Answers to RSPL/3

SECTION–A

1. They are present on the surface of plasma membrane of RBCs.

2. Seed ferns.

3. Mutation can be induced by

(*a*) use of chemicals.

(*b*) use of radiation like gamma radiation.

4. Butterflies and bees only forage for nectar in flowers and do not eat any part of the plant.

5. Polyblend enhances the water repelling property of bitumen and increases the life of road.

SECTION–B

6. Geitonogamy refers to the transfer of pollen grains from the anthers of one flower to the stigma of another flower of the same plant and is a type of self-pollination. Whereas Xenogamy refers to transfer of pollen grains from the anthers of one flower to the stigma of another flower on a different plant of the same species and is a type of cross-pollination.

7. Variable number of tandem repeats– VNTR.

VNTR is a class of satellite DNA where a small sequence is arranged tandemly in many copy numbers whereas probe is a labelled VNTR used for hybridisation with DNA segments.

8. (*i*) sporozoites

(*ii*) gametocytes

9. Pectinase is an enzyme that breaks down pectin and used as clarifying agents in making commercial fruit and vegetable juices.

10. Species diversity decreases from Equator region towards poles because equator regions have less seasonal or more constant environments, which promote niche specialisation and thereby more species diversity. These regions have more solar energy which contributes to more productivity and greater diversity.

e.g The tropics harbours more species than temperate and polar regions. Columbia situated near equator has about 1400 species of birds while New York has about 56 species.

OR

The DDT concentration increases because it cannot be metabolised, nor can it be excreted out of body. It is therefore passed on to the next trophic level, the phenomenon of passing DDT conc. from one trophic to another is called biomagnification.

SECTION–C

11. The diploid megaspore mother cell divides meiotically and forms four megaspores,which are usually arranged in a longitudinal row. Out of four megaspores formed, three degenerate. The remaining one acts as functional megaspore. The nucleus of functional megaspore undergoes three successive mitotic divisions forming eight haploid nuclei,which get organised into three groups-three nuclei migrate to the micropylar end and form the egg apparatus. Three migrate towards chalazal end and form antipodal cells. Two polar nuclei fuse to form a diploid secondary nucleus in the centre.

12. **Aneuploidy:** It is the phenomenon of loss or gain of one or more chromosomes from any pairs of chromosomes in a diploid cell.

It arises due to failure of segregation of one or more pairs of homologous chromosomes.

Polyploidy: It is the presence of three or more sets of chromosomes in an organism.

It arises due to failure of chromosomes to separate at the time of cell division.

13. DNA attaches to proteins called histones which are positively charged (rich in arginine). These histone proteins are organised to form histone octamer called a nucleosome around which negatively charged DNA is wrapped. Repeating units of nucleosomes constitute chromatin fibres and further coiling forms chromosome.

14. It depict changes/adaption in the butterfly due to environmental changes. Industrial melanism is an adaptation where the moths living in the industrial ares developed melanin pigments to match their body to the tree trunk that were covered with black soot.

Before industrialisation there used to be a thick growth of almost white coloured lichens on the tree trunks. In the same background, the white winged moths survived better;the dark coloured moths were easily spotted and picked by predators.

During the post industrialisation period, the trunks became dark with industrial smoke and white winged moths did not survive as they were easily spotted by predators while the dark winged moths survived as they could not be easily detected against a dark background due to air pollution.

15. After entering the body of a person, the virus enters the macrophages.

The viral genome undergoes replication and reverse transcription to become viral DNA with the help of reverse transcriptase enzyme. The viral DNA gets incorporated into the DNA of the host cells and directs these cells to produce viruses.

The macrophages function as HIV factory and produce a number of HIV virus. HIV virus which move out of macrophages and infect the helper T-lymphocytes and replicate to produce progeny viruses.

The progeny viruses released in the blood attack new helper T-cells which results in the decreasing number of helper T-cells in the body.

OR

(*i*) *Cannabis sativa*

(*ii*) The plant parts used are flower tops and leaves/resins.

(*iii*) Cardiovascular system is most affected by this compound.

16. Resistance to insect pests is genetically controlled and manifested in the form of morphological, physiological or biochemical characteristics.

Crop	Morphological/Physiological control	Resistance to
Wheat	Hairy leaves	Cereal leaf beetle
Maize	High aspartic acid and low nitrogen and sugar contents	Stem borer
Cotton	Hairy leaves	Jassids

17. Streptococcus.

Streptokinase enzyme is produced by this bacterium used as a clot buster for removing clots from the blood vessels of patients who have undergone myocardial infaction leading to heart attack.

18. Insertional inactivation is an efficient method to identify transformants. In this method, a recombinant DNA is inserted in the gene which inactivates the functioning of a particular gene.

Selectable markers have been developed which differentiate recombinants from non-recombinants on the basis of their ability to produce colour in the presence of a chromogenic substrate. A recombinant DNA is inserted within the coding sequence of an enzyme B-galactosidase which results into inactivation of the enzyme. Chromogenic substrate is used to identify the insertion of recombinant DNA. Presence of an insert results into insertional inactivation and white colonies are produced while the plasmid in the bacteria which does not have an insert, gives blue coloured colonies.

19. The product has to be subjected through a series of processes called downstream processing that includes separation and purification. The product has to be formulated with suitable preservatives. These formulations have to undergo through clinical trials as in the case of drugs and strict quality control testing for each product is carried out.

The down stream processing and quality control test keep varying for each product.

20. Nematode-resistant tobacco plants are produced through RNA interface. The process RNA interface (RNAi) involves:

- A complementary double-stranded RNA binds to the mRNA and prevents translation.
- 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 were introduced into the host plant by the use of *Agrobacterium* vectors.
- The introduction of DNA is such that it produced both sense and anti-sense RNA in the host cells.
- These two RNAs are complementary to each other and hence form a double stranded RNA, which initiates the RNA interface and silencing of mRNA.
- The parasite cannot live in such a transgenic host that expresses the specific interfering double stranded RNA, so, the transgenic plant is protected from the nematode.

21. (*i*) a = Unlimited food and space

b = Limited food and space

(*ii*) a – Exponential growth curve

b – Logistic growth curve

In normal environment, logistic growth curve is considered more realistic because food for the animals is finite.

(*iii*) $\frac{dN}{dt} = rN\frac{K - N}{K}$

[N = Population density at time t, r = intrinsic rate of natural increase,
K = carrying capacity]

22. Ecological pyramids are graphical representation designed to show the biomass or productivity at each trophic level in a given ecosystem.

Pyramid of numbers shows graphically the population of each level in a food chain

Pyramid of biomass shows the relationship between biomass and trophic level by quantifying the amount of biomass present at each trophic level.

Pyramid of energy shows graphically the amount of energy present at each level in a given time.

Limitations:

(*i*) They do not take into account the same species belonging to two or more trophic levels.

(*ii*) It assumes a simple food chain whereas in nature it does not exist and saprophytes and decomposers are not given any place in ecological pyramids.

SECTION–D

23. (*a*) Assisted Reproductive Technology.

(*b*) Methods are:

(*i*) Test tube baby programme which includes In vitro Fertization (IVF) and Zygote or embryo transfer

(*ii*) Gamete Intra Fallopian Transfer (GIFT)

(*iii*) Intracytoplasmic Sperm Injection (ICSI)

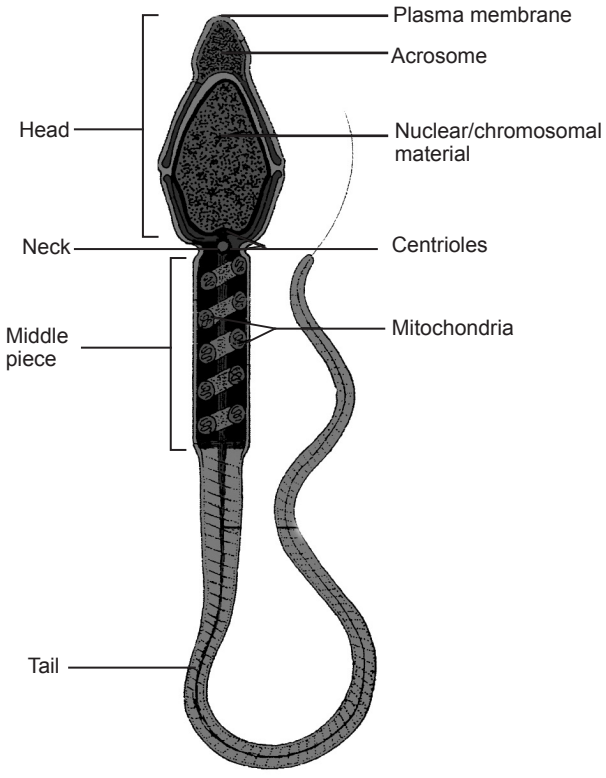
(*iv*) Artificial Insemination methods

(*c*) These techniques require extremely high precision handling by specialized professionals and expensive instrumentation. Therefore, these facilities are available only in a very few centres and treatment cost is high. Emotional, religious and social factors play a major role for the acceptance of these methods.

(*d*) Practical approach and sympathetic attitude.

SECTION–E

24.



A Human Spermatozoan

Functions:

(*i*) The anterior end of sperm's head has a cap like structure called acrosome which contains enzymes that help in dissolving membranes of the ovum for fertilisation.

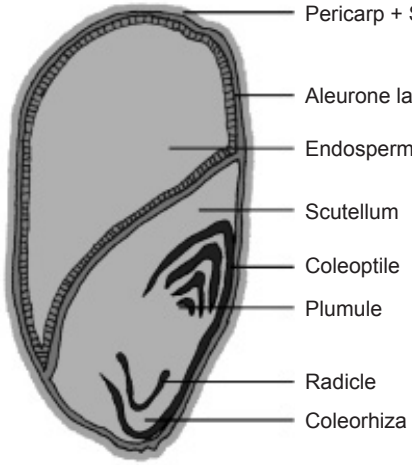
(*ii*) Neck contains centriole which is necessary for the first cleavage division of a zygote.

(*iii*) Middle piece contains a number of mitochondria that provide energy for the motility of sperms.

(*iv*) Tail helps the sperm to move towards the female gamete for fertilisation.

OR

(*a*)



V. S. of Maize Grain

(*any six*)

(*b*) (*i*) The exine of pollen grain is made of sporopollenin which can withstand high temperature and action of strong acids and alkalies. No enzyme can degrade sporopollenin and hence pollen grains are preserved as fossils.

(*ii*) Pollen grains are rich in nutrients and therefore, they are used as food supplements in the form of tablets.

25. Semi-conservative replication describes the mechanism by which DNA is replicated in which one strand of the daughter duplex is derived from the parent while the other strand is newly synthesised.

Mathew Meselson and Franklin Stahl performed the experiment:

- They grew *E.coli* in a medium containing $^{15}NH_4Cl$, until ^{15}N was incorporated in the two newly formed *E.coli* cells; this heavy DNA can be separated from the normal ^{14}N-DNA by centrifugation in Cesium Chloride density gradient.
- Then the cells were transferred into a medium with normal $^{14}NH_4Cl$. Samples were taken out at various time intervals.
- The DNA was extracted and centrifuged to measure the densities.
- The DNA extracted from the ^{15}N medium to ^{14}N medium (i.e. after about 20 minutes), had an intermediate/hybrid density.

- The DNA extracted after two generations (i.e. after 40 minutes) consisted of equal amounts of light DNA and hybrid DNA.
- This proves that after replication, each DNA molecule has one parental strand and one newly-synthesised strand, i.e. replication is semi-conservative.

OR

Symptoms of:

(*i*) **Haemophilia:**

There is continuous bleeding in case of any injury in the affected individual since a protein necessary for blood clotting is absent.

(*ii*) **Sickle cell anaemia:**

The RBCs become sickle-shaped and the oxygen transport to the tissues and organs are impaired. The body lacks sufficient amount of oxygen.

Inheritance pattern of:

(*i*) **Haemophilia:**

It is due to a defective recessive allele present on the X chromosome i.e it is a sex-linked disorder.

The female parent passes on the disorder to male progeny,but father never passes it on to the male progeny. More males than females are affected by this disorder.

(*ii*) **Sickle cell anaemia**

It is due to point mutation, i.e a single base pair change leading to a change in an amino acid,it is an autosomal disorder.

The female parent passes on the disorder to male or female progeny in equal frequency and father also passes on the disorder to male or female progeny.

Both males and females are affected equally.

26. (*a*) The type of interaction is mutualism because both the fig tree and the wasp are benefitted.

The female wasp uses the ovary as a site for oviposition and the developing seeds within the fruit for nourishing the larvae. The fig inflorescence is pollinated while the wasp is searching for the suitable place for egg laying.

(*b*) Heat loss or heat gain is a function of surface area.

Since small animals have a large surface area relative to their volume they lose body heat very fast.

Larger animals have a ratio of surface area to volume of the body much smaller compared to small animals and hence thermoregulation in them is more effective.

OR

(*a*) The process of hydric habitat changing to a meric habitat:

Phytoplanktons	(Pioneer community)
↓	
Floating angiosperms	
↓	
Rooted hydrophytes	(Seral communities)
↓	
Sedges	
↓	
Grasses	
↓	
Shrubs and trees	(Climax community)

(*b*) The process of xerarch succession:

Lichens	(Pioneer community)
↓	
Bryophytes (mosses)	
↓	
Herbaceous plants	(Seral communities)
↓	
Shrubs (bushes)	
↓	
Trees (forest)	(Climax community)

Succession stops when the sere has arrived at an equilibrium with the physical biotic environment. The final or stable community in a sere is the climax community and has a wide diversity of species.

Therefore, it can be said that all successions leads to similar climatic community.

The climax community remains stable as long as the environment remain unchanged.