Answers to RSPL/1

SECTION–A

1. Male (Klinefelter's syndrome).

2. Basmati rice variety.

3. (*a*) *Australopithecus africanus*

(*b*) *Homo habilis*

4. 99% of the particulate matter present in the exhaust of a thermal power plant is removed by electrostatic precipitator. In its absence, these particulates will remain in the air as pollutants.

5. Biofortified maize has twice the amount of amino acid, lysine and tryptophan compared to normal existing varieties. Wheat with high protein content has been developed from wheat variety, Atlas 66.

SECTION–B

6. In case of pollination by abiotic agents many pollen grains fail to reach the stigma of bisexual flowers. So to compensate for loss of pollen grains during transport, a large number of pollen grains are produced whereas in case of pollination by biotic agents there is less wastage of pollen grains.

7. It is a DNA sequence that provides binding site for RNA polymerase for transcription. It is located towards the 5′ end (upstream) of the structural gene.

8. (*a*) Typhoid (*b*) AIDS

9. **Primary sludge:** The solids (soil and small pebbles) that settle after primary sewage treatment constitute primary sludge.

Activated sludge: The effluent is passed into a settling tank and sediments formed by the bacterial flocs during secondary sewage treatment, constitute activated sludge.

10. *Ex situ* conservation as in this method, the endangered animal is taken out from the natural conservation, habitat and placed where they can be protected and given special care.

In *In situ* conservation, the endangered species is protected in its natural habitat by maintaining the habitat (whole ecosystem and biodiversity) itself.

Ex situ is a desirable approach.

OR

It reduces the number of organisms sensitive to high temperature because high temperature decreases dissolved oxygen content and aerobic decomposition is replaced by fermentation and putrefaction. Thus, most organisms may get killed and this may change the growth of aquatic plants and fish.

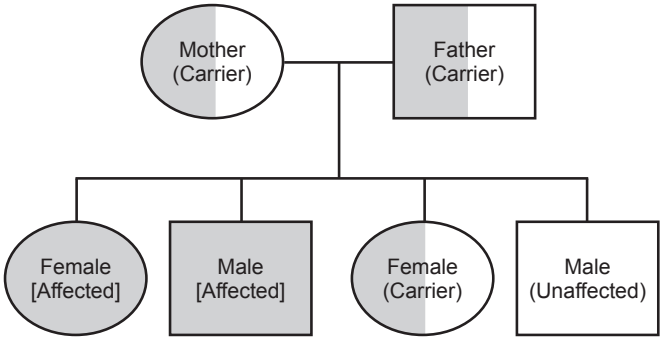
SECTION–C

11. The three strategies are:

- The release of pollen and receptivity of sigma are not synchronised. Either, the anther matures first or the stigma.
- The positions of anthers and stigma are placed differently so that the pollen cannot come in contact with the stigma of the same flower.
- A genetic mechanism that prevents self pollen from fertilsing the ovule either by inhibiting pollen germination or by retarding the growth of pollen tube know as self incompatibility.

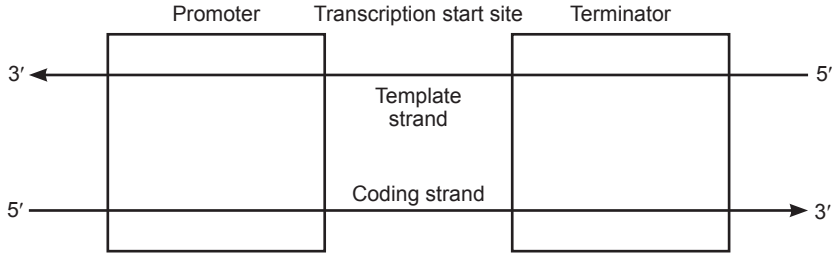
12. **Sickle cell anaemia** is an autosome linked recessive trait that can be transmitted from parents to the offspring when both the partners are carriers for the gene.
The disease is controlled by a single pair of allele Hb^A and Hb^S (heterozygous Hb^A Hb^S). Hb^SHb^S (homozygous) show the diseased phenotype.
The defect is caused by the substitution of glutamic acid by valine at the sixth position of the beta-globin chain of the haemoglobin molecule. This gene is found on the 11th chromosome.

Pedigree Chart:



Both the parents are carriers (Hb^A Hb^S). They may produce homozygous normal (Hb^A Hb^A), heterozygous carriers (Hb^A Hb^S) and homozygous sickle cell (Hb^S Hb^S) individuals (offspring).

13. (*a*)



(*b*) Promoter gene function: It is the binding site for RNA polymerase.

14. – Adaptive radiation is the evolutionary process in which a common ancestor evolves into a number of species, in a given geographical area, starting from a part and literally radiating to other areas of geography.

– When more than one adaptive functional structures appear in different group of organisms and these occur in an isolated geographical area, representing different habitats, it is called convergent evolution.

e.g. Australian marsupials and placental mammals like placental wolf and Tasmanian wolf-marsupial are different from the other though they have evolved from common ancestral stock, have similar functional structures living in similar habitats but different continents.

15. Lymphoid organs are those organs where origin or maturation and proliferation of lymphocytes occur, hence lymph nodes and bone marrow are called lymphoid organs. Main lymphoid organ is the bone marrow where blood cells and lymphocytes are produced.

Lymph nodes serve to trap the micros-organisms or other antigens that enter the lymph and thus acts as a filter. It is the secondary lymphoid organ that produce plasma cells to cause immune response.

OR

(a) High dosage of cocaine causes hallucination.

(b) Tobacco contains nicotine, an alkaloid which stimulates the adrenal glands to secrete adrenaline and nor-adrenaline which increase the blood pressure and heart rate.

Lung cancer is caused by smoking of cigarette and cancer of oral cavity is also caused by chewing of tobacco. Thus, it is injurious to health.

16. The crossing between different breeds is called outbreeding.

– The three outbreeding practices are outcrossing, cross-breeding and interspecific hybridisation.

– The practice of mating of animals of the same breed but have no common ancestor on either side of their pedigree for 4–6 generations is outcrossing

– Cross-breeding is a method in which superior males of one breed are mated with the superior females of another breed of the same species.

– Interspecific hybridisation is a method in which male and female animals of two different species are crossed to combine the desirable features of both the parents into one.

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. (*a*) DNA is a hydrophilic molecule so it cannot pass through cell membrane. Hence, to force the bacteria to take up the alien DNA, the cells must be made competent by treating it with a specific concentration of a divalent cation such as calcium. This increases the efficiency of the DNA to enter the bacterium through cell wall.

(*b*) *Agrobacterium tumefaciens* is considered a good cloning vector because it is able to deliver a piece of DNA called T-DNA into a plant cells and transform them into tumour cells on infection. It also dictates the host cells to synthesis its nutrients.

19. (*a*) Plasmid DNA – It is used for constructing recombinant DNA, by ligating the gene of interest with it.

(*b*) Recognition sequence- These are sequences of base pairs in DNA, where a restriction enzyme cuts the DNA.

(*c*) The DNA fragments are separated according to their size through the sieving effect of gel by Gel Electrophoresis.

20. **Gene therapy:** In this method, genes are inserted into the cells and tissues of an individual to replace a faulty gene and to correct certain hereditary diseases.

The first clinical gene therapy was given in 1990 to a four year old girl with ADA (Adenosine Deaminase) deficiency.

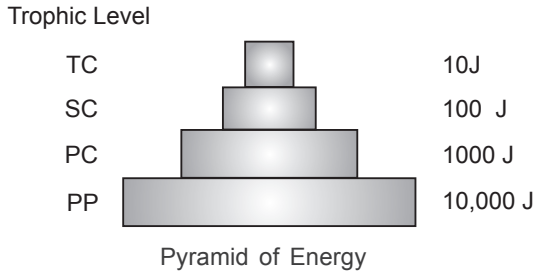
ADA deficiency has been corrected by gene therapy. It is a temporary cure as these cells do not remain alive for long time.

Correction of a genetic defect involves the delivery of a normal gene in the individual at the embryonic stage to replace the defective mutant allele of the gene.

21. (*a*) The monarch butterfly is highly distasteful to its predators because of a chemical present in its body which is acquired by it at the caterpillar stage by feeding on a poisonous weed.

(*b*) 'r' is intrinsic rate of natural increase.

22.



Pyramid of Energy

PP Primary Producers, PC-Primary Consumers, SC-Secondary Consumers, TC-Tertiary Consumers.

Pyramid of energy is a graphical representation showing different tropic levels of the food chain. It shows the amount of energy accumulated per unit area at each level.

SECTION–D

23. (*a*) Amrita's health would improve if the next pregnancy is delayed because it will give her body a chance to recover from deficiency of various nutrients. Her bones would have become weak as lot of calcium was directed towards development of foetus bones.

(*b*) The various ways by which gap between two children can be kept are:

(*i*) **Physical barrier:** Use of male/female condom does not allow sperm to come in contact with ovum.

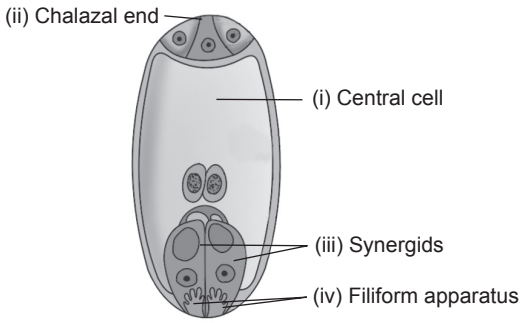
(*ii*) **Chemical methods:** Use of contraceptive pills by the female partner keeps the progesterone levels high and prevents ovulation.

(*iii*) **Intra uterine devices (IUD):** Cu T, Lippes loop etc. do not allow implantation of the foetus in the uterus.

(*iv*) **Surgical method:** Vasectomy in males in which vas deferens is cut and tied. Tubectomy in which fallopian tube is cut and tied.

SECTION–E

24. (*a*)



A fully developed embryo sac

(*b*) **Megaspore mother cell:** Nucleus of megaspore mother cell undergoes three mitotic division. Two cells move to opposite end of the cell and then undergoes two successive mitotic divisions to form an 8 nucleate structure (embryo sac), after nuclear division cell formation takes place. Three cells group together at micropylar end, egg apparatus with an egg cell and two synergids. Three cells group at chalazal end (Antipodal cells) and two nuclei move to centre to form polar nuclei.

It undergoes meiosis to form 7-celled 8 nuclei in the embryo sac.

Roles of various cells:

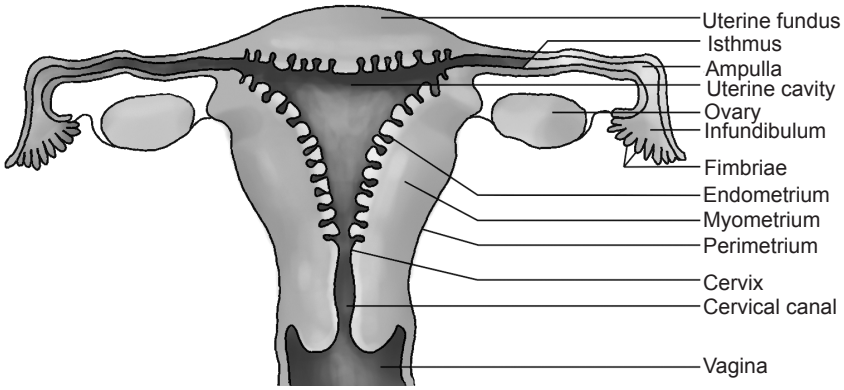
(*i*) Polar nuclei fuses with a male gamete to form triploid endosperm.

(*ii*) Egg cell fuses with male gamete to form zygote.

(*iii*) Synergids guides the pollen tube near the micropylar end. (*any two*)

OR

(*a*)



Human Female Reproductive System

(*b*) **Trophoblast:** Outermost layer of cells of the blastocyst. It gets attached to the endometrium and forms the foetal part of placenta.

Inner cell mass: Inner group of cells attached to trophoblast at one end. It forms the germ layers and the embryo proper.

25. (*a*) **Repetitive DNA** is that part of DNA which contains same sequence of bases repeated several times and exists as light bands during CsCl density gradient analysis whereas satellite DNA sequences which do not code for any protein and appears as small dark bands during CsCl density gradient analysis.

Satellite DNA: It refers to those repetitive DNA sequences which do not code for any protein, but form a large portion of the gene.

(*b*) Satellite DNA can be isolated by density gradient centrifugation; satellite DNA forms smaller peaks while the genomic DNA forms a major peak.

(*c*) (*i*) They form very useful identification tools.

(*ii*) It is the basis of paternity testing,in case of any family disputes (genetic mapping).

OR

(*a*) **Synthesis of mRNA:** RNA polymerase II transcribes a precursor of mRNA called hnRNA. This primary transcript contains both exons and introns and is non-functional. So it has to undergo splicing i.e removal of introns and joining of exons to form functional RNAs. After splicing, the hnRNA (hetrogeneous nuclear RNA) has to undergo capping and tailing. The ends are joined/sealed by RNA bigase. This fully processed hnRNA is now called mRNA and is ready for release into cytoplasm for translation.

(*b*) **mRNA synthesis in prokaryotes:** There is a single RNA polymerase to catalyse formation of all types of RNAs. There is no need for splicing, as information is continuous. There is no capping and tailing of RNA transcript.

26. The stepwise process of decomposition are:

(*i*) **Fragmentation:** It is the process of breaking of the detritus into smaller particles by detritivores like earthworm.

(*ii*) **Leaching:** It is the process in which water soluble inorganic substances run down into soil horizon and get precipitated as unavailable salts.

(*iii*) **Catabolism:** The enzymatic conversion of the detritus into simple organic compounds and then into inorganic compounds is called catabolism.

(*iv*) **Humification:** It leads to the accumulation of a dark coloured amorphous substance called humus during decomposition.

(*v*) **Mineralisation:** It is the process in which the humus is degraded by certain microbes and the inorganic nutrients are released.

OR

(*a*) The pioneers are the small phytoplanktons. They are replaced by free floating angiosperms, rooted hydrophytes, sedges, grasses and finally trees, the climax would be a forest. From a water body, it becomes a land (mesic condition)

Phytoplanktons (pioneer community)
↓
Floating angiosperms
↓
Rooted hydrophytes
↓
Sedges
↓
Grasses
↓
Shrubs and trees (climax community)

(*b*) Secondary succession is faster than primary succession because there is soil present and seeds and other propagules may also be present.

Primary succession occurs in an area where no living organisms ever existed. It takes a very long time because soil is essential for establishing a biotic community. Secondary succession being in areas where natural biotic communities have been destroyed due to forest fire or heavily overgrazed area or other factors and is biologically fertile. Since some soil or sediment is already present in secondary succession, it is faster than primary succession.