

Mock Board Exam
ISC SEMESTER 2 EXAMINATION
BIOLOGY

Section A - 7 MARKS

Question: 1

(i) Which component protects the child from a disease he/she is vaccinated against? [1]

Answer: - Antibodies

(ii) Given below are pairs of pathogens and diseases caused by them. Find out the incorrect match and mention the reason? [1]

- (a) Virus - Common Cold
- (b) *Salmonella* - Typhoid
- (c) *Microsporium* - Filariasis
- (d) *Plasmodium* - Malaria

Answer:

The given pair in option (c) is incorrect.

Reason - *Microsporium* is a fungus that causes ringworm disease, the fungal infections of the skin. Filariasis is caused by the nematode *Wuchereria bancrofti* or *W. malayi* (filarial worm).

(iii) Which of the following microbes is used for the commercial production of citric acid? [1]

- (a) *Xanthomonas citri*
- (b) *Asparagus*
- (c) *Penicillium*
- (d) *Aspergillus*

Answer: - *Aspergillus*

(iv) In rice fields, which biofertilizer is successfully used? [1]

Answer: - *Azolla pinnata*

(v) Which hormone is injected into cows for excess production of milk? [1]

Answer: - Oxytocin

Oxytocin is a hormone that helps in lactation in cattle. The breeds of cattle that are reared for commercial milk production are injected with the hormone oxytocin to secrete more milk. This hormone causes contraction of the mammary glands and allows the ejection of milk.

(vi) Assertion: - In recombinant DNA technology, human genes are often transferred into bacteria (prokaryotes) or yeast (eukaryotes).

Reason: - Both bacteria and yeast multiply very fast to form a huge population, which express the desired gene. [1]

- (a) Both assertion and reason are true, and the reason is the correct explanation of assertion
- (b) Both assertion and reason are true, but reason is not the correct explanation of assertion
- (c) Assertion is true but reason is false
- (d) Both assertion and reason are false

Answer: - Option A

The modification of the genetic material (RNA or DNA) of organisms to use them to produce commercially important substances is called genetic engineering.

The process of genetic engineering involves the following steps:

- (i) Formation of recombinant DNA - The gene of choice is inserted into the vector DNA and linked to the 'origin of replication. The vector DNA along with the gene of interest is called recombinant DNA.
- (ii) Gene transfer - It is the transfer of the recombinant DNA into the host cells like bacteria or yeast cells through the process of transformation.
- (iii) Gene cloning - It is the formation of multiple copies of the gene of interest in the host cell.

Hence, both assertion and reason are true, and the reason is the correct explanation of assertion.

(vii) Which of the following can be categorised as a parasite? [1]

- (a) A lion hunting a rabbit.
- (b) An orchid growing on a mango tree.
- (c) Head lice live on human scalp and lay eggs on the hair
- (d) The interaction between a sea anemone and clownfish.

Answer: - Correct option is (C)

The parasite is defined as the organism which survives on the body of the host organism for food and space. Examples include, the head lice (parasite) living on the human scalp (host) and laying eggs on hair cannot survive without this habitat and it completely depends on the host.

A lion hunting a rabbit is an example of predation. An orchid (epiphyte) living on a mango tree is an example of commensalism. Sea anemones and clownfish show mutualistic relationships.

Section B [16 marks]

Question: 1

With regard to population growth rate, when resources are limited, it shows logistic growth.

Verhulst - Pearl Logistic growth can be represented by the equation $\frac{dN}{dt} = rN\left(\frac{K}{K-N}\right)$. What is represented by the given letters in the equation?

(a) r [1]

(b) K [1]

Answer: - (a) r is the Malthusian parameter which refers to the intrinsic rate of natural increase. It is a very important parameter selected for assessing the impacts of any biotic or abiotic factor on population growth.

(b) K is the carrying capacity of the population. It is the maximum number of individuals of a population that can be sustained indefinitely in a given habitat.

Question: 2

Match the following: [2]

Column I	Column II
A. α diversity	1. The richness of different species in a habitat.
B β diversity	2. The richness of different species along with a gradient from one habitat to another habitat within the community.
C. γ diversity	3. The richness of different species in different habitats

(a) A - 3, B - 2, C - 3

(b) A - 1, B - 3, C - 2

(c) A - 2, B - 1, C - 3

(d) A - 3, B - 2, C - 1

Answer: - The correct answer is option 'A'.

Biodiversity is defined as the totality of genes, species and ecosystems of a region. It is of three types as follows:

- Alpha diversity - It is the number of species found in a particular area or ecosystem.
- Beta diversity - It is the variation of the species composition between two habitats or regions. It takes into account the alpha diversity of the habitats and the number of unique species in each habitat.
- Gamma diversity - It is a measure of the overall number of species (the diversity) within a region. It is basically the sum of all the species of all habitats within the region of interest.

Question: 3

Which system of our body has similar phenomena of saving memories as in computers, apart from our brain? [2]

Answer: - Memory cells of the Immune system have similar phenomena of saving memories as in computers apart from our brain. The immune response is the specific reactivity induced in a host by an antigenic stimulus. After the primary response by the immune system against pathogens, B cells and T cells retain the memory. During a subsequent encounter with the same antigen, the body shows a fast and stronger immune response called the secondary immune response with the help of memory cells.

Question: 4

A recombinant DNA molecule was created by ligating a gene to a plasmid vector. By mistake, an exonuclease was added to the tube containing the recombinant DNA. How does this affect the rDNA? [2]

Answer: - Recombinant DNA is formed by the introduction of foreign DNA (containing the gene of interest) into the vector DNA. This process involves the use of restriction endonucleases and ligases. When a DNA molecule is created by ligating a gene to a plasmid vector, It becomes circular DNA which is ready to replicate in the host organism.

Exonuclease is an enzyme that will act on the free ends of DNA and remove nucleotides. Once a circular rDNA is produced, exonuclease cannot act on the same and the rDNA remains intact. Hence the addition of exonuclease is not going to affect the rDNA.

Question: 5

Why do the toxic insecticidal proteins secreted by *Bacillus thuringiensis* kill the insect and not the bacteria itself? [2]

Answer: - The toxic insecticidal proteins called cry proteins of *Bacillus thuringiensis* kill the insect and not the bacteria itself because the Bt toxin proteins exist as an inactive proteins which become active due to the alkaline environment in the gut of insects and thus cause intestinal perforation and do not harm the bacteria itself.

Question: 6

If an ecosystem is composed of only three trophic levels, then how much energy will be conserved at the 3rd trophic level? [2]

Answer: - According to the ten percent law of energy given by Lindeman, during the transfer of energy from one trophic level to the next, only about ten percent of the energy is available to the next trophic level. The remaining is lost during transfer, broken down in respiration, or lost to incomplete digestion by higher trophic levels.

Therefore, if there is 100% energy at 1st trophic level (Producers), only 10% of it ($10\% \times 100 = 10\%$) is passed to 2nd trophic level (Primary Consumers) and ($10\% \text{ of } 10 = 1\%$) will be passed to 3rd Trophic level (Secondary consumers).

OR

Question: 6

Why is it desirable to use unleaded petrol in vehicles fitted with catalytic converters?

Answer: - Lead can quickly deposit onto the converter thereby poisoning the catalyst. As a result, in a very short time, the catalyst will be of no use. Hence, it is desirable to use unleaded petrol in vehicles fitted with catalytic converters.

Question: 7

State Gause's principle of competitive exclusion? [2]

Answer: - The competitive exclusion principle or Gause's law of competitive exclusion states that when two closely related species competing for the same resource occur in the same environment, they use a different food or become active at different periods to occupy different niches to avoid competition, otherwise the competitively inferior one will be eliminated.

Question: 8

A mixture containing DNA fragments a, b, c and d, with molecular weights of $a+b = c$, $a > b$ and $d > c$, was subjected to agarose gel electrophoresis. What will be the positions of these fragments on the gel after electrophoresis? [2]

Answer: - Agarose gel electrophoresis is the technique involving the separation of molecules based on their size and charge. For example, it is used for the separation of DNA fragments formed after treatment with endonucleases, based on their size and negative charge. The longer the size of the DNA fragment lesser will be the distance travelled by the fragment in the gel.

Hence, the fragment with the lowest molecular weight will appear farther from the well and the fragment with higher molecular weight will appear near the well. So, based on the given information, the molecular weight of d is maximum and the molecular weight of b is minimum. So, the order of fragments will be (b, a, c, d).

Question: 9

MOET programme has helped to increase the herd size of the desired variety of cattle. List the steps involved in conducting the programme. [2]

Answer: -

MOET stands for Multiple Ovulation Embryo Technology. It is one such programme that has helped to increase the herd size of any desired variety of cattle.

Steps involved in Multiple Ovulation Embryo Technology are as follows: -

- 1) Cattle is administered with hormones (FSH like activity) to induce follicular maturation and superovulation so that they produce 6 - 8 eggs, instead of one egg, which they normally yield per cycle.
- 2) Then the animal is either mated with an elite bull or artificially inseminated with the semen from a superior bull.
- 3) Fertilised eggs at 8 - 32 cell stages are then recovered non surgically and transformed to surrogate mothers. The genetic mother is again available for another round of superovulation.

Section C [12 marks]

Question: 10

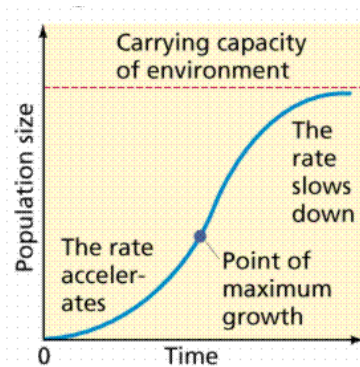
With the help of a graph, explain the population growth curve when resources are

- (i) Limited and (ii) Not limited? [3]

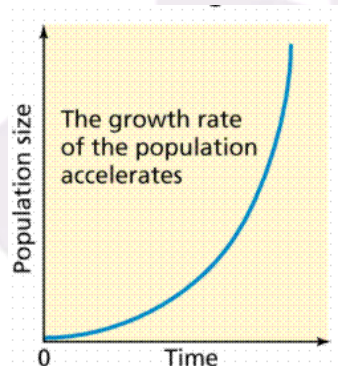
Answer: - Population growth rate is defined as the change in the number of individuals in a population over time. It is represented by $\frac{dN}{dT} = rN$. In this equation, N is the population size, T is time, and r is the intrinsic rate of increase.

When the resources are:

- (i) Limited - The population growth in a habitat with limited resources, shows initially a lag phase, followed by log phase, deceleration phase and finally reaches a constant level when the population density reaches the carrying capacity (K). In such cases, the population size (N) plotted over time (t) shows an S-shaped curve. This type of population growth is called Verhulst Pearl logistic growth.



(ii) Not Limited- When the resources are unlimited in a habitat, each species has the ability to realise fully its inherited potential to grow. The population grows exponentially under unlimited resources and reaches enormous population densities in a short time. This type of growth results in a J-shaped curve.



Question 11

- (i) Riya went to the garden to play with her father. After a few minutes, she started sneezing badly and had difficulty breathing. What do you think could be the possible reason?
 (ii) What will happen if a person does not have a thymus? [3]

Answer: -

(i) Riya might be having an allergy, due to which she started sneezing badly and had breathing difficulty. Allergy is an exaggerated response of the immune system against antigens like pollen grains, mites etc. The pollen of flowers presents in the garden acted as allergens in Riya's body. The allergens elicited a hypersensitive response and caused the production of IgE antibodies which activated the release of histamines. These histamines induced allergic symptoms like sneezing and difficulty breathing.

(ii) The thymus is a primary lymphoid organ where T-cells mature. If there is no thymus, then there will be no production of T-cells. It will result in loss of cell mediated immune response. T-helper cells are required for the activation of B-cells to produce antibodies (antibody mediated immune response). Hence this will lead to a greater rate of infection in that person, as the body will not be able to defend even the simple infections. People without thymus need to be in sterile environments throughout their life.

Question 12

A person is born with a weak immune system. The reason for this is the deficiency of an enzyme. Suggest a technique to completely cure this disease and identify the name of the deficient enzyme. Explain the technique used for the cure? [3]

Answer: - Severe combined immunodeficiency (SCID) is a disease that results in the weakening of the immune system of a person. It is caused by a defect in the gene responsible for producing the enzyme adenosine deaminase. SCID patients have no functioning T-lymphocytes and it affects the development and activation of B cells. This leads to the condition, of Severe Combined Immunodeficiency Syndrome (SCID). This disease can be very harmful and it is genetically inherited.

Adenosine deaminase (ADA) is an enzyme that converts deoxyadenosine to deoxy inosine. It is present in more amounts in lymphocytes which helps in the recycling of the nucleotides.

Adenosine deaminase (ADA) deficiency can be treated by the methods as follows:

- Bone marrow transplantation
- Enzyme replacement therapy - It involves the replacement of non-functional enzymes produced from a defective gene with functional enzymes. It is not as effective as gene therapy. It is also not a permanent cure method.
- Gene therapy - It is done by introducing bone marrow cells such as lymphocytes with ADA cDNA performed at the early embryonic stages.

Question 13

(i) Why do farmers prefer biofertilizers to chemical fertilisers these days? Explain.

(ii) How do *Anabaena* and mycorrhizae act as biofertilizers? [3]

Answer: -

(i) A farmer relies on biofertilizers than chemical fertilisers because:

- Chemical fertilisers significantly increase soil pollution, reduce the quality of soil, and cause water pollution, when it drains into nearby water bodies, after rain.
- Overuse of chemical fertilisers makes the soil infertile as it will change the pH of the soil and remove the normal microbial flora from that area

(ii) *Anabaena* fixes atmospheric nitrogen, thus enriching the nitrogen content of the soil, as well as the organic matter.

In mycorrhizae, the fungal symbiont absorbs phosphorus from the soil and passes it to the plant and provides resistance to root-borne diseases, Since, they fulfil the nitrogen and phosphorus requirement they act as biofertilizers.

OR

Consider the following food chains:

(a) Plants → Mice → Snakes → Hawks

(b) Plants → Mice → Hawks

If energy available at the producer level in both the food chains is 100 J, then in which case will hawk get more energy as food? Justify your answer.

Answer: - A food chain is a sequence of organisms in an ecosystem through which the food and its contained energy pass with each member becoming the food of a later member of the sequence.

In the case of (b), hawks will get more energy as they are placed at the third trophic level in the food chain but in the food chain (a), they are placed at the fourth trophic level. According to the 10% law of energy, only 10% of energy is transferred from one trophic level to the next. So organisms placed at higher trophic levels will get less energy than organisms placed at lower trophic levels. If energy available at the producer level in both the food chains is 100 J then in the first case according to the 10% law of energy, mice will get 10 J of energy which is 10% of 100 J, snakes will get 1 J and Hawks will get 0.1 J.

In the second case, mice will get 10 J and hawks will get 1 J according to the 10% law. So, in the first case, hawks will get 0.1 J and in the second case, hawks will get 1 J of energy from food.