

Answers to RSPL/2

1. Law of Segregation states that the members of the allelic pair that remained together in the hybrid, segregate or separate during gametogenesis and enter different gametes.
2. (i) Engineered vectors help easy linking of foreign DNA.
(ii) They facilitate selection of recombinants from non-recombinants.
3. Gametogenesis and gamete transfer.
4. Heat loss/gain is the a function of body surface area. Since large animals have a smaller surface area to volume ratio, they do not lose body heat fast while small animals have a large surface area as compared to their volume and lose body heat fast. Hence thermoregulation is more effective in large animals.
5. (i) The plane of one base pair stacks over the other in the double-helix; this confers stability in addition to the hydrogen bonds.
(ii) The presence of thymine.
(iii) The absence of free 2'-OH group as in RNA. (Any two)
6. – Males have 17 chromosomes
– Females have 18 chromosomes
– It is called XO mechanism of sex determination.
e.g. grasshopper
7. – Male parent – Marino Ram
– Female parent – Bikaneri Ewes
– Hisardale is the new breed of sheep
– Cross breeding, a method of outbreeding has resulted in this new breed.
8. (a) **Humification:**
– Humification during decomposition is a process that leads to the accumulation of a dark coloured, amorphous substance, called humus.
Mineralisation:
– It is the process in which the humus is degraded by certain microbes and the inorganic nutrients are released.
- (b) Temperature and soil moisture

9.	Oviparous animals	Viviparous animals
	<ul style="list-style-type: none"> – These are the animals which lay fertilised or unfertilised eggs. – Chances of survival are less as offspring of oviparous animals are at a great risk as they are threatened by their predators and unfavourable environmental conditions, e.g. frogs, birds. 	<ul style="list-style-type: none"> – These are the animals which give birth to young ones. – Chances of survival are high as offspring of viviparous animals are protected by the parent organism from predators/enemies and unfavourable climate, e.g. Human beings/mammals.

10. (a) It is a cannabinoid.
(b) They are taken by:
 (i) inhalation, and
 (ii) oral ingestion.
(c) They affect the cardiovascular system.

Or

- (i) A – Cellular barrier
 B – Phagocytosis of the pathogens
(ii) C – Interferons
 D – Protect the non-infected cells from viral infection.
11. (a) – Transgenic animals are produced in such a way that they carry genes which make them more sensitive to toxic substances than the non-transgenic animals.
 – They are exposed to the toxic substance and the effects studied.
 – Toxicity testing results are obtained in short time span.
- (b) Advantages of GMO:
 (i) Genetic modification has made the crops more tolerant to abiotic stresses like cold, heat, drought, salinity, etc.
 (ii) It has reduced the dependence of crops on chemical pesticides as they are made pest-resistant.
 (iii) Post-harvest losses are much reduced.
 (iv) These plants have increased efficiency of mineral usage and hence, the early exhaustion of soil fertility is prevented.
 (v) Food produced from GM crops have enhanced nutritional value. *(any three)*

Or

- (a) – The bacterial cells are treated with lysozyme, 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.
- (b) – Large volumes of culture can be processed in bioreactors for commercial production of the gene product.
 – Bioreactors provide optimal condition for obtaining the desired gene product.

12. (a) $N_{t+1} = N_t + [(B + I) - (D + E)]$
 (b) $N_{t+1} = 20 + [(8 + 5) - (6 + 7)] = 20$ rats
 20 rats will remain in the barn.
 (c) Immigration.

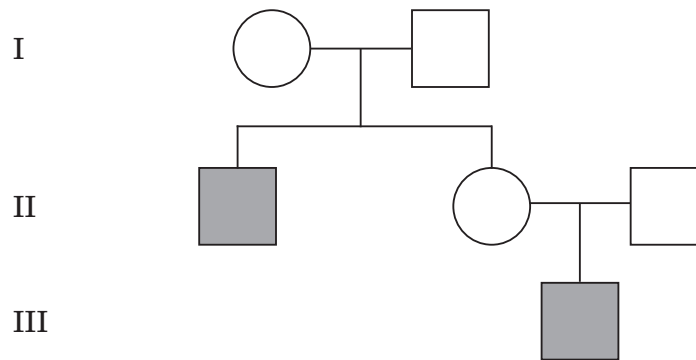
13. (a) An ideal contraceptive
 (i) should be user-friendly.
 (ii) should in no way interfere with the sexual desire and/or sexual act.
 (iii) should be easily available.
 (iv) should be effective and reversible.
 (v) should have no or least side effect.

(any four)

- (b) CuT, multiload 375, Cu7

(any two)

14. (a)



- Genotype of daughter XX^h
- Genotype of her husband XY

- (b) (i) Down's syndrome
 (ii) Klinefelter's syndrome

15. Life cycle of *Plasmodium* in human body:

- When an infected female *Anopheles* mosquito bites a person, the sporozoites are injected into the body.
- They reach the liver cells through blood.
- The parasite reproduces asexually in the liver cells and by the bursting of liver cells, the new cells are released into the blood.
- They enter the red blood cells (RBCs) and reproduce asexually; by bursting the red blood cells, the cells of the parasite release haemozoin, which causes the cycles of fever, chill and shivering.
- The released parasite cells infect new red blood cells; some continue the asexual reproduction and cause the cycles of fever.
- Others enter the sexual stage and form gametocytes in the RBCs, which are picked by the female *Anopheles* mosquito, along with the blood meal.

16. (a) Agarose; it is obtained from sea weeds (red algae)
 (b) Ethidium bromide
 (c) Elution
 (d) The DNA fragments separate according to their size through the sieving effect provided by agarose gel matrix.
17. (a) The process of cutting the desired gene (also called restriction digestion) is carried out by incubating the purified DNA molecule with the specific restriction enzyme at optimal conditions of pH, temperature, etc. of the enzyme.
 (b) The fragments are joined by use of DNA ligases.
 (c) Since DNA is negatively charged, it moves towards the anode.
18. Identification of the transforming principle:
 – The biochemicals like proteins, DNA and RNA were purified from the heatkilled S-cells.
 – When these fractions were added individually to the culture of live R-cells, DNA was able to cause transformation of R-cells into S-cells.
 – They also found that protein-digesting enzymes and RNA-digesting enzymes did not affect transformation, indicating that transforming substance is not a protein or RNA.
 – Digestion with DNase did inhibit transformation; this suggests that the DNA caused transformation.

Avery, MacLeod and McCarty, were the scientists who identified the transforming principle of Griffiths' experiment.

19. (a)

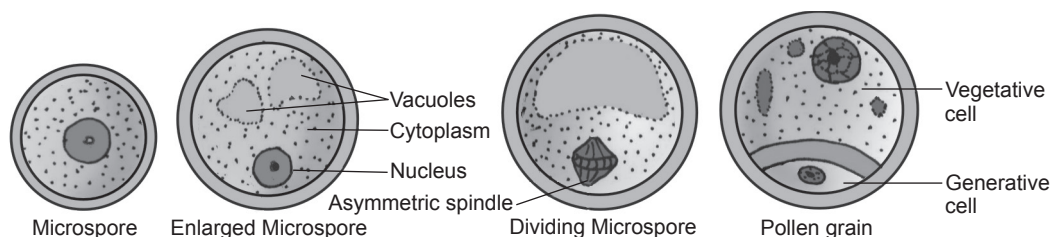
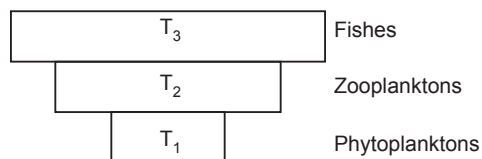


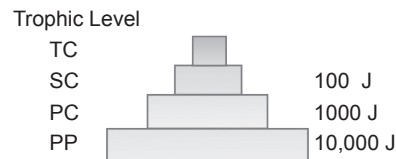
Fig. Development of Pollen Grain

- (b) – Sporopollenin
 – It is absent in the germ pore(s)

20. Pyramid of biomass



Pyramid of Energy



Sea Ecosystem

- The pyramid of biomass is inverted, since the biomass of fishes far exceeds that of the phytoplanktons.
 - The pyramid of energy is upright, as phytoplanktons are the primary producers and have the maximum amount of energy; only 10% of energy is transferred from one trophic level to the next higher trophic level and some energy is lost as heat.
- 21.** – A translational unit in mRNA is the sequence of RNA, which is flanked by the initiation codon, AUG and the termination codon, UAA/UAG/UGA.
- For initiation, the ribosome binds at the start codon of mRNA, which is recognised by the initiator tRNA.
 - The elongation phase proceeds, as the ribosome moves from codon to codon along the mRNA; during this step, the amino-acyl-tRNA complexes sequentially bind to the appropriate codons on mRNA by forming complementary base pairs (between codon of mRNA and anticodon of tRNA).
 - Amino acids are added one by one and become joined by peptide bonds, to form a polypeptide.
 - When the ribosome reaches the termination codon, a release factor binds to the termination codon and the polypeptide formed is released from the ribosome, i.e. termination has occurred.

22. (a) *Glomus*

Role of mycorrhizae:

- The fungus absorbs phosphorus from the soil and passes it to the plant.
- Plants with mycorrhiza show resistance to root-borne pathogens.
- They show increased tolerance to salinity and drought.
- There is an overall increase in plant growth and development.

(b) (i) *Monascus purpureus*

(ii) *Trichoderma polysporum*

23. (a) The parents fear that peer group can influence their ward to go for drugs/alcohol; but later the child may use them to escape from facing the day-to-day problems.

- (b) – Addiction refers to a psychological attachment to certain effects of the drugs or alcohol.
- Dependence refers to the tendency of the body to manifest a characteristic and unpleasant withdrawal symptom, when the regular dose of drug/alcohol is not available.

- (c) (i) Parents should not push their wards unduly to perform beyond his/her potential, in studies, sports or other activities.
- (ii) They should educate and counsel him/her to face problems and stresses and to accept disappointments and failures as a part of life.
- (iii) They should look for and identify the danger signs of drug/alcohol abuse and take appropriate remedial measures.
- (iv) Parents should channelise the child's energy into other healthy activities like music, sports, yoga, etc.
- 24. (a)** – It refers to the increase in concentration of the harmful/toxic substances at successive trophic levels.
- It happens because such harmful/toxic substances can neither be metabolised nor excreted, but are passed onto the next (higher) trophic level.
 - In fish-eating birds, the high concentrations of DDT disturb the calcium metabolism.
 - It causes thinning of eggshell and the premature breaking of such eggs leads to a decline in bird populations of fish-eating birds.

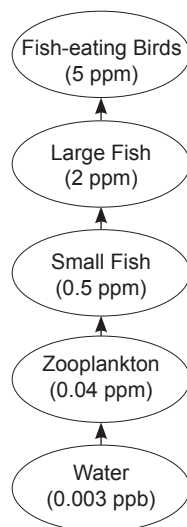


Fig. Biomagnification of DDT

- (b) – Catalytic converters have expensive metals like platinum, palladium and rhodium as catalysts.
- As the exhaust passes through the catalytic converter, unburnt hydrocarbons are converted into carbon dioxide and water; carbon monoxide and nitric oxide are changed into carbon dioxide and nitrogen gas.

- (c) Using nuclear energy has two problems.
- (i) The safe disposal of nuclear wastes.
 - (ii) Any accidental leakage can prove to be extremely damaging to living organisms.

Or

- (a) It is an international treaty to control the emission of ozone – depleting substances.
- (b) Causes of global warming:
- (i) Deforestation
 - (ii) Burning of fossil fuels
 - (iii) Excess use of nitrogenous fertilisers
 - (iv) Increased amounts of greenhouse gases (CO₂, CH₄, CFCs, N₂O).
- (c) – These gases absorb some of the infrared radiation, emitted by the earth surface.
- The molecules of these gases radiate heat energy, most of which comes back to the earth's surface and heat it again.
 - This cycle is repeated a number of times.
 - Since these gases are responsible for the greenhouse effect, i.e. heating of the earth's surface, they are called greenhouse gases.
25. (a) – Self-incompatibility is a genetic mechanism that prevents the self-pollen from fertilising the ovules by inhibiting pollen germination or pollen tube growth on the pistil.
- Since fertilisation cannot occur, there is no seed formation.
- (b) (i) Certain nucellar cells around the embryo sac divide, protrude into embryo sac and develop into embryos, e.g. *Citrus*, mango, etc.
- (ii) The diploid egg cell of the embryo sac, formed without meiosis develops into embryo without fertilisation.
- (c) – In castor, the endosperm is not completely used by the embryo during seed formation; so there is some residual endosperm in the mature seed.
- The food reserves of this endosperm will be used during germination of the seed.

(a)

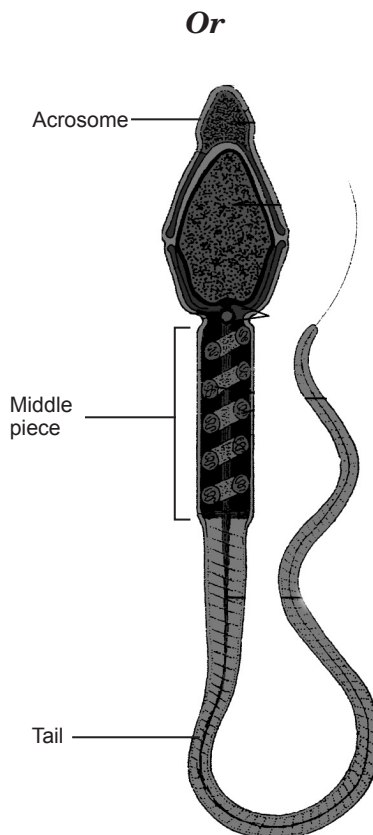


Fig. A Human Spermatozoan

- (i) The acrosome contains enzymes which help in the dissolution of egg envelopes so that the sperm can enter the cytoplasm of the ovum for fertilisation.
- (ii) The middle piece of the sperm contains a number of mitochondria that provide energy for the movement of sperm in the female genital tract.
- (iii) The movement of the tail is responsible for the motility of sperm towards the female gamete.

(b)

Spermatogenesis	Oogenesis
<ul style="list-style-type: none">– The process of formation of sperms in males starts from puberty.– It is not a cyclic process; it occurs continuously.– One primary spermatocyte forms four functional sperms.– The process is completed in the testes.	<ul style="list-style-type: none">– The process of formation of ova in females, starts from embryonic developmental stages.– It is a cyclical process, completed every 28/29 days.– One primary oocyte forms only one functional ovum.– The process is completed in the ampullary-isthmic junction of fallopian tube. <i>(any two)</i>

26. (a) Sphenosperms (horsetails), ferns, *Ginkgo*, conifers, Gnetales, progymnosperms.
(any four)

(b) Industrial Melanism:

- In England, before industrial revolution, there were more white-winged or dull-grey moths on the tree trunks, than the dark-winged or melanic moths.
- In the collection of moths, carried out in the same area after industrial revolution, there were more dark-winged moths.
- The explanation given for this observation was that predators will spot a moth against a contrasting background.
- During the post-industrialisation period, the trunks became dark with the industrial smoke and soot.
- Under this condition, white-winged moths did not survive as predators could easily spot these, while dark-winged or melanic moths survived better.
- Before industrialisation, there used to be a thick growth of the almost white-coloured lichens on the tree trunks and in that background, the white-winged moths survived better; the dark-coloured moths were easily spotted and picked up by their predators.
- In this case, the moths which were able to camouflage and hide in the background survived and increased their population size through reproduction.

(c) (i) Pharyngeal gill slits

(ii) Notochord

Or

(a) The steps/procedure in DNA-fingerprinting are as follows:

- (i) Extraction: DNA is extracted from the cells in a high-speed, refrigerated centrifuge.
- (ii) Amplification: Many copies of the extracted DNA are made by polymerase chain reaction.
- (iii) Restriction Digestion: DNA is cut into fragments with restriction enzymes into precise reproducible sequences.
- (iv) Separation of DNA sequences/restriction fragments: The cut DNA fragments are introduced and passed through electrophoresis set-up containing agarose polymer gel; the separated fragments can be visualised by staining them with a dye that shows fluorescence under ultraviolet radiation.
- (v) Southern Blotting: The separated DNA sequences are transferred on to a nitrocellulose or nylon membrane.

- (vi) Hybridisation: The nylon membrane is immersed in a bath and radioactive probes (DNA segments of known sequence) are added; these probes target a specific nucleotide sequence that is complementary to them.
- (vii) Autoradiography: The nylon membrane is pressed on an X-ray film and dark bands develop at the probe sites.
 - The bands form a characteristic pattern, which varies from individual to individual.
 - From the patterns developed by the samples, it can be confirmed whether they belong to one individual or two different individuals.
- (b) – In the absence of lactose, the *lac* operon is switched off and there is no transcription of the structural genes.
 - The regulatory (*i*) gene synthesises the repressor protein constitutively all the time.
 - The repressor binds to the operator region.
 - The RNA polymerase has no access to the promoter and hence there is no transcription of the structural genes.