

Answers to RBI-DS2/Set-3

1. (d) A – 3, B – 1, C – 4, D – 2
2. (b) Insects
3. (d) 3' TCCACCCGAT↓CC 3'
4. (d) Silencing of a specific *mRNA* segment by a complementary *dsRNA*
5. (b) Amniocentesis
6. (b) Mucus coating of epithelium
7. (a) Streptokinase
8. (c) It cannot distinguish between self cell and non-self cells.
9. (b) 4, 5 and 7 are primary consumers
10. (a) (i) –UUU, (ii)–GUG, (iii)–AAA, (iv)–CAC
11. (d) A and C
12. (a) A – 4, B – 3, C – 2, D – 1
13. (c) A is true but R is false.
14. (b) Both A and R are true but R is not the correct explanation of A.
15. (d) A is false but R is true.
16. (a) Both A and R are true and R is the correct explanation of A.
17. – The levels of pituitary gonadotropins, i.e., follicle stimulating hormone (FSH) and luteinising hormone (LH) increase gradually during the follicular/proliferative phase of the menstrual cycle.
 - The FSH stimulates secretion of estrogens from the follicle cells; hence, as the pituitary gonadotropins reach their peak levels during the middle (around the 14th day) of the menstrual cycle, the ovarian hormone, estrogen also reaches its peak level.
 - The maximum level of LH, called LH-surge occurs during the middle of the menstrual cycle.
 - As the levels of LH decreases (when fertilisation has not taken place), around the 23rd day of the cycle, the corpus luteum starts regressing and hence, the level of progesterone decreases and the levels of estrogens start increasing.
18. The other possible types of dominance are:
 - (i) Incomplete dominance.
e.g. Flower colour in snapdragon.
 - (ii) Codominance.
e.g. Human blood group AB.

19. Harmful effects of smoking tobacco

- (i) Nicotine stimulates the adrenal glands to secrete adrenaline and nor-adrenaline, both of which increase the blood pressure and the heart rate.
- (ii) It causes oxygen deficiency in the body by increasing the carbon monoxide content in the blood and reducing the concentration of haembound oxygen.
- (iii) It leads to cancer of throat, lungs and urinary bladder.
- (iv) It causes gastric ulcers and increased risk of coronary heart diseases.
- (v) Smoking also causes respiratory disorders like bronchitis and emphysema.
(any four)

20. – The plant cell is treated with enzyme cellulase to remove the cell wall.
- The proteins associated with the DNA are removed by treatment with proteases and the associated RNAs are removed by treatment with RNases.
 - Similarly other molecules (if any) are removed by appropriate treatments.
 - The purified DNA is precipitated by the addition of chilled ethanol and removed by spooling.
21. – Pyramid of numbers can look inverted in a tree ecosystem, where the single tree is the producer (first trophic level) and a number of insects are feeding on that tree (primary consumers or second trophic level).
- Pyramid of biomass in a sea is generally inverted because the biomass of fishes far exceeds those of the phytoplanktons, which are microscopic organisms.

OR

- Percent cover or biomass is a more meaningful measure of the population density of the single banyan tree.
 - Stating that the population density of the banyan is low relative to that of *Parthenium* amounts to underestimating the enormous role of the banyan tree in the community.
22. (a) (i) Endothecium
(ii) Middle layers
(iii) Tapetum
- (b) – The cells of tapetum possess
- dense cytoplasm and
 - more than one nucleus
- They nourish the developing pollen grains.

23. – A single DNA-dependent RNA polymerase catalyses the formation of *m*RNA, *t*RNA and *r*RNA 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.
24. (a) Paleontology is the study of fossils. It indicates:
- (i) the geological time period in which the organisms existed.
 - (ii) that life forms varied over time and certain life forms are restricted to certain geological time spans.
 - (iii) that new forms of life have appeared at different times in the history of earth.
- (b) – *Tyrannosaurus rex* was the largest dinosaur.
- About 65 mya, the dinosaurs suddenly disappeared from the earth.
25. (a) Vasectomy.
- (b) The surgical intervention blocks the transport of gametes and thereby prevents fertilisation and conception.
 - (c) In this method, a small part of the vas deferens is either removed or tied up through a small incision on the scrotum.
 - (d) The reversibility of this method is very poor (almost nil).
26. – When the human body encounters an antigenic protein of a pathogen or the pathogen for the first time, it elicits a primary response, which is of low intensity.
- On subsequent encounter with the same pathogen, the body elicits secondary or anamnestic response, which is highly intensified.
 - The primary response as well as the secondary response are carried out by specialised cells, B-lymphocytes and T-lymphocytes.
 - The B-lymphocytes produce an army of proteins, called antibodies; the T-lymphocytes only stimulate the B-lymphocytes to secrete antibodies.

OR

- (i) Statin
- (ii) It is a blood cholesterol-lowering agent.
- (iii) *Penicillium notatum*
- (iv) Penicillin
- (v) *Trichoderma polysporum*
- (vi) It is used as an immuno-suppressive agent in organ-transplant patients.

27. PCR (Polymerase Chain Reaction)

- It is the process/reaction of *in vitro* synthesis of multiple copies of the gene or DNA of interest.
- The reaction occurs in the following three steps:
 - (i) **Denaturation:** In this step, the two strands of DNA are segregated by high temperature treatment; they act as template for the synthesis of new strands.
 - (ii) **Annealing:** In this step, two sets of primers (the chemically synthesised oligonucleotides) that are complementary to the region of DNA become bonded at the complementary regions of the DNA.
 - (iii) **Extension:** In this step, the enzyme DNA polymerase extends the primers using the nucleotides provided in the reaction medium in a genomic template dependent manner.
- If this process of replication is repeated many times, a billion copies of DNA can be made; such repeated amplification is achieved by the use of thermostable DNA polymerase obtained from the bacterium, *Thermus aquaticus*.

28. Rivet-Popper Hypothesis:

- In an airplane (Ecosystem) all parts are joined together using thousands of rivets (species).
- If every passenger travelling in it, starts popping a rivet to take home (causing a species to become extinct), it may not affect the flight safety (proper functioning of the ecosystem) initially, but as more and more rivets are removed, the plane becomes dangerously weak over a period of time.
- Further, which rivet is removed may also be critical; *i.e.* loss of rivets on the wings, (key species that drive major ecosystem functions) is obviously a more serious threat to flight safety than loss of a few rivets on the seats or windows inside the plane.

29. (a) Human skin colour, height and intelligence. (any two)

OR

- Three genes
 - Seven phenotypes
- (b) 1/32

(c)	Polygenic Inheritance	Multiple allelism
	– One character is controlled by three or more genes.	– Each character is controlled by a single gene.
	– Each gene has two alleles.	– The gene exists in more than two allelic forms.
	– There is gradation in the phenotypes.	– There is no gradation in the phenotypes.

30. (a) Cowdung contains the methanogens which act on the cellulosic material in the cowdung to produce biogas; hence, there is no need to provide inoculum.
- (b) Indian Agricultural Research Institute (IARI) and Khadi and Village Industries Commission (KVIC)
- (c) – *Methanobacterium*
- The microbes at the source (rumen of cattle) help in digestion of cellulose and thereby in their nutrition.

OR

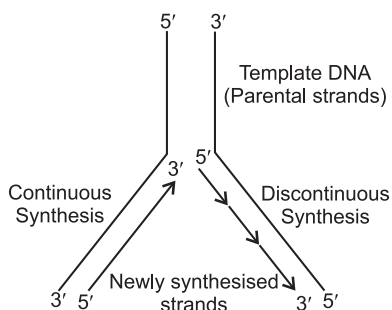
- (c) – Since cattle dung is available in large quantities in rural areas, where cattle are used for various purposes, the biogas plants are more often built in rural areas.
- The biogas produced by these plants is used as energy source for lighting and cooking.
31. (a) Biopiracy refers to the use of bioresources and traditional knowledge related to bioresources for commercial benefit by certain organisations or multi-national companies without proper consent from the countries and compensatory payment to the people concerned.
- (b) The ‘new’ variety of Basmati has been developed by crossing the Indian Basmati variety with the semi-dwarf varieties of the U.S.
- (c) 27 varieties.
- (d) Neem and turmeric
- (e) – India has framed the Indian Patents Bill.
- Recently, the parliament has cleared the second amendment of the Indian Patents Bill.

OR

- (a) The single-stranded regions formed at the ends of strands, are called ‘sticky ends’; they facilitate the action of DNA ligase to form hydrogen bonds easily with their complementary cut counterparts.

- (b) – The vector DNA is cut at a specific site by the use of a restriction endonuclease.
 – The gene of interest is ligated to the vector with the help of DNA ligase.
- (c) Two fragments are formed as given below:
- (i) 5' A T T T T G A G _____ 3'
 3' T A A A A C T C C T A G 5'
- and
- (ii) 5' G A T C C G T A A T G T C C T 3'
 3' _____ G C A T T A C A G G A 5'
- (d) – BamHI site is present in the coding sequence of the tetracycline-resistance gene; hence, the recombinant will lose the resistance to tetracycline due to insertional inactivation of the tetracycline-resistance gene.
 – The recombinants can be selected from the non-recombinants by plating the culture on a medium containing the antibiotic tetracycline; only the non-recombinants will be able to grow and not the recombinants.

32. (a)



- (b) – The new strand synthesised on the template strand with 3' → 5' polarity, is synthesised continuously.
 – The new strand synthesised on the template strand with 5' → 3' polarity, is synthesised as short stretches, called Okazaki fragments, which later become joined to form the lagging strand.
- (c) The enzymes involved in this process are
- (i) DNA-dependent DNA polymerase and
- (ii) DNA ligases.
- (d) *Vicia faba* (faba beans)

OR

(a) DNA Fingerprinting

The steps/procedure in DNA-fingerprinting include the following.

- (i) Isolation of DNA from the sample.
 - (ii) Digestion of DNA by restriction endonucleases.
 - (iii) Separation of DNA fragments by electrophoresis.
 - (iv) Transferring (blotting) of the separated DNA fragments to synthetic membranes, such as nylon or nitrocellulose.
 - (v) Hybridisation using labelled VNTR probe.
 - (vi) Detection of the hybridised DNA fragments by autoradiography.
- (b) – Single base differences in DNA, are called single nucleotide polymorphisms (SNPs).
- They are located in about 1.4 million locations in human genome.

33. (a) The outbreeding devices are as follows:

- (i) Self-incompatibility is the genetic mechanism that prevents self-pollen from fertilising the ovule by inhibiting pollen germination or retarding the growth of pollen tube.
 - (ii) Certain plant species produce male and female flowers on different plants, *i.e.* the plants are dioecious; this prevents both autogamy and geitonogamy.
 - (iii) Pollen release and stigma receptivity are not synchronised; either the anthers mature first or the pistil/gynoecium matures first.
 - (iv) The anthers and stigma of a flower are placed in such a way that the pollen of the flower cannot fall on the stigma of the same flower.
- (b) (i) Nectar and edible pollen grains are the most common rewards, the flowers offer to their insect pollinators.
- (ii) Flowers also provide safe place for oviposition, *i.e.*, laying eggs; the developing larvae feed on some of the developing seeds.

OR

- Oogenesis is the process of formation of mature female gametes or ova.
- Oogenesis is initiated during the embryonic developmental stage of a female foetus.
- Oogonia formed in ovary of the foetus start division and enter prophase I of meiosis and remain suspended at that stage; these are called primary oocytes.

- Each primary oocyte is surrounded by a layer of granulosa cells and becomes the primary follicle.
- When a primary follicle becomes surrounded by more layers of granulosa cells and a theca, it is called a secondary follicle.
- The secondary follicle transforms into a tertiary follicle, with the development of a fluid-filled cavity (antrum) around the primary oocyte.
- The theca becomes organised into an outer layer, called theca externa and an inner layer, called theca interna.
- At this stage the primary oocyte grows in size and completes meiosis I and forms a larger haploid secondary oocyte and a tiny first polar body.
- The tertiary follicle grows further and changes into the mature follicle or Graafian follicle; the secondary oocyte secretes a new membrane, called zona pellucida around it.
- At this stage, the follicle ruptures to release the secondary oocyte (i.e., ovulation) which moves into the fallopian tube.
- When a sperm enters the cytoplasm of the secondary oocyte, it completes meiosis II, resulting in an ootid (ovum), and a second polar body.