

BIOLOGY (Theory)

[Time allowed: 3 hours]

[Maximum marks:70]

General Instructions:

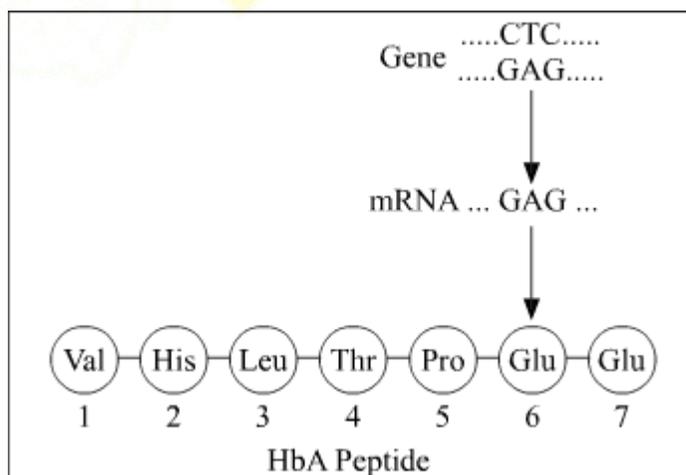
- (i) All questions are compulsory.
- (ii) This question paper consists of four sections A, B, C and D. Section A contains 8 questions of one mark each, Section B is of 10 questions of two marks each, Section C is of 9 questions, of three marks each and Section D is of 3 questions of five marks each.
- (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.

- Q19.** 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.

Ans:

- (a) **Middle piece in human sperm:** The middle piece contains several mitochondria, which produce energy for the motility of the sperm
- (b) **Tapetum in anthers:** It is the innermost layer in the anther. The main function of tapetum is to provide nourishment to the developing pollen grains.
- (c) **Luteinizing hormones in human males:** It stimulates the leydig cells to produce testosterone.

- Q20.** Given below is the representation of amino acid composition of the relevant translated portion of β -chain of haemoglobin, related to the shape of human red blood cells. (3)



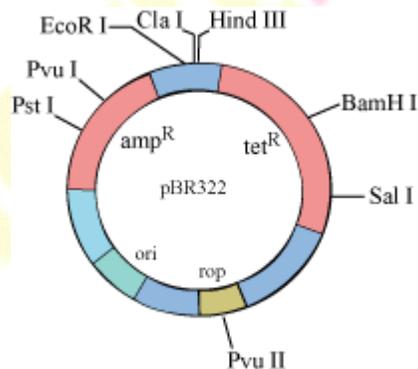
- (a) Is this representation indicating a normal human or a sufferer from certain related genetic disease? Give reason in support of your answer.
- (b) What difference would be noticed in the phenotype of the normal and the sufferer related to this gene?
- (c) Who are likely to suffer more from the defect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

- Ans:** (a) This representation is of a normal person. In a normal person the mRNA contains the codon GAG which codes for glutamic acid.
- (b) In a sufferer, the codon GAG is replaced by GUG in the mRNA. Hence, during translation of the defective mRNA, Glutamic acid is replaced by Valine.
- (c) The disease represented by the defect in the given gene is sickle-cell anaemia. It is an autosomal recessive trait. This disease is transmitted to the progeny when both the parents are carriers for the disease (heterozygous).

Q21. 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.

Ans: pBR322



The Restriction sites mentioned in the figure are Hind III, EcoR I, BamH I, Sal I, Pvu II, Pst I, Cla I (any two can be considered)

Antibiotic resistant genes: amp^R and tet^R

Q22. 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.

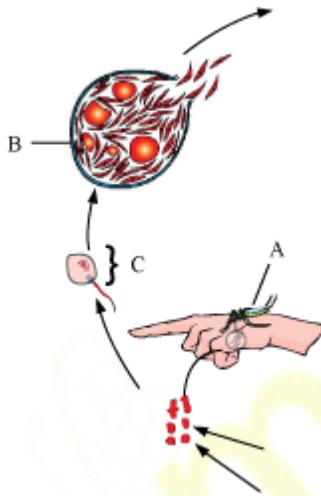
Ans: RNA was the first genetic material in cells because

- RNA is capable of both storing genetic information and catalyzing chemical reactions
- Essential life processes (such as metabolism, translation, splicing, etc.), evolved around RNA.
- It shows the power of self replication.

OR

- (a) RNA polymerase III is responsible for transcription of tRNA and methionine is the amino acid that gets linked with the initiator tRNA.
- (b) Initiator tRNA carries amino acid methionine at its amino acid binding site and has anticodon UCA at its anticodon binding site. Initiator tRNA binds with the codon (AUG) present on the mRNA and in this way the initiator tRNA plays a role in initiation of protein synthesis.

Q23. 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.

Ans:

(a) In the figure, 'A' represents the female *Anopheles* mosquito, the female mosquito takes up gametocytes of the malarial parasite along with the blood meal when it bites an infected person.

(b) The event 'C' in the figure is the fertilization stage and it takes place in the intestine of the mosquito.

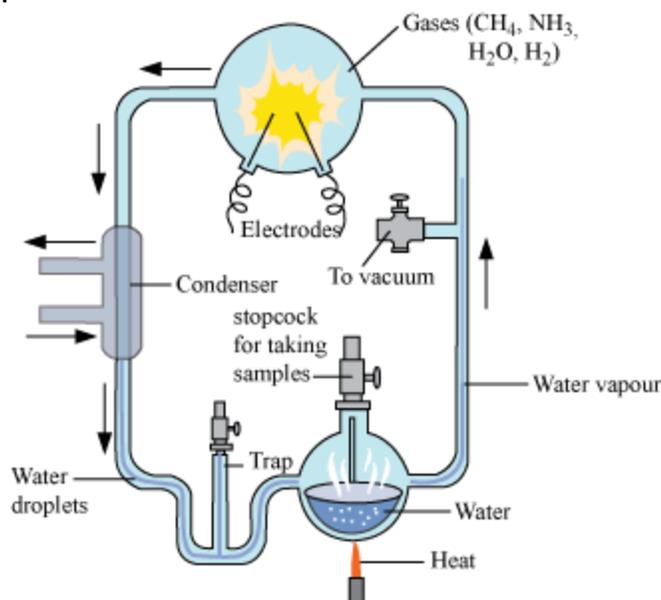
(c) The organ 'B' in the figure is the salivary gland of the mosquito and the sporozoites escape out of the mosquito's salivary gland.

Q24. State the theory of Biogenesis. How does Miller's experiment support this theory? (3)

Ans: The theory or law of biogenesis was proposed by Louis Pasteur. He proposed that all life

originated from pre-existing life. These cells further originated from the organic compounds. So, ultimately life could have come from pre-existing non-living organic molecules (e.g. RNA, protein, etc.) and that formation of life was preceded by chemical evolution, i.e., formation of diverse organic molecules from inorganic constituents.

In 1953, Urey and Miller conducted an experiment to prove this theory. They created the conditions of primeval earth – high temperature, volcanic storms, reducing atmosphere containing CH_4 , NH_3 , etc. at laboratory scale. They then stimulated electric discharge in a closed flask containing CH_4 , H_2 , NH_3 and water vapour at 8000°C . They observed formation of amino acids. In similar experiments others observed, formation of sugars, nitrogen bases, pigment and fats. These small organic molecules are the building blocks for proteins & other components. Hence, this experiment supported that life has come from pre-existing non-living organic molecules.



Q25. Name the genes responsible for making Bt cotton plants resistant to bollworm attack. How do such plants attain resistance against bollworm attacks? Explain. (3)

Ans: The Bt toxin is encoded by the *cry* gene. The *cry* I AC and *cry* II Ab control cotton boll worms, while the *cry* I Ab controls corn borer. Bt gene produces Bt toxin. This toxin provides resistance to plants against lepidopteron, coleopteron and dipterans pests.

An example is Bt cotton, in which the gene from the bacterium that encodes for the toxin is incorporated. The activated Bt toxin binds to the surface of the midgut epithelium of the insects and causes swelling and cell lysis, which eventually leads to the death of the insects.

In the process of producing insect-resistant crops, specific Bt toxin genes are isolated from *B.thuringiensis*, and incorporated into the crops. Since these toxins are insect specific, they do not harm the crops or humans.

Q26. How does an algal bloom cause eutrophication of a water body? Name the weed that can grow in such a eutrophic lake. (3)

Ans: Algae are the major producers of any aquatic ecosystem. Runoff of nutrients such as animal

wastes, fertilisers and sewage from land leads to an increase in the fertility of the lake. It causes a tremendous increase in the primary productivity of the water body and also leads to an increased growth of algae, resulting in algal blooms. Later, the decomposition of these algae depletes the supply of oxygen, leading to the death of other aquatic animal life. This phenomenon is called **eutrophication**.

Water hyacinth (*Eichhornia crassipes*) is a weed that can grow in such an eutrophic lake.

Q27. Name the two different categories of microbes naturally occurring in sewage water. Explain their role in cleaning sewage water into usable water. (3)

Ans: Bacteria and fungi are two categories of naturally occurring microbes present in sewage. The bacteria along with the fungal mycelia form flocs. These flocs are utilised during the secondary treatment of sewage. The primary effluent after separation of the grit and debris is taken to the secondary treatment. Here the effluent is passed to an aeration tank where it is constantly agitated and air is pumped into it. This leads to vigorous growth of bacteria and floc formation, the bacteria in these flocs consume organic matter; thus decreasing the BOD of the sewage.

Q22. Write the function of each one of the following: (3)

- (a) (Oviducal) Fimbriae
- (b) Coleoptile
- (c) Oxytocin

Ans: (a) Fimbriae are the feathery finger-like processes present at the end of the fallopian tubes and it collects the ovum after it is released from the ovary into the fallopian tube.
(b) Coleoptile is a conical sheath present in the monocot seeds, its function is to protect the developing plumule.
(c) Oxytocin is a hormone secreted by the posterior pituitary and it stimulates the contraction of uterine muscles during child birth (parturition).