

Answers to RBI-DS2/Set-1

1. (a) A – 4, B – 3, C – 1, D – 2
2. (a) (i) – 25.0%, (ii) – 75.0%
3. (d) (ii) and (iv)
4. (c) The DNA polymerase used in the extension step is obtained from *E. coli* cells.
5. (a) 420
6. (d) Decomposition occurs during the primary treatment of sewage.
7. (a) It is commensalism, in which the orchid is benefitted and the mango tree is neither benefitted nor harmed.
8. (d) Metastasis is the property of benign tumours.
9. (c) C
10. (b) Pyramid of energy in an aquatic ecosystem
11. (c) 1 – 697, 2 – 87
12. (b) coitus interruptus
13. (a) Both A and R are true, and R is the correct explanation of A.
14. (b) Both A and R are true, but R is not the correct explanation of A.
15. (a) Both A and R are true, and R is the correct explanation of A.
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17. **Reasons for selecting *Drosophila*:**
 - (i) There is clear differentiation of the sexes, i.e., the male and female flies are easily distinguishable.
 - (ii) It has many types of hereditary variations that are easily observable.
 - (iii) The fly completes its life cycle in about two weeks; hence, a number of generations can be raised to study the inheritance pattern of a given trait.
 - (iv) A single mating produces a large number of progeny flies.
 - (v) They could be easily grown on simple synthetic medium in the laboratory.

(any four)

18. – The secretion of gonadotropin releasing hormone (GnRH) by the hypothalamus increases significantly during puberty.
- GnRH acts on the anterior pituitary and stimulates the secretion of two gonadotropins namely follicle stimulating hormone (FSH) and luteinising hormone (LH), [also called interstitial cell stimulating hormone (ICSH)].
 - LH acts on the Leydig cells of testes and stimulates them to secrete testosterone, which stimulates the process of spermatogenesis.
 - FSH acts on the Sertoli cells and stimulates them to secrete certain factors which are necessary for the process of spermiogenesis.
19. – Pollen grains/mites in the dust/animal dander.
- The body produces IgE antibodies, which cause the release of histamines and serotonin from mast cells.
 - Sneezing, watery eyes, difficulty in breathing and running nose are the symptoms.
20. (a) – The recombinants can be selected by plating the culture on ampicillin-containing medium.
- The transformants will grow in the medium while the non-transformants cannot grow.
- (b) The ampicillin-resistance gene acts as a selectable marker.

21.

<i>In situ</i> Conservation	<i>Ex situ</i> Conservation
<ul style="list-style-type: none"> – It is the method of protecting the endangered species of plants or animals in their natural habitat, by protecting the whole ecosystem with its biodiversity at all levels. – Biosphere reserves, sacred groves, hotspots, etc. serve this purpose. 	<ul style="list-style-type: none"> – It is the method of protecting the endangered species of plants or animals by removing them from the unsafe or threatened habitat and placing them in special settings, where they can be protected and given special care. – Zoological parks, botanical gardens, cryopreservation, seed banks, etc. serve this purpose.

OR

- (a) – The equation represents the exponential growth of a population, where resources are unlimited.

- In a population of size N , b represents the per capita births and d represents the per capita deaths; the increase or decrease in N during a time period t is written as $dN/dt = (b - d) \times N$
- Let $(b - d) = r$, then $dN/dt = rN$.
- (b) – ‘ r ’ in the equation is called the intrinsic rate of natural increase.
 - It is a very important parameter chosen for assessing the impacts of any biotic or abiotic factor on the population growth.

22. Advantages of seeds to angiosperms:

- (i) Seeds have better adaptive strategies for dispersal to new habitats to colonise those areas.
- (ii) The hard seed coat provides protection to the young embryo.
- (iii) Seeds have sufficient food reserves (in the cotyledons or endosperm) to support the embryo and seedlings, till they are able to photosynthesise and become independent.
- (iv) Since they are formed as a result of sexual reproduction, they generate new genetic combinations resulting in variations. (any three)

23. (a) – It is copper T (CuT), an intra-uterine device (IUD).

- (b) – The copper ions released suppress sperm motility and the fertilising capacity of sperms.
 - It increases phagocytosis of sperms within the uterus.

(c) Cu 7 and multiload 375

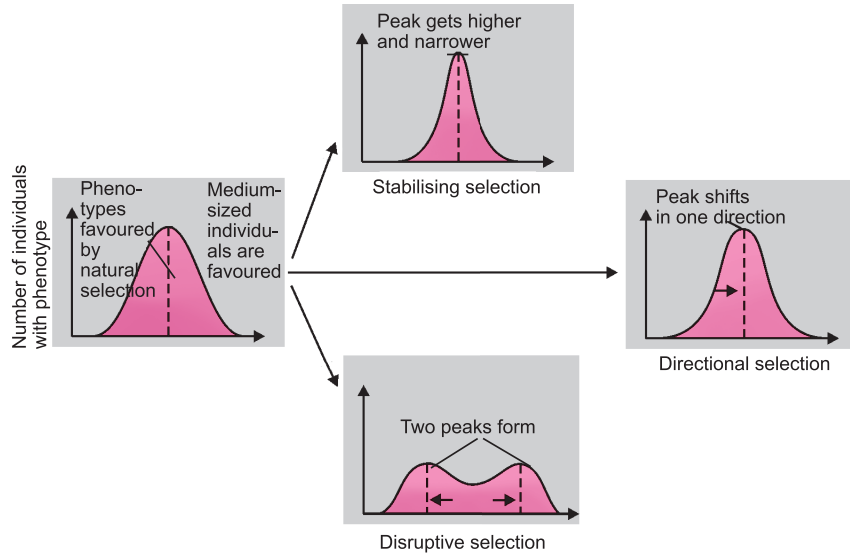
24. (a) – The polarity of $X \rightarrow X'$ is $5' \rightarrow 3'$

- No more amino acid will be added.
- (b) – Codon–GCA
 - Anticodon–CGU
- (c) – The untranslated regions are required for an efficient translation.
 - They are located before the initiation codon at the $5'$ end and after the termination codon at the $3'$ end.

25. Following are the different ways in natural selection affects a heritable trait in a population:

- (i) Stabilisation – more individuals acquire the mean character value, i.e. variation is much reduced.

- (ii) Directional change – more individuals acquire value other than the mean character value.
- (iii) Disruption – more individuals acquire peripheral character value at both ends of the distribution curve; two peaks are formed.



Types of Natural Selection

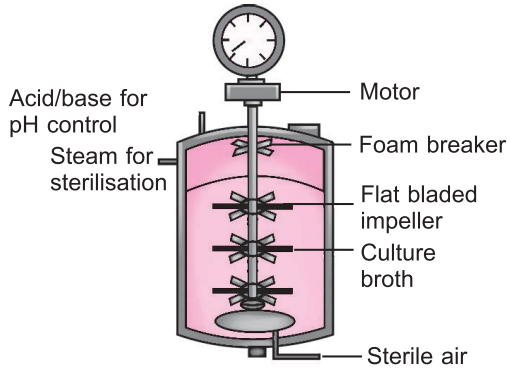
26. – All normal cells have cellular oncogenes (*c-onc*), which when activated under certain conditions cause oncogenic transformation.
- Such genes may become activated by:
 - (i) physical agents like X-rays, gamma rays or UV rays.
 - (ii) chemical agents like tobacco smoke.
 - (iii) biological agents like oncogenic viruses.
 - All these agents that cause transformation of normal cells into neoplastic (cancer) cells, are called carcinogens.

OR

- (a) – Vaccine against Hepatitis B has been developed using yeast cells as the host.
- (b) – When a foreign antigen enters the human body, the B-lymphocytes produce an army of proteins, called antibodies.
 - These antibodies keep circulating in the body fluids (humors) and neutralise the pathogenic agents.

- During subsequent encounters, the memory B-lymphocytes recognise the pathogen and overwhelm the pathogen by massive production of antibodies.

27. (a)



(b) The curved base facilitates the mixing of the reactor contents.

28. - Gause's Competitive Exclusion Principle states that two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior one will be eliminated eventually.
- This is true not only when the resources are limiting but also when resources are abundant.
 - For example, the Abingdon tortoise in Galapagos Islands became extinct within a decade after the goats were introduced into the Island.
 - It is probably due to the greater browsing efficiency of the goat or the feeding efficiency of one species (tortoise) is reduced by the interfering presence of the other species (goat).
29. (a) - It shows autosomal, recessive pattern of inheritance
- Thalassaemia/Phenylketonuria

OR

(i) 25%

(ii) 50%

- (b) - In sickle-cell anaemia, the haemoglobin is defective (qualitative disorder).
- In Thalassaemia, less amount of haemoglobin is synthesised (quantitative disorder).
- (c) (i) HbA peptide: Val-His-Leu-Thr-Pro-Glu-Glu
- (ii) HbS peptide: Val-His-Leu-Thr-Pro-Val-Glu

30. (a) The municipal waste water, is called sewage.
(b) Aerobic and anaerobic heterotrophic microbes, i.e., bacteria and fungi.
(c) – Primary treatment and secondary treatment.
– Primary sewage treatment is a physical process and secondary sewage treatment is a biological process.

OR

- (c) Activated sludge is the sediment of ‘flocs’, i.e. aerobic bacteria and fungi.

Uses:

- (i) A small part is pumped back into aeration tank as inoculum.
(ii) A major part is pumped into anaerobic sludge digester, where biogas (methane, carbon dioxide and hydrogen sulphide) is produced by the anaerobic digestion of the flocs.
31. (a) – They are the restriction sites in the cloning vector pBR322.
– They are the sites where the respective restriction endonuclease cut the DNA.
(b) – amp^R gene and tet^R gene
(c) – They have the ability to replicate within the bacterial cells independent of the genomic DNA of the bacteria.
(d) – Ori is the sequence of base pairs of DNA where replication is initiated.
– Any alien DNA can be made to replicate (prophage) only when ligated to ori.
(e) No; it does not provide the origin of replication.

OR

- (a) (i) Species A
(ii) Species B
(b) – *Bacillus thuringiensis* is the source organism.
– *cryIAb* is the gene.
(c) Since the corn borer species B is not affected by the Bt toxin, the farmers can grow Bt corn or non Bt corn.
(d) **Advantages of GM Plants:**
– Genetic modification has made the crops more tolerant to abiotic stresses like cold, heat, drought, salinity, etc.

- It has reduced the dependence of crops on chemical pesticides as they are made pest-resistant.
- Post-harvest losses are much reduced.
- As the plants have increased efficiency of mineral usage, the early exhaustion of fertility of soil is prevented.
- Food produced from GM (Genetically Modified) crops has enhanced nutritional value.
- Genetic modification has been used to create tailor-made plants to supply resources such as starch, fuels, pharmaceuticals, etc. to industries.

(any four)

32. (a) Charging of tRNA

- The amino acids are activated in the presence of ATP and linked to their cognate tRNA; this process is called charging of tRNA or amino acylation of tRNA.
- This process is necessary in translation as the formation of peptide bond between the amino acids is favoured energetically, when they are brought together.
- It is essential for translation as the activation of amino acids by ATP provides the energy for the formation of peptide bond.

(b) Initiation of translation

- When the small subunit of ribosome binds to the mRNA the process of translation starts; in bacteria the ribosome also acts as a catalyst (23S rRNA is ribozyme) for peptide bond formation.
- The ribosome binds to mRNA at the start codon (AUG), that is recognised by the initiator tRNA; it involves certain initiation factors.

(c) – Ribozyme catalyses the formation of peptide bond in bacteria.

- The release factor binds to the stop codon and terminates translation and releases the polypeptide synthesised from the ribosome.

OR

- (a) – Charles Darwin conjectured that all the varieties of the finches evolved on the island itself.**
- He reasoned that after originating from a common ancestral seed-eating stock, the finches must have radiated to different habitats and undergone

adaptive changes in their beaks, which enable them to become insectivorous and vegetarian finches, i.e., they had shown adaptive radiation.

- Adaptive radiation is the process of evolution of different species in a given geographical area starting from a point and literally radiating to other geographical areas (habitats).
- Living in isolation for long, they must have evolved into new kinds of finches, which could survive in the new habitats.

(b)

Darwinian Concept	de Vries Concept
<ul style="list-style-type: none"> – According to Darwin, speciation occurs with the accumulation of minor heritable variations. – Evolution was gradual and occurs through a number of generations. – Variations are small and directional. 	<ul style="list-style-type: none"> – According to de Vries, mutations arising suddenly in a population, are responsible for speciation. – Evolution occurs in a large single-step mutation (saltation). – Mutations are random and directionless.

33. (a) Double fertilisation

- In an angiosperm, two male gametes are discharged by a pollen tube into the embryo sac.
- One of the male gametes fuses with the ovum to form a zygote; this process, is called syngamy.
- The other male gamete fuses with the secondary nucleus (formed by fusion of two polar nuclei) to form the primary endosperm nucleus; this process is called triple fusion.
- Since there are two fusions (syngamy and triple fusion), inside an ovule during fertilisation, it is known as double fertilisation.

(b) Examples

- Parthenocarpy is seen in banana.
- Apomixis is seen in Citrus, mango, some members of Asteraceae and grasses. (any one)

Similarity

- There is no fertilisation involved in both parthenocarpy and apomixis.

Difference

- Parthenocarpy is fruit formation without fertilisation; the fruits are seedless or the seeds are not viable.
- Apomixis is seed formation without fertilisation; the seeds are viable.

OR

(a) 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.

- #### **(b)**
- Acrosome is present at the anterior end of the head region of a human sperm.
 - It contains enzymes that help in dissolving the envelopes (zona pellucida and plasma membrane) of ovum to facilitate entry of sperm into the cytoplasm of the ovum