Class: XII
SESSION : 2022-2023
SUBJECT: BIOLOGY (044)
SAMPLE QUESTION PAPER - 15
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. Three water samples namely river water, untreated sewage water and secondary effluent discharged for a sewage treatment plant were subjected to BOD test. The samples were labelled A, B, C respectively. But the laboratory attendant forget to note the BOD value of the samples. The BOD values of three samples were 200 mg/L, 8 mg/L and 400 mg/L. Can you assign BOD value to each samples. **[1]**

a) A = 8 mg/L, B = 400 mg/L. C = 200 mg/L
b) A = 400 mg/L, B = 8 mg/L, C = 200 mg/L
c) A = 200 mg/L, B = 400 mg/L, C =8 mg/L
d) A = 8 mg/L, B = 200 mg/L, C = 400 mg/L

2. Which among the following is not included under cyanobacteria? **[1]**

a) Oscillatoria
b) Anabaena
c) Rhizobium
d) Nostoc

3. Geitonogamy involves: **[1]**

a) Fertilization of a flower by the pollen from another flower of the same plant.
b) Fertilization of a flower by the pollen from a flower of another plant belonging to a distant population.
c) Fertilization of a flower by the pollen from the same flower.
d) Fertilization of a flower by the pollen from a flower of another plant in the same population.

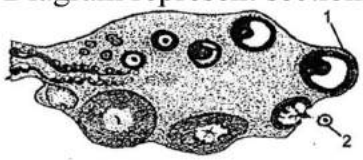
4. Shrew, rat, and rabbit living together in a grassland exhibit: **[1]**

a) Amensalism
b) Commensalism

c) Mutualism

d) Neutralism

5. Diagram represent sectional view of _____ and 1, 2 represent: [1]



a) Ovary-1-Graafian follicle-2-Ovum

b) Ovary-1-Tertiary follicle-2-Ovum

c) Ovary-1-Tertiary follicle-2-Ovum

d) Ovary-1-Tertiary follicle-2-Ovum

6. Gene flow i.e. movement of genes will: [1]

a) Increase impact of natural selection

b) Homogenized population

c) Disturbs and decreases genetic variation

d) Population degradation

7. In rabbit black skin (B) is dominant over brown skin (b) and short hair (5) is dominant over long hair (s). If homozygous black-short haired male is crossed with a homozygous brown-long haired female. All F_1 offspring are heterozygous black-short haired. F_1 male crossed with F-female. In F_2 generation what is the percentage of homozygous black-short haired offspring: [1]

a) 50%

b) 18.75%

c) 6.25%

d) 12.5%

8. Filiform apparatus present at micropylar part of the Synergids help in: [1]

a) Providing nutrition to the embryo

b) Help in germination of seed

c) Help in absorption of water

d) Guiding the entry of pollen tube

9. The tumour inducing capacity of Agrobacterium tumefaciens is located in large extra chromosomal plasmid and called: [1]

a) Plasmid PBR322

b) Ri-plasmid

c) Lambda phage

d) Ti - plasmid

10. Commonly used vectors for human genome sequencing are: [1]

a) Expression Vectors

b) T/A Cloning Vectors

c) BAC and YAC

d) T- DNA

11. Which one of the following alcoholic drinks is produced without distillation? [1]

a) Rum
b) Whisky
c) Brandy
d) Wine

12. The replicating units of DNA of a chromosome are called: [1]

a) Palindromes
b) Okazaki pieces
c) Replicons
d) Okazaki units

13. **Assertion (A):** Killer strain of Paramecium aurelia can kill sensitive strain. [1]
Reason (R): If the sensitive strain is provided kappa particle, it becomes a killer.

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.

14. **Assertion (A):** The two chains of DNA have anti-polarity. [1]
Reason (R): In one chain of DNA, ribose sugar at 5′ end consists of a free phosphate moiety while at the other end the ribose has a free 3′ OH group.

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 (A):** The rocks of early era contain less number of fossils. [1]
Reason (R): Life originated in the sea.

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.

16. **Assertion:** HIV person suffering from infections that could have been otherwise overcome such as those due to bacteria especially Mycobacterium, viruses, fungi and even parasites like Toxoplasma. [1]
Reason: The macrophages of HIV person continue produces vims and in this way acts like a HIV factory.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
c) Assertion is correct statement but reason is wrong statement.
d) Assertion is wrong statement but reason is correct statement.

Section B

17. Enumerate the steps which are involved in recombinant DNA technology. [2]

18. The following table shows the genotypes for ABO blood grouping and their phenotypes. Fill in the gaps left in the table. **[2]**

S.No.	Genotype	Blood Group
1	$I^A I^A$	A
2	_____	A
3	$I^B I^B$	B
4	_____	B
5	$I^A I^B$	_____
6	_____	O

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

20. How is the entry of only one sperm and not many ensured into an ovum during fertilization in humans? **[2]**

21. If in a population of size 'N' the birth rate is represented as 'b' and the death rate as 'd', the increase or decrease in 'N' during a unit time period 't' will be: **[2]**
$\frac{dN}{dt} = (b - d) \times N$
The equation given above can also be represented as:
$\frac{dN}{dt} = r \times N$, where r = (b - d)
What does 'r' represent? Write any one significance of calculating 'r' for any population.

OR

How is a monoculture disadvantageous?

Section C

22. Why is Rhizobium categorized as a symbiotic bacterium? How does it act as a biofertiliser? **[3]**

23. Write the functions of the following: **[3]**
a. Acrosome
b. Nucleus
c. Middle piece

24. (i) Give two reasons why Mendel chose garden pea for his experiments. Give the biological name of this plant. **[3]**
(ii) State Mendels principal of segregation.

25. Seeing a crowd of students in one corner of the school, the Principal rushed to see the matter and found some children beating and chasing a small monitor lizard. **[3]**

On seeing the Principal, all the children fled to their classes except Alok who requested the Principal to arrange for some medical assistance for the injured animal. The Principal rewarded the student.

a) Was Alok an indisciplined boy who did not run to the class on seeing the Principal? What values does the act promote?

b) How do endangered species differ from vulnerable species?

c) Mention the factors resulting in loss of biodiversity / extinction.

26. What will be the advantage of transforming hybrid into apomictic form? **[3]**

OR

i. Why is tender coconut considered as a healthy source of nutrition?

ii. How are pea seeds different from castor seeds with respect to endosperm?

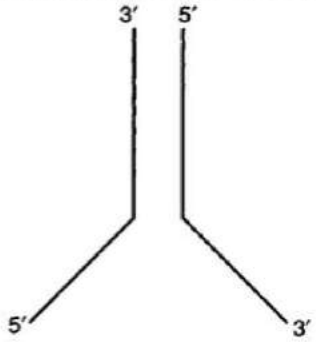
27. List the objectives of Reproductive and Child Health Care Programmes (RCH). **[3]**

28. What are the shortcomings of ecological pyramids in the study of an ecosystem? **[3]**

Section D

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

Study the image below:



(i) Identify the structure shown above.

(ii) Redraw the structure as a replicating fork and label the parts.

(iii) Write the source of energy for this replication and list the enzymes involved in this process.

OR

Mention the difference in the synthesis based on the polarity of the two template strands.

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

Transgenic animals can serve as factories that in some cases, may produce large amounts of proteins more efficiently. Transgenic mice have been engineered to express human antibodies by introducing a large segment of human DNA encoding human immunoglobulin genes. In transgenic large animals such as cows or sheep proteins of pharmaceutical value can be produced in large quantities in milk which is later purified. Transgenes can be used to alter many phenotypic

properties including growth rate, fat composition, milk production, hair texture, etc.

(i) In transgenic animals, i.e. cow and sheep proteins of pharmaceutical value are produced in large quantities in which gland.

(ii) Why is mouse the most preferred animal for studies on gene transfer?

(iii) Why does the production of transgenic animals take place?

OR

Assertion (A): Transgenic mice have been engineered to express human antibodies.
Reason (R): Large segments of human DNA encoding human immunoglobulin have been transferred to mice.

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.

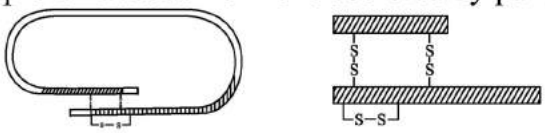
c) A is true but R is false.

d) A is false but R is true.

Section E

31. Peptide hormones or protein hormones are hormones whose molecules are **peptides or** proteins, respectively. These hormones have an effect on the endocrine system of animals, including humans. **[5]**

In the given figure, Form (A) and Form (B) represents different forms of a proteinaceous hormone secreted by pancreas in mammals.



Form (A) Form (B)

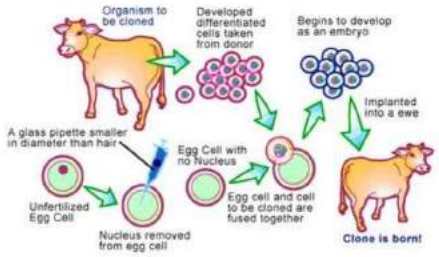
i. Name the hormone. What type of bonding is present between chains of this hormone?

ii. What are these form (A) and form (B)? How these forms differ from each other?

iii. Explain how was this hormone produced by Eli Lilly, an American company, using rDNA technology.

OR

Transgenic animals are routinely used in the laboratory as models in biomedical research. Over 95 percent of those used are genetically modified rodents, predominantly mice. They are important tools for researching human disease, being used to understand gene function in the context of disease susceptibility, progression and to determine responses to a therapeutic intervention.



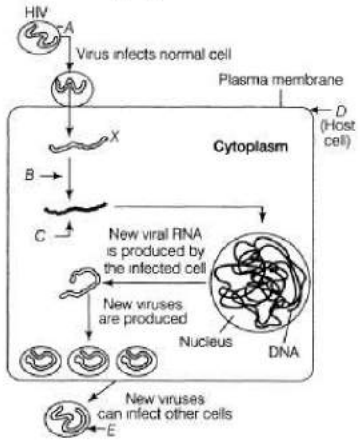
i. Why are transgenic animals so-called?

ii. Explain the role of transgenic animals in

a. Vaccine safety and

b. Biological products with the help of an example each.

32. Study the diagram showing replication of HIV in humans and answer the following questions accordingly. **[5]**



i. Write the chemical nature of the coat A.

ii. Name the enzyme B acting on X to produce molecule C. Name C.

iii. Mention the name of the host cell D the HIV attacks first when it enters into the human body. **OR**

iv. Name the two different cells the new viruses E subsequently attack.

OR

Many secondary metabolites of plants have medicinal properties. It is their misuse that creates problems. Justify the statement with an example.

33. **[5]**

Observe the picture showing the industrial melanism and answer the following questions:

A B

i. What do these pictures A and B illustrate with reference to evolution?

ii. Write the scientific name of the peppered moth.

iii. Picture A and B is a classical example of which type of natural selection?

OR

According to the Darwinian theory of natural selection, the rate of appearance of new forms is linked to the life-cycle or the life-span of an organism. Explain with the help of an example.

SOLUTION

Section A

1. **(c)** A = 200 mg/L, B = 400 mg/L, C =8 mg/L
   Explanation: A = 200 mg/L, B = 400 mg/L, C =8 mg/L
2. **(c)** Rhizobium
   Explanation: The rhizobia are soil bacteria that are nitrogen-fixing diazotrophic heterotrophs, not phototrophs like cyanobacteria. Some cyanobacteria species can fix nitrogen making them diazotrophic.
   All bacteria that can fix N_2 belong to the group of the Diazotrophs. Some species can also reduce carbon (CO_2) in autotrophic reactions while others need an organic carbon source so are diazotrophic heterotrophs like Frankia species of Rhizobium species.
3. **(a)** Fertilization of a flower by the pollen from another flower of the same plant.
   Explanation: Fertilization of a flower by the pollen from another flower of the same plant.
4. **(d)** Neutralism
   Explanation: Neutralism is a kind of relationship in which different organisms live in the same habitat but do not harm each other. Shrew, rats, and rabbits live in the same grassland but do not compete for food and shelter.
5. **(a)** Ovary-1-Graafian follicle-2-Ovum
   Explanation: Ovary-1-Graafian follicle-2-Ovum
6. **(b)** Homogenized population
   Explanation: Gene flow or movement of genes leads to homogenized populations of a species in an ecosystem. Homogenized populations have all the species having almost the same genetic makeup.
7. **(c)** 6.25%
   Explanation: In the Mendel Dihybrid ratio, we get a 9:3:3:1 phenotypic ratio.
   Out of 9/16 the plants having both dominant phenotypes is only one i.e., homozygous dominant.
   Hence, in the F_2 generation, the percentage of homozygous black short-haired offspring is:
   $\frac{1}{16} \times 100 = 6.25\%$
8. **(d)** Guiding the entry of pollen tube
   Explanation: The filiform apparatus is a finger-like projection attached to the egg apparatus. This apparatus guide the pollen tube carrying male gametes for facilitating Syngamy.
9. **(d)** Ti - plasmid
   Explanation: Ti - plasmid
10. **(c)** BAC and YAC
    Explanation: BAC and YAC
11. **(d)** Wine
    Explanation: Wine and beer are produced without distillation whereas whisky, brandy, and rum are produced by distillation of the fermented broth.

12. **(c)** Replicons
Explanation: Replicons
13. **(b)** Both A and R are true but R is not the correct explanation of A.
Explanation: Both A and R are true but R is not the correct explanation of A.
14. **(a)** Both A and R are true and R is the correct explanation of A.
Explanation: The two chains of DNA have anti-parallel polarity this is because one chain has free phosphate moiety at 5′-end of the sugar and another chain has free phosphate moiety at 3′-end.
15. **(b)** Both A and R are true but R is not the correct explanation of A.
Explanation: The rocks of early era contain less number of fossils than the rocks of later era and only fossils of simple marine invertebrates are present in these rocks. It is due to the fact that the life first originated in sea as a simple form. So fossils were not in plenty in the beginning as they were in later stage.
16. **(b)** Assertion and reason both are correct statements but reason is not correct explanation for assertion.
Explanation: Assertion and reason both are correct statements but reason is not correct explanation for assertion.

Section B

17. **Steps involved in recombinant DNA technology are following:**
(i) Isolation of DNA.
(ii) Fragmentation of DNA by restriction endonucleases.
(iii) Isolation of desired DNA fragment.
(iv) Ligation of DNA fragment into vector.
(v) Transferring recombinant DNA into host.
(vi) Culturing host cells at large scale.
(vii) Extraction of the desired product.
18.

S.No.	Genotype	Blood Group
1	$I^A I^A$	A
2	$\_I^A i\_$	A
3	$I^B I^B$	B
4	$\_I^B i\_$	B
5	$I^A I^B$	_AB_
6	_ii_	O

19. (i) Maternal mortality rate
(ii) In vitro fertilization
(iii) Gamete intra fallopian transfer
(iv) Assisted reproductive technologies.
20. During fertilization,when one sperm penetrates the oocytes cell membrane, it comes in contact with the zona pellucida layer of the ovum and induces changes in the membrane that block the entry of additional sperms.
21.
    - **'r' represents** the intrinsic rate of natural increase.

- **Significance of calculating 'r' for any population-** It is an important parameter for assessing the impacts of any biotic or abiotic factor on population growth.

OR

Monoculture (growth of one type of plants e.g., crop) is likely to be completely destroyed in case of an infestation of insect pests or by an epidemic of a fungal disease.

Section C

22. Rhizobium is a symbiotic bacteria as it lives in mutually beneficial association in the nodules on the roots of leguminous plants. The bacteria fix atmospheric nitrogen into organic forms, which is used by the plant as nutrient and in turn bacteria get carbohydrate food and shelter. The leguminous plants with nodulated roots are ploughed back into the field as green manure. They act as biofertilisers that enrich the nutrient quality of the soil. Beside inorganic nutrients, they also add organic matter to the soil, thereby also improving the texture of the soil.
23. Functions:
    1. **Acrosome:** It contains proteolytic and Lysosomal enzymes known as **Sperm lysins** like **acrosin** and **hyaluronidase**. These enzymes digest the outer covering of ova and thus help to penetrate the egg (ovum) at the time of fertilization.
    2. **Nucleus:** The nucleus of the sperm contains DNA as the genetic material. During fertilization nucleus of sperm fuses with the female egg nucleus. The genetic material of the sperm and ova nucleus help in the inheritance of characters to the offspring.
    3. **Middle piece:** It contains spiral mitochondria. These mitochondria generate energy for the movement of sperm.
24. (i) Mendel selected garden pea for his experiments because:-
    (a) Pure varieties of pea were available in which self as well as cross pollination could be carried out.
    (b) Pea plant showed a number of easily detectable contrasting characters.
    Biological name of garden pea is Pisum sativum
    (ii) Law of segregation: This law states that at the time of gametogenesis the two factors for a character separate, and get randomly distributed to different gametes.
25. **Ans-a)** No. Alok was a brave and courteous boy. He expressed his love for animals, commitment towards natural resource conservation.
    Ans-b) Endangered species (when population of a species reduces to a level which poses
    immediate danger of extinction, e.g. one horn rhinoceros, great Indian bustard, musk deer etc)
    Vulnerable species (species whose population have greatly reduced and may be endangered species in future if the causative factors continue to operate. E.g Asiatic wild ass, black buck, spotted deer, golden langur etc)
    Ans-c) (i) Habitat loss and fragmentation
    (ii) Over exploitation
    (iii) Alien species invasion
    (iv) Co-extinction
26. The production of hybrids have some major drawbacks:

i. Hybrid seeds have to be produced every year because if seeds collected from hybrid plants if sown subsequently do not maintain hybrid as mixed character get segregated in subsequent sowing.

ii. Production of hybrid seed is costly and thus increases the cost of crop production as these seeds cost high to farmers.

Apomixis is the mode of asexual reproduction that mimics sexual reproduction but produced seeds without fertilisation. Nowadays scientists are busy in identifying genes for apomixis so that they can be introduced in hybrid varieties.

Thus seed produced by apomixis can be sown year after year for raising crop because characters are not segregated and thus reduce the cost of crop production.

OR

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.

27. Different Objectives of RCH are as follow:

i. Creating awareness about various reproduction related problems.

ii. Providing facilities and support for building up

iii. Providing audio-visual and print media support to various government and non-government organisations a reproductively healthy society.

iv. Educating the people and providing the right information and to save them from myths and misconceptions.

v. Providing proper education regarding reproductive organs, adolescence and related changes, safe and hygienic sexual practices.

vi. Providing information regarding the danger of sexually transmitted diseases, AIDS, etc.

28. Following are the shortcomings of ecological pyramids:

i. It does not take into account the same species belonging to two or more trophic levels.

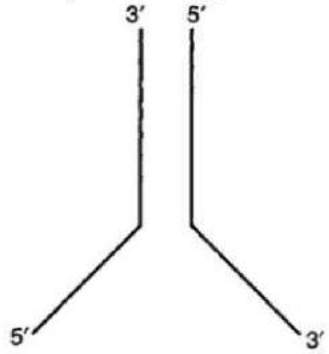
ii. It is based on the assumption of a simple food chain. However, a simple food chain never exists in nature; it does not accommodate a food web.

iii. A food pyramid does not take into account the decomposers. But the fact is, decomposers play an important role in the nutrient cycle.

Section D

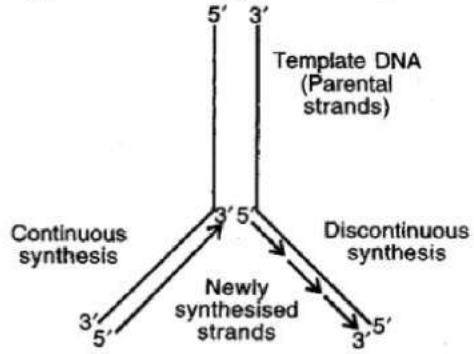
29. **Read the text carefully and answer the questions:**

Study the image below:



(i) The diagram shown is of the replication fork.

(ii) Fig: Labeled diagram of replication fork



(iii)Activated deoxyribonucleotide triphosphate (dNTPs) act as substrate and also provides energy for polymerisation reaction, similar to ATP.

List of enzymes:

i. **Helicases:** It unwinds the two strands of DNA.

ii. **Single-stranded DNA binding proteins:** They bind to the single strands and stabilize them.

iii. **Topoisomerases:** They release tension in the uncoiled part by nicking and then resealing the straightened DNA strands.

iv. **RNA polymerase primase:** They are needed for primer synthesis to initiate the replication process.

v. **DNA polymerase:** It adds the new nucleotides thus replicating the DNA. (Prokaryotes have three major types of DNA polymerases III, II and I).

vi. **DNA ligase:** The Okazaki fragments are joined by this enzyme at the end of replication.

OR

On the template strand with 3' $\longrightarrow$ 5' polarity (leading strand), the synthesis of new strand is continuous while on the other template strand with 5' $\longrightarrow$ 3' polarity (lagging strand), the synthesis of new strand is in discontinuous fashion forming **Okazaki fragments**.

30. **Read the text carefully and answer the questions:**

Transgenic animals can serve as factories that in some cases, may produce large amounts of proteins more efficiently. Transgenic mice have been engineered to express human antibodies by introducing a large segment of human DNA encoding human immunoglobulin genes. In transgenic large animals such as cows or sheep proteins of pharmaceutical value can be produced in large quantities in milk which is

later purified. Transgenes can be used to alter many phenotypic properties including growth rate, fat composition, milk production, hair texture, etc.

(i) Mammary gland

(ii) Short oestrus cycle.

(iii)a. All of these Identification and separation of desired gene.

b. Combining the desired gene with appropriate vector.

c. Introduction of vector in cells, tissues or embryos.

OR

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

Explanation: Both A and R are true and R is the correct explanation of A.

Section E

31. i. Insulin, Disulphide bonds

ii. Form (A): Proinsulin

Form (B) : Mature insulin.

Proinsulin contains an extra stretch called C - peptide which is absent in mature insulin.

iii. Eli-Lilly company prepared two DNA sequences corresponding to A and B peptide chains of human insulin and introduced them in plasmid *E. coli* to produce insulin chains. Chains A and B were produced separately, extracted and combined by creating disulphide bonds to form insulin.

OR

i. Transgenic animals are those that have had their DNA manipulated to possess and express an extra/foreign gene e.g., Transgenic rats, rabbits, pigs, sheep, cow, fish and mice.

ii. a. **Vaccine safety:** Transgenic mice/monkeys are being developed for use in testing the safety of vaccines (e.g., polio vaccine)

b. **Biological products:** Animals producing useful biological compounds can be created by introducing a portion of DNA that codes for that product from other organisms, e.g., α-I-antitrypsin, a human protein used to treat emphysema. The first transgenic cow, Rosie, produced the human-protein enriched milk (2.4 g/litre); it also contained human alpha lactoalbumin, a more nutritionally balanced product for human babies.

32. i. A - Protein coat

ii. B - Reverse transcriptase, X-viral RNA

C - Viral DNA

iii. D - Macrophages (animal or human cell)

iv. E - Macrophages and helper T-cells

OR

Morphine is a good example of a plant metabolite which is a very strong painkiller. But morphine is abused by many people for getting intoxicated. Similarly, codeine comes from opium plants. Codeine is used in cough syrups and is highly effective in suppressing coughing. But many people gulp down the whole bottle of cough syrup to get intoxicated. Drug abuse makes a person hallucinogenic and the person becomes useless not only for the society but also for himself. In extreme cases, drug

addicts resort to petty crimes to get money to buy their daily fix. So, drug abuse is not only a behavioral problem but also a social problem.

33. i. In picture A there is a melanic moth and a white-winged moth on a tree trunk in an unpolluted area that is before industrialization. In picture B there is a melanic moth and a white-winged moth on a tree trunk in a polluted area that is after industrialization.

ii. *Biston betularia*

iii. Directional or progressive selection.

OR

Consider this example:

A colony of **bacteria (say A)** growing in a given medium has built-in variation in terms of ability to utilize a feed component. A change in the medium composition would bring out only that part of the population **(say B)** that can survive under the new conditions. In due course of time, this variant population will outgrow the others (with no similar built-in ability) and appear as new species since, with shorter life-cycle or life-span, it will undergo evolution in a short time. Now, consider the same case for a fish or fowl whose life span is longer. Their progenies would take much longer time to outgrow others as life spans of these animals are in years and they attain reproductive maturity after few years thus taking a long time for the whole evolution process.

Hence, we can mention that the rate of appearance of new forms is linked to the life-cycle or the life-span of an organism