

Date: 30/05/2022

Question Paper Code

57/5/3

Time: 2 hours

Class-XII
BIOLOGY (Theory)
Term-II
(CBSE-2022)

Max. Marks: 35

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:

- (i) This question paper contains **13** questions. **All** questions are compulsory.
- (ii) This question paper has three sections – **Section-A, B** and **C**.
- (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 labelled diagrams should be drawn.

SECTION-A

1. Many members of genus *Glomus* form a mycorrhizal association with plants. Elaborate how is this association beneficial to the plants. [2]

Sol. Many members of genus *Glomus* form symbiotic association with plants and show several benefits to them such as

1. It absorbs phosphorus from soil and passes it to the plant.
 2. Plants show resistance to root-borne pathogens
 3. Plants show tolerance to salinity and drought.
 4. Helps in overall increase in plant growth and development. [2]
2. (a) State the mode of action of cocaine on human body. Write the scientific name of the source plant it is obtained from. [2]

OR

- (b) Enumerate four most common warning signs of drug and alcohol abuse amongst the youth. [2]

Sol. (a) The mode of action of cocaine on human body is as follows: (any 2)

- (i) It interferes with the transport of the neuro-transmitter dopamine.
- (ii) It has potent stimulating action on central nervous system, producing a sense of euphoria and increased energy.
- (iii) Excessive dosage of cocaine causes hallucinations.

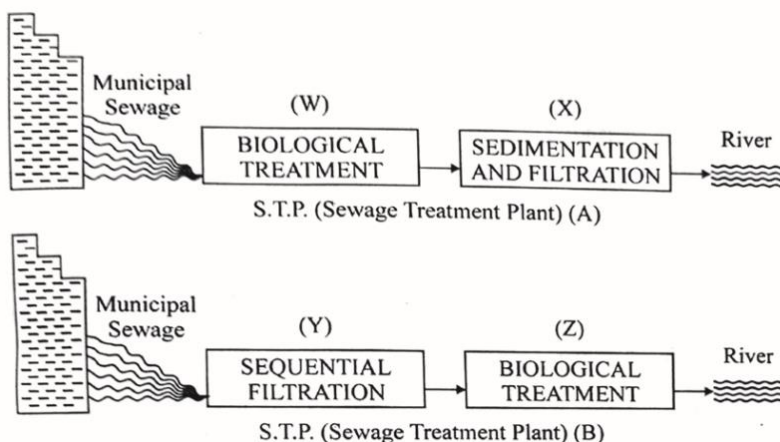
Coca alkaloid or cocaine is obtained from coca plant *Erythroxylum coca*.

OR

- (b) Four most common warning signs of drug and alcohol amongst the youth are as follows:

- (i) Drop in academic performance along with unexplained absence from school/college.
- (ii) Lack of interest in personal hygiene, withdrawal, isolation, depression, fatigue, aggressive and rebellious behaviour may also be seen.
- (iii) Deteriorating relationships with family and friends and loss of interest in hobbies is also observed.
- (iv) Change in sleeping and eating habits, fluctuations in weight, appetite etc. is seen.
- (v) If unable to get money to buy drugs/alcohol, he/she may turn to stealing.
- (iv) At times, a drug/alcohol addict becomes the cause of mental and financial distress to his/her entire family and friends.

3. Study the given diagram of Sewage Treatment Plant (S.T.P) and answer the questions that follow: [2]



- (a) Which one of the two 'S.T.P.' (A) or (B) will be more effective in treating the human excreta in the municipal waste?
- (b) Write the steps followed in carrying the treatment of the sewage in step (Z), once the BOD of sewage is reduced significantly till it is passed on to the "anaerobic sludge digesters".

Sol. (a) Sewage Treatment Plant (S.T.P) 'B' will be more effective in treating the human excreta in the municipal waste as sedimentation and filtration are steps of primary treatment which are done before biological or secondary treatment then the treated water is released in the river. [½]

- (b) Once the BOD of sewage or waste water is reduced significantly, the effluent is then passed into a settling tank where the bacterial flocs are allowed to sediment. This sediment is called activated sludge. A small part of the activated sludge is pumped back into the aeration tank to serve as inoculum. The remaining major part of the sludge is pumped into large tanks called anaerobic sludge digesters. [1½]

4. Ringworm is one of the most common infectious fungal diseases in humans. Name any **two** genera of fungi which cause ringworm and state any of its **two** symptoms. [2]

Sol. Two genera of fungi which cause ringworm are: [2]

- *Microsporum*
- *Epidermophyton*
- *Trichophyton*

Two symptoms of fungal diseases may include:

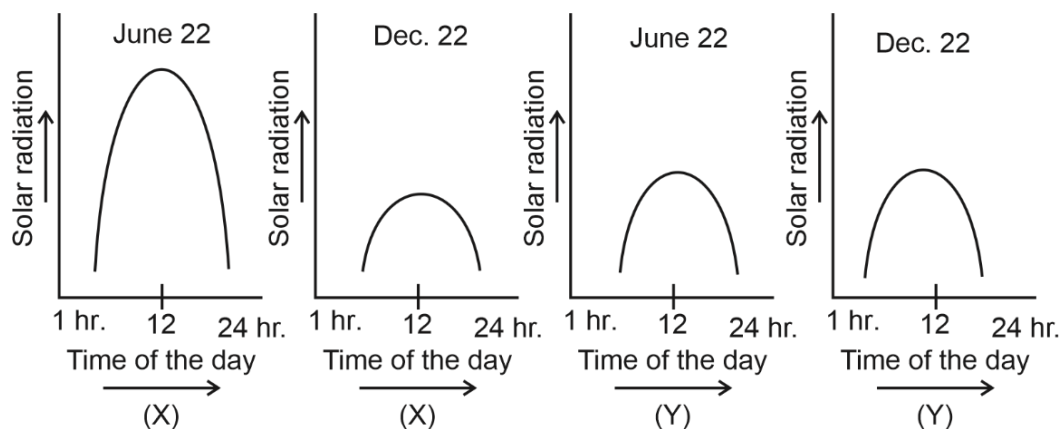
- Appearance of dry, scaly lesions on various parts of body such as skin, nails and scalp
- Intense itching

5. (a) (i) Write the observation made at the end of Connell's field experiment on barnacles on the rocky sea coasts of Scotland. [2]

- (ii) Name any two categories of organisms that in general are adversely affected by competition.

OR

(b) The graphs (X) and (Y) given below depict the diurnal variations in the solar radiations in the month of June (Summer) and in December (Winters): [2]



- (i) Which of the two graphs depicts tropical region and temperate regions respectively?
- (ii) Which of the two regions (X) or (Y) will show high biological diversity and why?

- Sol.** (a) (i) Connell's field experiments showed that on the rocky sea coasts of Scotland, the larger and competitively superior barnacle *Balanus* dominates the intertidal area and excludes the smaller barnacle *Chathamalus* from that zone. [1]
- (ii) In general, herbivores and plants appear to be more adversely affected by competition. [1]

OR

- (b) (i) Graph X represents tropical region as it shows maximum solar radiation in summer and minimum in winter. Graph Y represents temperate region as it shows lesser solar radiations in summer as compared to tropical region [1]
- (ii) The region (X) will show high biological diversity as this area receives more solar energy over the year. [1]
6. What would be the best method to measure the total population density of the number of fishes in river and why? [2]

Sol. The number of fish caught per trap is the best method to measure its total population density in the river, because in this case total number is not an easily adoptable measure as the population is huge and counting is impossible or very time consuming. [1+1]

SECTION-B

7. Many people experience allergic symptoms of sneezing or wheezing on exposure to certain substances in the environment. Give **two** examples of such substances. Which type of antibodies are produced by the body in response to these substances? Mention the role of mast cells in this kind of allergic response. [3]

Sol. The exaggerated response of the immune system to certain antigens present in the environment is called allergy. The substances to which such an immune response is produced are called allergens. [3]

- Two common examples of allergens are: dust mites, pollen, animal dander etc.
- The antibodies produced by the body in response to allergens are of IgE type. (Any 2)
- Mast cells secrete chemicals like histamine and serotonin which are the cause of allergic responses.

8. (a) Enlist two criteria that are used to identify a region for maximum protection as 'Biodiversity hotspots'. [3]
- (b) Name any two "hotspot" regions in our country.

Sol. (a) The two criteria used to identify a region for maximum protection as 'Biodiversity hotspots' are given below:

- (i) Very high levels of species richness
- (ii) High degree of endemism [1+1]

(b) Two 'hotspots' regions in our country are: (any 2)

- (i) Western Ghats and Sri Lanka
- (ii) Indo-Burma
- (iii) Himalaya [½+½]

9. 'An HIV patient normally doesn't die of 'AIDS', but death is caused due to many other infections.' Do you agree with the statement? Give explanatory reasons in support of your answer. [3]

Sol.

- 'An HIV patient normally doesn't die of AIDS, but death is caused due to many other infections'. Yes, I agree with this statement.
- Death is caused in these immuno-compromised individuals due to many other **opportunistic infections** caused by bacteria like *Mycobacterium*, virus, fungi and even parasites like *Toxoplasma*.
- The patient becomes so immunodeficient that he/she is unable to protect himself/herself against these infections as HIV enters into helper T-lymphocytes which are responsible for cell-mediated immunity of the body.
- HIV replicates and produces progeny viruses. These progenies are released in the blood and attack other T-lymphocytes. This is repeated leading to a progressive decrease in the number of helper T-lymphocytes in the body of an infected person.

10. A cell free method of amplifying DNA first developed in the mid 1980's revolutionized the field of biotechnology. Name the method and explain the basic steps of the technique involved. [3]

- Sol.**
- A cell-free method of amplifying DNA under *in vitro* conditions is Polymerase Chain Reaction (PCR).
 - The basic steps of PCR are:

Denaturation: The high temperature at this step breaks the hydrogen bonds between the two strands of the original DNA double helix, providing the necessary single-stranded templates.

Annealing: In this step, two sets of primers (small chemically synthesised oligonucleotides) bind to their complementary sequences on the single-stranded templates at 3' end.

Extension: During this, the thermostable enzyme *Taq* polymerase extends the primers using the nucleotides provided in the reaction and the genomic DNA as template. It leads to a new DNA strand.

11. Non-viral and non-vector methods are sometimes used to transfer genes or alien DNA into a plant cell. Explain one such method used in genetic engineering. [3]

- Sol.** Non-viral and non-vector methods are direct methods for transfer of recombinant DNA into host cells.

Alien DNA can be introduced by making host cells competent to take up DNA by heat shock method.

Biolistic method: This method is also known as the gene gun method. It is suitable for plant cells as they have a cell wall. In this technique, cells are bombarded with high velocity microparticles of gold or tungsten coated with DNA.

12. (a) How does a gene therapy involving direct modification of the cells, in order to achieve a therapeutic goal is used in the treatment of ADA deficiency? Explain. [3]
- (b) A host cell must be made competent, before it is able to receive an rDNA. Justify.

- Sol.** (a) Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child/embryo. Here, genes are inserted into a person's cells and tissues to treat a disease.

Adenosine deaminase (ADA) is crucial for the immune system to function. The ADA deficiency disorder is caused due to deletion of the gene for ADA.

In gene therapy, for the treatment of ADA deficiency, a functional ADA cDNA (using a retroviral vector) is introduced into lymphocytes obtained from blood of the patient which are cultured outside the body.

When these lymphocytes are subsequently returned to the patient, they take over the function and compensate for the deleted gene for adenosine deaminase.

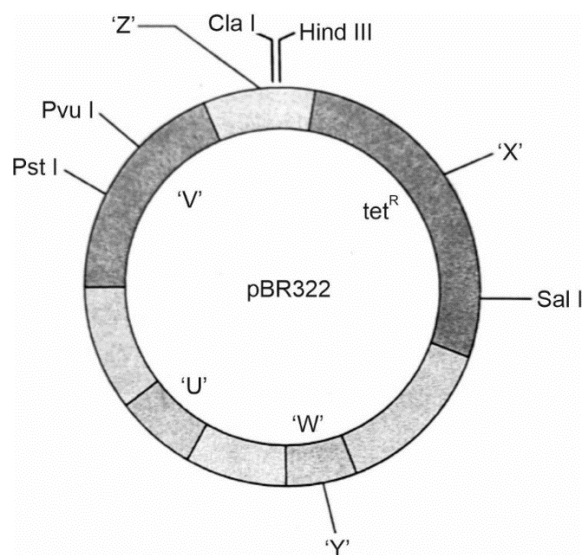
In children, ADA deficiency can be cured by bone marrow transplantation or enzyme replacement therapy but both of these approaches are not completely curative.

If gene isolated from marrow cells producing ADA is introduced into the cells at early embryonic stages, it could be a permanent cure.

- (b)
- Since DNA is a hydrophilic molecule, it cannot pass through cell membrane as cell membrane is mostly made up of lipids (phospholipids). So, in order to force bacteria to take up the plasmids, the bacterial cells must first be made 'competent' to take up DNA.
 - This is done by treating them with a specific concentration of a divalent cation, such as calcium which increases the efficiency with which DNA enters the bacterium through pores in its cell wall.
 - Recombinant DNA enters the host cells due to heat shock at 42°C.

SECTION-C

13. (a) Cloning of genes, play a very significant role in genetic engineering, helping the transfer of desirable foreign genes into different hosts. The scientists, to make this process easier and effective are creating engineered vectors in such a way that they help easy linking of foreign DNA and selection of recombinants from non-recombinants. 'pBR322' is one such engineered vectors developed by scientists. A diagram of an engineered vector pBR322 is given below: [5]



- (i) Name the host for this cloning vector.
- (ii) Identify 'Rop' and 'Ori' in the diagram from 'U', 'V', 'W', 'X', 'Y' and 'Z'. Write their functions.
- (iii) Draw the fragments that will be formed by the action of 'Z' (marked in the diagram) on the specific site of the DNA segment given below:

5'---GTACGAATTCCTGA---3'

3'---CATGCTTAAGGACT---5'

- Sol.** (a) (i) The host for the cloning vector pBR322 is *Escherichia coli*.
(ii)

S. No.	Label	Identity	Function
1.	U	'Ori' sequence	<ul style="list-style-type: none"> • Replication starts from this sequence and any piece of DNA when linked to this sequence can be made to replicate within the host cells. • It also controls the copy number of the linked DNA.
2.	W	Rop	Rop sequence codes for the proteins involved in the replication of the plasmid.
3.	V	amp ^R	Ampicillin resistance gene
4.	X	<i>Bam</i> HI	Recognition site for the enzyme <i>Bam</i> HI
5.	Y	<i>Pvu</i> II	Recognition site for the enzyme <i>Pvu</i> II
6.	Z	<i>Eco</i> RI	Recognition site for the enzyme <i>Eco</i> RI

(iii) 'Z' marked in the diagram is *EcoRI*.

The palindromic recognition sequence for *EcoRI* is

5'---GAATTC---3'

3'---CTTAAG---5'

Hence, the fragments with sticky ends formed for the given DNA segment are,



Fragment 1

5'---GTACG

3'---CATGCTTAA

Fragment 2

AATTCCTGA---3'

GGACT---5'

OR

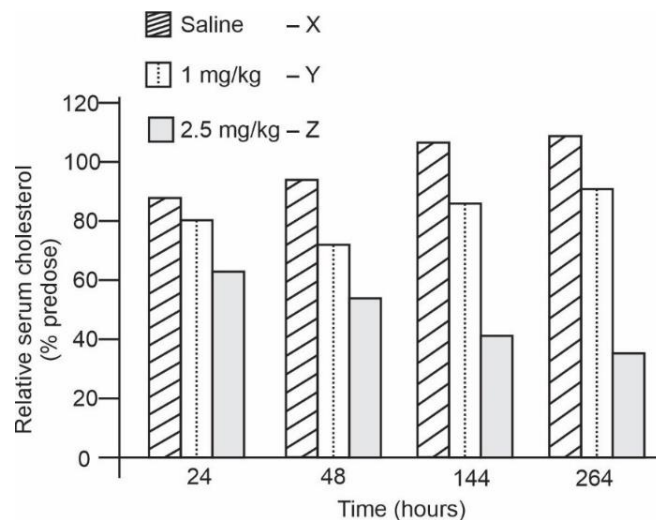
(b) RNA interference (RNAi) holds great potential as a therapeutic agent for the treatment of human diseases and as biocontrol agents in controlling pests in the field of agriculture. An experiment was carried to study the use of 'RNAi' for the potential treatment of disorders of cholesterol metabolism. Some people possess genetic mutations with elevated levels of ApoB gene which predisposes them to coronary artery diseases. Lowering the amount of ApoB can reduce the number of lipoproteins and lower the blood cholesterol.

Tracy Zimmerman and her colleagues used RNAi in 2006 to reduce the level of ApoB in non-human primates **Cynomolgus** monkeys.

One group of monkeys were given RNAi treatment (small interfering RNAs, SiRNAs) (doses 1 mg/kg SiRNAs), second group of monkeys were given RNAi treatment (doses 2.5 mg/kg SiRNAs) and third group of monkeys were injected with saline.

The results of the study are depicted in the graph below:

[5]



(i) How does the treatment with 2.5 mg/kg brings an effect on cholesterol metabolism when compared from 24 hours and 144 hours.

(ii) Write any two natural sources from where dsRNA molecule could be obtained for silencing the specific mRNA.

(iii) How is RNAi used in controlling the infection on the roots of tobacco plants by the nematode *Meloidogyne incognitia*.

Sol.: (b) (i) The cholesterol level reduced from 60% at 24 hours to 40% at 144 hours.

The relative serum cholesterol levels were a little above 60% after 24 hours in the group of monkeys who were given the dose 2.5 mg/kg SiRNAs.

The relative serum cholesterol levels were at approximately 40% after 144 hours in the same group of monkeys.

(ii) Two natural sources of dsRNA molecule which are used for silencing the specific mRNA are as follows:

- an infection by viruses having RNA genomes.
- mobile genetic elements (transposons) that replicate via an RNA intermediate.

(iii) Steps involved in RNAi used for controlling infestation by nematode *Meloidogyne incognitia* in roots of tobacco plants are:

- Nematode-specific genes were introduced in the host plant (tobacco) using *Agrobacterium* vectors.
- This introduction of DNA produces both sense and anti-sense RNA in the host cells.
- These two RNAs form a dsRNA as they are complementary to each other.
- This initiates RNAi and thus silences the specific mRNA of the nematode.
- The result of this is that, the parasite cannot survive in the transgenic host which expresses the specific interfering RNA.

