

Answers to RBI-DS1/Set-1

SECTION-A

1. (a) A, B and C.
2. (c) A. Vasa efferentia, B. Vas deferens
3. (d) (ii) and (iv)
4. (b) X - Z - W - Y
5. (c) density gradient centrifugation
6. (c) HIV infects macrophages or helper T-lymphocytes in the body of the infected person.
7. (c) rumen
8. (a) A - 3, B - 4, C - 5, D - 1
9. (d) They are the completely automated devices for continuous culture of cells.
10. (b) While the cry genes *cryIAC* and *cryIIAb* control cotton bollworms, the cry gene *cryIAb* controls corn borer.
11. (c) Producer
12. (b) 2 and 4 only
13. (c) A is true but R is false.
14. (b) Both A and R are true and R is not the correct explanation of A.
15. (a) Both A and R are true and R is the correct explanation of A.
16. (a) Both A and R are true and R is the correct explanation of A.

SECTION-B

17.

| GIFT | ZIFT |
|---|---|
| <ul style="list-style-type: none">- It is a method of ART in which ovum collected from a woman is transferred to the fallopian tube of another woman.- It is advised for a woman who cannot produce functional gametes, but can provide suitable conditions for fertilisation and embryo development.- It is a method of gamete transfer. | <ul style="list-style-type: none">- In this method, the zygote or early embryo with upto 8-blastomeres is transferred into the fallopian tube of a woman for further development.- It is advised for a woman who cannot conceive but can provide suitable condition for implantation and further development of the embryo.- It is a method of embryo transfer. |

(any two)

18. – Nature selects for fitness.
- The fitness is based on the characteristics which are inherited.
 - Some organisms are better adapted to survive in an otherwise hostile environment.
 - Adaptive ability is inherited and has a genetic basis.

19. Functions of Spleen

- (i) Spleen acts as a filter of blood and trap the blood-borne microbes (pathogens).
- (ii) It also acts as a large reservoir of erythrocytes.

Cells in spleen

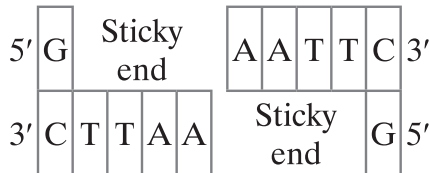
Lymphocytes and phagocytes.

20. – Each restriction endonuclease recognises a specific palindromic nucleotide sequence in the DNA and cuts the DNA strands a little away from the centre of the palindromic sequence, but between the same two bases on the two strands.

- EcoRI recognises and cuts the DNA strands as given below:



- This leaves single-stranded portions, called sticky ends, overhanging at the end of each strand.



- Since, the stickiness facilitates the action of DNA ligase, they easily form hydrogen bonds with their complementary counterparts.

21. (a) Decomposition is controlled by

(i) Chemical composition of detritus

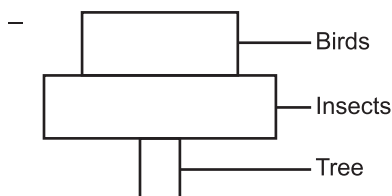
- Decomposition is slow, if detritus is rich in lignin and chitin.
- Decomposition is faster, if detritus is rich in nitrogen and water-soluble substances like sugars.

(ii) Climatic factors

- Oxygen is necessary; anaerobiosis inhibits decomposition.
- Temperature and soil moisture regulate decomposition.

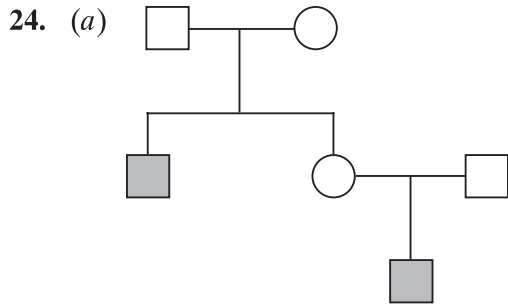
OR

(b) – It is a pyramid of numbers in a tree ecosystem.



SECTION–C

22. – The two gonadotropins involved in the menstrual cycle are (i) Follicle stimulating hormone and (ii) Luteinising hormone.
- The follicle stimulating hormone (FSH) stimulates the growth of primary follicle in the ovary into a mature Graafian follicle.
 - It also stimulates the secretion of estrogens by the developing follicle cells.
 - Rapid secretion of luteinising hormone (LH) during the middle of the menstrual cycle, also called LH surge, causes the rupture of Graafian follicle and the release of the ovum (secondary oocyte) in the process, called ovulation.
 - It also stimulates the formation of corpus luteum from the ruptured Graafian follicle and secretion of progesterone from it
 - The gonadotropins reach their peak levels in the middle of menstrual cycle, i.e., about the 14th day of the cycle.
23. (a) A – Morula
B – Blastocyst
C – Inner cell mass
D – Trophoblast
- (b) – Just after implantation, the inner cell mass (C) differentiates into ectoderm and endoderm.
- The trophoblast (D) gets attached to the endometrium of the uterus; it forms the foetal part of placenta.



The genotype of the daughter is XX^h and her husband is XY .

- (b) – The gene for haemophilia is present on the X-chromosome, i.e. it is a sex-linked trait.
- The disorder is due to a recessive mutant allele.
 - The female is an unaffected carrier and passes on the disease to some of her male offspring.
 - For a female to be haemophilic, the father must be a haemophilic and mother must be haemophilic too or atleast a carrier.
25. (a) Neanderthal man lived in near east and Central Asia, between 1,00,000–40,000 years before.
- (b) His brain capacity was 1400 cc.
- (c) He used hides to protect the body. He buried the dead.
- His brain size was more (1400 cc) than that of *Homo erectus* which was 900 cc.
26. (a) The possible levels of regulation of gene expression in eukaryotes could be at
- (i) transcriptional level, i.e. formation of primary transcripts of RNAs.
 - (ii) processing level, i.e. regulation of splicing.
 - (iii) transport of mRNA from the nucleus to the cytoplasm.
 - (iv) translational level.
- (b) Ribozyme is the 23S rRNA in bacteria, which catalyses the peptide bond formation.
27. (a) (i) **ADA deficiency:**
- It is caused by the deletion of the gene coding for adenosine deaminase.
 - The enzyme is crucial for the functioning of the immune system; hence, the immune system gets affected.

(ii) Vector – A retroviral vector

Recipient cells – Lymphocytes.

(iii) 1. Polymerase chain reaction (PCR).

2. Enzyme-linked immunosorbent assay (ELISA).

OR

(b) – *Agrobacterium tumefaciens*, a pathogen of many dicot plants, is able to deliver a piece of DNA, called T-DNA to transform normal plant cells into tumour cells.

– Retroviruses are able to transform the normal animal cells into tumour cells.

– The tumour-inducing plasmid has been modified such that it is no more pathogenic, but is still able to deliver the genes of interest ligated to it into plant cells.

– Similarly, retroviruses are disarmed and are used to deliver genes of interest into animal cells.

– Hence, once a gene or a DNA fragment has been ligated into such suitable vectors, it can be delivered into a target host cell and multiplied, i.e. amplification of gene of interest can be carried out.

28. (a) Primary sludge

– All the solids that settle during the primary treatment, constitute the primary sludge.

– The primary treatment involve physical processes like sequential filtration and sedimentation.

(b) Activated sludge

– The sediment formed in the settling tank during secondary treatment of sewage, is called activated sludge.

– A small part of it is pumped into aeration tank as inoculum.

– The remaining major part is pumped into the aerobic sludge digester.

(c) Anaerobic sludge digester

– In this, the anaerobic bacteria digest the bacteria and fungi in the activated sludge.

– During the process gases like methane, carbon dioxide and hydrogen sulphide are formed, which form the biogas.

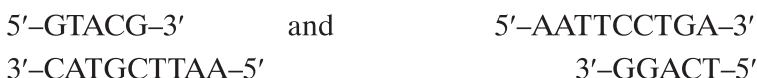
SECTION-D

29. (a) The mucus coating of the epithelium lining the gastrointestinal, urinogenital and respiratory tracts.
- (b) Physiological barriers:
- (i) Saliva in the mouth
 - (ii) Acid in the stomach
 - (iii) Tear in the eyes (any two)
- (c) (i) – The virus-infected cells secrete proteins, called interferons, which protect the non-infected cells from viral infections.

OR

- (c) (ii) – Macrophages form cellular barrier.
30. (a) *Escherichia coli*
- (b) 'V' – Ampicillin-resistance gene (amp^R)
- (c) (i) 'Z' is EcoRI recognition site.

The fragments would be:



OR

- (c) (ii) – 'W' is rop; it codes for the proteins involved in the replication of the plasmid.
- 'U' is ori; this is the sequence of DNA where replication starts and any piece of DNA linked to this sequence can be made to replicate within the host cell.

SECTION-E

31. (a) (i) – Pollen grains may be 2-celled, with a vegetative cell and a generative cell.
- Pollen grains may be 3-celled with a vegetative cell and two male gametes.
- (ii) 1. D, Exine
2. A, Generative cell
3. B, Vegetative cell
4. C, Intine
- (iii) Germ pores are those places on the exine of a pollen grain, where sporopollenin is thin or absent and gives the appearance of an aperture.

OR

- (b) (i) 1. 360 megaspore mother cells, i.e. one in each ovule; though each of the megaspore mother cell forms four megaspores by meiosis, only one of them forms the female gametophyte, the embryo sac, while the other three degenerate.
2. 720 male gametes; each ovule requires two male gametes for fertilisation (double fertilisation).
3. 90 microspore mother cells; each microspore mother cell forms four microspores, each of which transforms into a pollen grain.
- (ii) – All those events from the deposition of pollen on the stigma till the entry of pollen tube into the ovule, are collectively referred to as pollen-pistil interaction.
- It is mediated by the interaction of chemicals secreted by the pollen and the stigma.

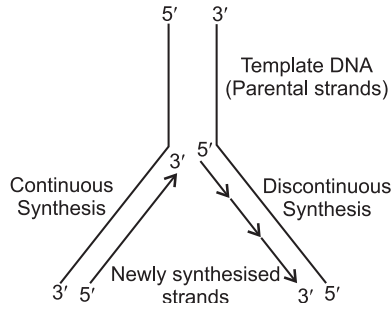
32. (a) (i) – A single DNA-dependent RNA polymerase catalyses the formation of mRNA, tRNA and rRNA in bacteria.
- The enzyme is capable of catalysing only the elongation step of transcription.
- It combines transiently to the initiation or sigma factor and binds to the promoter and initiates transcription.
- It somehow facilitates the opening of the DNA helix and catalyses the polymerisation of ribonucleoside triphosphates in a template-dependent fashion, i.e. elongation.
- When it reaches the terminator sequence, the enzyme associates transiently with the termination or rho(ρ) factor and terminates transcription; the RNA and the enzyme fall off the template.

(ii)

| Transcription in Prokaryotes | Transcription in Eukaryotes |
|--|---|
| <ul style="list-style-type: none">– A single RNA polymerase catalyses transcription of all types of RNA.– Primary transcript does not need to undergo any processing.– Transcription and translation are coupled because mRNA requires no processing and both processes take place in the cytoplasm. | <ul style="list-style-type: none">– There are at least three different RNA polymerases in the nucleus.– Primary transcript of RNA has to undergo processing.– Transcription and translation are not coupled because hnRNA requires processing and transcription occurs in nucleus whereas translation takes place in the cytoplasm. |

OR

(b) (i)

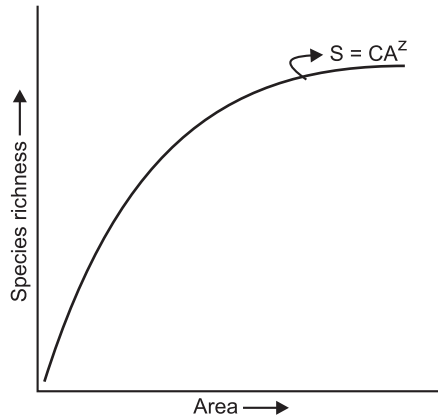


Replication Fork of DNA

- Replication of DNA occurs in small replication forks, because DNA is such a long molecule that the separation of the two strands along its entire length requires a very high amount of energy.
- (ii)
1. DNA polymerase: It polymerises the nucleotides only in the $5' \rightarrow 3'$ direction, at the rate of about 2000 bp per second.
 2. DNA ligases: They catalyse the formation of hydrogen bonds between the bases of the two complementary strands.
33. (a) (i) - The number of fish caught in a trap is a good measure of the population density in the river.
- For certain ecological investigations, there is no need to know the absolute density of the population; relative densities serve the purpose equally well.
- (ii) - Brood parasitism refers to the phenomenon in which a (parasitic) bird species lays its eggs in the nest of another (host) bird species and lets the host incubate them.
- The eggs of the parasitic bird must have evolved resemblance to the eggs of the host in size and colour to reduce the chances of the host bird detecting the foreign eggs and ejecting them from the nest, e.g. the cuckoo lays its eggs in the nest of a crow.

OR

(b) (i) 1.



Species-Area Relationship

2. 'S' represents species-richness
 3. Z value is 1.15 for frugivorous birds and mammals.
- (ii) 1. Ramsar Convention is a global environmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.
2. – Estuaries of Kerala
– Mangroves /Sundarban of West Bangal