

Answers to RBI/Set-3

1. (c) The phenotypic ratio of a Mendelian monohybrid cross is 3 : 1.
2. (c) A – 5, B – 4, C – 1, D – 2
3. (b) the value of K is equal to N
4. (c) Producer
5. (c) rumen
6. (d) They are the completely automated devices for continuous culture of cells.
7. (a) A – 4, B – 3, C – 2, D – 5
8. (c) HIV infects macrophages or helper T-lymphocytes in the body of the infected person.
9. (b) While the cry genes *cryIAc* and *cryIIAb* control cotton bollworms, the cry gene *cryIAb* controls corn borer.
10. (c) density gradient centrifugation
11. (a) A, B and C.
12. (a) A - 3, B - 4, C - 5, D - 1
13. (d) A is False but R is true.
14. (a) Both A and R are true and R is the correct explanation of A.
15. (c) A is true but R is false.
16. (c) A is true but R is false.
17. A. **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.

OR

- B.
- (i) The immunity provided by colostrum to the new-born.
 - (ii) The immunity provided to the foetus by the antibodies that pass through placenta from the mother.
 - (iii) Immunity provided against rabies and tetanus through inoculation.

(any two)

18. A. Decomposition is controlled by

(i) Chemical composition of detritus

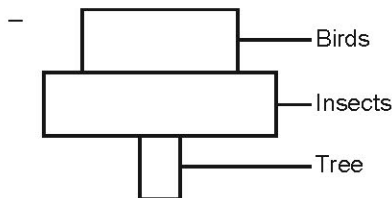
- Decomposition is slow, if detritus is rich in lignin and chitin.
- Decomposition is faster, if detritus is rich in nitrogen and water-soluble substances like sugars.

(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.

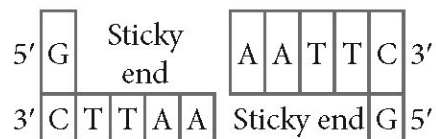


19. - Each restriction endonuclease recognises a specific palindromic nucleotide sequence in the DNA and cuts the DNA strands a little away from the centre of the palindromic sequence, but between the same two bases on the two strands.

- 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.

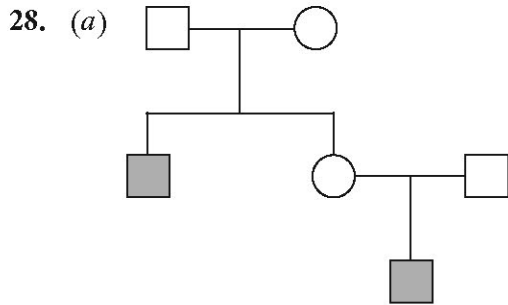
20.	GIFT	ZIFT
	<ul style="list-style-type: none"> - It is a method of ART in which ovum collected from a woman is transferred to the fallopian tube of another woman. - It is advised for a woman who cannot produce functional gametes, but can provide suitable conditions for fertilisation and embryo development. - 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.

21. A.
 - 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.

OR

- B.
 - Reptiles show internal fertilisation and lay shelled-eggs in safe places; hence, their number increases.
 - In amphibians, fertilisation is external that occurs in the medium of water; it is a chance event; the eggs may dry up if water bodies become dry.
22. (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.
23. (a) It is due to non-disjunction, the failure of segregation of XX-chromosomes during ova formation and fertilisation of an ovum with XX-chromosomes by a sperm carrying Y-chromosome.
- (b) A true-breeding line is one that has undergone continuous self-pollination/inbreeding and shows stable inheritance and expression of a trait for several generations.

24. – 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.
25. (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.
26. (a) – Streptokinase is the ‘clot buster’.
- It is obtained from *Streptococcus* bacterium.
- (b) – Cyclosporin A is the bioactive molecule.
- It is extracted from *Trichoderma polysporum*.
- (c) – Statins are prescribed.
- The source organism of statins is *Monascus purpureus*
27. (a) **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.
- (b) Vector – A retroviral vector
 Recipient cells – Lymphocytes.
- (c) (i) Polymerase chain reaction (PCR).
 (ii) Enzyme-linked immunosorbent assay (ELISA).



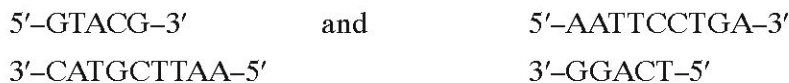
The genotype of the daughter is XX^h and her husband is XY .

- (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.
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) – The virus-infected cells secrete proteins, called interferons, which protect the non-infected cells from viral infections.

OR

- (d) – Macrophages form cellular barrier.
30. (a) *Escherichia coli*
- (b) 'Z' is EcoR1 recognition site.

The fragments would be:



- (c) 'V' – Ampicillin-resistance gene (amp^R)

OR

- (d) – ‘W’ is rop;
- ‘U’ is ori;

31. A. (a) – 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.
- (b) – Organisms have evolved life history variations to maximise their reproductive/Darwinian fitness in the habitat in which they live.
- The variations are evolved in relation to the constraints imposed by the abiotic and biotic components of the habitat.

Following are the different strategies:

- (i) Some organisms breed only once in their life time, eg. bamboo and Pacific salmon fish.
- (ii) Some breed many times during their life time, eg. mammals and birds.
- (iii) Some produce large number of small-sized offspring, eg. pelagic fishes and oysters.
- (iv) Some produce a small number of large-sized offspring, eg. mammals.

OR

- B. (a) It is a mechanism evolved by competing species for coexistence and avoid competition by changing their feeding time, foraging pattern and other behaviours. e.g. MacArthur had shown that five different species of warblers competing for the same resources coexisted in a tree by changing their foraging activities.

(b) **Differences**

- Competition is defined as the process in which the fitness of one species, measured in terms of its intrinsic rate of increase (‘r’) is lowered by the presence of another species; in this, the interaction can prove to be detrimental to both.
- Predation is the interspecific interaction in which the stronger animal (predator) kills and eats the weaker one (prey); it is beneficial for one and detrimental to the other.
- Commensalism is the interspecific interaction in which one of the species is benefitted and the other is neither benefitted nor harmed.

Similarity

- The interacting species live closely together in the above population interactions.
 - One of the species is benefitted.
32. A. (a) - 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.
- (b) 1. D, Exine
2. A, Generative cell
 3. B, Vegetative cell
 4. C, Intine
- (c) 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. (a) (i) 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.
- (ii) 720 male gametes; each ovule requires two male gametes for fertilisation (double fertilisation).
- (iii) 90 microspore mother cells; each microspore mother cell forms four microspores, each of which transforms into a pollen grain.
- (b) - 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.
33. A. (a) - 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.

(b)

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. Morgan's Dihybrid Crosses

- Morgan hybridised yellow-bodied and white-eyed female *Drosophila* with brown-bodied and red-eyed male and intercrossed their F_1 progeny; 98.7% of the progeny showed parental traits while 1.3% of the progeny were recombinant types.
- In another cross, Morgan crossed white-eyed and miniature-winged female with red-eyed and normal-winged male and intercrossed the F_1 progeny; 62.8% of the progeny showed parental combination of traits while 37.2% were recombinant types.
- Morgan *et al* observed that when two genes of a dihybrid cross were present on the same chromosome, the proportion of parental combinations was much higher than that of non-parental combinations.
- Even on the same chromosome, some genes are tightly linked and showed very low recombination while others are loosely linked and showed a higher recombination.

- Morgan coined the term linkage to the physical association of the genes present on the same chromosome.
- The term recombination refers to the non-parental gene combinations.
- Gene mapping refers to the locating or positioning of genes on a chromosome; Sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of distance between two genes and mapped the chromosomes.