhea is a method of contraception Justify. What is the maximum effectiveness of this method in terms of period/duration? 2
8. Draw and label the parts of the head region only of a human sperm. 2
9. Where are B-cells and T-cells formed? How do they differ from each other? 2

**OR**

- Differentiate between inbreeding and outbreeding in animals. 2

10. A bacterium *Bacillus thuringiensis* produces a toxic protein named *cry* protein that is lethal to certain insects but not to bacterium
- a. Why this toxin does not kill the bacteria?
  - b. What type of changes occurs in the gut of insects on consuming this protein?
- 2

### Section C

11. Name two main steps which are collectively referred to as down streaming process. Why is this process significant? 3
12. a. There is a sharp decline in dissolved oxygen downstream from the point of sewage discharge. Why? What are its adverse effects?
- b. At what stage of Sewage treatment is the (BOD) test performed?
- c. Provide two reasons that make the count of prokaryotic species difficult. 3
13. a. Habitat loss and fragmentation has caused severe damage to a particular type of ecosystem. Name it.
- b. Name the two gases contributing maximum to the green house effect.
- c. What is BOD? 3
14. a. How is apomixis different from parthenocarpy ?
- b. Describe any two modes by which apomictic seeds can be produced. 3

15. Why is haemophilia rare in human females? Mention a clinical symptom for the disease. 3
16. a. What are the transcriptional products of RNA *polymerase III*?  
b. Differentiate between 'Capping' and 'Tailing'.  
c. Expand *hnRNA*. 3
17. Giving three reasons, write how Hardy-Weinberg equilibrium can be affected. 3
18. What are Cannabinoids? From which plant Cannabinoids are obtained? Which part of the body is affected by consuming these substances? 3
19. Suggest and describe a technique through which a virus-free healthy plant can be obtained from a diseased sugarcane plant. 3
20. Draw a schematic diagram of the *E. coli* cloning vector pBR322 and mark the following in it :  
a. ori  
b. rop  
c. ampicillin resistance gene  
d. tetracycline resistance gene  
e. restriction site BamHI  
f. restriction site EcoRI 3

**OR**

- a. Draw schematic diagrams of segments of a vector and a

- foreign DNA with the sequence of nucleotides recognised by EcoRI.
- b. Draw the vector DNA segment and foreign DNA segments after the action of EcoRI and label the sticky ends produced. 3
21. How does the shape of age pyramid reflect the growth status of a population? 3
22. Some crop plants are modified genetically by manipulating their genes. How are they made beneficial? 3

### Section D

23. Arvind s mother has developed Diabetes. Doctor suggests her to take Insulin injections. But his mother declines as she presumes injections are prepared by slaughtering of animals
- a. How will you solve his mother's problem with your knowledge of biotechnology?
- b. Identify the values which Arvind has shown. 4

### Section E

24. a. Describe the formation of mature female gametophyte within an ovule in angiosperms.
- b. Describe the structure of the cell(s) that guide(s) the pollen tube to enter the embryo-sac. 5

**OR**

Explain the different phases of menstrual cycle and correlate

the phases with the different levels of ovarian hormones in a human female. 5

25. Work out a monohybrid cross upto  $F_2$  generation between two pea plants and two *Antirrhinum* plants both having contrasting traits with respect to color of flower. Comment on the pattern of inheritance in the crosses carried above. 5

**OR**

Describe the process of transcription in a bacterium. 5

26. What is altitude sickness? What its causes and symptoms? How does human body try to overcome altitude sickness? 5

**OR**

- a. With suitable examples, explain the energy flow through different trophic levels. What does each bar in this pyramid represent?
- b. Write any two limitations of ecological pyramids. 5

# ANSWERS

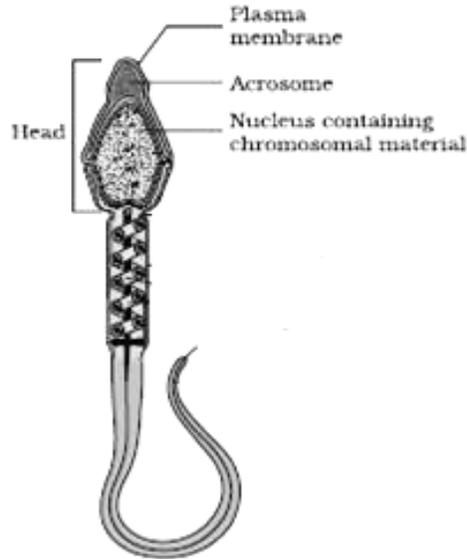
## Section A

1. High temperature of abdomen prevents spermatogenesis in the testes so no sperms are formed.
2. Ovum and sperm should reach simultaneously to the ampullary – isthmic junction.
3. a.
4. GAG changes as GUG, Glutamic acid is substituted by valine.
5. Palm tree, by fermentation.

## Section B

6. *Zosterophyllum*; Psilophyton; Conifers; *Ginkgo*
7. a. Ovulation and menstrual cycle do not occur during the period of intense lactation following parturition. Therefore, as the mother breast feeds, chances of conception are nil.  
b. It is effective only upto a maximum period of six months following parturition.

8.



9. B-cells and T-cells are formed in bone marrow. B-cells produce antibodies but E-cells do not produce antibodies but help B-cells to produce them.

**OR**

When breeding is between animals of the same breed, it is called inbreeding, while cross between different breeds in called out breeding.

10. a. The toxin is produced in an inactive form as Prototoxins.  
b. Prototoxin becomes active toxin in alkaline pH of gut of insects. Toxins bind to surface of midgut and cause perforation, swelling, lysis of cells ultimately leading to death.

### **Section C**

11. The two main steps which are collectively referred to as down streaming process are separation and purification.

This process is significant as the product has to be formulated with suitable preservatives and is essential because before reaching into market, the product has to be subjected for clinical trial and quality control.

12.
  - a. Following discharge of sewage into river, micro organisms involved in biodegradation of organic matter present in sewage consume more oxygen. This cause mortality of fish and other aquatic creatures.
  - b. The BOD test is carried out during biological treatment or secondary treatment Separation and Purification
  - c.
    1. The conventional taxonomic methods are not suitable for identifying microbial species
    2. Many species are not culturable under laboratory conditions.
  
13.
  - a. Tropical Rain Forest.
  - b. Carbon di oxide, Methane
  - c. The BOD test measures the rate of uptake of oxygen by microorganisms in a sample of water.
  
14.
  - a. Apomixis is a form of asexual reproduction that mimics sexual reproduction. It forms seeds without fertilization and meiosis. Parthenocarpy is a process in which fruits develop without fertilization be induced through the application of growth hormones
  - b. Two modes by which apomictic seeds can be produced are:
    1. Diploid egg cell formed without reduction division and develops into the embryo without fertilisation.

2. Some of the nucellar cells surrounding the embryo sac start dividing, protrude into the embryo sac and develop into the embryos.
15. Haemophilia is rare in human females as the heterozygous female for haemophilia is a carrier and does not exhibit the symptoms.  
Only a homozygous female suffers from the disease and the possibility of a female suffering from the disease is extremely rare as it occurs only when the mother of the female is a carrier ie  $XhX$  and father is haemophilic ie.  $XhY$ .  
A clinical symptom for the disease is excessive bleeding when injured.
16. a. The transcriptional products of RNA *polymerase III* tRNA, 5 srRNA and snRNA.  
b. In **capping** a nucleotide methyl guanosine triphosphate is added to the 5'-end of hnRNA.  
In **tailing**, 200-300 adenylate residues are added at 3'-end in a template independent manner.  
c. *hnRNA* is expanded as **Heterogeneous nuclear RNA**.
17. a. Gene migration: It is addition of New genes/alleles to the new population when there is migration of a section of population to another place and population occurs resulting in change in gene frequencies in the original as well as in the new population. When gene migration, happens multiple times there would be a gene flow.  
b. Genetic drift: When gene migration occurs by chance it is called genetic drift.

c. Natural Selection: It is a process in which heritable variations enabling better survival are enabled to reproduce and leave greater number of progeny.

18. Cannabinoids are a group of chemicals which interact with cannabinoid receptors.

a. They are present principally in the brain

b. Cannabinoids are obtained from the inflorescence of the plant *Cannabis sativa*.

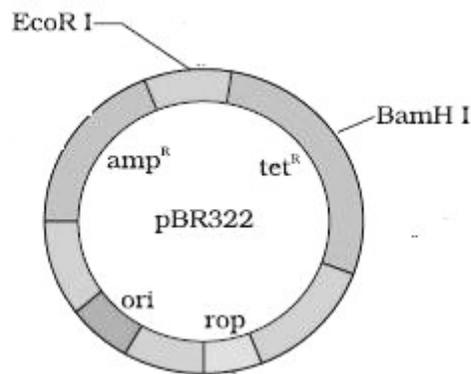
c. The substances affect the cardiovascular system adversely.

19. a. The **meristem** (apical and axillary) is free of virus.

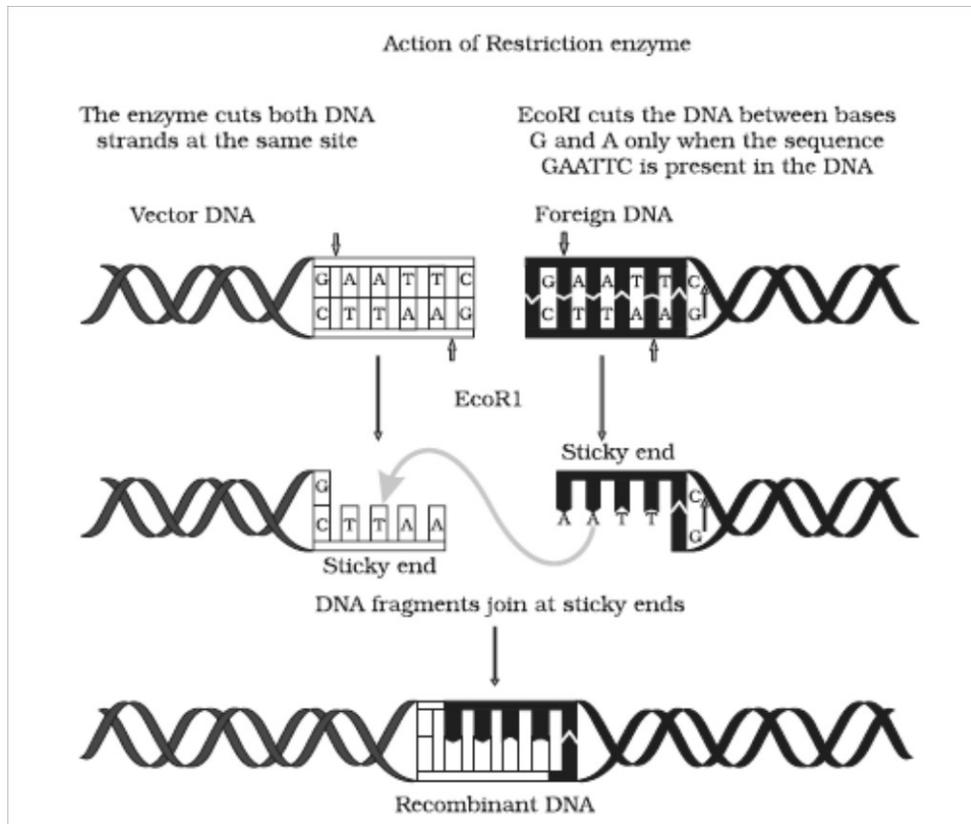
b. Removal of the meristem

c. Growing the meristem *in vitro* to obtain virus-free plants.

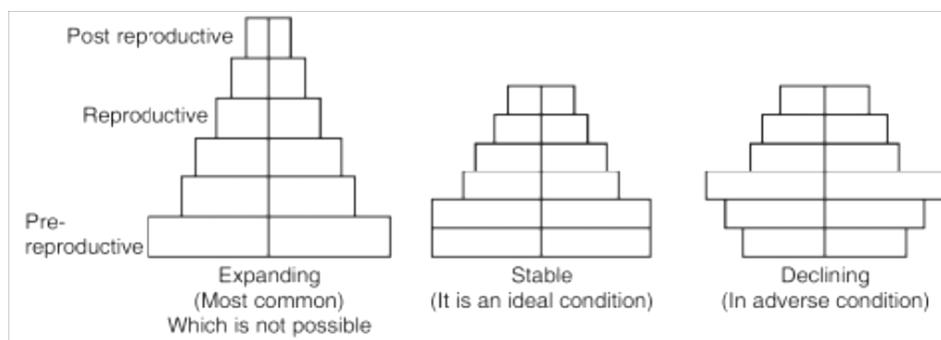
20.



OR



21. A population at any given time is composed of individuals of different ages. If the age distribution is plotted for the population, the resulting structure is called an age pyramid. The shape of the pyramids reflects the growth status of the populations
- a. Whether it is growing (expanding)
  - b. Stable or
  - c. Declining.
- Pyramids for human population (males and females) are represented below.



22. Genetically modified plants are more beneficial due to the following reasons:
- Crops are more tolerant to abiotic stresses like cold, drought, salt, heat.
  - Crops are pest resistant
  - Causes reduction in post harvest losses.
  - There is increased efficiency of mineral usage by plants that prevents early exhaustion of fertility of soil.
  - There is enhanced increased nutritional value of food.e.g., Vitamin 'A' enriched rice.
  - It has been used to create tailor-made plants to supply alternative resources like starches, fuels and pharmaceuticals to industries.

### Section D

23. a. Arvind can explain his mother that now *E. coli* bacteria can be easily grown in large quantity and genetically engineered to produce insulin instead of extraction from pancreas of slaughtered cattle and pigs.
- Using rDNA techniques two DNA sequences are prepared corresponding to A and B, chains of human insulin and introduced them in plasmids of *E. coli* to produce insulin chains.

The Chains A and B are produced separately, extracted and combined by creating disulfide bonds to form human insulin.

- b. Sympathetic attitude with alertness and practical approach.

### **Section E**

24. a. In a majority of flowering plant one of the megaspore is functional while other three degenerate. The functional megaspore develops in embryo sac. The nucleus of the functional megaspore (n) undergoes three successive mitotic cell division which results the formation of eight nucleate stage of embryo sac (free nuclear division) The cell wall formation starts at eight nuclear stages. Three cells are grouped together at micropylar end to form the egg apparatus (2 synergids + 1 egg cell).

Three cells are grouped at chalazal end, called antipodal cells.

The remaining 2 nuclei are called polar nuclei move to the centre of embryo sac, called central cell. Thus typical angiospermic embryo sac at maturity is 8 nucleated and 7 celled.

- b. The egg apparatus consists of two **synergids** and one **egg cell**.

The synergids have special cellular thickenings at the micropylar tip called filiform apparatus that guide(s) the pollen tube to enter the embryo-sac.

### **OR**

The different phases of menstrual cycle are as follows:

- a. Menstrual phase: During this phase menstrual flow occurs and it lasts for 3-5 days.
- b. Follicular phase: During this phase, the primary follicles in the ovary grow to become a fully mature Graafian follicle and

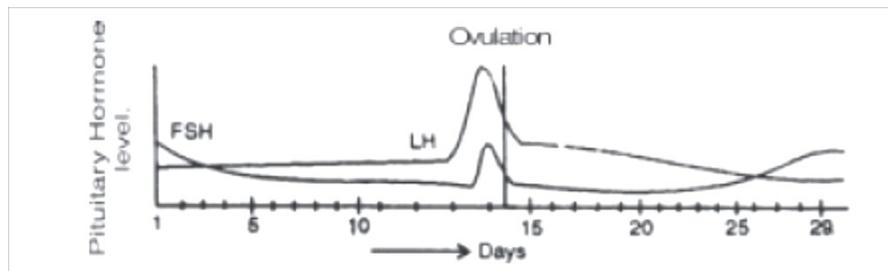
simultaneously the endometrium of uterus regenerates through proliferation. These changes are induced by changes in the levels of pituitary(FSH) and ovarian hormones (Estrogen).

The secretion of gonadotropins (LH and FSH) increases gradually during the follicular phase, and stimulates follicular development as well as secretion of estrogens by the growing follicles.

Both LH and FSH attain a peak level in the middle of cycle (about 14th day).

Rapid secretion of LH leading to its maximum level during the mid-cycle called LH surge induces rupture of Grafian follicle and thereby the release of ovum (**ovulation**).

- c. The luteal phase during which the remaining parts of the Grafian follicle transform as the **corpus luteum**. The corpus luteum secretes large amounts of progesterone which is essential for maintenance of the endometrium.



25. A monohybrid cross upto F<sub>2</sub> generation between two pea plants are as follows:

- a. In a cross between true-breeding Violet coloured flower (**WW**) and truebreeding white-flowered plants (**ww**), the F<sub>1</sub> (**Ww**) was all violet where violet colour flower (W) is dominant over white colour flower (w).

Parents	Phenotypes	Violet	White
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The pattern of inheritance follows **incomplete dominance**.

**OR**

In prokaryotes the process of transcription is completed in three steps:

- a. **Initiation:** RNA polymerase binds with initiation factor (sigma factor) and then binds to promoter site.
- b. **Elongation:** RNA polymerase separates from sigma factor and adds nucleoside triphosphate as substrate. RNA is formed during the process following the rule of complementarity and remains bound to enzyme RNA polymerase.
- c. **Termination:** On reaching terminator region RNA polymerase binds with rho factor (terminator factor). As a result nascent RNA separates.

**26.** Breathlessness at high altitudes.

**Cause :** Low atmospheric pressure at high altitudes due to which body does not get enough oxygen.

**Symptoms :** Nausea, fatigue and heart palpitations.

**The body adapts by :**

- a. increasing red blood cell production
- b. decreasing binding affinity of haemoglobin
- c. by increasing breathing rate.

**OR**

- a. **Energy Flow :** Energy flow is the key function in the ecosystem. The plants (producers) capture only 2 . 10 percent of the photosynthetically active radiation (PAR). Unidirectional flow of energy is taken place from the sun to producers and then to

consumers. About 10% energy flows from one trophic level to another.

**Grazing Food Chain :** It begins with producers.

**Detritus Food Chain :** It begins with dead organic matter. It is made up of decomposers (Fungi, Bacteria). They meet their energy and nutrient requirements by degrading detritus. These are also known as saprotrophs.

Each bar in an ecological pyramid represents trophic levels:

At the base PP (Primary producer) --→PC (Primary Consumer) --  
→SC(Secondary Consumer)-→TC (Tertiary Consumer)

- b. 1. Does not take into account same species belonging to two or more trophic levels.
2. Assumes simple food chain, does not accommodate food web.
3. Saprophytes have not been given any place in ecological pyramids.