Solution

Class 12 - Biology

2020-21 paper 4

Section A

1. A molecule of insulin consists of two chains A and B. The chain A has 21 amino acids and chain B has 30 amino acids.
2. **Atmospheric factors :** Light, wind, water, temperature.
   Edaphic factors - Soil texture, pH, minerals.
3. - Sarus crane
   - Asiatic lion.
4. Mortality is the number of deaths in the population during a given period of time.
5. **Gene Therapy.** It is a collection of methods that allows correction of a gene defect that has been diagnosed in a child or embryo. In gene therapy, normal genes are inserted into a person's cells and tissues to treat a hereditary defect. Gene therapy is being tried for sickle cell anemia and severe combined Immuno-Deficiency (SCID).
   In some children ADA deficiency can be cured by bone marrow transplantation. In others, it can be treated by enzyme replacement therapy, in which functional ADA is given to the patient by injection. But both of these approaches are not completely curative. However, in gene therapy, 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. Since these cells are not immortal, the patient requires periodic infusion of such genetically engineered lymphocytes. However, if the gene isolated from marrow cells producing ADA is introduced into cell at early embryonic stages, the disease could be cured permanently.
6. Malarial parasite (*Plasmodium vivax*).
7. Activated Bt-toxin binds to the surface of midgut epithelial cells and creates pores that cause cell swelling and lysis. It finally leads to the death of an insect.
8. It represents Genetic diversity.
9. Following are the reasons for mass extinctions of species in the past:
   i. Natural disturbances in habitat.
   ii. Alien invasion.
10. Snails and fish go into aestivation to avoid summer-related unfavourable conditions by suspending their metabolic activities.
11. **(a)** Both assertion and reason are corrected
    Explanation: A single-stranded DNA or RNA, tagged with a radioactive molecule (probe) is allowed to hybridise to its complementary DNA in a clone of cells followed by detection using autoradiography. The clone having the mutated gene will hence not appear on the photographic film, because the probe will not have complementarity with the mutated gene.
    ELISA is based on the principle of antigen-antibody interaction. Infection by a pathogen can be detected by the presence of antigens or by detecting the antibodies synthesized in the body.
12. **(c)** Assertion is correct statement but reason is wrong statement.
    Explanation: Community and ecosystem diversity are of three types- alpha, beta, and gamma. Alpha diversity is the species diversity in a given community or habitat, alpha diversity is dependent upon species richness and evenness or equitability. Beta diversity is biodiversity, which appears in a range of communities due to the replacement of species with the change in community or habitat due to the presence of different micro-habitats, niches and difference in environment conditions. Gamma diversity is diversity present in ranges of communities as represented by the diversity of habitats or ecosystems over a total landscape or geographical area. Biodiversity is not uniform on the Earth. It varies with the change in latitude or altitude. Biodiversity increase, when we move from high to low latitude (i.e., from the poles to the equator)

OR

Many proteins including certain toxins are secreted in their inactive form. They get activated, only when exposed to a specific trigger (pH, temperature, etc.). It is advantageous to the bacteria producing it because the bacteria does not get killed due to the action of the protein.

13. **(a)** Assertion and reason both are correct statements and reason is correct explanation for assertion.
Explanation: When large habitats are broken up into small fragments due to various human activities, mammals and birds requiring large territories and certain animals with migratory habits are badly affected, leading to population declines.

14. **(a)** Assertion and reason both are correct statements and reason is correct explanation for assertion.
Explanation: Although India has only 2.4 percent of the world's land area, its share of the global species diversity is an impressive 8.1 percent. That is what makes our country one of the 12 mega diversity countries of the world. Nearly 45,000 species of plants and twice as many of animals have been recorded from India. Applying this proportion to India's diversity figures, we estimate that there are probably more than 1,00,000 plant species and more than 3,00,000 animal species yet to be discovered and described.

15. i. (a) amphibian species
ii. (c) both (a) and (b)
iii. (b) Edward Wilson
iv. (c) Ecological diversity
v. (c) (a)-mollusces, (b)-crustaceans

16. i. (d) competition
ii. (d) All of these
iii. (d) commensalism
iv. (c) Bacteria decomposing organic matter
v. (a) Both Assertion and Reason are true and Reason is the correct explanation of the Assertion

Section B

17. DNA ligase is an enzyme that repairs irregularities or breaks in the backbone of double-stranded DNA molecules. It has important role in the process of DNA replication and DNA repair.
It has three general functions:
    - It seals repairs in the DNA,
    - it seals recombination fragments, and
    - it connects Okazaki fragments (small DNA fragments formed during the replication of double-stranded DNA).

    DNA ligase functions by forming a bond between the end of a “donor” nucleotide and the end of an “acceptor” nucleotide. hence it is also known as molecular glue.

18. S-shaped growth curve (sigmoid growth curve) A pattern of growth in which, in a new environment, the population density of an organism increases slowly initially, in a positive acceleration phase; then increases rapidly approaching an exponential growth rate as in the J-shaped curve; but then declines in a negative acceleration phase until at zero growth rate the population stabilizes.
Equation for the Verhulst-pearl Logistic growth of population.
$\frac{dN}{dt} = nt\left[\frac{K-N}{K}\right]$

19. IUCN maintains a red data book or red list which is a catalogue of taxa facing risk of extinction. It aims to convey the urgency of conserving threatened species to the public and policy makers so as to reduce species extinction.
Uses:
(i) Identification and documentation of endangered species of plants and animals.
(ii) Creating awareness about importance of preserving the threatened biodiversity.

20. Four techniques where the principle of ex situ conservation of biodiversity has been employed are
i. Tissue culture
ii. Cryopreservation
iii. Botanical gardens
iv. Zoological parks.

21. The strategy is based on the process of RNA interference.

It involves blocking of a specific mRNA due to complementary ds RNA molecule that binds to and prevent translation of the mRNA. It is called silencing of mRNA.

OR

Habitat is the place where an organism lives and ecological niche means a place where it performs functions. Odum has differentiated these terms by saying that habitat is the organisms 'address' and the ecological niche is its 'profession'.

22. When a gene from one organism is purposely moved to improve or change another organism in a laboratory, the result is a genetically modified organism (GMO). It is also sometimes called "transgenic" for transfer of genes.
    There are different ways of moving genes to produce desirable traits. For both plants and animals, one of the more traditional ways is through selective breeding. For example, a plant with a desired trait is chosen and bred to produce more plants with the desirable trait
23. Biodiversity is more in tropical latitudes than in temperate followed by polar regions. The reasons are:
    i. More solar radiation is available in the tropical region. This leads directly to more productivity and indirectly to greater species diversity.
    ii. The environment of tropics is less seasonal and relatively more constant and predictable, which encourages niche specialization and species diversity.
24. Polar bears tolerates narrow range of temperature so these are called stenothermal animals, while cows and dogs can tolerate and survive variety of temperature and are called eyrythermal animals.

OR

    i. The transgenic product may cause toxicity or produce allergies.
    ii. The bacteria present in the alimentary canal of the human could take up the antibiotic resistance gene that is present in GM food.
25. Leaves modified into thorns, development of spiny margins on the leaves. Many plants produce and store chemicals that make the herbivore sick e.g calotropis produces highly poisonous cardiac glycosides. Some other chemical substances like nicotine, quinine, opium etc. are produced by plants and provide defence against grazing animals.

Section C

26. i. Insulin is a hormone is produced in very little amounts m the body. Hence, a large number of animals need to be sacrificed for obtaining small quantities of This makes the cost of insulin very high- Demand being many folds higher than supply.
    ii. Slaughtering of animals is also not ethical.
    iii. There is the potential of the immune response in humans against the administered insulin which is derived from animals.
    iv. There is a possibility of slaughtered animals being infested with some infectious microorganism which may contaminate the insulin.
27.

Ectoparasites	**Endoparasites**
1. Ectoparasites live on the surface of the host.	1. Endoparasites live in the body of the host.
2. They can be temporary, intermittent or permanent.	2. They are generally permanent parasites.
3. They can be hemiparasites or holoparasites.	3. They are usually holoparasites.
4. Respiration is aerobic.	4. Respiration is often anaerobic.
5. Specialisation has lead to loss of fewer structures, e.g., wings in fleas, bedbugs and lice.	5. For successful parasitic life, specialisation has led the loss of several structures, e.g., digestive organs in Taenia.

28. Biodiversity is the biological wealth of world. The loss of biodiversity will result in:
    (i) Decline in plant production which will lead to climatic change and pollution
    (ii) Extinction of various species
    (iii) Disruption in food chain and food web
    (iv) Imbalance in various ecosystems

(v) As man is dependent on biodiversity for food and other necessities, its loss will be hard pressed for mankind.

OR

Advantages of GMOs are as follows:

i. Tolerance against abiotic stresses, such as cold, drought, salt, heat.
ii. Reduce dependence on chemical pesticides.
iii. Reduce post-harvest losses.
iv. Increased efficiency of mineral usage by plants.

29. Heat loss or heat gain is a function of surface area.
- Since small animals have a large surface area relative to their volume, they lose body heat very fast.
- But larger animals have a ratio of surface area to volume of the body much smaller compared to small animals and hence thermoregulation in them is more effective.

30.
- The destruction of microorganisms harmful to the society is justified if they are not the essential biotic components of the ecosystem.
- For example, Small pox virus which has killed millions in the past has been successfully eradicated. Currently, we are trying to eradicate disease causing organisms such as polio virus and HIV from this world as they cause immense damage to health and life.
- The loss of few such harmful species of microorganisms would not affect the functioning of ecosystem. Therefore, under these situations deliberately making a species extinct is justified.

OR

Yes, our blood has both proteases and nucleases. Monocytes of WBCs enlarge into macrophages. These cells are phagocytic in nature. Macrophages are fixed and wandering. They catch hold of the microbes and dead cells that are carried along with the blood and lymph. Whenever a bacterium enters the macrophage or neutrophils, it forms a phagosome. The phagosome fuses with the lysosome to form **phagolysosome** for the digestion of bacterium. The lysosome contains various types of hydrolytic enzymes-proteases, nucleases, lipases, and glycosidases, etc.

Section D

31. The process involved in the production of nematode-resistant tobacco plants is called RNA interference (RNAi), which involves silencing of a specific mRNA.
Process of RNA interference (RNAi) is related to the silencing of a specific mRNA. It is a method of cellular defence in all eukaryotes.

i. A complementary RNA binds to the target mRNA making it double-stranded and prevents its translation.
ii. This complementary RNA could be from infection by viruses having RNA genomes or mobile genetic elements (transposons) that replicate via an RNA intermediate.
iii. Using Agrobacterium vectors, nematode-specific genes are introduced into the host plants.
iv. It produces both sense and antisense RNA in the host cells.
v. These two RNAs being complementary to each other form a double-stranded RNA (dsRNA) that initiates RNAi or silencing of the specific mRNA of the nematode.
vi. Due to this, the parasite could not survive in a transgenic host expressing interfering RNA. So, the transgenic plant is protected.

OR

Since plants produce food through photosynthesis, a process that is only possible when sunlight is available as a source of energy, we can quickly understand the importance of light for living organisms, particularly autotrophs. Many species of small plants (herbs and shrubs) growing in forests are adapted to photosynthesize optimally under very low light conditions because they are constantly overshadowed by tall, canopied trees. Many plants are also dependent on sunlight to meet their photoperiodic requirement for flowering. For many animals too, light is important in that they use the diurnal and seasonal variations in light intensity and duration (photoperiod) as cues for timing their foraging, reproductive and migratory activities. The availability of light on land is closely linked with that of temperature since the sun is the source for both.

32. i. Population density means a number of individuals present per unit area, population density can be measured by determining the population size.
Ecologists are interested in measuring population density for the following reasons:

a. The size of the population tells us a lot about its status in the habitat.
b. Ecological processes such as the outcome of competition with another species, the impact of a predator or the effect of pesticide application can be easily evaluated in terms of change in the population size.

ii. The different methods to study population size are as follows:

a. **Percent cover or Biomass:** In an area with 200 Parthenium plants and only one banyan tree with a large canopy, the density of banyan tree is small but does not reflect its important role in the community. Here the percent cover or biomass is a more meaningful method of assessing population density.
b. **Total number:** It involves the counting of organisms in the given area.
c. **Relative density:** In this method, there is no need to count the organisms individually. Example, the number of fishes caught per trap gives the measure of their total density m a given waterbody.
d. **Indirect assessment:** The tiger census is based on pugmarks and faecal pellets.

OR

i. **Following are uses of biodiversity:**

a. Biodiversity is essential for the maintenance and sustainable utilization of goods and services from the ecological system as well as from individual species.
b. Aesthetic and cultural benefits.
c. As a source of drugs and medicines.
d. As a source of food and improved varieties.
Examples of aesthetic rewards include ecotourism, bird watching, wildlife, pet-keeping, gardening etc.

ii. **Following are the effects of habitat fragmentation on Biodiversity:**

a. Fragmentation creates barriers that limit the potential of species to disperse and colonise new areas.
b. Species get divided into the smaller population which are unable to sustain.
c. It increases edge areas thus making the species more vulnerable to predators as well as wind and fire.
d. Migratory birds lose their seasonal habitats.

33. Alexander Von Humboldt observed that within a region species richness increased with increase in explored area, but only up to certain limit. This relationship between species richness and area is a rectangular hyperbola for a large variety of taxa such as angiosperm plants, birds, bats and freshwater fishes.
On a logarithmic scale, the relationship is a straight line which can be described by following equation:
$\log S = \log C + Z \log A$
where S = species richness
Z = slope of line (regression coefficient)
C = Y-intercept
A = Area
Z is generally 0.1-0.2 regardless of taxonomic group or region i.e. when analysis of species area relationship is done among small areas, the values of slopes of regression are remarkably similar regardless of the taxonomic group or the region. If analysis of species area relationship is done among very large areas like a whole continent, the slope of regression line would be much steeper. In such cases, the Z values occur in the range of 0.6 to 1.2

OR

Gene therapy is a collection of methods that allows the 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.
The first clinical gene therapy was given in 1990 to a 4 -year old girl with adenosine deaminase (ADA) deficiency. This enzyme is crucial for the immune system to function. The disorder is caused due to the deletion of the gene for adenosine deaminase. In some children ADA deficiency can be cured by bone marrow transplantation: in others, it can be treated by enzyme replacement therapy, in which functional ADA is given to the patient by injection. But the problem with both of these approaches that they are not completely curative. As a first step towards gene therapy, 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. However, as these cells are not immortal, the patient requires "periodic infusion of such genetically engineered Lymphocytes. However, if the gene isolate from marrow cells producing ADA is introduced into cells at early embryonic stages, it could be a permanent cure.