Board Paper of Class 12 Science Term-II 2022 Biology Delhi(Set 1) - Solutions

Total Time: 120

Total Marks: 35.0

Section A

Solution 1

Ringworm is an infection caused by the fungi that belong to the genera *Microsporum*, *Trichophyton* and *Epidermophyton*. The symptoms of this infection involve- the appearance of dry, scaly lesions on various parts of the body like skin, nails, and scalp.

Solution 2

Biogas is a mixture of gasses that contain predominantly methane. These are produced by microbial activity and can be used as fuel. Cow dung slurry contains certain bacteria that grow anaerobically on cellulosic material that produce large amounts of methane along with carbon dioxide and hydrogen gas. Such bacteria are called *Methanobacterium*. These bacteria are also present in the rumen of cattles. Methane gas is responsible for the production of biogas and is absent in human excreta.

Solution 3

Cocaine or coca alkaloid is obtained from coca plant *Erythroxylum coca.* This drug interfers with the transport of the neuro-transmitter dopamine. It is snorted and has a potent stimulating action on the central nervous system that produces a sense of euphoria and increased energy. The excessive dosage of cocaine causes hallucinations.

OR

The most common warning signs of drug and alcohol abuse among youth are as follows:

(i) Drop in their academic performance.
(ii) Lack of interest in personal hygiene.
(iii) Deterioration of relationships with the family and friends.
(iv) Loss of interest in hobbies.
(v) Change in sleeping and eating habits.

Solution 4

(a) The 'S.T.P' (B) will be more effective in treating the human excreta in the municipal waste because the first step in 'S.T.P' involves physical removal of particles – large and small – from the sewage through filtration and sedimentation. While the second step of 'S.T.P' involves the biological treatment of the sludge.

(b) The effluent is passed into a settling tank after the biological treatment, 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 the inoculum. The remaining major part of the sludge is pumped into large tanks called anaerobic sludge digesters. Different kinds of bacteria, that grow anaerobically, digest the bacteria and the fungi in the sludge. During this digestion, bacteria produce a mixture of gases such as methane, hydrogen sulfide and carbon dioxide. These gases form biogas and can be used as source of energy as it is inflammable.

Solution 5

Population size, technically called population density need not necessarily be measured in numbers only. Although total number is generally the most appropriate measure of population density, it is in some cases either meaningless or difficult to determine. In an area, if there are 200 carrot grass (*Parthenium hysterophorus*) plants but only a single huge banyan tree with a large canopy, stating that the population density of banyan is low relative to that of carrot grass amounts to underestimating the enormous role of the Banyan in that community. In such cases, the per cent cover or biomass is a more meaningful measure of the population size.

Solution 6

(i) Connell's elegant 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. A species whose distribution is restricted to a small geographical area because of the presence of a competitively superior species is found to expand its distributional range dramatically when the competing species is experimentally removed.

(ii) Plants and herbivores are organisms that are adversely affected by competition. Competition occurs when closely related species compete for the same resources that are limiting, but this is not entirely true.

OR

(i) Graph X represents the temperate region while graph Y represents the tropical region. The tropical region gets equal amount of solar radiation throughout the year. But the temperate region shows greater difference in temperature between summers and winters. In summers this region receives high solar radiation and becomes hot. During winters due to low solar radiation receptivity this region becomes cold.
(ii) The tropical region will show high biological diversity because this latitude receives more solar radiation than the temperate zone resulting in the high

productivity and high diversity of plants and animals. In such regions, seasonal changes are fewer than in the temperate region. They have a more stable climate.

Section B

Solution 7

Acquired immunodeficiency syndrome (AIDS) is a chronic condition which is caused by the human immunodeficiency virus (HIV). This virus damages our immune system and interferes with our body's ability to fight infection and disease. Syndrome means a group of symptoms. AIDS leads to a group of symptoms or diseases. In HIV infection as the immune system weakens, the body is not able to fight with even small infections like cough, cold, diarrhoea. Tha patient becomes so immuno deficient that he/she is unable to protect himself/herself against any kinds of infections. A simple cough and cold becomes tuberculosis, diarrhoea becomes severe which ultimately leads to death of an individual.

Solution 8

(a) When any patient needs to undergo a transplantation surgery, searching for a suitable donor is necessary for which doctors have to carry out many tests. It is because grafts from just any source – an animal, another primate, or any human being cannot be made since the grafts would be rejected sooner or later. Tissue matching and blood group matching are essential before undertaking any graft/transplant, and even after this, the patient has to take immuno-suppressants all his/her life. The body is able to differentiate 'self ' and 'nonself' and the cell-mediated immune response is responsible for the graft rejection.

(b) Cyclosporin A is produced by the fungus *Trichoderma polysporum* and is used as an immunosuppressive agent in organ-transplant patients. These patients have to take this drug all his/her life.

Solution 9

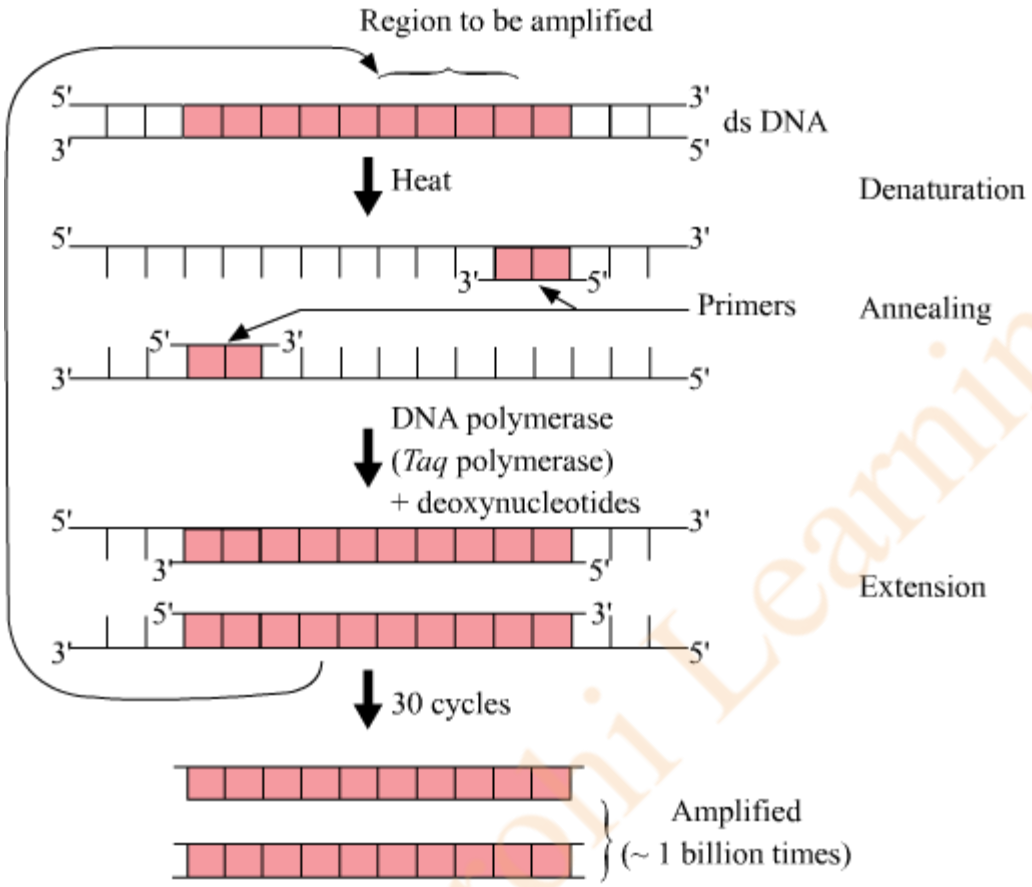
A cell-free method of amplifying DNA is Polymerase Chain Reaction (PCR) which was developed in 1985 by Kary Mullis. Recombinant DNA can be amplified by PCR and several identical copies of it can be synthesized in vitro. In this process, two sets of primers (chemically synthesized oligonucleotide stretches that are complementary to a region of DNA), enzyme DNA polymerase, and deoxynucleotides are added. It is a technique used to amplify a specific gene into multiple copies.

There are three steps involved in the PCR technique-

(a) **Denaturation**- In this step, heat treatment is provided to the PCR mixture, containing the DNA. It leads to denaturation i.e., breaking of H-bond between the two strands of the DNA. *Taq* DNA polymerase enzyme is used as it is thermostable enzyme extracted from the bacteria *Thernus aquaticus.*
(b) **Annealing**- Once the single strands of DNA are obtained, they are hybridized with primers in the presence of DNA polymerase.
(c) **Extension of primers**- DNA polymerase adds complementary nucleotides

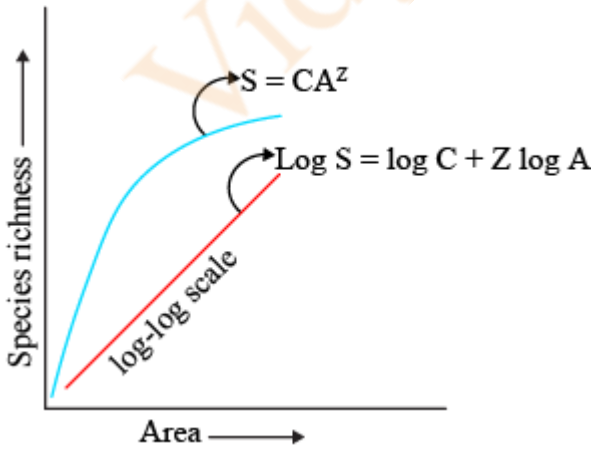
to the strands of DNA to form a new double-stranded DNA. Hence, doubling the initial DNA content.

This cycle is repeated several times to generate up to 1 billion identical copies of the DNA.



Solution 10

(i) The graphical representation of the given equation showing Species-Area relationship is:



(ii) S represents Species richness in the given equation.

(iii) Z represents the slope of line (regression coeeficient). For frugivorous (fruit-eating) birds and mammals in the tropical forests of different continents, the slope is found to be **1.15.**

OR

(i) The given pie chart represents global biodiversity: the proportionate number of species of major taxa vertebrates in the given pie chart. Here, X represents Fishes and Y represents Amphibians.

(ii) Amphibians, among the vertebrates are more vulnerable to extinction.

(iii) One example of recent extinctions of species in Russia, Mauritius, and Australia is as follows:
Steller's Sea Cow in Russia
Dodo in Mauritius
Thylacine in Australia

Solution 11

(a) The gene therapy is used to cure adenosine deaminase (ADA) deficiency in individuals. Adenosine deaminase enzyme is crucial for the immune system to function and the disorder is caused due to the deletion of the gene for adenosine deaminase. Its cure involves, lymphocytes from the blood of the patient are grown in a culture outside the body. A functional ADA cDNA (using a retroviral vector) is then introduced into these lymphocytes, which are subsequently returned to the patient. But these cells are not immortal, the patient requires the periodic infusion of such genetically engineered lymphocytes. So, the permanent cure of this disease involves the gene isolated from marrow cells producing ADA is introduced into cells at early embryonic stages.

(b) DNA molecules are hydrophilic molecules and they cannot pass through cell membranes. For recombinant DNA to be integrated into vector or host genome, it is necessary for the DNA to be inserted in the cell. Thus, making the host cells competent is important to receive the rDNA.

Solution 12

(a) Two criteria that are used to identify a region for maximum protection as 'Biodiversity hotspots' are-
(i) very high levels of species richness and
(ii) high degree of endemism (that is, species confined to that region and not found anywhere else).

(b) The Western Ghats and Sri Lanka and Indo-Burma and Himalaya are two "hotspot" regions in our country.

Section C

Solution 13

(i) *Escherichia coli* is the host for this cloning vector.
(ii) In the given diagram 'Rop' is W and 'Ori' is U. Function of 'Rop' is to code for proteins that are involved in the replication of plasmid. 'Ori' is a sequence from

where replication starts and any piece of DNA when linked to this sequence can be made to replicate within the host cells. This sequence is also responsible for controlling the copy number of the linked DNA.
(iii) Z is *Eco*R I. It cuts between the G and A bases at the 5' end within the recognition sequence 5'---GAATTC---3'. So, if the given sequence is treated with *Eco*R I then the fragments generated will be-

5'---GTACG AATTCCTGA---3'
3'---CATGCTTAA GGACT---5'

OR

(i) Treatment with RNAi showed a remarkable effect as compared to the saline treatment. During initial 24 hours the Cynomolgus monkeys showed about 60% of relative serum cholesterol. However, at 144 hours this amount of serum cholesterol drastically decreased to approximately 40% when treated with 2.5mg/Kg SiRNAs. This signifies that production of the ApoB protein is reduced as the mRNA can not translate due to the presence of SiRNA.
(ii) The natural sources where double stranded RNA molecules could be obtained for silencing the specific mRNA are an infection by viruses having RNA genomes or mobile genetic elements (transposons) that replicate via an RNA intermediate.
(iii) Several nematodes parasitise a wide variety of plants and animals including human beings. A nematode *Meloidegyne incognitia* infects the roots of tobacco plants and causes a great reduction in yield. A novel strategy to prevent this infestation was based on the process of RNA interference (RNAi). 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). Using *Agrobacterium* vectors, nematode-specific genes were introduced into the host plant. The introduction of DNA was such that it produced both sense and anti-sense RNA in the host cells. These two RNA's being complementary to each other formed a double stranded RNA (dsRNA) that initiated RNAi and thus, silenced the specific mRNA.