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. Differentiate between perisperm and endosperm giving one example of each. **(3)**

Ans:

Perisperm	Endosperm
Perisperm is the residual persistent nucellus. It encloses the embryo and provides nourishment to it in certain seeds.	Endosperm is the tissue formed after double fertilisation. It surrounds, stores food and provide nourishment to the embryo in an angiosperm seed.
It is diploid in nature.	It is triploid in nature because it is formed as a result of triple fusion.
Example- Black pepper	Example- wheat

Q20. How does industrial melanism support Darwin's theory of Natural Selection? Explain. **(3)**

Ans: Darwin's theory of natural selection says that natural selection is the mechanism by which new species arise from pre-existing ones. The organisms which have favourable varitions in order to survive in the changed environment are selected by the nature to continue their generations and the rest fail to survive. Industrial melanism also showed the same case as was explained by Darwin in his theory of natural selection.

Industrial melanism − In England, it was noted that before industrial revolution, the number of white-winged moths was more than that of dark melanised moth. However, after industrialisation, there were more of dark melanised moths. The explanation was that after industrialization, the tree trunks became darker with deposits of soot and smoke and hence, the number of dark moths increased as they were not easily visible to their predators while the

white-winged ones were easily picked up by the predators. Thus, dark ones were selected by nature (natural selection) and light ones fail to survive.

Q21. List the salient features of double helix structure of DNA. **(3)**

OR

How are the structural genes activated in the *lac* operon in *E.coli*?

Ans: Watson and Crick proposed the double helix for structure of DNA.
Its features are:

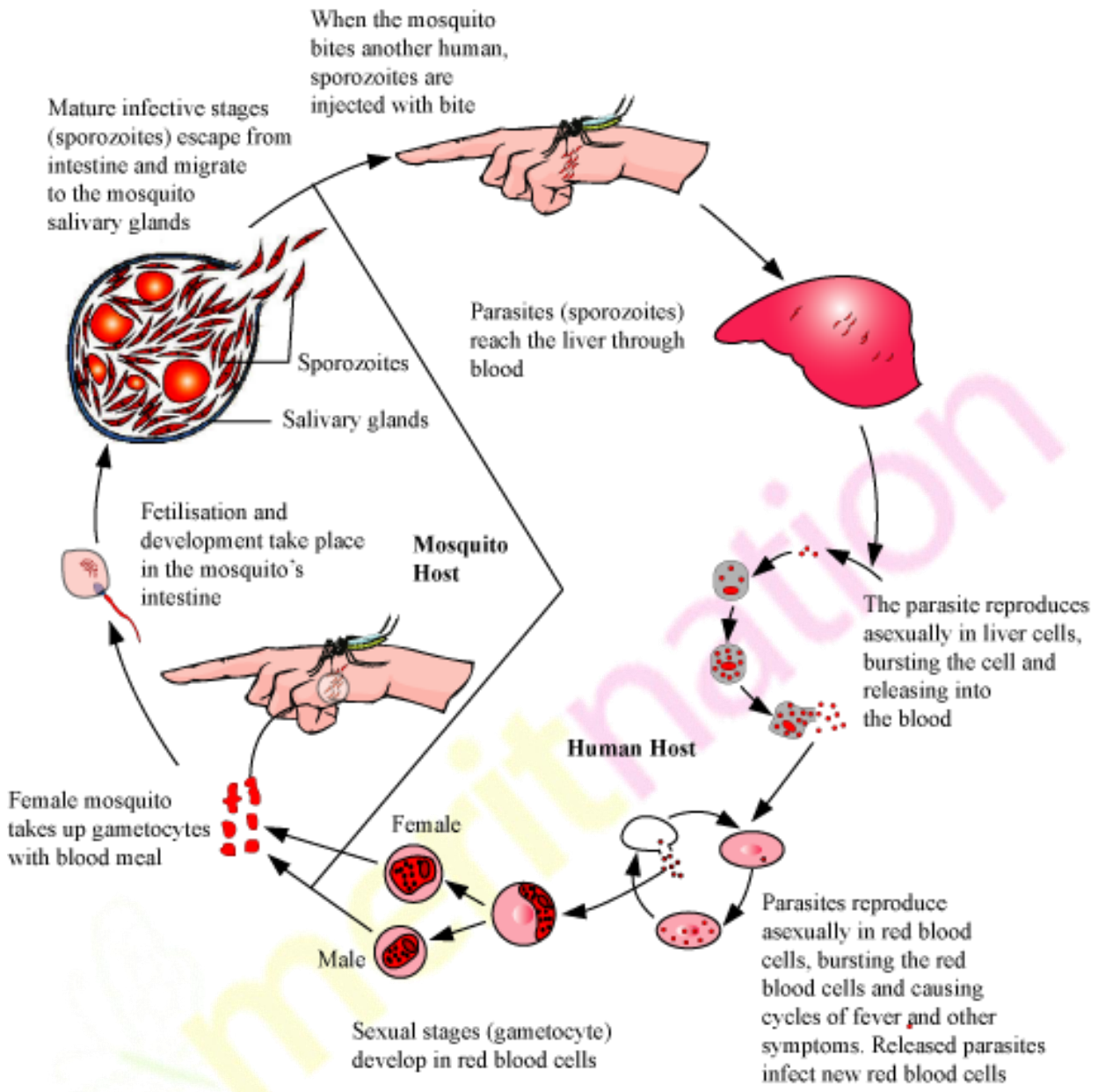
1. In a DNA, two polynucleotide chains are coiled to form a helix. Sugar-phosphate forms backbone of this helix while bases project in wards to each other.
2. Complementary bases pair with each other through hydrogen bonding. Purines always pair with their corresponding pyrimidines. Adenine pairs with thymine through two hydrogen bonds while guanine pairs with cytosine through three hydrogen bonds.
3. The helix is right-handed.
4. The plane of one base pair stacks over the other in a double helix. This provides stability to the helix along with hydrogen bonding.

Or

The structural gene in the *lac* operon consists of three genes, *lac* z, y and a. The structural gene is inactivated in the presence of repressor or in the absence of inducer (lactose). The repressor of the operon is produced by the *i* gene. The repressor protein when produced binds to the operator region of the operon and prevents RNA polymerase from transcribing the operon.

Q22. Trace the life-cycle of malarial parasite in the human body when bitten by an infected female *Anopheles.* **(3)**

Ans: *Plasmodium (*malarial parasite*)* requires two hosts to complete its life cycle. When female *Anopheles* mosquito bites a healthy human being, it releases *Plasmodium*, which lives in its body as sporozoite (infectious form). The parasites multiply (asexual reproduction) in the liver cells and finally burst the liver cells. Sporozoites are released in blood. Parasites enter RBCs and further multiply (asexual reproduction) here and finally burst RBCs also. Bursting of RBCs is accompanied by release of a toxic substance called haemozoin (associated with fever and chills). In the RBCs, only sporozoites change into gametocytes (sexual stage). Gametocytes multiply.



When the diseased person is bitten by a female *Anopheles* mosquito, gametocytes are introduced into the mosquito.

Q23. (a) Tobacco plants are damaged severely when infested with *Meloidegyne incognitia*. Name and explain the strategy that is adopted to stop this infestation.

(b) Name the vector used for introducing the nematode specific gene in tobacco plant. **(3)**

Ans: a) RNA interference or RNA*i* is a method adopted to prevent infestation of roots of tobacco plants by a nematode *Meloidogyne incognita*. In this method, a complementary

RNA binds to mRNA to form a *ds* RNA, which cannot translate. Hence, its expression is blocked. It is also known as gene silencing.
These RNA*i* genes can be incorporated into the tobacco plant through vectors. The introduced DNA forms both sense and anti-sense RNA. Two strands being complementary to each other bind and form *ds* RNA, leading to RNA*i*. Thus, the mRNA of nematode is silenced and the parasite cannot survive in the transgenic tobacco plant.

b) *Agrobacterium* vectors are used for introducing nematode specific genes into the tobacco plant.

Q24. (a) Explain the phenomena of multiple allelism and co-dominanace taking ABO blood group as an example.

(b) What is the phenotype of the following:
(i) $I^A i$
(ii) *i i* **(3)**

Ans: a) The inheritance of **ABO blood groups** in humans exhibits dominance, codominance and multiple allelism. In humans, the ABO blood groups are controlled by a gene called gene 'I'. It has three alleles, namely I^A, I^B and *i*.
Co-dominance: If both I^A and I^B are present in an individual, then they both are expressed because of the phenomenon of co-dominance.
Multiple allelism: Since the blood grouping is governed by more than two alleles, it is a good example of multiple allelism.

Table Showing the Genetic Basis of Blood Groups in Human Population is given as follows:

Allele from Parent 1	Allele from Parent 2	Genotype of offspring	Blood-types of offspring
I^A	I^A	$I^A I^A$	A
I^A	I^B	$I^A I^B$	AB
I^A	*i*	$I^A i$	A
I^B	I^A	$I^A I^B$	AB
I^B	I^B	$I^B I^B$	B
I^B	*i*	$I^B i$	B
i	*i*	*i i*	O

b) i) Phenotype of I^Ai will be A blood group
ii) Phenotype of *ii* will be O blood group

Q25. (a) List any three ways of measuring population density of a habitat.
(b) Mention the essential information that can be obtained by studying the population of an organism. **(3)**

Ans: a) **Population density** means number of individuals present per unit area. We can find out population density of a habitat by determining the population size.

The different methods to study population size are as follows:-

1) **Quadrat method**: It is a method which involves the use of square of particular dimensions to measure number of organisms. For example the number of *Parthenium* plants in a given area can be measured using the quadrat method.

2) **Direct observation** involving counting of organisms. For example, in order to determine the number of bacteria growing in a Petri dish, their colonies are counted.

3) **Indirect method:** The number fish caught per trap gives the measure of their total density in a given water body.

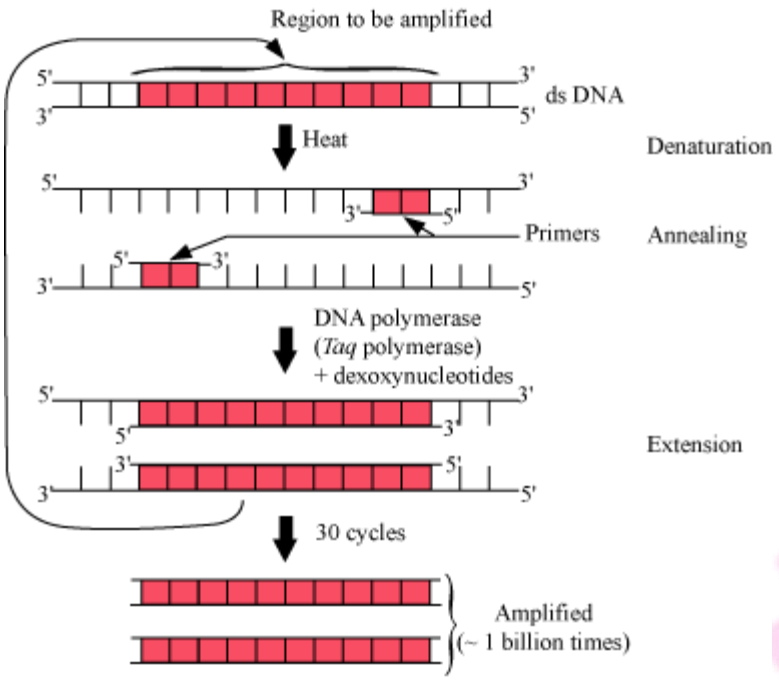
b) **Population density or population size** of an organism give many essential information such as

- If the population density is more, then the chances of competition would also be more due to crowding effect. This causes a decline in the reproduction rates and survival rates due to limiting resources.
- If the organism whose population density is being studied is endemic to the area, then the information could help in conserving the organism.

Q26. How is the amplification of a gene sample of interest carried out using Polymerase Chain Reaction (PCR)? **(3)**

Ans: To amplify the gene segment of the interest we should know the sequence of gene of interest. Primers are designed for amplifying the gene of interest. Two sets of primers (chemically synthesized oligonucleotide stretches) that are complementary to the gene of interest, DNA polymerase enzyme, and deoxynucleotides are added.

- PCR consists of 3 steps:
- **Denaturation** − Double helical DNA is denatured by providing high temperature. DNA polymerase does not get degraded in such high temperatures. The DNA polymerase used in this reaction is thermostable and is isolated from the thermophilic bacteria, *Thermus aquaticus* (*Taq*).



- **Annealing-** It is the step in which primers are annealed to single stranded DNA templates. Two sets of primers are used. The temperature of reaction mixture is lowered to 50- 65°C for some seconds to allow annealing of primers. DNA polymerase extends the primer in 5' to 3' direction.
- **Extension** − Replication of DNA occurs in vitro.
- This cycle is repeated several times to generate up to 1 billion identical copies of the DNA.

Q27. (a) What is the programme called that is involved in improving success rate of production of desired hybrid and herd size of cattle?

(b) Explain the method used for carrying this programme for cows. **(3)**

Ans: a) To improve chances of successful production of desired hybrids and herd size of cattle, **Multiple Ovulation Embryo Transfer Technology (MOET)** is used.

b) In this method, a cow is administered hormones, with FSH-like activity, to induce follicular maturation and super ovulation – instead of one egg, which they normally yield per cycle, they produce 6-8 eggs. The animal is either mated with an elite bull or artificially inseminated. The fertilised eggs at 8–32 cells stages, are recovered non-surgically and transferred to surrogate mothers. The genetic mother is available for another round of super ovulation. This technology has been demonstrated for cattle, sheep, rabbits, buffaloes, mares, etc. High milk-yielding breeds of females and high quality (lean meat with less lipid) meat-yielding bulls have been bred successfully to increase herd size in short time.