Answers to RBI–DS2/Set-2

1. (*c*) The generative cell has abundant reserve food material and it floats in the cytoplasm of the vegetative cell.

2. (*a*) Lysine and Arginine

3. (*b*) 50 red-flowered : 100 pink-flowered

4. (*b*) they share a common ancestor

5. (*a*) lactose is present and it binds to the repressor.

6. (*b*) A – 3, B – 4, C – 2, D – 1

7. (*c*) *Lupinus arcticus*

8. (*c*) Anaphase I

9. (*d*) Both (*a*) and (*b*)

10. (*a*) introducing rDNA into plant cells

11. (*a*) A – 2, B – 3, C – 4, D – 5

12. (*a*) inorganic nutrients from humus

13. (*a*) Both A and R are true and R is the correct explanation of A.

14. (*a*) Both A and R are true and R is the correct explanation of A.

15. (*b*) Both A and R are true but R is not the correct explanation of A.

16. (*b*) Both A and R are true but R is not the correct explanation of A.

17. – Corpus luteum is formed from the ruptured Graafian follicle, under the influence of luteinising hormone.
– It is formed after ovulation during luteal phase of menstrual cycle.
– It regresses if fertilisation has not occurred and the level of luteinising hormone decreases.

18. (*a*) – In cross A – Brown body (y^+) and red eyes (w^+)
– In cross B – Red eyes (w^+) and normal wings (w^+)
(*b*) – In cross A – 1.3%
– In cross B – 37.2%

19. An auto-immune disease is produced when the immune system goes off the track and starts attacking the 'self' cells, due to genetic or other unknown reasons, *e.g.* Rheumatoid arthritis.

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:

5′ — G ↓ A A T T C — 3′

3′ — C T T A A ↑ G — 5′

– 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*) Standing crop is measured as

(*i*) biomass, *i.e.* mass of living organisms in an unit area

(*ii*) number of organisms in an unit area.

(*b*) Measurement of biomass in terms of dry weight is more accurate because it avoids variations in weight due to seasonal moisture differences.

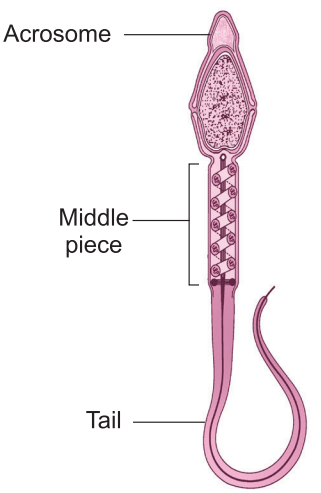
OR

(*a*) (*i*) In aquatic ecosystem, the pyramid of biomass is inverted, where a small standing crop of phytoplanktons supports a larger standing crop of zooplanktons.

(*ii*) In terrestrial ecosystem, the pyramid of numbers is inverted, where a large number of insects feed on the leaves of a single tree.

(*b*) No, the pyramid of energy will be upright; because when energy flows from one trophic level to the next higher trophic level, some amount of energy is always lost.

22.



(*i*) Acrosome contains enzymes that help in dissolving egg envelopes and gain entry into the cytoplasm of the ovum for fertilisation.

(*ii*) Middle piece contains a number of mitochondria and provide energy for the movement of sperm in the female genital tract, towards the ovum.

(*iii*) Tail – The movement of tail is responsible for the motility of sperm towards the ovum.

23. – Implantation occurs at the blastocyst stage.

– The trophoblast layer of the blastocyst gets attached to the endometrium.

– The uterine cells divide rapidly and cover the blastocyst.

– So, the blastocyst becomes embedded in the endometrium of uterus, *i.e.* implantation has occurred.

24. (*a*) **Linkage**

– Morgan coined the term linkage for the physical association of the genes present on a chromosome.

– The genes studied by Morgan showed linkage and did not segregate independently of each other; hence, the dihybird ratio deviated from that of Mendel's experiments.

Recombination

– The term recombination refers to the non-parental gene 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 found that genes for white eye and miniature wings showed 37.2% recombination, whereas genes for yellow body and white eye showed only 1.3% recombination.

(*b*) Sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of distance between the genes and mapped their position on the chromosome.

25. (*a*) – During the post-industrialisation period, the tree trunks became dark due to deposition of industrial smoke and soot.

– The dark-coloured moths were able to camouflage better and were not picked up by the predators and hence, increased their population size.

(*b*) – *Coelacanth* has evolved into the first amphibians; they are fish with stout and strong fins that could move on land and go back to water.

– They were thought to be extinct, but were caught in the year 1938 in South Africa.

(*c*) *Ichthyosaurs.*

26. (*a*) (*i*) LAB increase the nutritional quality of curd by increasing the content of Vitamin B_{12}.

(*ii*) They also check the growth of disease-causing microbes in our gut.

(*b*) *Propionibacterium sharmanii*

27. – Cotton plants resistant to insect pests like lepidopterans have been raised through recombinant DNA technology using the genes from the bacterium, *Bacillus thuringiensis*, which produces Bt-toxins.

– These genes *cryIAc* and *cryIIAb*, encoding the Bt toxins, have been isolated from the bacterium and incorporated into cotton plants.

– These genes code for the insecticidal crystal protein that is ingested by the insect pest along with the plant parts.

– The inactive toxin is converted into its active form by the alkaline pH of the gut.

– The active form of the toxin binds to the surface of the midgut epithelial cells and creates pores that cause swelling and lysis of the cell and eventually kills the insect pest (lepidopterans).

OR

(*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).

28. Genetic diversity

– It refers to the high diversity of a species at the genetic level over its distributional range. *e.g.* India has more than 50,000 genetically different strains of rice.

Species diversity

– It refers to the diversity at species level, *i.e.*, the number of different species in a given region, *e.g.* Western Ghats have a greater amphibian species diversity than Eastern Ghats.

Ecological diversity

– It refers to the diversity at the ecosystem level, *i.e.*, presence of different types of ecosystems in a given landscape. *i.e.*, India has a number of ecosystems like rain forests, coral reefs, deserts, wetlands, etc.

29. (*a*) – The equation describes exponential growth.

– Such a growth pattern occurs, when the resources in the habitat are unlimited.

OR

'r' represents the 'intrinsic rate of natural increase'.

(*b*) It is an important parameter for assessing the impacts of any biotic and abiotic factor on population growth, i.e., increase or decrease in N during the given time period.

(*c*) – This growth pattern is not realistic.

– Since, the resources are finite and become limiting sooner or later, the population growth will be severely impacted.

30. (*a*) Hind II

(*b*) – Plasmids have the ability to multiply within the bacterial host cell independently of the genomic DNA of the bacterium.

– They provide origin of replication.

(*c*) (*i*) Biolistics/gene gun is the method in which the plant cells are bombarded with high velocity microparticles of gold or tungsten coated with the alien/recombinant DNA.

(*ii*) By using the Ti plasmid from *Agrobacterium tumefaciens*, after disarming the pathogen.

OR

(*c*) – Gene cloning refers to making multiple copies of a gene/DNA of interest.

– Polymerase chain reaction (PCR) is carried out *in vitro* for gene cloning.

– Taq polymerase, a thermostable DNA polymerase is the enzyme used in this process.

– It is obtained from the bacterium, *Thermus aquaticus*.

31. (*a*) 360 megaspore mother cells are involved.

– Though each megaspore mother cell produces four magaspores after meiosis, three of them degenerate and only one remains functional.

(*b*) 360 pollen grains are necessary.

– Each pollen grain produces two male gametes, both of which are involved in the double fertilisation of an ovule.

(*c*) 1080 gametes, i.e., 360 female gametes and 720 male gametes are involved.

– During double fertilisation, one of the male gametes fuses with a female gamete (syngamy) to form a diploid zygote.

– The second male gamete fuses with the secondary nucleus (formed by the fusion of two haploid polar nuclei) (triple fusion), to form a triploid primary endosperm nucleus (PEN).

(*d*) 450 meiotic divisions

– 90 pollen mother cells undergo meiosis to form 360 pollen grains to fertilise 360 ovules.

– 360 megaspore mother cells undergo meiosis; only one megaspore mother cell is differentiated in each ovule and each megaspore mother cell produces only one functional megaspore.

OR

(*a*) The seminal analysis determines the number of sperms in an ejaculate, their morphology and motility.

(*b*) It indicates slow rate of maturation of follicles in the ovary.

(*c*) Intra-cytoplasmic sperm injection (ICSI) and Intra-uterine Insemination (IUI).

– ICSI is a specialised procedure to form an embryo in the laboratory, in which a sperm is directly injected into the ovum.

– IUI involves the transfer of embryo with more than eight blastomeres into the uterus of the recipient female

(*d*) During ovulatory phase of menstrual cycle.

(*e*) Progesterone

32. (*a*) Wolf is a placental mammal and Tasmanian wolf is a marsupial mammal.

(*b*) – Both marsupial mammals and placental mammals exhibited adaptive radiation in the Australian continent.

– When more than one adaptive radiation has occurred in an isolated geographical region, it is called convergent evolution.

– They have evolved adaptations to the given habitat and look similar.

(*c*) – Kangaroo, Koala, Banded anteater, Tiger cat, Spotted cuscus. (*any four*)

OR

(*a*) – Permease facilitates the permeability of lactose into the cell; so, lactose cannot enter the cell.

– Lactose is the inducer of *lac* operon and in the absence of lactose, the *lac* operon cannot be switched on.

(*b*) – The abnormal repressor cannot bind to the operator of the *lac* operon; hence, the RNA polymerase is free to transcribe the structural genes and transcription continues.

(*c*) – The operon will not be expressed;

– Galactose is not the inducer to bind to repressor; it is a product of hydrolysis of lactose.

33. (*a*) – The drug shown in the figure is morphine.

– *Papaver somniferum* is its source plant.

(*b*) It is used as a sedative and painkiller for patients who have undergone surgery.

(*c*) – 'Smack' is chemically diacetylmorphine.

– Its physical features include:

(*i*) white in colour, (*ii*) odourless

(*iii*) bitter to taste (*iv*) crystalline in nature

OR

(*a*) (*i*) Marijuana

– The source plant is *Cannabis saliva*.

– It affects the cardiovascular system of the body.

(*ii*) Cocaine

– Its source plant is *Erythroxylum coca*

– It has a potent stimulating effect on the central nervous system and produces a sense of euphoria

(*b*) *Atropa belladona* and *Datura*.

(*c*) The various routes of transmission of human immunodeficiency virus include:

(*i*) sexual contact with the infected person.

(*ii*) by transfusion of contaminated blood and blood products.

(*iii*) from infected mother to the child through the placenta.

(*iv*) through contaminated needles and syringes.