Section A

Question 1.
Remnants of nucellus are persistent during seed development in
(a) pea
(b) groundnut
(c) wheat
(d) black pepper
Answer:
(d) black pepper

Question 2.
The wall layer of microsporangium which nourishes the pollen grain is
(a) epidermis
(b) endothecium
(c) middle layers
(d) tapetum
Answer:
(d) tapetum

Question 3.
A short piece of DNA, having 20 base pairs, was analysed to find the number of nucleotide bases in each of the polynucleotide strands. Some of the results are shown in the table.

	Number of nucleotide bases			
	Adenine	Cytosine	Guanine	Thymine
Strand 1	4	4		
Strand 2				

How many nucleotides containing Adenine were present in strand 2?
(a) 2
(b) 4
(c) 5
(d) 7
Answer:
(d) 7

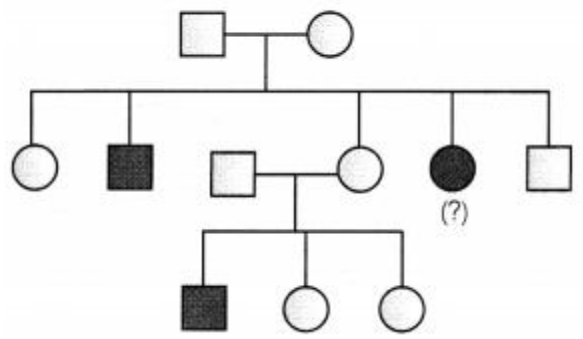
Question 4.
In a certain species of insects, some have 13 chromosomes, and the others have 14 chromosomes. The 13 and 14 chromosome bearing organisms are
(a) males and females, respectively
(b) females and males, respectively
(c) all males
(d) all females
Answer:
(a) males and females, respectively

Question 5.
At a particular locus, the frequency of allele A is 0.8 and that of allele a is 0.2. What would be the frequency of heterozygotes in a random mating population at equilibrium?
(a) 0.32
(b) 0.16
(c) 0.24
(d) 0.48
Answer:
(a) 0.32

Question 6.
Variations caused due to mutations are
(a) random and directionless
(b) random and directional
(c) random and small
(d) random, small and directional
Answer:
(a) random and directionless

Question 7.
What is the smallest part of a DNA molecule that can be changed by a point mutation?
(a) Oligonucleotide
(b) Codon
(c) Gene
(d) Nucleotide
Answer:
(d) Nucleotide

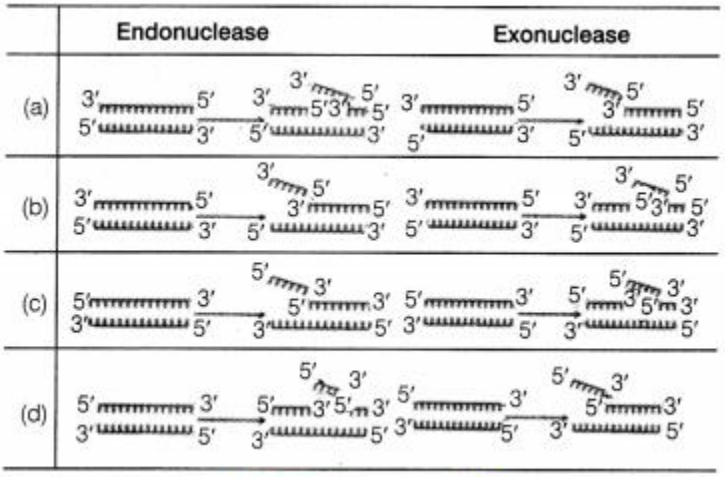
Question 8.
What should be the genotype of the indicated member?



(a) AA
(b) Aa
(c) XY
(d) aa
Answer:
(d) aa

Question 9.
A patient was advised to have a kidney transplant. To suppress the immune reaction, the doctor would administer him
(a) statins produced from Monascus purpureus
(b) statins produced from Streptococcus thermophilus
(c) cyclosporin-A produced from Trichoderma polysporum
(d) cyclosporin-A produced from Clostridium butylicum
Answer:
(c) cyclosporin-A produced from Trichoderma polysporum

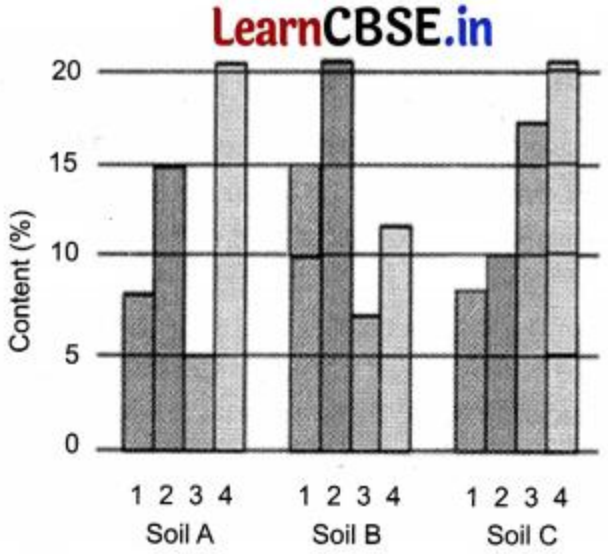
Question 10.
Identify the activity of endonuclease and exonuclease in the given image.



Answer:
(d)

Question 11.
The main objective of production of pest resistant GM crops is to
(a) encourage eco-friendly pesticides
(b) reduce pesticide accumulation in food chain
(c) eliminate pests from the field without the c use of manual labour
(d) retain maximum nutritional content in the crop that would be otherwise consumed by pest
Answer:
(b) reduce pesticide accumulation in food chain

Question 12.
Observe the contents 1,2,3 and 4 of soil samples A,B and C shown in the graph. If the temperature and soil moisture of all soil samples are identical, which soil sample(s) will show faster decomposition?



1 indicates lignin content, 2 indicates chitin, 3 indicates nitrogen content and 4 indicates sugar content.
(a) Soil sample A
(b) Soil sample B
(c) Soil samples A and B both
(d) Soil sample C
Answer:
(d) Soil sample C

Question Nos. 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

Question 13.
Assertion (A) : Primary endosperm nucleus is diploid.
Reason (R) : It is the product of double fertilisation.
Answer:
(d) A is false, but R is true. A can be corrected as Primary endosperm nucleus formed by the fusion of two polar nuclei and one male nucleus, so it is triploid (3n).

Question 14.
Assertion (A) : Ribosomal RNA is synthesised in the nucleus of the cell.
Reason (R) : It is translated with the enzyme RNA polymerase-III.
Answer:
(c) A is true, but R is false. R can be corrected as rRNA transcribed by RNA polymerase-I.

Question 15.
Assertion (A) : Smoking can raise blood pressure and increase heart rate.
Reason (R) : Nicotine stimulates adrenal glands to release adrenaline and nor-adrenaline into the blood circulation, both of which raise blood pressure and increase heart rate.
Answer:
(a) Both A and R are true and R is the correct explanation of A.

Question 16.
Assertion (A) : PCR is a powerful technique to identify genetic disorders.
Reason (R) : PCR can detect mutations in low amounts of DNA.
Answer:
(a) Both A and R are true and R is the correct explanation of A.

Section B

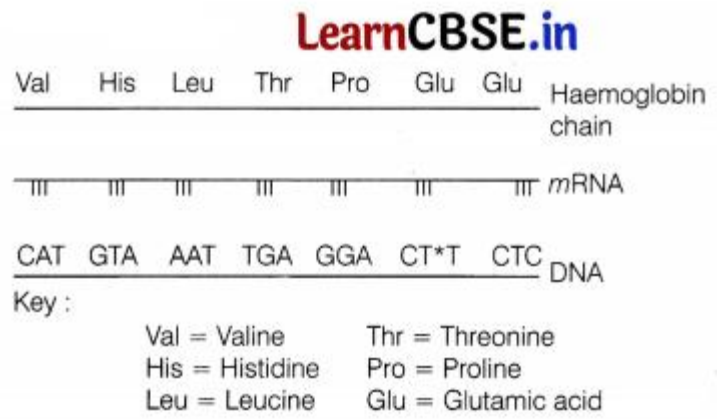
Question 17.
Explain the process of hormonal regulation of spermatogenesis.
Answer:
Spermatogenesis starts at the age of puberty due to significant increase in the secretion of Gonadotropin Releasing Hormone (GnRH). This is a hypothalamic hormone.

The increased levels of GnRH then act at the anterior pituitary gland and stimulate secretion of two gonadotropins – Luteinising Hormone (LH) and Follicle Stimulating Hormone (FSH).

LH acts at the Leydig cells and stimulates synthesis and secretion of androgens. Androgens, inturn, stimulate the process of spermatogenesis.

FSH acts on the Sertoli cells and stimulates secretion of some factors which help in the process of spermiogenesis.

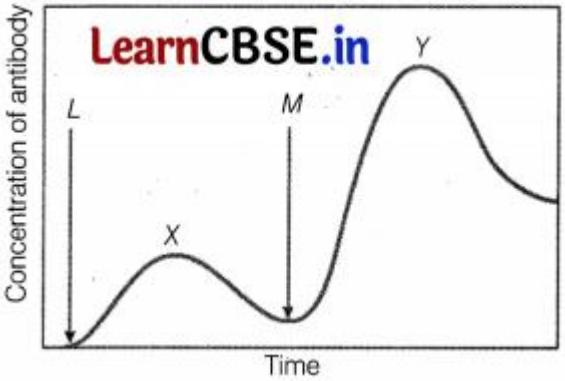
Question 18.
The diagram below shows the sequence of amino acids in part of a haemoglobin molecule.



(a) If the base T* was substituted with A, how would it affect the haemoglobin chain?
(b) Name the condition and the effects associated with the above substitution.
Answer:
(a) CTT would become CAT which codes for valine. Thus, valine would replace glutamic acid at that point.

(b) Sickle-cell anaemia, the mutant haemoglobin molecule undergoes polymerisation leading to the change in the shape of the RBC from biconcave disc to elongated sickle like structure. The structure drops the oxygen level of the blood. Such cell do not transport oxygen efficiently.

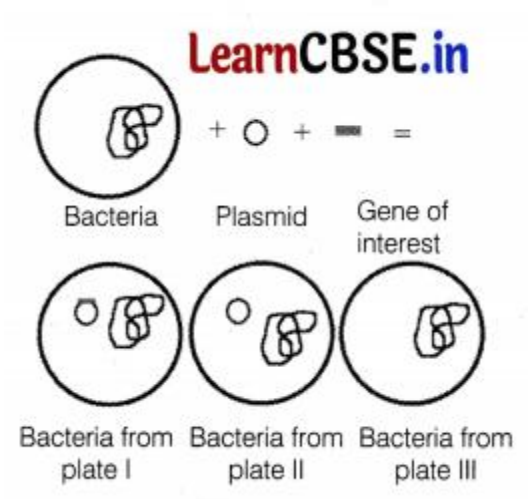
Question 19.
The graph given below indicates the administration of the first (L) and second dose (M) of a vaccine. The corresponding response of the body is indicated by X and Y. Interpret the graph and explain the reason for such a response shown by the body.



Answer:
On administration of the first dose of the vaccine (L), the body shows a response of low intensity (X) as the immune system comes in contact with the antigenic protein of the weakened/inactivated pathogen for the first time. This is called primary immune response.

On subsequent encounter with the same antigenic protein in the second dose (M), the body elicits a highly intensified secondary response (Y). Because of the memory of the first contact with the antigen, the secondary immune response is faster and stronger, leading to more effective pathogen elimination in comparison to the primary immune response.

Question 20.
The image below shows the result of plating bacteria in chromogenic medium after incorporating the gene of interest in plasmid. Some plates had blue colonies; some plates had white colonies. A single bacterium extracted from plate I, II, III is shown below.



On the basis of your observations
(a) Identify the plate(s) which is/are white. Give a reason.
(b) Identify the plate(s) which is/are blue. Give a reason.
Answer:
(a) Plate I β-galactosidase enzyme is responsible for blue colour. Gene is inserted in the β-galactosidase site of the plasmid thereby causing insertional inactivation of the enzyme, so no blue colour is made.

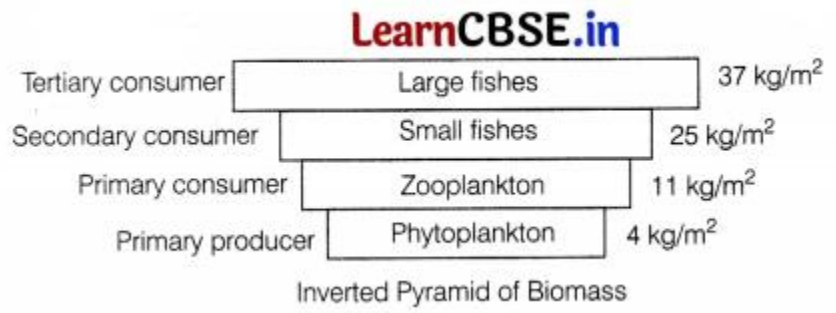
(b) Plate II Gene of interest not inserted in the plasmid. So, blue colour of colonies will appear.
Plate III No plasmid

Question 21.
Biomass of a standing crop of phytoplankton is 4 kg/m^2 which supports a large standing crop of zooplankton having a biomass 11 kg/m^2. This is consumed by small fishes having biomass 25 kg/m^2 which are then consumed by large fishes with the biomass 37 kg/m^2 . Draw an ecological pyramid indicating the biomass at each stage and also name the trophic levels. Mention whether it is an upright or inverted pyramid.
Or
Use the information provided in the table given below to answer the following questions.

Trophic Level	Net Production ($KJm^{-2}y^{-1}$)	Respiration ($KJm^{-2}y^{-1}$)
Top carnivore	50	35

Carnivores	420	378
Herbivores	4490	4041
Producers	45000	40,367

(a) Calculate the gross primary productivity.
(b) Analyse the trend in the net production from producers to top carnivore. Give a reason for your observation.
Answer:

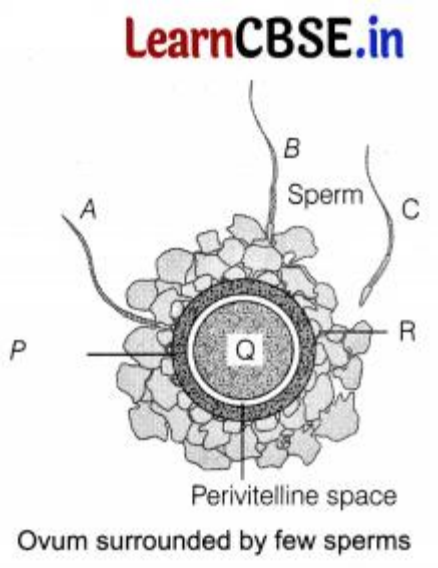


Or
(a) The GPP is the total amount of carbon compounds produced by photosynthesis of plants in an ecosystem in a given period of time.
GPP = NPP + R
∴ GPP = 45,000 + 40,367
= 85367 $kgm^{-2}y^{-1}$

(b) Net production is gradually reducing as we move from producers to consumers due to heat loss/respiration/10% law.

Section C

Question 22.
The figure given below shows 3 sperms A, B and C.
(a) Which one of the three sperms will gain entry into the ovum?
(b) Describe the associated changes induced by it on P and Q.



Ovum surrounded by few sperms

Answer:
(a) Sperm A

(b) In the figure given, Sperm A has come in contact with the zona pellucida layer (P) of the ovum (Q), it will induce changes in the membrane that will block the entry of additional sperms (B and C). Thus, it ensures that only one sperm can fertilise the ovum.

- The secretions of the acrosome of sperm A will help it to enter into the cytoplasm of the ovum (Q) through the zona pellucida (P) and the plasma membrane, this will induce the completion of the meiotic division of the secondary oocyte (Q).
- The second meiotic division in Q being unequal will result in the formation of a second polar body and a haploid ovum. Then, the haploid nucleus of the sperm A and that of the ovum (Q) will fuse together to form a diploid zygote.

Question 23.
Explain the phases in embryonic development from the morula stage till the establishment of pregnancy in a human female.
Answer:
The development of embryo from fertilised ovum involves the following events
(i) Cleavage : The mitotic division starts as the zygote (fertilised ovum) gradually moves through the isthmus of the oviduct towards the uterus. This event results in the formation of 2, 4, 8, 16 daughter cells called blastomeres. This process is called cleavage.

Since, the blastomeres divide completely in humans, the cleavage process is called holoblastic. The embryo with 8-16 blastomeres is called a morula. But, it is not larger than a zygote.

(ii) Blastulatlon : The morula continues to divide and transforms into blastocyst, as it moves further into the uterus. This process of transformation is called blastulation.
The blastomeres in the blastocyst are arranged into an outer layer (trophoblast) and the inner group of cells (inner cell mass).

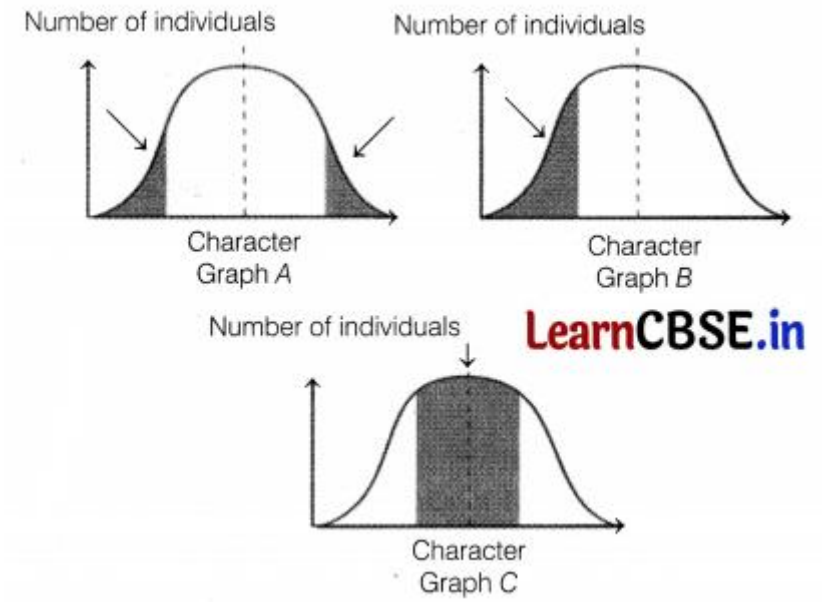
(iii) Implantation : The trophoblast layer then gets attached to the endometrium and the inner cell mass differentiates into the embryo. After attachment, the uterine cells divide rapidly and covers the blastocyst.
As a result, the blastocyst becomes embedded in – the endometrium of the uterus. This is called implantation and it leads to pregnancy (i.e. the time from conception to birth).

Question 24.
A pregnant human female was advised to undergo MTP. It was diagnosed that the foetus she was carrying had developed from a zygote having 45 chromosomes with only one X-chromosome.
(a) What is this condition called and how does it arise?
(b) Why was she advised to undergo MTP?
Answer:
(a) The embryo has Turner's syndrome due to aneuploidy of the sex chromosome. Such a disorder is caused due to the absence of one of the X- chromosomes, i.e. 45 with XO.

(b) She was advised MTP as the child will have the following problems

- rudimentary ovaries
- poorly developed breasts
- lack of other secondary sexual characters
- delayed or no onset of the menstrual cycle and infertile. (Any two)

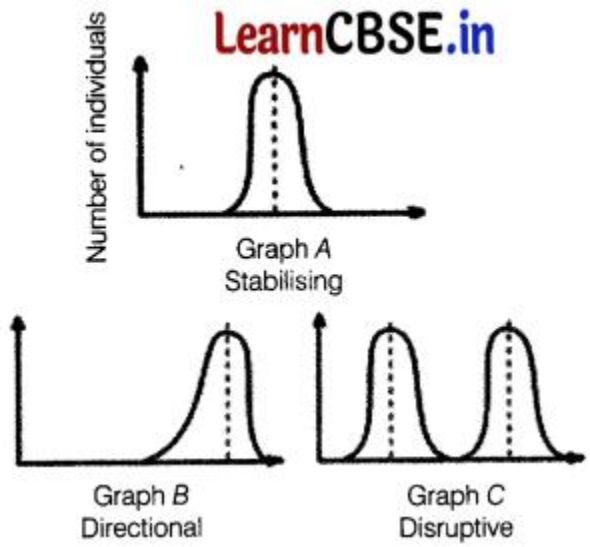
Question 25.
The graphs below show three types of natural selection. The shaded areas marked with arrows show the individuals in the population which are not selected. The dotted vertical lines show the statistical means.



(a) What names are given to the types of selection shown in graphs A, B and C?
(b) After the selection has operated for several generations in the above populations indicated as graph A, B and C, graphically illustrate the probable results.

Answer:
(a) A-stabilising; B-directional; C-disruptive;

(b) Graph A – Stabilising
Graph B – Directional
Graph C – Disruptive



- Stabilising selection meaning a non-extreme trait is favoured instead of one of the two extremetraits.
- Directional selection mean that an extreme phenotype (character or traits) is favoured over other phenotypes and this causes the allele frequency to shify over time in favour of the extreme phenotype.
- Disruptive selection favours both extreme traits in a population.

Question 26.
The aeration tank of a sewage treatment plant is not functioning properly. Explain in detail the impact of this on the treatment of sewage and BOD of the effluent.
Answer:

- It will adversely affect the secondary treatment or biological treatment of sewage.
- When the aeration tank is not functional, the air will not be pumped into it.
- This will not allow the vigorous growth of useful aerobic microbes into floes (masses of bacteria associated with fungal filaments to form mesh-like structures).
- Thus, the major part of the organic matter in the effluent will not be consumed by these bacteria.
- The BOD (Biochemical Oxygen Demand) of the effluent will not be reduced. BOD refers to the amount of the oxygen that would be consumed if all the organic matter in one litre of water were oxidised by bacteria.

- The greater the BOD of wastewater, more is its polluting potential. Thus, the effluent will remain polluted with high amount of organic matter and high BOD.

Question 27.
A farmer grew 2 varieties of corn crop in fields A and B. He grew normal corn crops in field A and GM corn crops in fields. He observed corn borers attacked only in field A. To control it, spores of Bt were sprayed in field A.
(a) Name the gene in the spores responsible for the control of this pest.
(b) What effect will the spores of Bt have on the insect pest?
(c) How has field B developed resistance against this pest?
Or
Lipoprotein Lipase Deficiency (LPLD) is a igenetic disorder in which a person has a defective gene for lipase. This leads to high triglycerides, stomach pain, fat deposits under the skin. It may eventually affect the liver, pancreas and may also cause diabetes. The disorder occurs if a child acquires defective genes from both parents (autosomal recessive). ERT (Enzyme Replacement Treatment) is one of the treatments offered to patients with LPLD.
(a) (i) What procedure is followed in ERT?
(ii) What could be one possible drawback of ERT?
(b) How can LPLD be treated using biotechnology? Elaborate.
Answer:
(a) cry I Ab

(b) The spores of Bt contain crystalline toxin which is inactive; for this crystalline toxin protein to become active it needs alkaline pH, which is present in insect gut. The gut lining is broken down/midgut epithelial cells become porous/swollen/cell lysis.

(c) The Bf-toxin gene is cloned and inserted into the plant genome by recombinant DNA technology. These Genetically Modified (GM) plants express the Bf-toxin genes and become pest-resistant in field B.
Or
(a) (i) Functional enzyme lipase is given to the patient by injection.
(ii) This procedure is not completely curative.

(b)

- The disease can be treated by using gene therapy.
- Gene therapy is a collection of methods that allows 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. Correction of a genetic defect involves delivery of a normal gene into the individual or embryo to take over the function of and compensate for the non-functional gene.

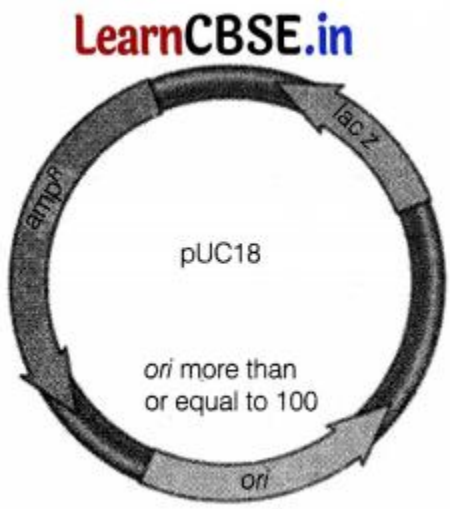
Question 28.
Give three reasons as to why the prokaryotes are not given any figures for their diversity by the ecologists.
Answer:
Prokaryotic organisms diversity is not given any figures by ecologist because of following reasons

- Classification and identification of vast diversity of microbes is very difficult and cannot be efficiently done with use of currently available methods.
- For many microorganisms, it is difficult to culture them under laboratory condition.
- According to current biochemical and molecular techniques, it is estimated that microbes diversity can range in billions with microbes inhabiting diverse habitat on earth, with enormous diversity present in air, water and soil. Hence, more advanced molecular and biochemical techniques are needed to classify and identify this enormous diversity of microbes.

Section D

Q. Nos. 29 and 30 are case-based questions. Each question has 3 subparts with internal choice in one subpart.

Question 29.
The structure below shows pUC18 which is similar to pBR322 in its function. However, they differ in some of their restriction sites and number of ori. The ori number for pBR322 is approximately 20.



(a) How are pUC18 and pBR322 used in biotechnological studies?
Or
What will be the impact if ori in the above structure gets damaged?
(b) The lac z gene has many recognition sites. Study the segment of DNA given below and answer the questions
5'… ATC GTA AAG CTT CAT…3'
3'… TAG CAT TTC GAA GTA…5'
(i) Applying your knowledge of palindrome sequences identify and mark the possible region where the restriction enzyme X will act.
(ii) Restriction enzyme Y was used to extract gene of interest from a plant. This gene needs to be inserted in the given DNA segment which has been treated with restriction enzyme X. Will there be a successful recombination? Explain with a reason.
(c) Which one of the two (pUC18 and pBR322) would you prefer for biotechnological studies? Justify.
Answer:
(a) Plasmids which can be used to insert the gene of interest from a desired organism into a

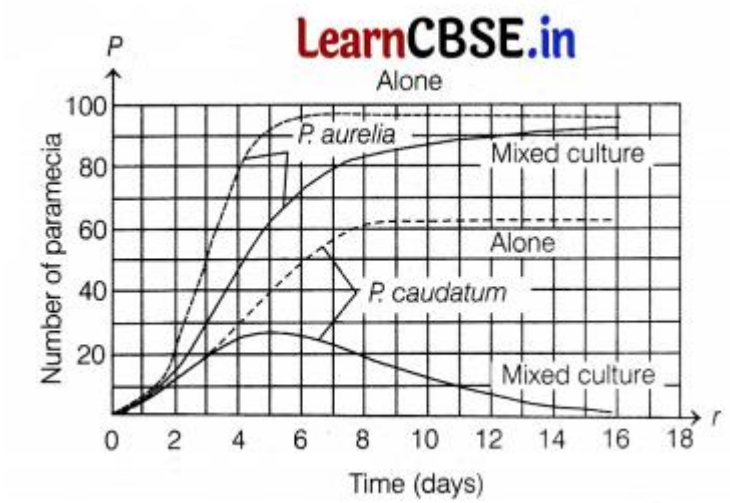
host/ they act as vectors to transfer gene of interest into the host.
Or
ori (Origin of replication) – No replication will take – place resulting in no copies of linked DNA.

(b) (i) 5'… ATC GTA/AAG CTT /CAT.. .3'
3'… TAG CAT/TTC GAA /GTA.. .5'
Or
5'… AAG CTT …3'
3'…TTCGAA…5"

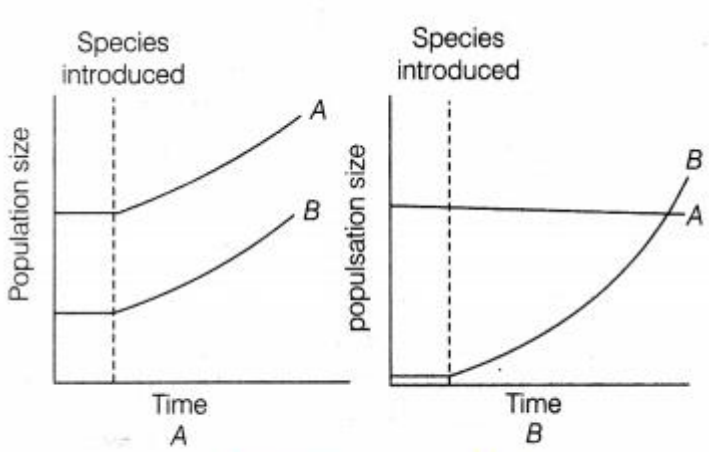
(ii) No, as the restriction enzymes need to be the same which cut the DNA of the plasmid and the gene of interest from the plant.

(c) pUC18 as it has a higher copyrate.

Question 30.
Observe the graph given below.
The graph represents inter-specific interaction between two species of paramecia competing for the same resource in a culture medium. Paramecium caudatum and Paramecium aurelia were grown in separate cultures as well as in mixed cultures. It was found that each species grew in numbers according to the logistic equation.



(a) Which species is competitively superior? Support it with the data provided in the graph.
(b) State the underlying principle for the above result and name the scientist associated with this principle.
(c) Explain the mechanism in which two or more species competing with each other can coexist.
Or
Graphs A and B shown below depict interaction of two species. Which graph indicates mutualism? Give reason.



Answer:
(a) P. aurelia species is competitively superior P. aurelia grows in numbers more quickly than P. caudatum and shows more individuals in the same volume of culture/100 Paramecium aurelia in 6 days whereas 60 P. caudatum in 8 days.

(b) Competitive exclusion principle' which states that two closely related species competing for the same resources cannot coexist indefinitely and the competitively inferior one will be eliminated. G.F. Gause is associated with it.

(c) One such mechanism is 'resource partitioning'. If two species compete for the same resource, they could avoid competition by choosing different times for feeding or different foraging patterns, to avoid competition and coexist due to behavioural differences in their foraging activities.
Or
Graph A indicates mutualism. As both species grow simultaneously.

Section E

Question 31.
Placed below are case studies of some couples who were not able to have kids. These couples are not ready for adoption or taking gametes from donors. After thoroughly examining the cases, which assisted reproductive technology will you suggest to these couples as a medical expert? Explain briefly with justification of each case.

Couples	Test Reports of Female Partner	Test Reports of Male Partner

Couple 1	Normal reports	Normal sperms in testes, missing connection in epididymis and vas deferens
Couple 2	Blockage in the Fallopian tube	Normal reports
Couple 3	Normal reports	Poor semen parameters in terms of count, motility and morphology
Couple 4	Low ovarian reserve	Normal reports
Couple 5	Sterilisation in male	Morphologically abnormal sperms

Or

Given below are certain situations. Analyse the situation and suggest the name of suitable contraceptive device along with mode of action.

Situation	Requirement of Contraceptive for	Name of Contraceptive Device	Mode of Action
1	Blocking the entry of sperms through cervix		
2	Spacing between children		

3	Effective emergency contraceptive		
4	Terminal method to prevent any more pregnancy in female		
5	Sterilisation in male		

Answer:
Couple 1 Normal reports of female, normal sperms in testes, missing connection in epididymis and vas deferens in male.

Assisted Reproductive Technology
Semen will be devoid of sperms in this case. So, In Vitro Fertilisation (IVF) by collecting the sperms from epididymis, followed by ZIFT or IUT (Test tube baby) is suggested. ZIFT is transfer of zygote or early embryo upto 8 blastomeres in Fallopian tube and IUT refers to transfer of embryos with more than 8 blastomeres in uterus.

Couple 2 Blockage in the Fallopian tube in the female, normal reports of male.

Assisted Reproductive Technology Blockage of Fallopian tube will not allow transfer of sperms to the site of fertilisation. In Vitro Fertilization (IVF) followed by IUT (Test tube baby). It would involve transfer of embryo with more than 8 blastomeres in uterus.

Couple 3 Normal reports of female, poor semen parameters in terms of count, motility and morphology in male partner.

Assisted Reproductive Technology Intracytoplasmic Sperm Injection (ICSI) in which sperm is directly injected into the ovum. Artificial insemination procedure is used mainly when sperms have poor characteristic or low sperm count.

Couple 4 Low ovarian reserve in female, normal reports in male.

Assisted Reproductive Technology
In Vitro Fertilisation (IVF) by selection of normal blastocysts from ovary followed by Zygote Intra-Fallopian Transfer (ZIFT) involving transfer of zygote or early embryos upto 8 blastomeres or transfer of embryo with more than 8 blastomeres in the uterus (by IUT).

Couple 5 Poor ovarian reserve in female, morphologically abnormal sperms in male partner.

Assisted Reproductive Technology ICSI Intra Cytoplasmic Sperm Injection in which selected normal sperms will be injected into the selected blastocyst. Intra Cytoplasmic Sperm Injection (ICSI) procedure is used mainly when sperms have poor characteristic or low sperm count.
Or

Situation	Requirement of Contraceptive for	Name of Contraceptive Device	Mode of Action
1.	Blocking the entry of sperms through cervix	Diaphragms/cervical caps/ vaults	Cover the cervix during coitus.
2.	Spacing between children	Cu or hormone releasing IUDs such as Cu T/Cu7/ Multiload 375/Progestasert/ LNG 20	Cu ions from Cu containing IUDs increase phagocytosis of sperms within uterus, suppress sperm motility and fertilising capacity/ hormone releasing IUDs make uterus unsuitable for implantation.
3.	Effective emergency contraceptive	Pills containing progestogens or progestogenoestrogen combination or IUDs within 72 hours of coitus.	Pills inhibit ovulation and implantation as well as alter the quality of cervical mucus to prevent the entry of sperms/IUDs – Cu ions increase phagocytosis of sperms within uterus, suppoess sperm rnotihty

			and fertilising capacity/hormone releasing IIJDs make uterus unsuitable for implantation.
4.	Terminal method to prevent any more pregnancy in female	Tubectomy	Block gamete transport and prevent conception.
5.	Sterilisation in male	Vasectomy	Blocks sperm transport.

Question 32.
Given below is a stretch of DNA showing the coding strand of a structural gene of a transcription unit?
5-ATG ACC GTA TTT TCT GTA GTG CCC GTA CTT CAG GCA TAA—3'
(a) Write the corresponding template strand and the raRNA strand that will be transcribed, along with its polarity.
(b) If GUA of the transcribed mRNA is an intron, depict the sequence involved in the formation of mRNA /the mature processed hnRNA strand.
(i) In a bacterium
(ii) In humans
(c) Upon translation, how many amino acids will the resulting polypeptide have? Justify.
Or
In shorthorn cattle, the coat colours red or wh,ite are controlled by a single pair of alldles. A calf which receives the allele for red coat from its mother and the allele for white coat from its father is called a 'roan'.
It has an equal number of red and white hairs in its coat.
(a) Is this an example of codominance or of incomplete dominance?
(b) Give a reason for your answer.
(c) With the help of genetic cross explain what will be the consequent phenotype of the calf when
(i) red is dominant over white
(ii) red is incompletely dominant.
Answer:
5'—ATG ACC GTA ITT TCT GTA GTG CCC GTA CTT CAG GCATAA—3'= Coding
(a) 3 —TAC TGG CAT AAA AGA CAT CAC GGG CAT GAA GTC CGT ATT—5'= Template
mRNA 5'—AUG ACC GUA UUU UCU GUA GUG CCC GUA CUU CAG GCA UAA—3'

(b) (i) In a bacterium
5'—AUG ACC GUA UUU UCU GUA GUG CCC GUA CUU CAG GCA UAA—3' [1]

(ii) In humans
5'—mGpppAUG ACC UUU UCU GUG CCC CUU CAG GCA UAA- Poly A tail—3' [1]

(c) 9 amino acids in the polypeptide because UAA is stop/terminator codon and does not code for any amino acid.
Or
(a) Codominance

(b) Codominance is a condition in which two different
alleles for a genetic trait are expressed. Individuals receive one version of a gene, called an allele, from each parent.

(c) (i) If pure breeding red coated cattles are represented as 'RFT and pure breeding white coated as 'rr'. If red is dominant over white. A cross between 'RR' and 'rr' would produce red coated cattles (RR) and white coated cattle (rr) in the ratio of 3 : 1

Parents : RR (Red) × rr (White)
Gametes R r

	R	r
R	RR (Red coat)	Rr (Red coat)
r	Rr (Red coat)	rr (White coat)

F_1-generation-3 :1

(ii) If the red and white coated cattles produce pink colour on a cross then, they exhibit incomplete dominance in the inheritance of coat colour due to which they produce pink coloured coat upon hybridisation.

If pure breeding red coated cattles are represented as 'RR' and pure breeding white coated as 'rr', then the pink coated cattles are 'Rr'.

A cross between 'RR' and 'rr' would produce pink coated cattles (Rr) and white coated cattle (rr) in the ratio of 1 : 2 : 1

Parents : RR (Red) × rr (White)
Gametes R - W

	R	r
R	RR (Red coat)	Rr (Pink coat)
r	Rr (Pink coat)	rr (White coat)

F_1-generation 1 : 2 : 1

Question 33.
Explain the role of primary and secondary Lymphoid organs with the help of suitable examples.
Or
With the help of a flowchart illustrate how an infected animal cell can survive while viruses are being replicated or released.
Answer:
Lymphoid organs These are the organs where lymphocytes originate, proliferate and get matured. They can be categorised as

1. Primary Lymphoid Organs
In primary lymphoid organs, immature lymphocytes differentiate to mature antigen sensitive lymphocytes. After maturation, lymphocytes migrate to secondary lymphoid organs.

The two primary lymphoid organs are as follows
(i) Bone Marrow It is the main lymphoid organ where all the blood cells including lymphocytes are produced. It is the major site of B-lymphocytes development and maturation.

(ii) Thymus It is a lobed organ, located near the heart and beneath the breast bone. It is large at the time of birth, but with age, the size keeps on reducing and becomes very small on attaining puberty. Growth and maturation of T-lymphocytes takes place here.

Both bone marrow and thymus provide micro-environments for the development and maturation of T-lymphocytes.

Bursa of fabricus is the primary lymphoid organ in birds that is considered equivalent to mammal's bone marrow.

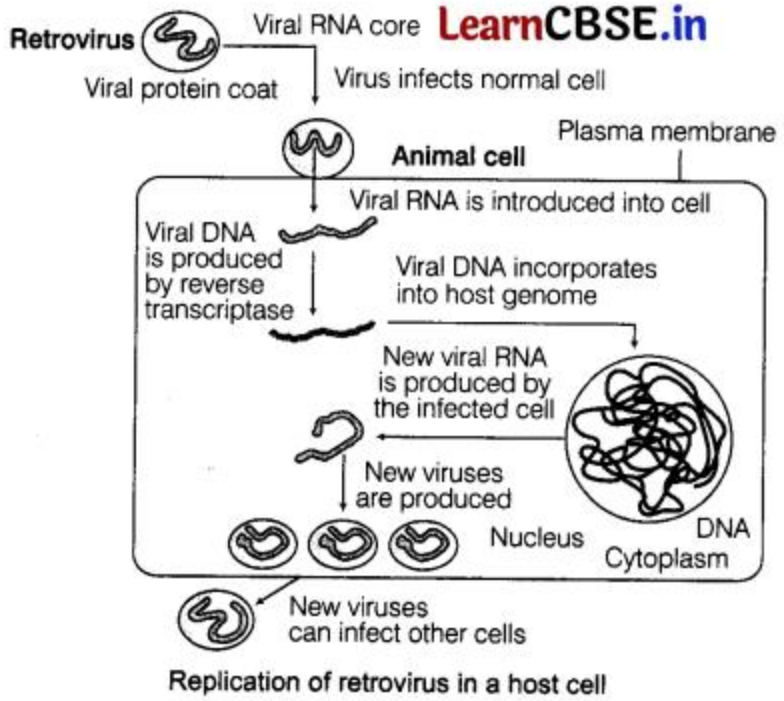
2. Secondary Lymphoid Organs
These organs provide the sites for the interaction of lymphocytes with the antigen, which then proliferate to become effector cells.

The secondary lymphoid organs are as follows
1. Spleen It is a large bean-shaped organ containing lymphocytes, phagocytes and large number of erythrocytes. It filtres the blood by trapping blood-borne microorganisms.

2. Lymph Nodes These are small solid structures located at different points along the lymphatic system. Their function is to trap the microorganisms or other antigens that enter the lymph and tissue fluid. The trapped antigens in the lymph nodes are responsible for the activation of lymphocytes present there and cause the immune response.

Peyer's patches of small intestine, tonsils and appendix are also considered as secondary lymphoid organs.

3. Mucosal Associated Lymphoid Tissue (MALT) It is
located within the lining of major tracts in the body like respiratory, digestive, urogenital tracts. MALT constitutes about 50% of the lymphoid tissue in human body.
Or
In the figure given below infected cell can survive while viruses are being replicated and released.



Replication of retrovirus in a host cell