

SECTION – A

(Q. Nos. 1 - 5 are of one mark each)

1. Biotechnological techniques can help to diagnose the pathogen much before the symptoms of the disease appear in the patient. Suggest any two such techniques.

Ans. PCR / ELISA / Autoradiography / Recombinant DNA technology (*Any two*) = $\frac{1}{2} + \frac{1}{2}$

[1 mark]

OR

Mention the form in which inactive protein toxin is produced by *Bacillus thuringiensis*. How does it get activated in the pest body to kill it ?

Ans. Present in the form of inactive *protoxins* crystals, the alkaline pH of the gut which solubilises the crystals = $\frac{1}{2} + \frac{1}{2}$

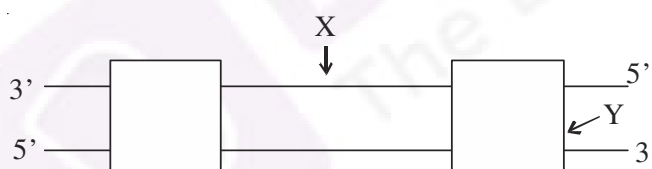
[1 mark]

2. 'Swiss cheese' is characterised by the presence of large holes. Name the bacterium responsible for it.

Ans. *Propionibacterium sharmanii*

[1 mark]

3. What do 'X' and 'Y' represent in the transcription unit of the DNA molecule shown ?



Ans. X-Template Strand, Y- Terminator = $\frac{1}{2} + \frac{1}{2}$

[1 mark]

4. Name the disorder in humans with the following karyotype :

(a) 22 pairs of autosomes + XO

(b) 22 pairs of autosomes + 21st chromosome + XY

Ans. (a) Turner's Syndrome = $\frac{1}{2}$

(b) Down's Syndrome = $\frac{1}{2}$

[1 mark]

5. The diploid number of chromosomes in an angiospermic plant is 16. What will be the number of chromosomes in its endosperm and antipodal cells ?

Ans. Endosperm - 24 chromosomes , Antipodals - 8 chromosomes = $\frac{1}{2} + \frac{1}{2}$

[1 mark]

OR

State the reason why pollen grains lose their viability when the tapetum in the anther is malfunctioning.

Ans. Lack of nourishment for the developing pollen grain due to malfunctional tapetum = 1

[1 mark]

SECTION B

(Q. Nos. 6 - 12 are of two marks each)

6. Differentiate between spermiogenesis and spermiation.

Ans. Spermiogenesis - The spermatids are transformed into spermatozoa (sperms) = 1

Spermiation - Release of sperms from the sertoli cells in the seminiferous tubules = 1

[2 marks]

7. You are given a tall pea plant and asked to find its genotype. How would you find its genotype ? Explain.

Ans. By Test cross , the given plant is crossed with another homozygous recessive (dwarf) plant , If the individuals of progeny are all tall then the given plant is homozygous i.e with genotype TT , but 50% individuals Tall and 50% dwarf progeny confirms that the given plant is heterozygous (Tt) = $\frac{1}{2} \times 4$

[2 marks]

8. Scientists tried to develop a single plant exhibiting the characteristic of tomato and potato by using cells from tomato and potato plants respectively. Name the procedure and list the steps to achieve this.

Ans. Somatic hybridisation = 1

Isolation of protoplast of Tomato cell and Potato cell having desirable character , fused to get hybrid protoplast which further grown to form a new plant = $\frac{1}{2} + \frac{1}{2}$

[2 marks]

9. (a) How will you measure population density of fish in a lake ?
- (b) In a pond there are 100 frogs. 20 more were born in a year. Calculate the birth rate of this population.

Ans. a) Number of fish caught per trap = 1

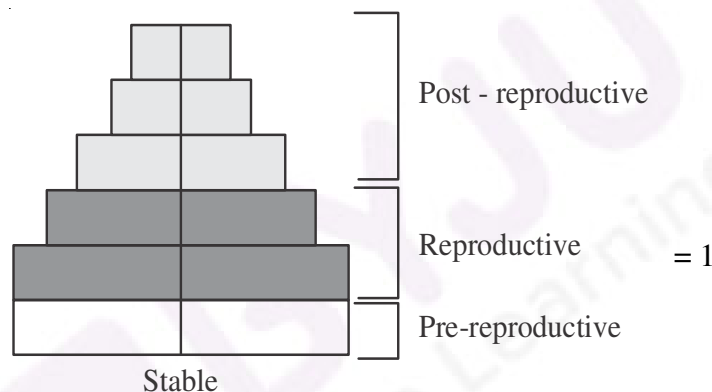
b) Birth rate = $\frac{20}{100} = 0.2$, frogs per year = $\frac{1}{2} + \frac{1}{2}$

[2 marks]

OR

Draw a “stable” human age pyramid. Comment on the population growth rate that is depicted by it.

Ans.



($\frac{1}{2}$ mark deducted for any mistake)

- Pre-reproductive and reproductive population is same (constant) = $\frac{1}{2}$
- Post-reproductive population declines = $\frac{1}{2}$

[2 marks]

10. MOET is a programme for herd improvement. Write the steps in correct sequence that are carried in the programme.

- Cow is administered hormones with FSH like activity = $\frac{1}{2}$
- Induces follicular maturation and superovulation (produce 6-8 eggs per cycle) = $\frac{1}{2}$
- Either mated with elite bull or artificially inseminated, the fertilized eggs at 8-32 cell stages are recovered non- surgically and transferred to surrogate mothers = $\frac{1}{2} + \frac{1}{2}$

[2 marks]

OR

Why is tobacco smoking associated with rise in blood pressure and emphysema ? Explain.

Nicotine in tobacco stimulates adrenal glands to release adrenaline and nor-adrenaline in the blood circulation raising blood pressure and cause emphysema

[2 marks]

11. What is cryopreservation ? Mention how it is used in conservation of biodiversity.

- Ans. - It is a technique to preserve gametes for long period in viable and fertile condition at very low temperature / - 196°C in liquid Nitrogen = 1
- Preserving gametes of threatened species = 1

[2 marks]

12. How did David Tillman show that “stability of a community depends on its species richness”? Explain.

- Ans. David Tilman (long term ecosystem experiment using outdoor plots) found that presence of more species showed less year-to-year variation in total biomass, and increased diversity contributed to higher productivity = 1 + 1

[2 marks]

SECTION C

(Q. Nos. 13 - 24 are of three marks each)

- 13. (a) A patient had suffered myocardial infarction and clots were found in his blood vessels. Name a ‘clot buster’ that can be used to dissolve the clots and the micro-organism from which it is obtained.**
- (b) A woman had just undergone a kidney transplant. A bioactive molecular drug is administered to oppose kidney rejection by the body. What is the bioactive molecule ? Name the microbe from which this is extracted.**
- (c) What do doctors prescribe to lower the blood cholesterol level in patients with high blood cholesterol ? Name the source organism from which this drug can be obtained.**

- Ans. a) Streptokinase, *Streptococcus* = $\frac{1}{2} + \frac{1}{2}$
- b) Cyclosporin A, *Trichoderma polysporum* = $\frac{1}{2} + \frac{1}{2}$
- c) Statins, *Monascus purpureus* = $\frac{1}{2} + \frac{1}{2}$

[3 marks]

14. Give reasons for the following :

- (a) Antibody mediated immunity is called humoral immunity.
- (b) How is a child protected from a disease for which he/she is vaccinated ?
- (c) Name the type of cells the AIDS virus enters after getting into the human body.

- Ans. a) as antibodies are found in the blood the response is called humoral immunity =1
- b) host is exposed deliberately to antigen in attenuated or dead form or proteins and antibodies are produced in the host body providing active immunity =1
- c) macrophages =1

[3 marks]

OR

(a) Identify the nos. (i) to (iv) in the following table :

	Name of Disease	Causative Organism	Symptoms
w	Pneumonia	<i>Streptococcus</i>	(i)
X	Typhoid	(ii)	High fever, weakness, headache, stomach pain
y	(iii)	Rhinoviruses	Nasal congestion and discharge, sore throat, cough, headache
	Ascariasis	<i>Ascaris</i>	(iv)

(b) Which ones of the above mentioned diseases are transmitted through mechanical carriers ?

- Ans. a) i) fever, chill, cough and headache
- ii) *Salmonella typhi*
- iii) Common cold
- iv) internal bleeding/ muscular pain/ fever/ anemia / blockage of intestinal passage = $\frac{1}{2} \times 4$
- b) all = 1

[3 marks]

15. Charles Darwin during his famous sea voyage around the world in a ship (HMS Beagle), concluded that there has been gradual evolution of life. Answer the following questions :

(a) What is his theory known as ? Explain the salient features of his theory.

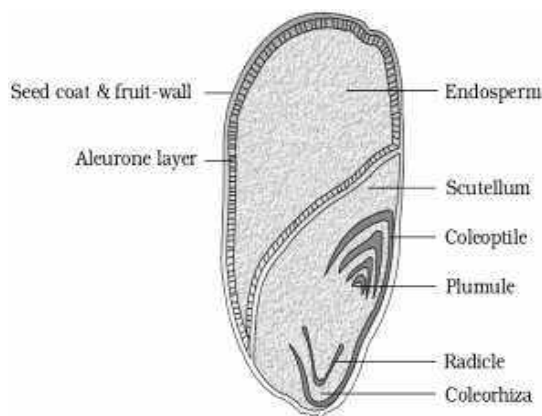
(b) Name a scientist who arrived at a similar conclusion as that of Charles Darwin.

- Ans. (a) - Theory of Natural Selection = $\frac{1}{2}$
- Any population has built in variation, those characteristics which enables some to survive better (in natural condition) will outbreed others that are less endowed to survive / better adapted individuals will survive, those individuals would leave more progeny / reproductively fit individuals, they will survive more and hence selected by nature = $\frac{1}{2} \times 4$
- (b) Alfred Wallace (a Naturalist) = $\frac{1}{2}$

[3 marks]

16. Draw a diagram of LS of Maize grain and label its any six parts.

Ans.



(Any six) = $\frac{1}{2} \times 6$

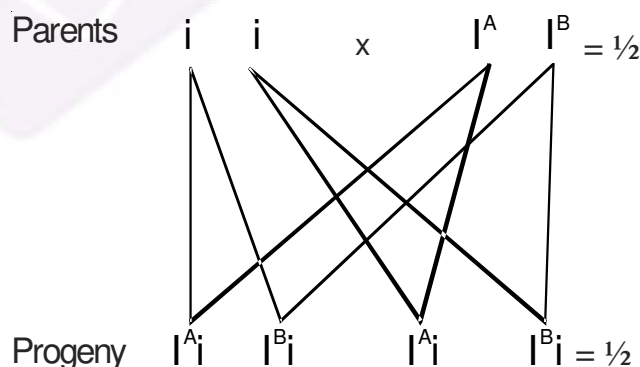
[3 marks]

17. A woman with 'O blood group' marries a man with 'AB blood group'.

Work out the cross to show all the possible phenotypes and genotypes of the progeny with respect to blood groups. Explain the pattern of inheritance observed in this cross.

Ans. Co-dominance,

When I^A and I^B are present together, they both express their own type of sugars on RBC = $\frac{1}{2} + \frac{1}{2}$



Phenotype 50% with A and 50% with B blood group = $\frac{1}{2}$

Genotype of blood group A = $I^A i$ and that of blood group B = $I^B i$ = $\frac{1}{2}$

[3 marks]

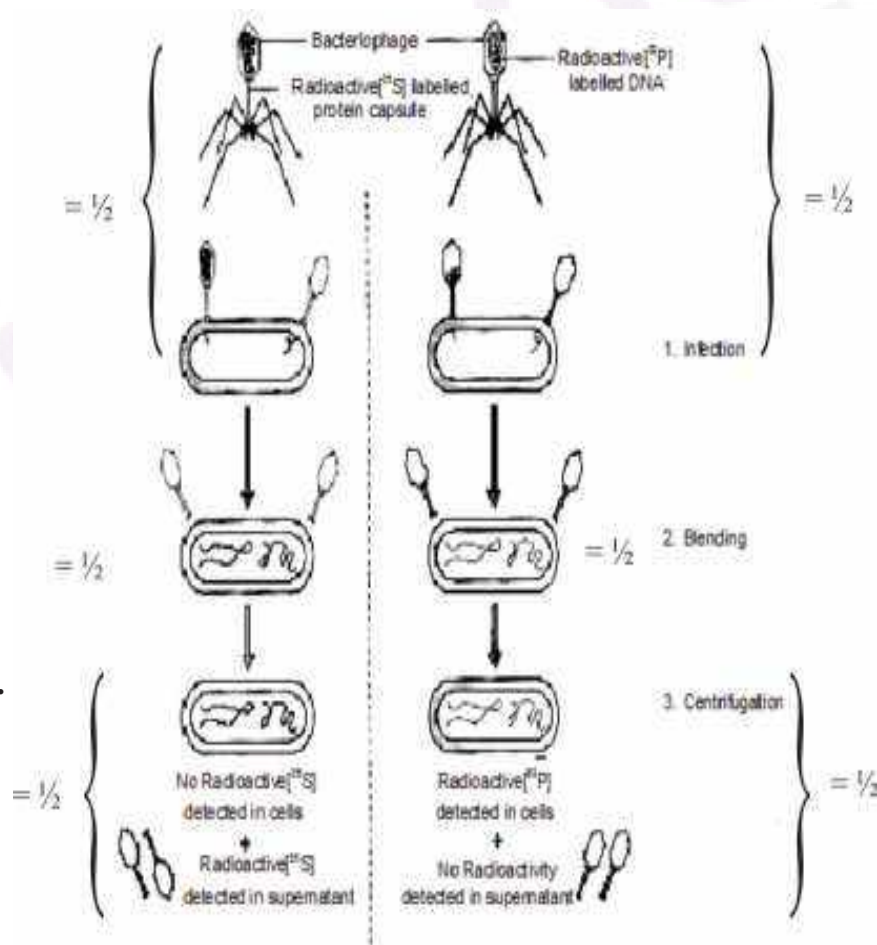
18. Hershey and Chase carried out their experiment under three steps :

(a) **Infection, (b) Blending, and (c) Centrifugation.** Explain each one of these steps that helped them to prove that DNA is the hereditary material.

- Ans. • Infection - Bacteriophage with the ^{32}P / radioactive phosphorus labelled DNA and bacteriophage with , ^{35}S / radioactive sulphur labelled protein coat were allowed to infect *E. coli* = $\frac{1}{2}$
- Blending - In both the cases viral coats were removed from the bacteria by agitating them in a blender = $\frac{1}{2}$
 - Centrifugation - The virus particles were separated from the bacteria by spinning them in a centrifuge = $\frac{1}{2}$
 - Bacteria that were infected with viruses that had radioactive DNA were radioactive , whereas bacteria that were infected with viruses that had radioactive proteins were not radioactive , this indicating that viral DNA entered the bacterium and not viral protein = $\frac{1}{2} \times 3$

[3 Marks]

// The following diagrammatic representation can be considered in lieu of the above explanation



[3 marks]

OR

- (a) Why does DNA replication occur within a replication fork and not in its entire length simultaneously ?
- (b) “DNA replication is continuous and discontinuous on the two strands within the replication fork.” Give reasons.

- Ans. (a) Due to very high energy requirement , the two strands of DNA cannot be separated along its entire length (so replication occur within a small opening) =1 + 1
- (b) DNA dependent DNA polymerase catalyses polymerisation only in one direction that is $5' \rightarrow 3'$ (two strands of DNA are antiparallel) =1

[3 marks]

19. (a) What is the breeding of crops for enhancing their nutritional value called ? Why is the need felt for enhancing the nutritional value of the crops ?
- (b) Rice, wheat and maize are the most commonly used food grains the world over. How have these grains improved in their nutritional value in comparison to their conventional varieties ?

- Ans. a) biofortification , to improve the public health = $\frac{1}{2} + 1$
- b) Rice- iron fortification = $\frac{1}{2}$
- Wheat- high protein content = $\frac{1}{2}$
- Maize- have twice the amount of amino acids lysine / tryptophan = $\frac{1}{2}$
- (Any other suitable answer)

[3 marks]

OR

- (a) Write the scientific names of the source plants from where opioids and cannabinoids are extracted.
- (b) Write their receptor sites in the human body. How do these drugs affect the human beings ?

- Ans. (a) *Papaver somniferum* , *Cannabis sativa* = $\frac{1}{2} + \frac{1}{2}$
- (b) - In the brain = 1
- Effect on the cardiovascular system = 1

[3 marks]

20. Restriction endonucleases have played a very significant role in rDNA technology. Explain the roles of EcoRI and DNA ligase in formation of recombinant DNA.

Ans. (Restriction endonuclease) EcoRI cut the strand of DNA a little away from centre of the palindrome sites, but between the same two bases i.e. G and A on the opposite strands of the host and foreign DNA, this leaves single stranded portions at the both ends, which are overhanging stretches called sticky ends, sticky ends of the host and foreign DNA join by DNA ligase, to form a recombinant DNA = $\frac{1}{2} \times 6$

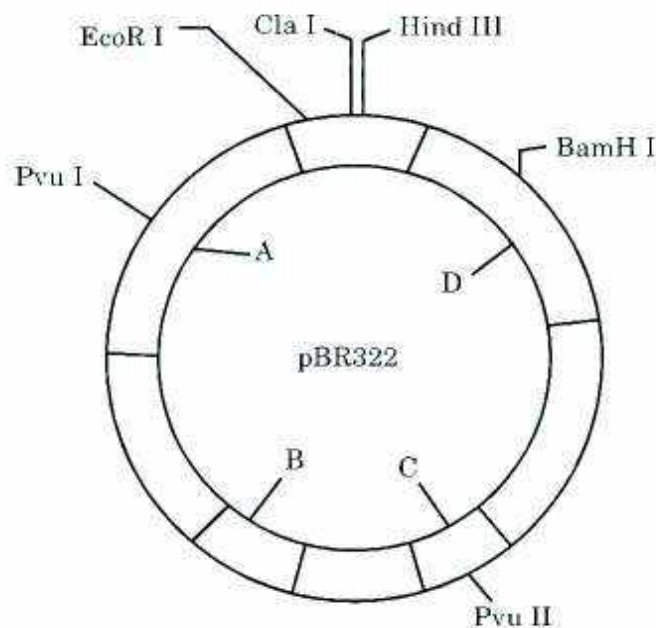
[3 marks]

21. Why DNA cannot pass through the cell membrane? How can the bacteria be made competent to take up a plasmid? Explain a method for introduction of alien DNA into a plant host cell. Name a pathogen that is used as a disarmed vector.

- Ans.
- DNA is a hydrophilic molecule = $\frac{1}{2}$
 - Bacterial cell is treated with a specific concentration of a divalent cation such as calcium, DNA enters the bacterium through pores in its cell wall = $\frac{1}{2} + \frac{1}{2}$
 - In plants cells are bombarded with high velocity micro-particles of gold or tungsten coated with DNA, in a method known as biolistics or gene gun = $\frac{1}{2} + \frac{1}{2}$
 - *Agrobacterium tumefaciens* / Retroviruses = $\frac{1}{2}$

[3 marks]

22. Study the figure of vector pBR322 given below.



Identify A, B and C and explain their roles in cloning a vector.

- Ans.
- A - antibiotic resistance genes, the ligation of alien DNA is carried out at a restriction site on this gene / acts as selectable marker present in this antibiotic resistance gene = $\frac{1}{2} + \frac{1}{2}$
 - B - ori, the sequence where replication starts = $\frac{1}{2} + \frac{1}{2}$
 - C - rop, codes for proteins involved in the replication of the plasmids = $\frac{1}{2} + \frac{1}{2}$

[3 marks]

OR

Many people are apprehensive of accepting GM crops. Give three reasons so as to convince them to use these crops.

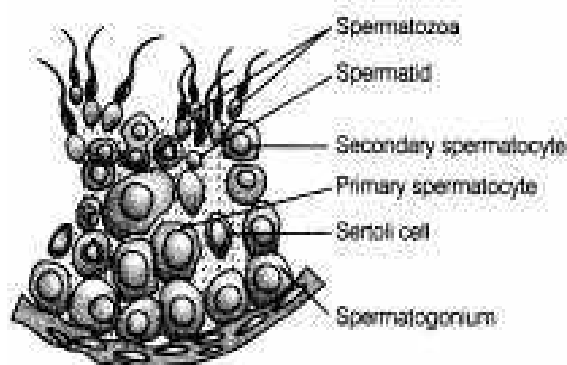
- Ans. (i) Crops are more tolerant to abiotic stresses (cold, drought, salt, heat)
(ii) reduced reliance on chemical pesticide (pest-resistant crops)
(iii) helped to reduce post harvest losses
(iv) increased in efficiency of mineral usage by plants (this prevents early exhaustion of soil fertility)
(v) enhanced nutritional value of food (eg. Vitamin A enriched -rice)

(Any three) = 1×3

[3 marks]

23. Draw a diagram of the sectional view of a human seminiferous tubule and label any six of its parts.

Ans.



(Any six correct labels) = $\frac{1}{2} \times 6$

[3 marks]

24. Which one of the two “in-situ” or “ex-situ” biodiversity conservation measures help the larger number of species to survive ? Explain.

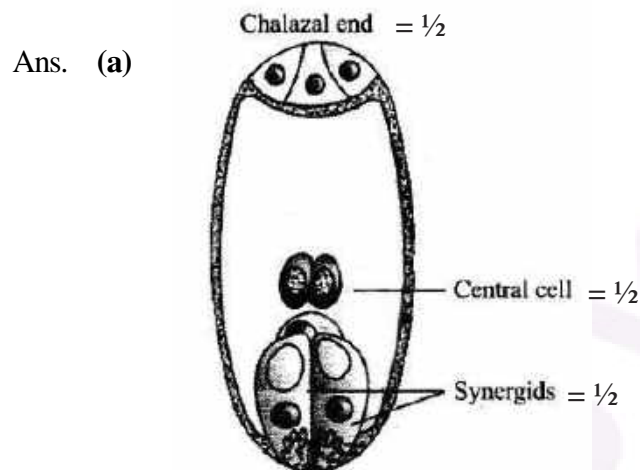
- Ans. - In situ is onsite conservation which implies that species are conserved in their natural habitat, while ex situ conservation implies conservation of genetic resources and different organisms outside their natural habitat = $\frac{1}{2} + \frac{1}{2}$
- To conserve species in their natural habitat the entire ecosystem has to be conserved including all other organisms, biotic and abiotic components of the ecosystem associated with the target species = $\frac{1}{2} + \frac{1}{2}$
- In situ conservation helps in the restoration of degraded ecosystem and habitats that are means of conserving genetic resources species ecosystem and landscapes, without uprooting the local people = $\frac{1}{2} + \frac{1}{2}$

[1+1+1 = 3 marks]

SECTION D

(Q. Nos. 25 - 27 are of five marks each)

25. (a) Draw the embryo sac of a flowering plant and label the following :
- (i) Central cell
 - (ii) Chalazal end
 - (iii) Synergids
- (b) Name the cell and explain the process it undergoes to develop into an embryo sac.
- (c) Explain the development of endosperm in coconut.



- (b) Functional Megaspore = $\frac{1}{2}$

Nucleus of functional megaspore divides mitotically three times to form 8 free nucleate stage of embryo sac, after this cell walls are laid down leading to 7 celled embryo sac = $\frac{1}{2} \times 2$

- (c) the two polar nuclei fuse with one male gamete, to produce triploid primary endosperm nucleus (PEN), which divides repeatedly forming free nuclei, subsequently cell wall formation occurs = $\frac{1}{2} \times 4$

[5 marks]

OR

Write the duration and the events that occur in the ovary and the uterus during follicular and luteal phases of the menstrual cycle in humans.

How do pituitary and ovarian hormones influence these two phases ?

- Ans. - **Follicular phase:** between 7th -14th day of the (menstrual) cycle, the primary follicles in the

ovary grow to become a fully mature Graafian follicle, and simultaneously the endometrium of uterus regenerates through proliferation (which are induced by changes in the levels of pituitary and ovarian hormones) = $\frac{1}{2} \times 3$

- **Luteal phase:** between 14th-28th day of the (menstrual) cycle, during which the remaining parts of the Graafian follicle transform as the corpus luteum, the corpus luteum secretes large amounts of progesterone which is essential for maintenance of the endometrium (Such an endometrium is necessary for implantation of the fertilised ovum and other events of pregnancy) = $\frac{1}{2} \times 3$
- The secretion of gonadotropins / LH and FSH / increases during the follicular phase, and stimulates follicular development as well as secretion of estrogens by the growing follicles, both LH and FSH attain a peak level in the middle of cycle (about 14th day), rapid secretion of LH leading to (its maximum level during the mid-cycle called LH surge induces) rupture of Graafian follicle and thereby the release of ovum (**ovulation**) = $\frac{1}{2} \times 4$

[5 marks]

26. (a) Describe aminoacylation of tRNA.
- (b) Explain the process that takes place in the ribosomes when mRNA makes its entry into it in a prokaryote.
- (c) Due to transcription error, ATG codon of DNA is transcribed into UAG in mRNA which translates a non-functional polypeptide chain in the ribosome. Justify the statement.

- Ans.** a) Amino acids are activated in the presence of ATP, and linked to their cognate tRNA
 $\frac{1}{2} \times 2 = 1$
- b) Small subunit of ribosome binds to mRNA at start codon (AUG) at 5' end, in the two sites of large subunits of ribosome, the charged tRNA with the amino acid corresponding to the codon on mRNA align, formation of peptide bond between the two closely placed amino acids in the two sites occur, with the help of ribozyme in the ribosome, peptide chain elongation continues till the stop codon (UAG, UGA, UAA) on the mRNA reach the big unit of ribosome = $\frac{1}{2} \times 6$
- c) UAG being a stop codon termination occurs before the completion of the functional polypeptide = 1

[5 marks]

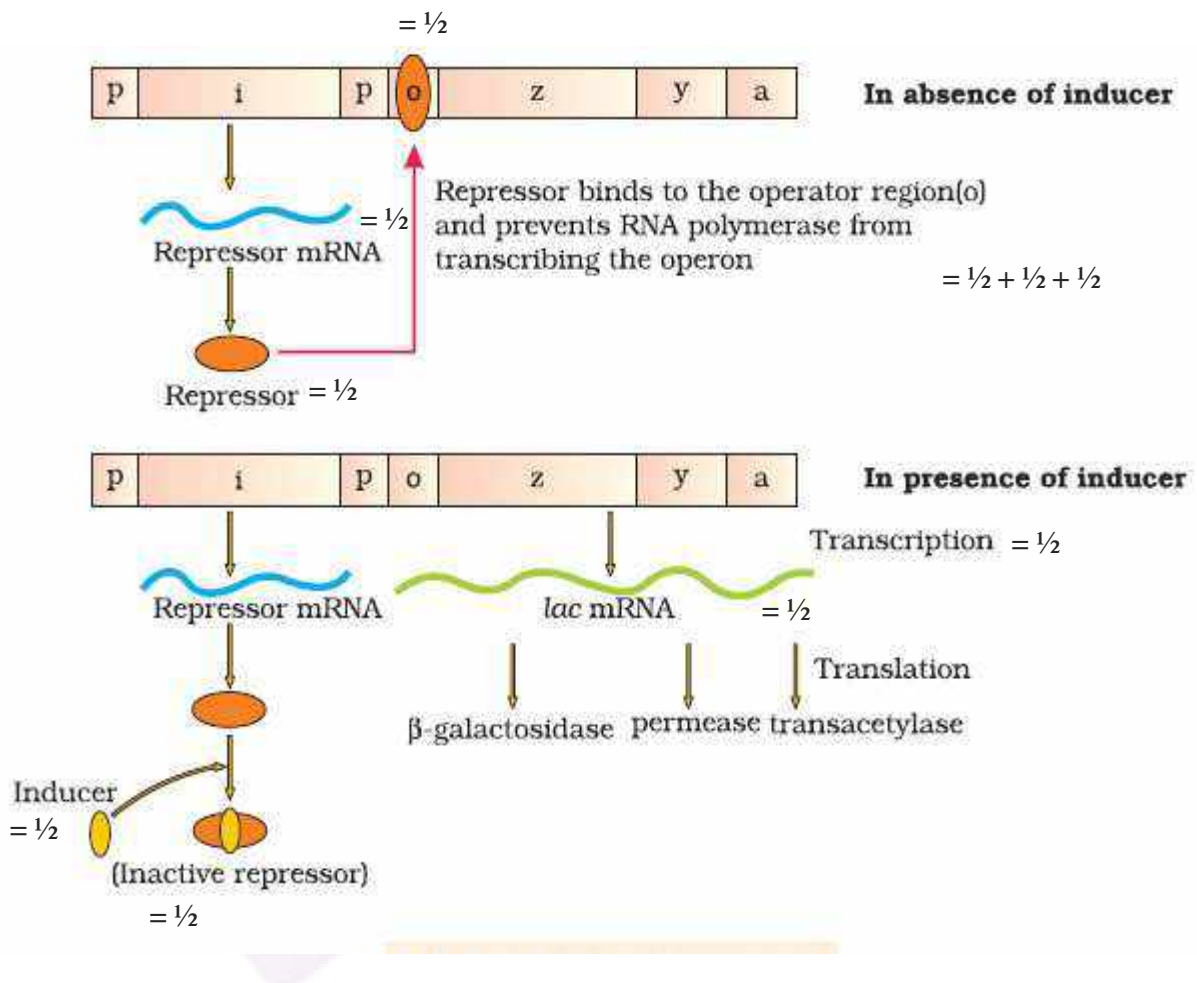
OR

Explain how does lac operon in *E. coli* operate

- (a) in the absence of an inducer.
- (b) in the presence of an inducer.

- Ans. a) The repressor of the Lac-operon is synthesised (all-the-time – constitutively) from the *i* gene, The repressor protein binds to the operator region of the operon in absence of the inducer, and prevents RNA polymerase from transcribing the operon $1+1+1=3$
- b) In the presence of an inducer, (lactose) the repressor is inactivated by interaction with the inducer, This allows RNA polymerase access to the promoter and transcription proceeds $1+1=2$

//



[5 marks]

27. (a) State what is an ecological succession.
- (b) Write one similarity and one difference between hydrarch and xerarch successions.
- (c) Explain the mechanism of co-evolution as seen in orchid *Ophrys* and bee.

- Ans.. a) The gradual and fairly predictable change in the species composition of a given area (in response to the changing environmental conditions) is called ecological succession = 1

- b) Both hydrarch and xerarch successions lead to medium water (mesic) conditions = 1

Hydrarch succession

- takes place in wetter areas
- The successional series progress from hydric to the mesic conditions
- the pioneers are the small phytoplanktons

xerarch succession

- takes place in dry areas
- the series progress from xeric to mesic conditions
- Pioneers on rocks are usually lichens

(Any one difference) = 1

- c) The male bee 'pseudocopulates' with the petal of female flower, (bearing an uncanny resemblance to the female of the bee in size, colour and markings) and during that process is dusted with pollen from the flower. When this same bee 'pseudocopulates' with another flower it transfers pollen to it and thus pollinates the flower

If the female bee's colour patterns change even slightly for any reason, pollination success will be reduced unless the orchid flower co-evolves to maintain the resemblance of its petal to the female bee = $\frac{1}{2} \times 4$

[5 marks]

OR

- (a) List any two ways the biodiversity loss affects any region.
- (b) Explain any two causes of biodiversity loss, with the help of suitable examples.

Ans. (a) (i) decline in plant production, (ii) lowered resistance to environmental perturbations such as drought and (iii) increased variability in certain ecosystem processes such as plant productivity, water use, and pest and disease cycles (Any two) = $\frac{1}{2} + \frac{1}{2}$

- b) i) **Habitat loss and fragmentation** = $\frac{1}{2}$: This is the most important cause driving animals and plants to extinction = $\frac{1}{2}$

Examples- Tropical rain forests. Once covering more than 14 per cent of the earth's land surface, these rain forests now cover no more than 6 per cent. //

The Amazon rain forest (it is so huge that it is called the 'lungs of the planet')

harbouring probably millions of species is being cut and cleared

for cultivating *soya beans* or for conversion to grasslands for raising

beef cattle.// the degradation of many habitats by

pollution also threatens the survival of many species = 1

- ii) **Over-exploitation** = $\frac{1}{2}$: Humans have always depended on nature for

food and shelter, but when 'need' turns to 'greed', it leads to over-exploitation of natural resources = $\frac{1}{2}$

Example- many marine fish populations around the world are over harvested, endangering the continued existence of some commercially important species = 1

- (iii) **Alien species invasions** = $\frac{1}{2}$: When alien species are introduced unintentionally or deliberately for whatever purpose, some of them turn invasive, and cause decline or extinction of indigenous species = $\frac{1}{2}$

Example -The Nile perch introduced into Lake Victoria in east Africa led eventually to the extinction of more than 200 species of cichlid fish in the lake / threat posed to native species by invasive weed species like carrot grass (*Parthenium*), *Lantana* / water hyacinth (*Eicchornia*) / illegal introduction of the African catfish *Clarias gariepinus* for aquaculture purposes is posing a threat to the indigenous catfishes in our rivers = 1

- (iv) **Co-extinctions** = $\frac{1}{2}$: When a species becomes extinct, the plant and animal species associated with it in an obligatory way also become extinct = $\frac{1}{2}$

Example-When a host fish species becomes extinct, its unique assemblage of parasites also meets the same fate // coevolved plant-pollinator mutualism where extinction of one invariably leads to the extinction of the other = 1

(Any two causes with examples) = 2 + 2

[1 + 4 = 5 marks]