Sample Question Paper - 18
Biology (044)
Class- XII, Session: 2021-22
TERM II

Time allowed : 2 hours ***Maximum marks : 35***

General Instructions :

(i) All questions are compulsory.

(ii) The question paper has three sections and 13 questions. All questions are compulsory.

(iii) Section–A has 6 questions of 2 marks each; Section–B has 6 questions of 3 marks each; and Section–C has a case-based question of 5 marks.

(iv) There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.

(v) Wherever necessary, neat and properly labeled diagrams should be drawn.

SECTION - A

1. Explain the process of secondary treatment given to the primary effluent up to the point it shows significant change in the level of biological oxygen demand (BOD) in it.

2. Describe the mutual relationship between fig tree and wasp and comment on the phenomenon that operates in their relationship.

OR

Many freshwater animals cannot survive in marine environment. Explain.

3. Explain the work carried out by Cohen and Boyer that contributed immensely in biotechnology.

4. What is *Eco*RI? How does *Eco*RI differ from an exonuclease?

5. A student on a school trip started sneezing and wheezing soon after reaching the hill station for no explained reasons. But, on return to the plains, the symptoms disappeared. What is such a response called? How does the body produce it?

6. RNAi takes place in all eukaryotic organisms as a method of cellular defense. How does 'RNA interference' take place in eukaryotes?

OR

What is gene therapy? Name the first clinical case in which it was used.

SECTION - B

7. **(a)** State how the constant internal environment is beneficial to organisms.
(b) Explain any two alternatives by which organisms can overcome stressful external conditions.

OR

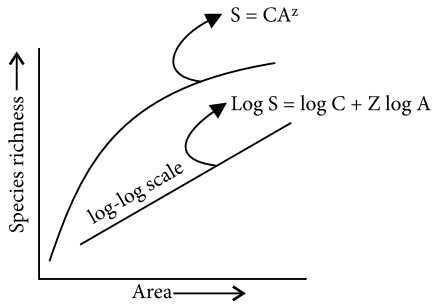
The population of a metro city experiences fluctuations in its population density over a period of time.
(a) When does the population in a metro city tend to increase?
(b) When does the population in a metro city tend to decline?
(c) If N is the population density at time 't', write the population density at time 't + 1'.

8. A person gets addicted to a drug when taken for a non-medical use that impairs one's physical, physiological and psychological functions. Write the source and the effect on the human body of the following drugs:
   (a) Morphine **(b)** Cocaine **(c)** Marijuana

9. **(a)** Why must a cell be made 'competent' in biotechnology experiments? How does calcium ion help in doing so?
   (b) State the role of 'biolistic gun' in biotechnology experiments.

10. Name the pest that destroys the cotton bolls. Explain the role of *Bacillus thuringiensis* in protecting the cotton crop against the pest to increase the yield.

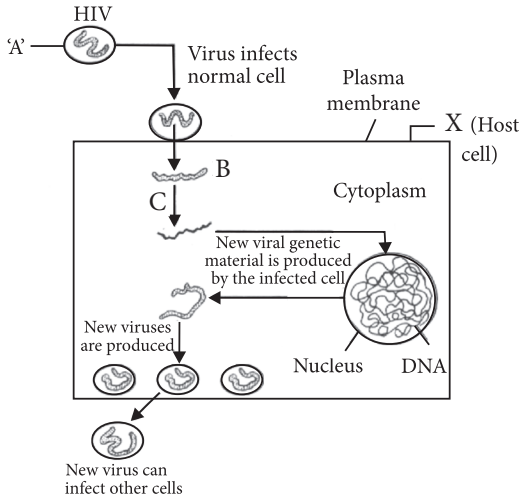
11. Explain the species-area relationship using the graphical representation given below.



12. There is a great concern all over the world to conserve biodiversity for maintaining ecological balance in nature. Explain giving three reasons.

SECTION - C

13. AIDS, first reported in 1981 means deficiency of immune system and acquired during the life time of an individual. Study the diagram showing the entry of HIV into the human body and the process that are followed:



   (a) Name the human cells X, HIV enters into. Mention the genetic material B HIV release into the cell.
   (b) Name the group of viruses responsible for causing AIDS in humans. Why are these viruses so named?
   (c) Identify enzyme 'C'.

   OR

   (a) Sewage is treated in sewage treatment plants before disposal into rivers and streams because it contains large amount of organic matter and microbes, many of which are pathogenic. Name the category of microbes occurring naturally in sewage and making it less polluted during the treatment.
   (b) Explain the different steps involved in the secondary treatment of sewage.

Solution

BIOLOGY - 044

Class 12 - Biology

1. During secondary treatment, the primary effluent is taken to aeration tanks. A large number of aerobic heterotrophic microbes grow in the aeration tank. They form flocs which are masses of bacteria held together by slime and fungal filaments to form mesh like structures. The microbes digest a lot of organic matter, converting it into microbial biomass and releasing a lot of minerals. As a result, the BOD of the waste matter is reduced to 10-15% of raw sewage, it is passed into settling tank.

2. Many species of fig trees have mutual relationship with the pollinator species of wasp. A given fig species can be pollinated only by its partner wasp species and not by other species. The female wasp uses the fruit not only as an oviposition (egg laying) site but also uses the developing seeds within the fruit for nourishing its larvae. The wasp pollinates the fig inflorescence while searching for suitable egg-laying sites. In return the fig offers the wasp some of its developing seeds as food for the developing wasp larvae.

OR

If a freshwater animal is placed in marine environment, then it will not be able to survive because of osmoregulation problem. The freshwater animal is adapted to live in fresh environment, so, if it is kept in saline water, it will not be able to cope with outside hypertonic environment and it would face death.

3. Cohen and Boyer contributed to the field of biotechnology by constructing the first recombinant DNA molecule in 1972. They cut the piece of DNA from a plasmid carrying antibiotic resistance gene, using restriction enzymes. This piece of foreign DNA, was linked with the plasmid DNA, acting as a vector with the help of enzyme DNA ligase. This newly formed DNA molecule is called recombinant DNA.

4. *Eco*RI is a restriction endonuclease enzyme. It recognises base sequences $\begin{matrix}5'\text{-GAATTC-}3'\\3'\text{-CTTAAG-}5'\end{matrix}$ in DNA duplex and cuts each of the two strands between G and A. On the other hand, exonuclease remove nucleotide from the terminal ends of DNA in one strand of duplex. Hence, *Eco*RI cut each of the two strand of DNA duplex at specific point whereas exonuclease remove nucleotide from the terminal ends (either 5′ or 3′) of DNA in one strand of duplex.

5. Atmospheric pressure is low at higher altitudes as compared to plains. When we go for a trek/trip on high altitude, then due to low atmospheric pressure our body does not get enough oxygen, as a result of which we experience nausea, fatigue and heart palpitation (altitude sickness). But by taking rest for first two days, body gets acclimatised to high altitude conditions. The body compensates low oxygen availability by increasing red blood cell production, decreasing binding capacity of haemoglobin and increasing breathing rate. Hence, we will automatically stop experiencing altitude sickness.

6. RNA interference (RNAi) is the phenomenon of inhibiting activity of a gene through production of sense and antisense RNA. RNAi takes place in all eukaryotic organisms as a method of cellular defense. This method involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA (silencing). The source of this complementary RNA could be from an infection by viruses having RNA genomes or mobile genetic elements (transposons) that replicate *via* RNA intermediate.

OR

Gene therapy is the technique of genetic engineering which involves replacement of a faulty gene by a normal healthy functional gene. The first clinical gene therapy was given in 1990 to a 4 years old girl with adenosine deaminase deficiency (ADA deficiency). This enzyme is very important for the immune system to function.

7. **(a)** Constant internal environment is beneficial to organisms as it permits all biochemical reactions and physiological functions to proceed with maximum efficiency, thereby enhancing the overall efficiency of organisms.

(b) Organisms can overcome stressful external conditions by following adaptations:

(i) Migration - Birds of colder areas of northern hemisphere begin their southward migration as the day length begins to shorten.

(ii) Aestivation- Ground squirrels undergo aestivation to avoid heat by spending dry hot period in burrows.

OR

(a) Population of a metro city tends to increase when natality rate exceeds mortality rate due to better health services and lack of unplanned population control measures. Also when immigration exceeds emigration, population of a city tends to increase.

(b) Population of a city tends to decline when mortality rate is higher than natality rate and emigration exceeds immigration.

(c) If N is the population density of time t, then its density at time t + 1 will be

$$N_{t+1} = N_t + [(B + I) - (D + E)]$$

Where B = Natality

I = Immigration

D = Mortality

E = Emigration

8. (a) Morphine – It is obtained from *Papaver somniferum*. It is strong analgesic and has sedative and calming effect. It decreases blood pressure and depresses respiratory centre.

(b) Cocaine – It is obtained from *Erythroxylum coca*. It has vasoconstrictor properties and is powerful CNS stimulant. Its excessive dosage causes hallucinations.

(c) Marijuana – It is obtained from *Cannabis sativa*. It is a hallucinogen and may cause psychosis.

9. (a) Competent host is essential for biotechnology experiment. Since DNA is a hydrophilic molecule, it cannot pass through membranes, so the bacterial cells must be made capable to take up DNA *i.e.*, made competent.

Treatment of DNA with divalent cation of $CaCl_2$ or rubidium chloride : Treating them with a specific concentration of a divalent cation, increases the efficiency with which DNA enters the bacterium through pores in its cell wall.

(b) Biolistic or Gene gun method is a vector less gene transfer in which tungsten or gold particles, coated with foreign DNA are bombarded into target cells at a very high velocity.

10. The pest that destroy the cotton bolls are cotton bollworms. Cotton bollworms enjoy feeding on cotton plants but get killed when feed on Bt cotton plant because the latter is genetically modified for pest resistance specifically to bollworm infestation.

Two genes *cry*IAc and *cry*IIAb control cotton bollworms. These two genes were isolated from *Bacillus thuringiensis* and incorporated into cotton plant. The genetically modified plant is called Bt cotton as it contains Bt toxin genes. The bacterium *Bacillus thuringiensis* produces Bt toxin proteins as inactive protoxins. When the insect larvae ingest any plant part, toxin becomes active in the alkaline pH of the gut and kills the insect pests. That is how Bt cotton attains resistance against bollworm.

11. Alexander von Humboldt studied species-area relationship. He observed that within a region, the species richness increased with increasing area but upto a certain limit. Relation between species richness and area for a wide variety of taxa turns out to be rectangular hyperbola. On a logarithmic scale, the relationship is a straight line described by the equation log S = log C + Z log A where

S = Species richness

C = Y – intercept

A = Area

Z = Slope of the line (regression coefficient).

Ecologists have discovered that the value of Z lies in the range of 0.1–0.2 regardless of taxonomic group or region, i.e., whether it is plants in Britain, birds in California or molluscs in New York the slopes of the regression line are similar.

When the species-area relationship is considered for a very large area like a whole continent, regression coefficient Z or slope of the line become steeper with Z values in the range of 0.6 –1.2.

Slope would become steeper when the value of Z ranges from 0.6 to 1.2 as for mammals of tropical forests of different continents, the slope is found to be 1.15.

12. Biodiversity is very important for maintaining ecological balance. Biodiversity is fundamental to ecosystem services of nature.

(i) Photosynthetic activity of producers replenishes oxygen in the atmosphere.
(ii) Forests and oceanic systems regulate global climate. Plants cover is essential for retention of rain water, its percolation and storage in aquifers and reservoirs.
(iii) Different species present on earth play important role in ecological food chains bringing balance in species population. Disturbance in any species population may disturb the entire food chain thereby creating ecological disbalance.

13. (a) HIV enters into macrophages (A). B is viral RNA.
(b) AIDS is caused by human immunodeficiency virus (HIV), a member of a group of viruses called retroviruses. These viruses are called retroviruses because they have RNA as their genome, enclosed within an envelope.
(c) Enzyme C is reverse transcriptase.

OR

(a) Aerobic heterotrophs like bacteria and fungi occur in sewage water. They are natural decomposers and digest a lot of organic matter present in the polluted water thereby releasing minerals and reducing organic waste. Hence, they play an important role in cleaning water and making it fit for various domestic uses.
(b) Secondary treatment of the sewage is also called biological treatment because microbes are used to digest the organic matter in the sewage water. The steps involved in the process are :
(i) Primary effluent is passed into aeration tank where liquid is constantly agitated and air is pumped into it.
(ii) Large number of aerobic heterotrophic microbes grow in aeration tank and form flocs.
(iii) Microbes digest organic matter, convert it into microbial biomass and reduce BOD.
(iv) In settling tank, the bacterial flocs are allowed to undergo sedimentation. The effluent is passed into natural waters like rivers and streams. It can also be further treated with chemicals to purify it.
(v) The sediment is called activated sludge. A part of this sludge is passed into anaerobic sludge digester where anaerobic microbes digest the organic mass as well as anaerobic microbes.
(vi) During digestion, microbes produce methane, H_2S and CO_2. These gases form biogas that can be used as source of energy.