Class: XII
SESSION : 2022-2023
SUBJECT: BIOLOGY (044)
SAMPLE QUESTION PAPER - 4
with SOLUTION

Maximum Marks: 70 **Time: 3 hours**

General Instructions:

(i) All questions are compulsory.
(ii) The question paper has five sections and 33 questions. All questions are compulsory.
(iii) Section–A has 16 questions of 1 mark each; Section–B has 5 questions of 2 marks each; Section– C has 7 questions of 3 marks each; Section– D has 2 case-based questions of 4 marks each; and Section–E has 3 questions of 5 marks each.
(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. Which one of the following set of organism and their function is correctly matched? **[1]**

a) Mycorrhizae - Mineral uptake from soil
b) Mycomycetes - The disease ringworm
c) Rhizobium - Parasite in the roots of leguminous plants
d) Yeast - Production of biogas

2. The sequence of development during the formation of female gametophyte is: **[1]**

A. Archesporium → megaspore mother cell → megaspore → embroyo sac
B. Megaspore mother cell → archesporium → megaspore → embroyo sac
C. Archesporium → megaspores → megaspores mother cell → embroyo sac
D. Megaspore mother cell → spore mother cell → embryospore mother cell → embroyo

a) Only D
b) Only C
c) Only B
d) Only A

3. YAM (Vesicular - orbuscular mycorrhizae) represents: **[1]**

a) Saprophytic fung
b) Symbiotic fungi
c) Parasitic algae
d) Saprophytic bacteria

4. Which of the following could be most intense and strongest? **[1]**

a) interspecific competition
b) intraspecific competition
c) natural selection
d) intercommunity competition

5. From the seminiferous tubules the spermatozoa pass into: **[1]**

a) Epididymis
b) Seminal vesicle
c) Vas deferens
d) Rete testis

6. In India how many biodiversity hot spots are present? **[1]**

a) 5
b) 15
c) 1
d) 3

7. On crossing red and white flowered plants the ratio of red and white flowered plants in F_2-generation was 60 : 20, then on selfing the heterozygous red flowered plants, the offsprings would be: **[1]**

a) 52 : 48
b) 84 : 16
c) 40 : 60
d) 72 : 24

8. Which of the following statements is correct about the role of regulatory proteins in transcription in prokaryotes? **[1]**

a) They can act both as activators and as repressors.
b) They only increase expression.
c) They only decrease expression.
d) They interact with RNA polymerase but do not affect the expression.

9. Choose the correct statement from the following: **[1]**

a) Chasmogamous flowers always exhibit geitonogamy.
b) Cleistogamous flowers always exhibit autogamy.
c) Cleistogamous flowers exhibit both autogamy and geitonogamy.
d) Chasmogamous flowers never exhibit autogamy.

10. The cutting out of separated bands of DNA from the agars gel is called: **[1]**

a) Elution
b) Polymerisation
c) Electrophoresis
d) Annealing

11. Determination of one amino acid by more than one codon is due to: **[1]**

a) Universal nature of genetic code
b) Degeneracy of genetic code
c) Continuous nature of genetic code
d) Punctuation of genetic code

12. **Assertion (A):** Phenylketonuria affected individual lacks an enzyme that converts the amino acid phenylalanine into tyrosine. **[1]**
Reason (R): Accumulation of urea in the brain results in mental retardation.

a) Both A and R are true and R is
b) Both A and R are true but R is

the correct explanation of A.

not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

13. How was penicillin discovered? **[1]**

a) Obtained by scientist when working for discovery of penicillin

b) Chance discovery

c) All of these

d) Obtained by scientist when treated American soldiers

14. **Assertion (A):** The modern horse evolved during pliocene epoch. **[1]**
Reason (R): It arose from pliohippus.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

15. **Assertion:** Interferons are a type of antibodies produced by body cells infected by bacteria. **[1]**
Reason: Interferons stimulate inflammation at the site of injury.

a) If both Assertion and Reason are false statements

b) If both Assertion & Reason are true and the reason is the correct explanation of the assertion

c) If both Assertion & Reason are true but the reason is not the correct explanation of the assertion

d) If Assertion is true statement but Reason is false

16. **Assertion:** VNTR of two persons may be similar at certain sites but could be different at other sites. **[1]**
Reason: A child inherits 50% of chromosomes from the mother and the remaining 50% from father.

a) Assertion and reason both are correct

b) Assertion is correct but reason is incorrect

c) Both assertion and reason are incorrect

d) Reason does not explain the assertion correctly

Section B

17. Write the full form of the following: **[2]**
(i) MMR
(ii) IVF
(iii) GIFT
(iv) ART

18. Do eukaryotic cells have restriction endonucleases? **[2]**

19. Fertilization is _____ in humans (external / internal) **[2]**

20. What is a mutagen? Give one example. **[2]**

21. An orchid plant is growing on the branch of mango tree. How do you describe this interactions? **[2]**

OR

List any three important characteristics of a population and explain.

Section C

22. Name the place where the first meiotic division is completed during oogenesis. What are the products of this division? Give the chromosome number of each type of cells, involved in the process. **[3]**

23. What are the drawbacks of use of enzymes in biotechnology as compared to inorganic catalyst? **[3]**

24. Differentiate between the following: **[3]**
    a. Dominant and Recessive
    b. Homozygous and Heterozygous
    c. Monohybrid and Dihybrid

25. i. Why is tender coconut considered as a healthy source of nutrition? **[3]**
    ii. How are pea seeds different from castor seeds with respect to endosperm?

OR

What is meant by emasculation? When and why does a plant breeder employ this technique?

26. i. Explain the significance of ecological pyramids with the help of an example. **[3]**
    ii. Why are the pyramids referred to as upright or inverted? Explain.

27. Amazonian rain forest has the greatest biodiversity on earth. List any two hypothesis that are proposed by the biologists to account for the greater biological diversity. **[3]**

28. Write short note on RCH programmes. **[3]**

Section D

29. **Read the text carefully and answer the questions:** **[4]**

Gene therapy is an experimental technique that uses genes to treat or prevent disease. In the future, this technique may allow doctors to treat a disorder by inserting a gene into a patient's cells instead of using drugs or surgery.
Clinical gene therapy is given to a 4 years old patient for an enzyme that is crucial for the immune system to function.

(A) Lymphocytes of the Patient.
↓
(B) _____

↓
(C) Introduction of functional ADA cDNA into Lymphocytes.
↓
(D) _____

Observe the therapeutical flow chart:

(i) Complete the missing steps (B) and (D).

(ii) Identify the disease to be cured.

(iii) Why the above method is not a complete solution to the problem?

OR

Scientists have developed a method to cure this disease permanently. How?

30. **Read the text carefully and answer the questions:** **[4]**

Study the schematic representation of the genes involved in the lac operon given below and answer the questions that follows:

p	i	p	o	z	y	a

(i) Identify and name the regulatory gene in this operon. Explain its role in 'switching off the operon.

(ii) Why is lac operon's regulation referred to as negative regulation?

(iii) Name the inducer molecule and the products of the genes z and y of the operon.

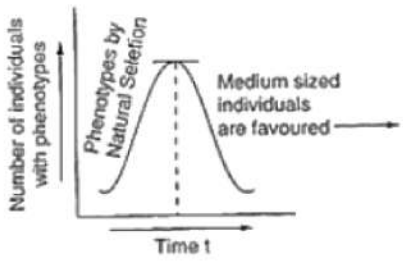
OR

Write the function of these gene products.

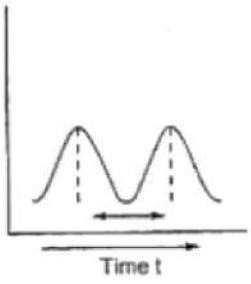
Section E

31. Study the figure (a) and (b) given below and answer the questions given after the graphs. **[5]**

a.



b.



i. Under the influence of which type of Natural selection would graph (a) become like a graph.

ii. What could be the likely reasons of new variations arising in the population?

iii. Who suggested Natural Selection as a mechanism of evolution?

OR

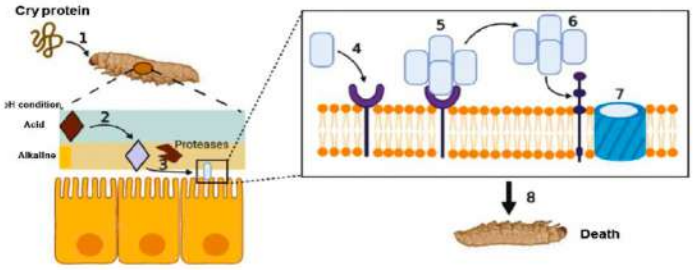
Explain the origin of simple organic compounds on the primitive earth.

32. What are recombinant DNA vaccines? Give two examples of such vaccines. Discuss their advantages. **[5]**

OR

Write the events that take place when a vaccine for any disease is introduced into the human body.

33. The image below shows how Cry proteins work. **[5]**



i. What are Cry proteins?

ii. Name an organism that produce it.

iii. How has man exploited this protein to his benefit?

OR

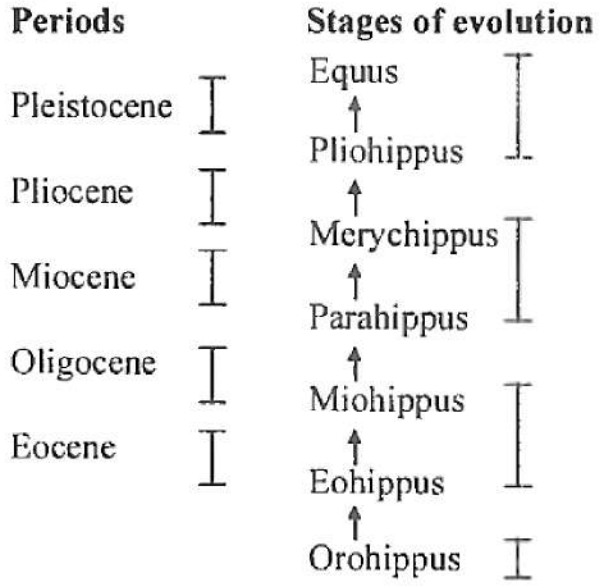
Who was the first patient who was given gene therapy? Why was the given treatment recurrent in nature?

SOLUTION

Section A

1. **(a)** Mycorrhizae - Mineral uptake from soil
   Explanation: Mycorrhizae - Mineral uptake from soil
2. **(d)** Only A
   Explanation: Archesporium → megaspore mother cell → megaspore → embroyo sac
3. **(b)** Symbiotic fungi
   Explanation: Symbiotic fungi
4. **(b)** intraspecific competition
   Explanation: Intraspecific competition could be most intense and strongest as it occurs between organisms having the same types of requirement of food, water, etc. They may have competition for food, shelter, water, space or matter also.
5. **(d)** Rete testis
   Explanation: Rete testis
6. **(d)** 3
   Explanation: 3
7. **(d)** 72 : 24
   Explanation: 72 : 24
8. **(a)** They can act both as activators and as repressors.
   Explanation: The RNA polymerase is only capable of catalyzing the process of elongation. It associates transiently with initiation-factor (σ) and termination-factor (ρ) to initiate and terminate the transcription, respectively. The initiation factor and the termination factor are regulatory proteins.
9. **(b)** Cleistogamous flowers always exhibit autogamy.
   Explanation: Cleistogamous flowers do not open at all. In such flowers, the anther and stigma lie close to each other. As these flowers are closed at all, a foreign pollen cannot pollinate the flower, and hence they always exhibit autogamy.
10. **(a)** Elution
    Explanation: In gel-electrophoresis, the separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is called elution.
11. **(b)** Degeneracy of genetic code
    Explanation: Degeneracy of genetic code
12. **(c)** A is true but R is false.
    Explanation: A is true but R is false.
13. **(b)** Chance discovery
    Explanation: Chance discovery
14. **(d)** A is false but R is true.
    Explanation:
    Equus is the modern horse which arose from Pliohippus in pleistocene epoch. Pliohippus, the pliocene horse, evolved from Merychippus in pliocene epoch about one crore years

ago.



15. **(a)** If both Assertion and Reason are false statements
Explanation: Interferons are produced by white blood cells when the immune system is activated due to viral infection or other immune responses. Interferons do not directly kill viral or cancerous cells; they boost the immune system response and reduce the growth of cancer cells by regulating the activity of several genes that control the secretion of numerous cellular proteins that affect growth.
16. **(a)** Assertion and reason both are correct
Explanation: VNTR of two persons may be similar at certain sites but could be different at other sites because a child inherits 50% of chromosomes from the mother and the remaining 50% from father. VNTR genes also undergo different kinds of mutations.

Section B

17. (i) Maternal mortality rate
(ii) In vitro fertilization
(iii) Gamete intra fallopian transfer
(iv) Assisted reproductive technologies.
18. No, eukaryotic cells do not have restriction endonucleases. This is because the DNA of eukaryotes is highly methylated by a modification enzyme, called methylase. Methylation protects the DNA from the activity of restriction enzymes. These enzymes are present in prokaryotic cells where they help prevent the invasion of DNA by virus.
19. internal
20. A mutagen is a physical or chemical agent that changes the genetic material, usually DNA, of an organism and thus increases the frequency of mutations above the natural background level. Example: X-rays.
21. An orchid growing on the branch of a mango tree is an epiphyte. Epiphytes are plants growing on other plants which however, do not derive nutrition from them.
Therefore, the relationship between a mango tree and an orchid is an example of commensalisms, where one species gets benefited while the other remains unaffected.
In the above interaction, the orchid is benefited as it gets support while the mango tree remains unaffected.

OR

A population can be defined as a group of individuals of the same species, residing in a particular geographical area at a particular time and functioning as a unit. For example, all human beings living at a particular place at a particular time constitute the population of humans.

Three important characteristics of a population are:

- **Birth rate (Natality)**: It is the ratio of live births in an area to the population of an area. It is expressed as the number of individuals added to the population with respect to the members of the population.
- **Death rate (Mortality):** It is the ratio of deaths in an area to the population of an area. It is expressed as the loss of individuals with respect to the members of the population.
- **Age Distribution**: It is the percentage of individuals of different ages in a given population. At any given time, a population is composed of individuals that are present in various age groups. The age distribution pattern is commonly represented through age pyramids.

Section C

22. The first meiotic division completed in the primary oocyte during oogenesis.
Then primary oocyte undergoes Meiotic-I phase to form a large haploid secondary oocyte and a tiny first polar body as its product.
The primary oocyte comprises of 46 chromosomes, whereas secondary oocyte and first polar body have 23 chromosomes each.
23. Drawbacks of use of enzymes in Biotechnology:
    i. Extraction and purification of enzymes are not only laborious but also highly expensive.
    ii. Enzymes are not stable and are quite fragile.
    iii. Enzymes are denatured at a slightly higher temperature than room temperature.
    iv. Changes in pH deactivate the enzymes.
    v. Enzymes are influenced by a number of organic solvents, exposure to air or protein poisons. However, there is no alternative to enzymes.
24. a. Dominant character shows in F_1 generation, while the recessive character remains hidden.
    b. The alleles are similar in homozygous, while they are dissimilar in heterozygous. Homozygous individuals can carry either dominant or recessive alleles but not both but heterozygous individual has both dominant and recessive alleles.
    c. Crossing one set of two contrasting characters is called monohybrid cross. Crossing one set of 4 contrasting characters is called dihybrid cross.
25. i. The tender coconut is immature with soft and gentle solid white kernel (it is Primary Endosperm Cell) also called coconut 'meat' and the central watery fluid, free nuclear endosperm, called coconut milk(it is Primary Endosperm Nucleus) or water is highly nutritious as it contains a large number of nucleus having high amount of proteins, oils, vitamins and minerals.
    ii. The seeds of pea are dicot, non-endospermic/ex-albuminous because the whole of endosperm is consumed during embryogenesis. The food is stored in massive cotyledons and there are no remnants of endosperm in the mature pea, seeds.
    However, in castor seeds, the whole of endosperm is not consumed completely during embryogenesis. The cotyledons are papery and the fleshy massive endosperm is present in the mature castor seeds. Seeds are known as an endospermic seed or albuminous seeds.

OR

Emasculation is the process of removal of anthers before maturation from the flower buds of female parent so that chances of self pollination are eliminated.
Plant breeders employ this technique for artificial hybridization for crop improvement programme.

26.

i. **Significance of ecological pyramids:**
They graphically represent the relation between producers and consumers in order to calculate energy content, biomass and number of organisms of that trophic level A trophic level represents only a functional level not a species as such. A given species may occupy more than one trophic level in the same ecosystem at the same time The ecological pyramids provide an overall idea of the trophic levels occupied by an organism in an ecosystem.
Example: A sparrow is a primary consumer when it eats seeds, fruits, peas and a secondary consumer when it eats insects and worms.

ii. **Upright pyramids** When producers are more in number and biomass than the herbivores and herbivores are more in number and biomass than the carnivores. The energy at a lower trophic level is always more than at a higher trophic level. Pyramid of energy is always upright.
Inverted pyramids When the numbers of producers are less and consumers increase and become largest in top consumer level. Pyramid of number and biomass may be inverted.

27. Two hypothesis proposed to explain the greater biological diversity in amazon rainforest are:
(i) Speciation is generally a function of time. Temperate regions have been subjected to frequent glaciations in the past but tropical latitudes have remained undisturbed for millions of years. This has provided longer time for evolution and species diversification.
(ii) Tropical environments are less seasonal, relatively more constant and predictable. Such constant environments promote niche specialization which leads to a greater diversity in plant and animal species. Also, more solar energy is available in the tropics which contributes to higher productivity. This indirectly contributes to species diversity.

28. RCH (reproductive and child health care) programmes through health centres provide:
i. necessary and right information, guidance and help to the mothers before and after delivery so that they can properly look after themselves and the infants.
ii. ensures the safe delivery of the infant and postnatal care.
iii. provides for immunization of infants and prophylaxis against anaemia and vitamin deficiency.
iv. arranges milk feeding programmes.
v. training midwives.
vi. educating fertile couples about the benefits of a small family.

Section D

29. **Read the text carefully and answer the questions:**
Gene therapy is an experimental technique that uses genes to treat or prevent disease. In the future, this technique may allow doctors to treat a disorder by inserting a gene into a patient's cells instead of using drugs or surgery.
Clinical gene therapy is given to a 4 years old patient for an enzyme that is crucial for the immune system to function.

(A) Lymphocytes of the Patient.
↓
(B) _____
↓
(C) Introduction of functional ADA cDNA into Lymphocytes.
↓

(D) _____

Observe the therapeutical flow chart:

(i) Step (B): Lymphocytes are grown in the culture medium.
Step (D): Infusion of genetically engineered lymphocytes into patients.
(ii) Adenosine deaminase (ADA) deficiency.
(iii) As genetically engineered lymphocytes are not immortal, the patient requires the periodic infusion of cells.

OR

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

30. **Read the text carefully and answer the questions:**
Study the schematic representation of the genes involved in the lac operon given below and answer the questions that follows:

p	i	p	o	z	y	a

(i) i gene-regulatory gene.
It codes for the repressor protein of the operon, which is synthesised constitutively. The repressor has the affinity for the operator gene. It binds to the operator and prevents the RNA polymerase from transcribing the structural genes.
(ii) When repressor binds to the operator, the operon is switched off and transcription is stopped. So, it is called negative regulation.
(iii) Lactose is an inducer molecule.
Gene 'z' codes for β-galactosidase, which is responsible for the hydrolysis of lactose into galactose and glucose.
'y' gene codes for permease. It increases the permeability of the cell to lactose.

OR

'y' gene codes for permease. It increases the permeability of the cell to lactose.

Section E

31. i. When disruptive natural selection operates.
ii. Mutation, gene flow genetic drift, recombination.
iii. Charles Darwin.

OR

(i) Early earth had innumerable free atoms of all those elements, which were essential for the formation of protoplasm.
(ii) Free atoms combined to form molecules and simple inorganic compounds.
(iii) The primitive atmosphere contained gases like CO_2, CO, N, H_2 The nitrogen and carbon of the atmosphere combine with metallic atoms, forming nitrides and carbides water vapour and metallic carbides reacted to form the first organic compounds, methane (CH_4) Later on hydrogen cyanide was formed.
Torrential rain must have dissolved away and carried with it salts and minerals, and ultimately accumulated in the form of present occurrence. Thus ancient oceanic waters contained large amounts of dissolved NH_3, CH_4, HCN nitrides, carbides, various gases and elements. The early compounds interacted and produced simple organic compounds such as simple sugars, nitrogenous bases, amino acids, glycerol, fatty acids, etc. under the action of external forces such as solar radiations electrical discharges and like lightning and high energy radiations.

32. A vaccine which is made through recombinant DNA technology is called recombinant DNA vaccine. In such a vaccine; instead of a whole strain of the causative pathogen, only one or two antigens is inserted into the DNA of a suitable host to prepare the vaccine. Recombinant DNA technology enables one to make vaccines on a larger scale with the least chances of contamination. This technology also helps in bringing down the cost of the vaccine.
Hepatitis B Vaccine and HPV (Human Papilloma Virus) Vaccine are two examples of recombinant DNA vaccine.
Large scale production of vaccines was earlier done by using cell culture. In this method, strains of the pathogen were injected into a suitable animal; like horses and antigens were allowed to proliferate inside the horse's cells. Subsequently, the serum of the horse is collected to extract the antigens to prepare the vaccine. This technique had severe shortcomings. Contamination and chances of some other diseases because of the horse's serum was quite high. It also involved cruelty against animals. These problems could be overcome because of recombinant DNA technology. Using this technology, yeast is normally used to produce antigens. Large scale production at lower cost has become possible with this technology.

OR

Events after vaccination:

- It is based on the property of "Memory" of the immune system. In vaccination, a preparation of antigenic proteins of disease-causing pathogens or inactivated/weakened pathogens are introduced into the body of a person who has to be immune. These antigens can not cause the disease but can initiate the process of antibody formation.
- The antibodies produced in response to these antigens in the body would neutralize the pathogenic agents during actual infection.
- The vaccines dosage also generate memory-B and T-cells that recognize the pathogen quickly on subsequent exposure and produce antibodies quickly in a massive amount as they have memory for the pattern of that pathogen from the earlier attempt.

33. - Cry proteins refer to the protein crystals containing a toxic insecticide.
- It is produced by a soil bacterium, Bacillus thuringiensis
- The genes encoding cry proteins called Bt toxin genes were isolated from B. thuringiensis and incorporated into several crop plants such as Bt cotton, Bt corn etc. to provide resistance against insect pests.

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.