Roll No._____	Series JPR_PB/25-26/12/044/SET No.1

NOTE:-

- Please check that this question paper contains __13___ printed pages.
- Please check that this question paper contains _33____ questions.
- Please write down the serial number of the question in the answer-book before attempting it.
- 15 minutes time has been allotted to read the question paper. The students will read the question paper only and will not write any answer on the answer-book during this period.

Biology (044)

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

General Instructions:

(i) All questions are compulsory.

(ii) The question paper has five sections and 33 questions.

(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.

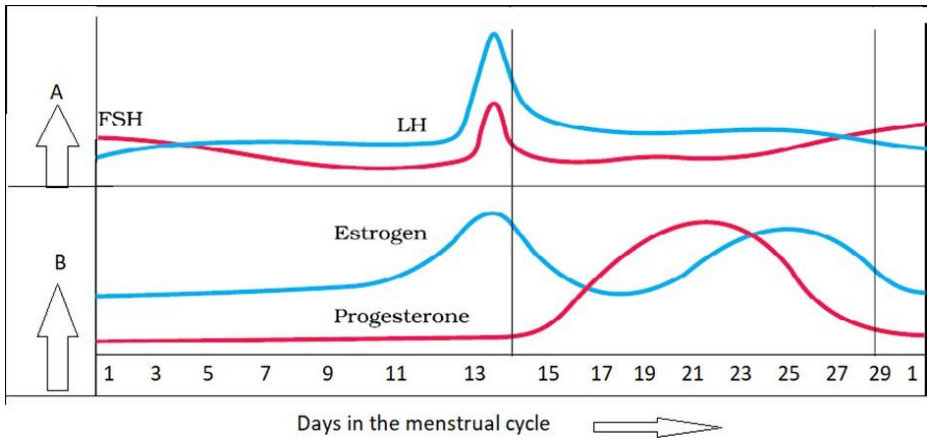
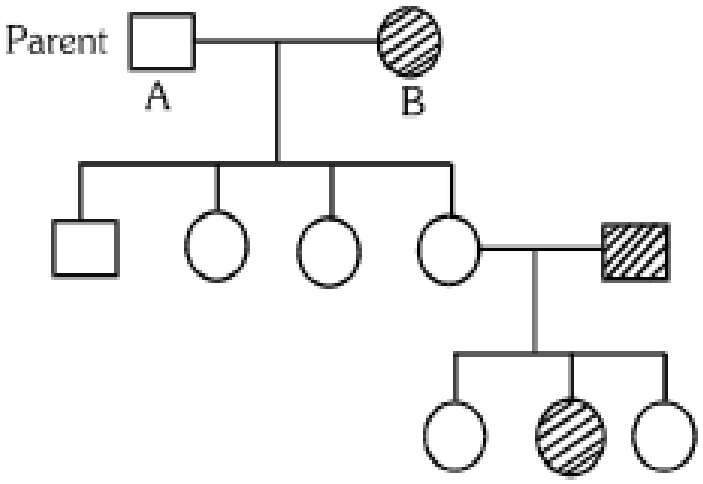
(iv) There is no overall choice. Answer all 33 questions. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.

(v) Wherever necessary, neat and properly labeled diagrams should be drawn.

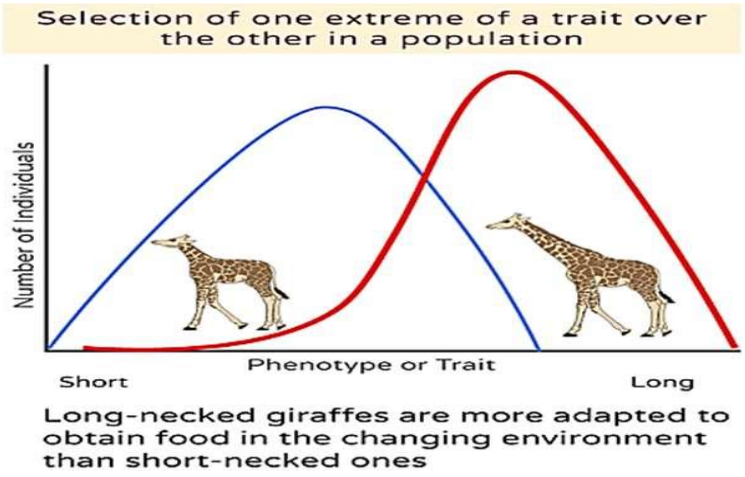
SECTION – A

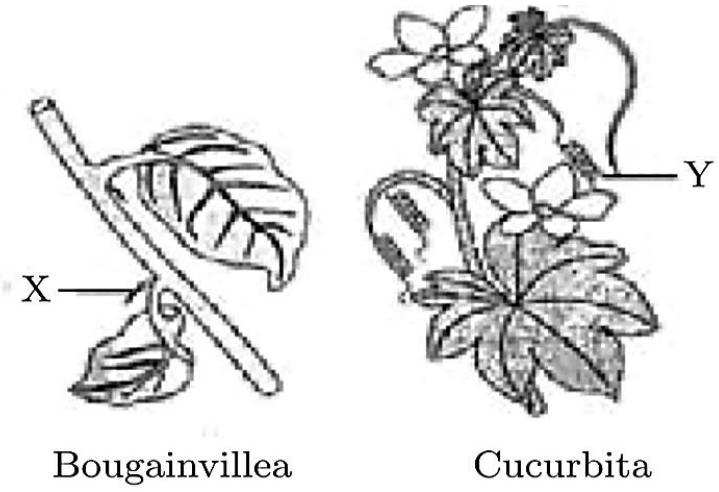
Select and write one most appropriate option out of the four options given for each of the questions 1-16

Q. No.	Questions	Marks
1.	From the statements given below choose the options that are true for a typical female gametophyte of a flowering plant. (i) It is 8-nucleate and 7-celled at maturity (ii) It is free-nuclear during the development (iii) It is situated inside the integument but outside the nucellus (iv) It has an egg apparatus situated at the chalazal end. Choose correct option: (a) (i) and (iv) (b) (ii) and (iii) (c) (i) and (ii) (d) (ii) and (iv)	1

2.	The ploidy of apomictic embryos developing from the nucellus and antipodal cells respectively would be : (a) 2n, 3n (b) 2n, n (c) 3n, 2n (d) n, 2n	1
3.	 Name the organs which secrete the hormones represented in parts A and B (a) **A- ovary** **B- pituitary** (b) **A- placenta** **B- pituitary** (c) **A- pituitary** **B- ovary** (d) **A- hypothalamus** **B- pituitary**	1
4.	Given pedigree shows inheritance of autosomal recessive gene. What is the genotype of given parent B and A respectively?  (a) AA, aa (b) aa, AA (c) aa, Aa (d) Aa, Aa	1

<table>
<tr><td>5.</td><td>What is the haploid content of human DNA in base pairs?
(a) 4.6 X10^6 bp
(b) 3.3 X10^9 bp
(c) 5.38 X10^3 bp
(d) 4.8×10^4 bp</td><td>1</td></tr>
<tr><td>6.</td><td>The promoter site and the terminator site for transcription are located at
(a) The 3′ (downstream) end and 5′ (upstream) end, respectively of the transcription unit
(b) The 5′ (upstream) end and 3′ (downstream) end, respectively of the transcription unit
(c) The 5′ (upstream) end of the transcription unit
(d) The 3′ (downstream) end of the transcription unit</td><td>1</td></tr>
<tr><td>7.</td><td>A short piece of DNA, having 20 base pairs, was analyzed to find the number of nucleotide bases in each of the polynucleotide strands. Some of the results are shown in the table.
<table>
<tr><td></td><td></td><td colspan="3">Number of nucleotide bases</td></tr>
<tr><td></td><td>Adenine</td><td>Cytosine</td><td>Guanine</td><td>Thymine</td></tr>
<tr><td>Strand 1</td><td>4</td><td>4</td><td></td><td></td></tr>
<tr><td>Strand2</td><td></td><td>5</td><td></td><td></td></tr>
</table>
How many nucleotides containing Adenine were present in strand 2?
(a) 2
(b) 4
(c) 5
(d) 7</td><td>1</td></tr>
<tr><td>8.</td><td>Imagine an island ecosystem where a single species of bird, colonizes a previously uninhabited island. Over time, different populations of this bird evolve into distinct species with specialized beak shapes adapted to various available food sources on the island. If you were to analyze the evolutionary process of these bird species, which of the following scenarios would best illustrate adaptive radiation?
(a) Bird populations develop different beak shapes to exploit various food sources on the island, depicting divergent evolution.
(b) Bird populations evolve different beak shapes due to random genetic drift, with no relation to the availability of food sources depicting convergent evolution
(c) Bird populations remain morphologically similar despite the different food sources available on the island showing no evolution.
(d) Bird populations develop similar beak shapes regardless of the different food sources depicting random evolution.</td><td>1</td></tr>
</table>

9.	Ancestral population of giraffes consisted of giraffes of short, medium and long necked ones but present day only long necked giraffes are found. Which type of natural selection does the following graph represent?  (a) Stabilising selection (b) Disruptive selection (c) Directional selection (d) None of the above	1
10.	*"The soldiers of a country kill their own king".* In your body, similar situation take place. Find out that process with a brief explanation. (a) AIDS. HIV attacks Helper T cells of the immune system causing weakening of immunity. (b) Autoimmunity. Due to genetic and other unknown reasons, the immune system attacks self-cells, resulting in damage to the body. (c) Graft rejection. When an organ from a donor is transplanted to the recipient body, the immune system tries to reject it. (d) Allergy. It is the exaggerated response of the immune system to certain antigens present in the environment.	1
11.	What would happen if oxygen availability in aeration tanks during secondary treatment is reduced- (a) It will slow down the rate of degradation of organic matter (b) Flocs would increase in size as anaerobic bacteria would grow around flocs (c) It will reduce the BOD of waste water rapidly (d) Protozoa would grow in large numbers	1
12.	Which statement is true about T-DNA of Agrobacterium (a) It is present in the nucleus (b) It is present in the plant cells and induces tumor in bacteria (c) It is a part of Ti plasmid of Agrobacterium. (d) All the above	1

	Question No. 13 to 16 consist of two statements – Assertion (A) and Reason (R). **Answer these questions selecting the appropriate option given below:** **A. Both A and R are true and R is the correct explanation of A.** **B. Both A and R are true and R is not the correct explanation of A.** **C. A is true but R is false.** **D. A is False but R is true.**	
13.	**Assertion:** Although geitonogamy is functionally cross pollination involving a pollinating agent, genetically it is similar to autogamy. **Reason:** In geitonogamy, pollen grains from the anthers of one flower are transferred to the stigma of another flower borne on the same plant.	1
14.	The given below figures show the different modification found in *Bougainvillea* and *Cucurbita*. Observe the figures carefully and comment upon the appropriateness of the Assertion and Reason.  Bougainvillea Cucurbita **Assertion:** The given structures X and Y show convergent evolution. **Reason:** Structures X and Y are modified axillary buds of stem that perform different functions.	1
15.	**Assertion**: Smoking can raise blood pressure and increase heart rate. **Reason**: Nicotine stimulates adrenal glands to release adrenaline and nor-adrenaline into the blood circulation.	1
16.	**Assertion:** In gel electrophoresis, DNA fragments are separated. **Reason:** DNA is negatively charged, so it moves towards anode under electric field.	1

SECTION – B

Q. No. 16 to 21 are very short answer questions.

17. ***Attempt either option A or B.*** 2

A.

"Continued self-pollination results in inbreeding depression".

(a) Mention ONE impact of inbreeding depression on the upcoming generations in a farmland.

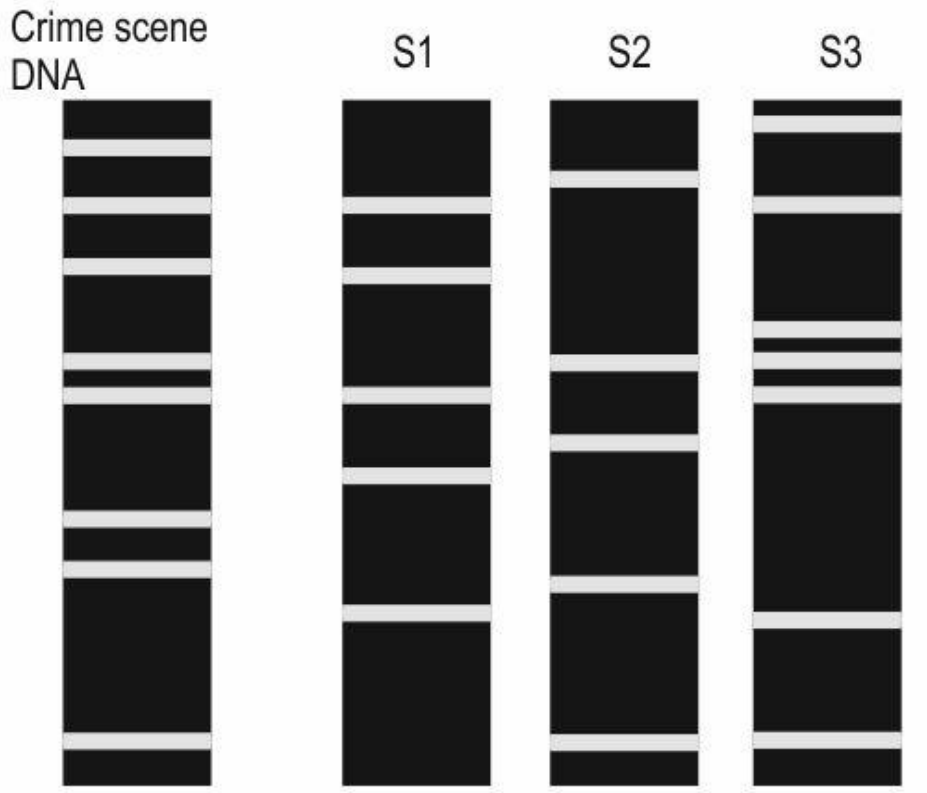
(b) State ONE way in which cross-pollination helps in avoiding inbreeding depression.

OR

B.

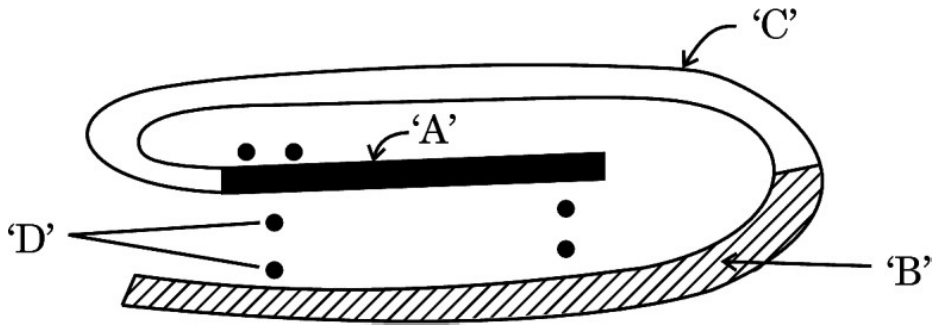
Do you think apomixis can be compared to asexual reproduction? Justify your answer. State the benefits of apomixis to the farmers.

18. In a quiet neighborhood, a woman had been murdered at her home when her roommates were supposedly away. Her roommates were two twin brothers (S1 and S2) and another woman (S3). The investigating officer found the skin of the murderer under her fingernails. The officer sent the DNA from the skin sample along with DNA from the roommates for DNA profiling. Given below is an image of the bands obtained. 2

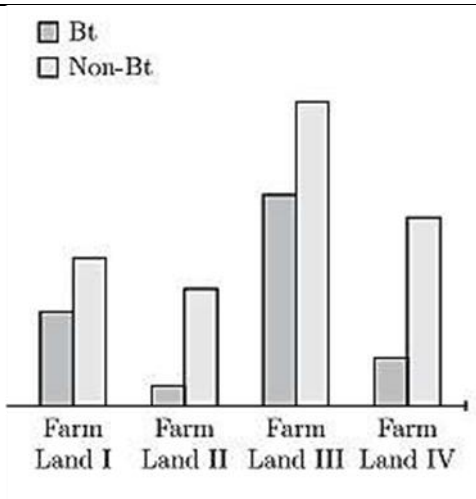


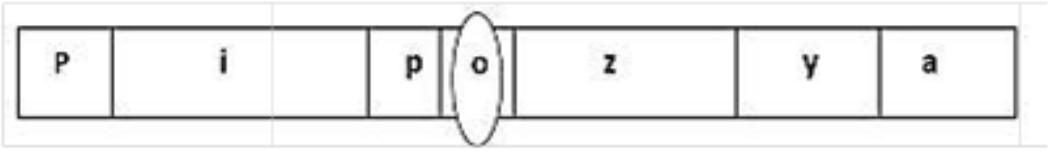
(a) Who is likely to be the murderer? Give a reason to support your answer.

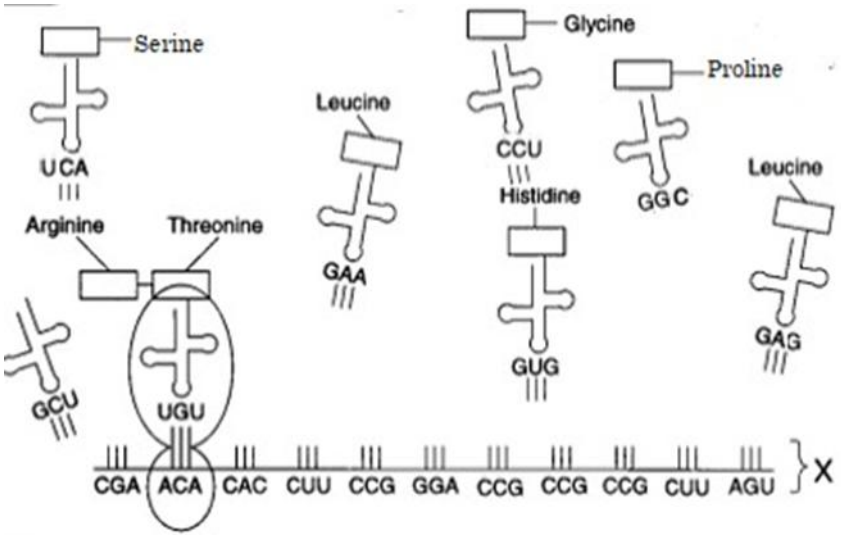
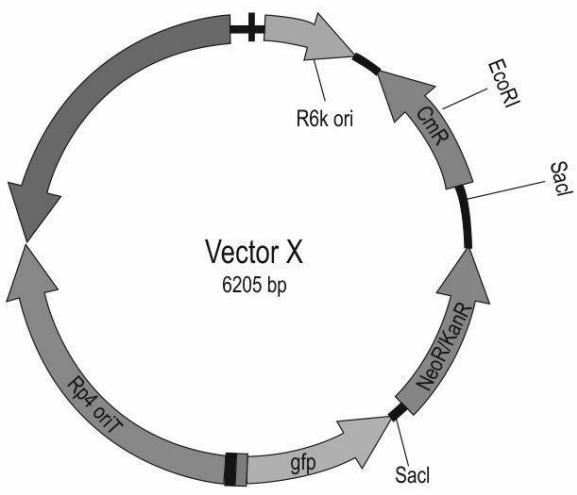
(b) S1 and S2 are twin brothers. What can you conclude about them from the image?

19.	A patient who has been undergoing chemotherapy is suffering from blood coagulations around central venous catheters that have been used to administer the related drugs. (a) Suggest one possible enzyme that could be considered for administration, with the aim of potentially restoring proper blood flow. (b) Based on (a), mention the micro-organism that it is produced from.	2
20.	***Attempt either option A or B.*** **A.** The Tundra desert's gross primary productivity (GPP) is 800 kilocalories/m^2 and respiration losses are about 200 kilocalories. (i) What is the net primary productivity of the desert? Show calculations. (ii) Why do deserts have the least NPP across most ecosystems? **OR** **B.** (i) When prickly pear cactus was introduced into Australia in early 1920s, it caused havoc and ecosystem instability by achieving very high population densities. Explain the reason for its rapid spread into millions of hectares of rangeland. (ii) State the importance of Prey-predator relationship in a habitat.	2
21.	The diagram given below is a biomolecule needed for sugar metabolism in human beings.  (a) Name this biomolecule and mention whether it is in active state or inactive state. (b) Identify the parts marked as 'A', 'B', 'C' and 'D'. OR Name the host plant and its part that Meloidogyne incognita infects. Explain the role of Agrobacterium in the production of dsRNA in the host plant.	2
SECTION – C Q. no. 22 to 28 are short answer questions.		

22.	(a) Highlight one aspect by which meiosis during oogenesis differs from regular meiosis. (b) Name two hormones that are common to spermatogenesis and oogenesis. (c) State the function of hormone identified in (b) in both human male and female.	3
23.	Answer the following questions: (i) Based on the site of fertilization, state one difference between Intra-Uterine Transfer (IUT) of embryo and Intra-Uterine Insemination (IUI). (ii) All Assisted Reproductive Technologies (ARTs) require the extraction of the female gamete from the ovary. Is this statement TRUE or FALSE? Give a reason. (iii) State one characteristic each of the donor and recipient's reproductive system that enables them to participate in Gamete Intra Fallopian Transfer (GIFT).	3
24.	ACHOO syndrome is characterized by uncontrollable sneezing in response to the sudden exposure to bright light, typically intense sunlight. It is inherited as an autosomal dominant condition. (a) Draw a Punnett grid to determine the probability of producing an unaffected child by a heterozygous father and an unaffected mother. (b) Depict the inheritance using a pedigree.	3
25.	A population of peppered moths is in Hardy-Weinberg equilibrium for a gene with two alleles. The 'A' allele for dark-coloured wings is dominant over the 'a' allele for light-coloured wings. The frequency of homozygous dominant individuals is 0.36. Based on this information, calculate the frequency of: (a) allele A in the population (b) allele a in the population (c) heterozygous individuals	3
26.	Given below are three chemical equations. Suggest specific microorganisms that can be used as inoculants for synthesizing the desired products. (a) $C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2$ (b) $N_2 + 3\ H_2 \rightarrow 2\ NH_3$ (c) $(C_6H_{10}O_5)_n + H_2O \rightarrow CO_2 + H_2 + CH_4$	3
27.	GM crops especially Bt crops are known to have higher resistance to pest attacks. To substantiate this an experimental study was conducted in 4 different farmlands growing Bt and non Bt-Cotton crops. The farm lands had the same dimensions, fertility and were under similar climatic conditions. The histogram below shows the usage of pesticides on Bt crops and non-Bt crops in these farm lands	3

	 (i) Which of the above 4 farm lands has successfully applied the concepts of biotechnology to show better management practices and use of agrochemicals? If you had to cultivate, which crop would you prefer (Bt or Non- Bt) and why? (ii) Cotton bollworms were introduced in another experimental study on the above farm lands wherein no pesticide was used. Explain what effect would a Bt and Non-Bt crop have on the pest.	
28.	Cryopreservation is a technique used in the conservation of endemic species. (a) Explain how this method helps with the conservation of a species. (b) Which process that is carried out with humans is similar to cryopreservation and what is it used for?	3
	SECTION - D Q.no. 29 to 30 are case - based/data -based questions with 2 to 3 short sub - parts. Internal choice is provided in one of these sub-parts.	
29.	Read the following passage and answer the questions that follow. Pollen viability is the capability of pollen to get mature and then fertilize and after fertilization, it's the ability to develop into seed and fruit. Male gametophytes are pollen grains. They're made within microsporangia in anthers and discharged when the anther dehisces. A. Write the factors Pollen viability is dependent upon. B. How pollen grains are stored for longer period? ***Attempt either subpart C or D.*** C. Mention any two families whose pollens are viable for months. **OR** D. Storage of pollen grains for longer periods is of any importance yes or no. Give reason in support of your answer.	4
30.	Read the following passage and answer the questions that follow.	4

	In 1981, the health workers of United States of America had become aware of the increased frequency of Kaposi's sarcoma, cancer of the skin and blood vessels and another disease pneumocystis pneumonia, a respiratory infection caused by a protozoan. Both these diseases were very rare in the general population, but occurred frequently in more severely immunosuppressed individuals. This led to the recognition of the immune system disorder that was named Acquired Immune Deficiency Syndrome (AIDS). In 1983, virologists working in the USA and France had identified a causative agents for 'AIDS', now known as Human Immunodeficiency Virus (HIV). HIV follows a set path to attack the human body to cause the disease. A. Name the group of cells the HIV attacks after gaining entry into the human body and write the various events that occur within this cell. B. Write the diagnostic test used for detecting AIDS. Write the possible treatment available for the disease at present. ***<u>Attempt either subpart C or D.</u>*** C. Mention any two steps suggested by WHO for preventing the spread of this disease. **OR** D. A patient suffering from AIDS does not die of this disease but from some other infection. Justify the statement.	
	SECTION - E Q.no. 31 to 33 are Long answer question	
31.	Observe the representation of genes involved in the lac operon given below:  (a) Identify the region where the repressor protein will attach normally. (b) Under certain conditions repressor is unable to attach at this site. Explain. (c) If repressor fails to attach to the said site what products will be formed by z, y, and a? (d) Analyse why this kind of regulation is called negative regulation? **OR** A. Explain the process of aminoacylation of tRNA. Mention its role in translation.	5

	B. How do ribosomes in the cells act as factories for protein synthesis? C. Given below is a strand of mRNA undergoing the process of translation, what will be the sequence of Amino acids that will be translated? Name the triplet codons that should be added to bring to the end of translation at X.  	
32.	A researcher used a vector X to insert a foreign gene to create a recombinant vector. The image of vector X is shown below.  It has sites for two restriction enzymes - SacI and EcoRI. The foreign gene can be cut using either of these two enzymes. The vector also has a green fluorescent protein (gfp) gene that can be used as a selectable marker, and two genes - chloramphenicol resistance (CmR) and neomycin resistance (NeoR) that provide antibiotic resistance. Chloramphenicol and neomycin are two different antibiotics. (a) What is/are the possible end product(s) that will be obtained post-ligation if the researcher uses the following enzyme to insert the foreign gene:	5

(i) SacI

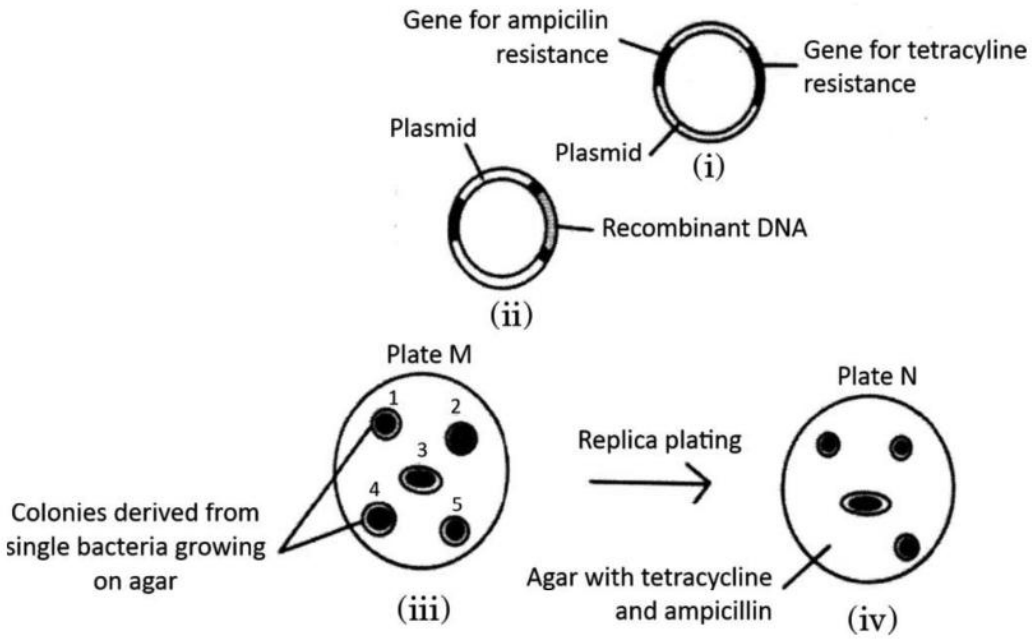
(ii) EcoRI

(b) Based on (a), which enzyme will be better to use to ensure that the foreign gene has been inserted in the vector? Why?

(c) If the well of an agarose gel is filled with a solution of the intact vector and the foreign gene, what will the DNA band closer to the well contain? Why?

OR

Study the diagram given below that shows the steps involved in the procedure of selecting transformed bacteria and answer the questions that follow :



(a) Identify the colony that has got transformed. Justify your answer.

(b) What are the sites in a plasmid called where ampicillin and tetracycline resistance genes are inserted? State their role in genetic engineering.

(c) Name two enzymes playing an important role in genetic engineering.

(d) State the role of β-galactosidase in insertional inactivation.

33. The following table contains values of the population of bacteria growing over time. 5

Time (in days)	Population ($\times 10^6$ cells/mL)
0	**0.5**
2	**0.6**
4	**1.0**
7	**3.2**
9	**5.2**

11	**5.3**
14	**5.3**

Based on the values in the table above,

(a) Construct a population growth curve.

(b) Indicate the carrying capacity in the graph.

(c) Give reason for the position of the carrying capacity.

OR

Read the scenario below and answer the questions that follow.

In the Caribbean, there are several species of Anolis lizards that live in the same habitats and feed on similar prey. However, research has shown that when two species have nearly identical body size and feeding habits, one species will out-compete the other for resources, leading to the exclusion of the other species.

(a) For the above example of competition to satisfy Gause's Competitive Exclusion Principle, name two conditions that MUST be met.

(b) State two ways by which the two species could co-exist in the same habitat.

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