

Answers to RBI-DS1/Set-2

1. (d) The filiform apparatus is present in the antipodal cells.
2. (d) RNA-dependent DNA polymerase
3. (c) A – 5, B – 4, C – 1, D – 2
4. (d) both (b) and (c)
5. (c) life comes from pre-existing life
6. (c) the normal DNA from ^{15}N -DNA
7. (d) A – 5, B – 3, C – 1, D – 2
8. (c) Extension of primer end on the template DNA
9. (b) corn borer
10. (b) T.H. Morgan
11. (d) both (a) and (c)
12. (c) Detritus; Grazing food chain respectively.
13. (b) Both A and R are true, but R is not the correct explanation of A.
14. (a) Both A and R are true, and R is the correct explanation of A.
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16. (a) Both A and R are true, and R is the correct explanation of A.
17. – Corpus luteum is formed from the ruptured Graafian follicle under the influence of luteinising hormone.
 - Luteinising hormone influences the secretion of large quantities of progesterone by the corpus luteum during luteal/secretory phase of the menstrual cycle; progesterone is necessary for the maintenance of endometrium.
 - If fertilisation does not occur, the level of luteinising hormone decreases and the corpus luteum regresses and the level of progesterone decreases; in the absence of progesterone, the endometrium disintegrates leading to menstruation.
 - Thus, luteinising hormone influences the endometrium through progesterone.
18. – In mutation A, the change in the codon GAG to GAA does not change the amino acid coded, *i.e.* both GAG and GAA code for amino acid glutamic acid; hence, there is no change in the haemoglobin structure.

- In mutation B, the codon GAG is changed to GUG, where GUG codes for valine, while the original codon GAG codes for glutamic acid; hence, there is a change in the haemoglobin structure and it leads to sickle-cell anaemia.
19. (i) The mucus coating of the gut epithelium is a barrier that traps microbes.
- (ii) The hydrochloric acid secreted by gastric glands retards the growth of microbes.
20. – Bacterial colonies with cloning vector A are colourless, as they are recombinants with the insert.
- Presence of the insert has resulted in insertional inactivation of the enzyme and hence, do not produce any colour.
 - Bacterial colonies with cloning vector B are non-recombinants, *i.e.* have no insert and produce colour as the enzyme is produced.
21. The first trophic level in an ecosystem is occupied by:
- (i) producers in a grazing food chain which produce organic food through photosynthesis and support all other organisms directly or indirectly; they transduce energy into the ecosystem.
- (ii) decomposers in a detritus food chain, which are the saprotrophs that carry out the decomposition of organic matter ultimately into simple inorganic nutrients for the use by producers (green plants); they play an important role in nutrient cycling.

OR

- The microbes are also heterotrophs; they are saprotrophs or parasites.
 - Those microbes which meet their energy requirement by degrading the dead and decaying organic matter, are called saprotrophs; they are also called decomposers.
 - Those microbes which depend on living organisms for their food as well as shelter, are called parasites.
22. (a) Primary oocytes.
- (b) Y–Fimbriae; they help in the collection of ovum into the fallopian tube, after ovulation.
- (c) Z–Ampullary-isthmic junction; this is the site of fertilisation in humans.
- The sperm comes in contact with the ovum and enters the cytoplasm with the help of the secretions from its acrosome.
 - Meiosis II of the secondary oocyte is completed and the ootid formed fuses with the sperm nucleus to form a zygote.

23. Ovarian events during follicular/proliferative phase

- In this phase that follows the menstrual phase, one primary follicle in the ovary grows and becomes a fully mature Graafian follicle.
- The primary follicle becomes surrounded by more granulosa cells and a theca and transforms into a secondary follicle.
- The secondary follicle transforms into a tertiary follicle with the development of a fluid-filled cavity, called antrum around the primary oocyte.
- The theca becomes differentiated into an outer layer, the theca externa and an inner layer, the theca interna.
- At this stage, the primary oocyte completes meiosis I and forms a secondary oocyte and the first polar body.
- The tertiary follicle grows further to become a Graafian follicle; the secondary oocyte secretes a new membrane, called zona pellucida, around it.

24. Sex determination in Grasshopper:

- Sex determination in grasshopper is of XO type and shows male heterogamety.
- The males have one X-chromosome other than the autosomes.
- The females have two X-chromosomes (XX) other than the autosomes.
- Males produce two types of sperms, 50% of them with one X-chromosome and 50% of them with no X-chromosome.
- Ova fertilised by a sperm carrying X-chromosome develop into females, while those fertilised by a sperm, carrying no X-chromosome develop into males; hence, the males have one chromosome less than that of females.

25. (a) – It demonstrated that life comes only from pre-existing life.

- Theory of spontaneous generation was disproved.

(b) The individual organism passes on the (genetic) variation(s) to the next generation; the useful variations are selected by nature and it can lead to speciation.

(c) – They are analogous organs, which perform similar functions, but are dissimilar in their anatomy and origin.

- Analogous organs are the result of convergent evolution.

26. (a) (i) Cyanobacteria can fix atmospheric nitrogen in the soil.
(ii) They also add organic matter to the soil to increase soil fertility.
- (b) – The small amount of curd added to the milk contains millions of lactic acid bacteria (LAB). They start multiplying at the suitable temperatures.
- LAB produce acids that coagulate and partially digest the milk proteins; thus, milk is converted into curd.
 - Vitamin B₁₂ content is increased.
27. – RNA interference (RNAi) occurs as a method of cellular defence in all eukaryotic organisms.
- It involves the silencing of a specific mRNA by a complementary dsRNA.
 - The complementary RNA for making the double-stranded RNA comes either from an infection by RNA viruses or mobile genetic elements, called transposons, which replicate through an RNA intermediate.
 - The nematode-specific genes are introduced into the host plant, using *Agrobacterium tumefaciens* as vector, in such a way that it produced both sense and anti-sense RNA in the host.
 - The sense and antisense RNAs are complementary to each other and form dsRNA.
 - The dsRNA binds to and prevents the translation of a specific mRNA.
 - Consequently, the parasite is not able to live in the transgenic tobacco plant and hence, the plant is protected.

OR

(a) **Options to increase food supply:**

- Agrochemical based agriculture, using chemical fertilisers and pesticides.
- Organic agriculture, using biofertilizers, biopesticides, vermicomposting, etc.
- Genetically-engineered (GM) crops-based agriculture.

(b) **The success of Green Revolution was due to:**

- Use of improved/hybrid crop varieties
- Better management practices.
- Use of agrochemicals (pesticides and fertilisers).

28. (a) Loss of biodiversity in a region leads to:

- (i) decline in plant productivity.
 - (ii) lowered resistance to environmental perturbations like drought.
 - (iii) increased variability in certain ecosystem processes like water use, productivity, pest and disease cycles, etc.
- (b) (i) Habitat loss and fragmentation.
- (ii) Over-exploitation.
- (iii) Alien species invasion
- (iv) Co-extinctions (any three)

29. (a) – A – Mutualism can show coevolution.

- e.g. 1. A particular species of wasp pollinating the fig plants.
- 2. The fungus and a photosynthesising alga in lichens.
- 3. *Rhizobium* in the root nodules of leguminous plant.
- 4. Mycorrhizae, i.e. association between fungi and the roots of higher plants. (any two)

(b) – B is Competition, a process in which the fitness of one species (measured as 'r', the intrinsic rate of increase) is significantly lowered in the presence of the other species; it is an interaction in which both the partners are affected.

- C is Amensalism, an interspecific interaction in which one of the species is harmed while the other species is neither benefitted nor harmed, i.e., neutral.

OR

- (b) (ii) Clown fish living among the tentacles of sea anemone.
- (v) An orchid plant growing on a mango tree.
- (vi) Sucker fish attached to the back of a whale.

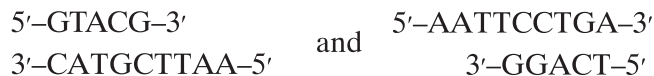
The interaction is commensalism.

30. (a) *Escherichia coli*
- (b) 'V' – Ampicillin-resistance gene (amp^R)
- (c) – '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 alien/recombinant DNA linked to this sequence can be made to replicate within the host cell.

OR

- (c) 'Z' is EcoR1 recognition site.

The fragments would be:



31. (a) (i) – Corpus luteum secretes progesterone; it is essential for the maintenance of endometrium that is needed for implantation and other events of pregnancy.
- Placenta secretes human chorionic gonadotropin (hCG) that is essential for supporting the foetal growth and maintenance of pregnancy.
- (ii) – During follicular phase, follicle-stimulating hormone is secreted by the anterior pituitary; it controls the growth and maturation of a primary follicle into a mature Graafian follicle and secretion of estrogens from the follicle cells.
- During parturition, oxytocin is secreted by the maternal posterior pituitary; it acts on the uterine muscles and brings about their vigorous contractions leading to child birth.
- (b) (i) During gestation/pregnancy, both corpus luteum and placenta co-exist.
- (ii) During follicular phase, ovulatory phase and menstrual phase of the menstrual cycle, corpus luteum does not exist.

OR

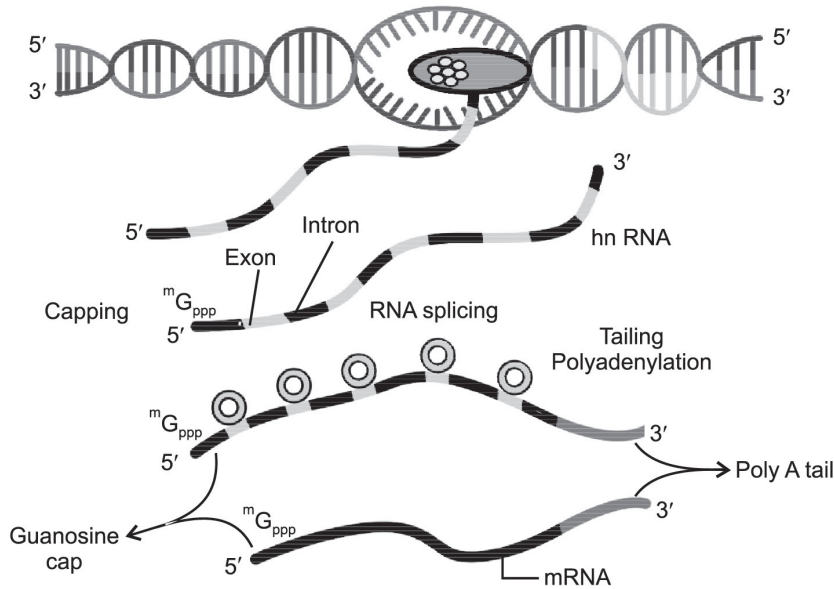
- (a) The steps taken include:

- (i) motivating the couples to have small families by using various contraceptive methods.
 - (ii) raising the marriageable age of the females to 18 years and of males to 21 years.
 - (iii) providing incentives to couples with small families
- (b) – *In vitro* fertilisation (IVF) and embryo transfer are the two steps involved in a test tube baby programme.
- In this method, the ova from the wife or a healthy female donor and the sperms from the husband or a male donor are collected and induced to form a zygote under simulated conditions in the laboratory.
 - The zygote or early embryo with upto 8-blastomeres is transferred into the fallopian tube (ZIFT) or embryo with more than 8-blastomeres, is transferred into the uterus (IUT) for further development upto parturition.

32. Following are the complexities in eukaryotic transcription, but not in prokaryotic transcription:

- (i) – In prokaryotes, there is a single DNA-dependent RNA polymerase, which catalyses the formation of all the three types of RNAs, i.e. *mRNA*, *tRNA* and *rRNA*; though the enzyme catalyses the elongation step, it somehow facilitates initiation and termination as well, with the help of initiation and termination factors, respectively.
 - In eukaryotes, there are three different DNA-dependent RNA polymerases, catalysing the formation of RNAs as follows:
 - ⇒ RNA polymerase I – ribosomal RNA (*rRNA*)
 - ⇒ RNA polymerase II – messenger RNA (*mRNA*)
 - ⇒ RNA polymerase III – transfer RNA (*tRNA*)
- (ii) The RNA formed in prokaryotes is functional and does not require any processing; but in eukaryotes, the primary transcript has to undergo the following changes, to become functional:
 - Splicing is necessary, as the RNA transcript contains both coding sequences (exons) and non coding sequences (introns); the introns are removed and exons are joined during splicing.

- Capping of heterogenous nuclear RNA (*hnRNA*) occurs at the 5' end, where methyl guanosine triphosphate is added.
- In tailing of *hnRNA*, about 200-300 adenylate residues are added at the 3' end of *hnRNA* to make it into an active *mRNA*.



OR

(a) A – I^Bi, B – I^Bi.

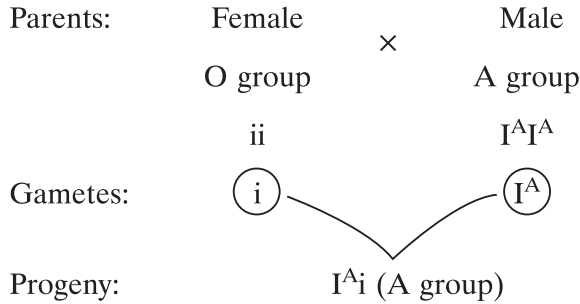
(b) – X can be I^Ai (A group) or I^Bi (B group)

– The cross is as follows:

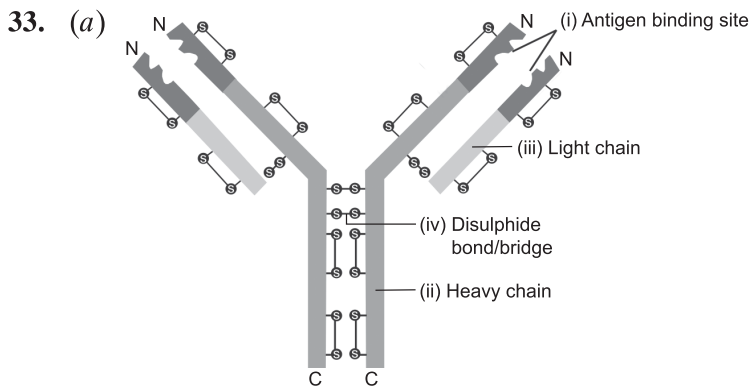
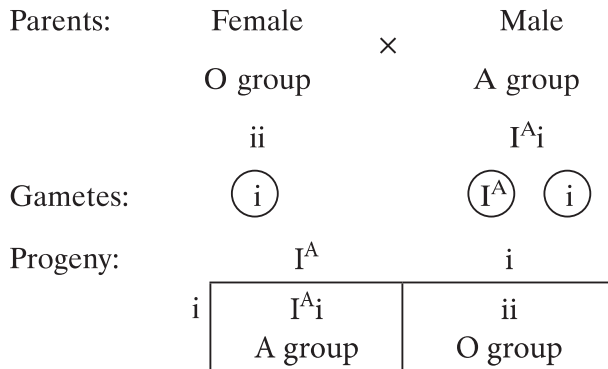
Parents:	Female	×	Male		
	O group		AB group		
	ii		I ^A I ^B		
Gametes:	(i)		(I^A) (I^B)		
Progeny:	I ^A		I ^B		
	i	<table style="border-collapse: collapse; width: 100%;"> <tr> <td style="padding: 5px; text-align: center;">I^Ai A group</td> <td style="padding: 5px; text-align: center;">I^Bi B group</td> </tr> </table>	I ^A i A group	I ^B i B group	
I ^A i A group	I ^B i B group				

– Y can be $I^A i$ (A group) if the male parent is homozygous ($I^A I^A$) or ii (O group) or $I^A i$ (A group) if the male parent is heterozygous for blood group A.

(i) Male parent is homozygous



(ii) Male parent is heterozygous



- (b) – Each antibody molecule has four polypeptide chains.
 - Of them, two are small and called light chains (L) and two of them are longer and called heavy chains (H); hence, written as H_2L_2 .
- (c) – IgA, IgE, IgM, IgG.

OR

- (a) Baculoviruses belong to the genus *Nucleopolyhedrovirus*.
 - (i) They are species-specific, narrow-spectrum insecticides that are the pathogens which attack insects and other arthropods.
 - (ii) They have no negative impacts on plants, birds, mammals, fish and even non-target insects.
 - (iii) This is desirable because beneficial insects are conserved to aid in integrated pest management (IPM) programmes or in the treatment of ecologically-sensitive area.
- (b) Those bacteria which produce large quantities of methane, are referred to as methanogens.

Characteristics:

- (i) They are anaerobes.
- (ii) They grow on cellulosic material.