

Answers to RSPL/2

1. Homozygous 50% and Heterozygous 50%.
2. *Propionibacterium sharmanic*.
 - The large amount of carbon dioxide produced causes the large holes.
3. The engineered vectors facilitate easy linking of the foreign DNA and selection of recombinants from non-recombinants.
4. Spermiation is the process of release of spermatozoa from the seminiferous tubules of testes.
5. (a) Chromosome 1
(b) Y-chromosome
6. (a) – The virus-infected cells of our body secrete interferons.
– Interferons protect the non-infected cells from further viral infection.
(b) *Wuchereria bancrofti*
Wuchereria malayi

7.	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.

8.	Convergent evolution	Divergent evolution
	<ul style="list-style-type: none"> – It is the evolutionary process in which anatomically different structures in different groups of organisms, evolve for the same function in similar habitats. – It results in analogous structures/organs. 	<ul style="list-style-type: none"> – It is the evolutionary process in which the same structure develops in different directions in different organisms as adaptations to different needs. – It results in homologous structures/organs.

9. The characteristic unpleasant symptoms exhibited by the body of a drug/alcohol addict, when the regular dose of drug/alcohol is abruptly discontinued, constitute withdrawal syndrome symptoms.

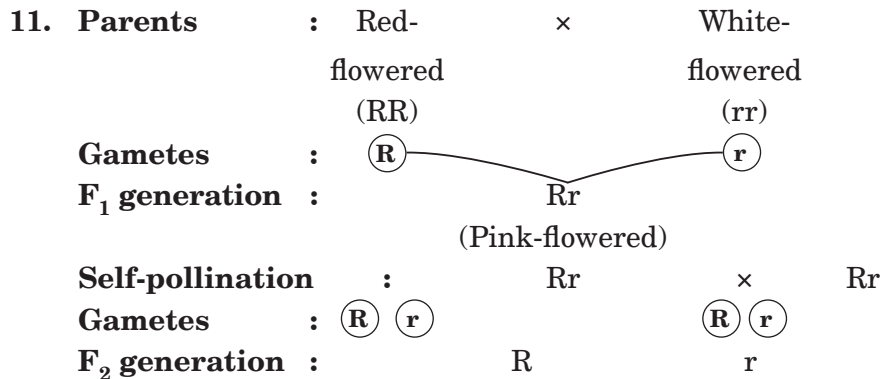
Withdrawal syndrome symptoms are:

- Anxiety – Nausea
- Shakiness – Sweating

(any three)

- A – *Trichoderma polysporum*
- B – Immuno-suppressive agent
- C – Streptokinase
- D – To remove blood clots from the blood vessels of the patients of myocardial infarction.

10. (a) Because their natural predator(s) is/are absent.
- (b) – The monarch butterfly is highly distasteful to the predators.
- It is due to a chemical present in its body; the butterfly acquires this chemical during its caterpillar stage, by feeding on a poisonous weed.



	R	r
R	RR Red-flowered	Rr Pink-flowered
r	Rr Pink-flowered	rr White-flowered

Red-flowered : Pink-flowered : White-flowered
 RR : Rr : rr
 1 : 2 : 1

- The F₁ plants produced pink flowers, because it is a case of incomplete dominance, where neither of the two alleles of the gene, is completely dominant over the other.
- It is not a case of blending inheritance, because the parental traits (red flowers and white flowers) appear without any change in the F₂ generation.

12. Primary lymphoid organs	Secondary lymphoid organs
– These are the organs where the immature lymphocytes differentiate into antigen-sensitive lymphocytes. e.g. bone marrow, thymus.	– These are the organs, where the mature lymphocytes interact with the antigen and proliferate in become the effector cells. e.g. lymph nodes, tonsils Peyer's patches.

13. (a) Ori

- It is a sequence of bases on DNA, from where replication starts.
 - Any piece of alien DNA linked to this sequence can be made to replicate within the host cells.
 - it is also responsible for controlling the copy number of linked DNA.
- (b) Rop gene: Rop gene codes for the protein involved in the replication of the plasmid.
- (c) Amp^R
- It is a selectable marker, i.e., it helps to select the recombinants from non-recombinants.

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) Since DNA is a hydrophilic molecule and cannot pass through the cell membrane the bacterial cell must be made competent.

14. Adenosine deaminase (ADA) deficiency

Procedure

- The lymphocytes are isolated from the blood taken out from the patient.
- They are grown in a culture medium outside the body.
- A functional ADA cDNA is then introduced into these lymphocytes, using a retroviral vector.
- These lymphocytes are returned to the blood of the patient.
- The genetically engineered lymphocytes can synthesise ADA, but the lymphocytes have a life span and they are not immortal; hence they have to be periodically infused into the patient.

Permanent cure

- If the functional gene isolated from the marrow cells is introduced into the cells at the embryonic stage, it could be a permanent cure.

15. (a) Curve a : $S = CA^Z$

Curve b : $\log S = \log C + Z \log A$,

Where S = species richness

A = Area

Z = Slope of the line (regression coefficient)

C = Y intercept

- (b) (i) For any taxonomic group, in any region on the earth for a limited area.
(ii) When a large area like entire continent is analysed.
16. – 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.

17. (a)

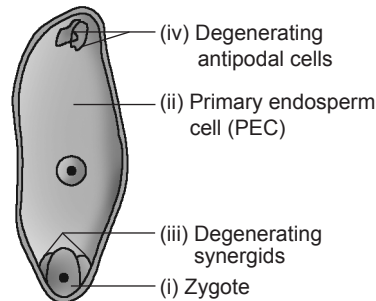


Fig. A Fertilised Embryo Sac

- (b) Fertilisation by a self-incompatible pollen is prevented by:
- (i) inhibiting the germination of the pollen.
 - (ii) retarding the growth of the pollen tube.
18. Secondary Treatment:
- The effluent from the primary treatment is passed into large aeration tanks, where it is constantly agitated and air is pumped into it.
 - This allows the rapid growth of aerobic microbes into flocs, which consume the organic matter of the sewage and reduce the BOD.
 - The effluent is passed into a settling tank, where the flocs are allowed to sediment forming the activated sludge.
 - A small part of the activated sludge is pumped back into aeration tank as inoculum.
 - The remaining major part of the sludge is pumped into anaerobic sludge digesters, where the anaerobic bacteria digest the bacteria and fungi of the sludge and produce methane, hydrogen sulphide and carbon dioxide.

- The effluent from this is passed into the waterbody.
- It is a biological process, since it employs the heterotrophic microbes naturally present in the sewage.

19. (a) 5' G A A T T C 3'
3' C T T A A G 5'

(b) Naming of restriction enzymes

- The first letter of the name comes from the genus of the bacterium.
- The second and third letters come from the name of the species of the prokaryote cell from where it is isolated.
- The next letter comes from the strain of the prokaryote.
- The Roman Numbers following these four letters indicate the order in which the enzymes were isolated from that strain of the bacterium, e.g. EcoRI is isolated from *E.coli*, R Y 13.

20. (a) - In males it is called vasectomy

- In females, it is called tubectomy

(b)	ICSI	IUI
	<ul style="list-style-type: none"> - It is the ART technique in which the sperm is directly injected into the cytoplasm of the ovum, to form a zygote, under laboratory conditions. - Fertilisation is <i>in vitro</i>. - Embryo transfer is necessary. 	<ul style="list-style-type: none"> - It is method of artificial insemination, in which the semen from the husband or a donor is introduced into the uterus. - Fertilisation is <i>in vivo</i>. - No need for embryo transfer.

21. DNA-Fingerprinting

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

- Extraction: DNA is extracted from the cells in a high-speed, refrigerated centrifuge.
- Amplification: Many copies of the extracted DNA are made by polymerase chain reaction.
- Restriction Digestion: DNA is cut into fragments with restriction enzymes into precise reproducible sequences.
- 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.
- Southern Blotting: The separated DNA sequences are transferred on to a nitrocellulose or nylon membrane.
- 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 A and B, it can be confirmed whether they belong to one individual or two different individuals.

22. (a) The four steps to obtain a disease-resistant crop are:

- (i) Screening the germplasm for sources of disease-resistance.
- (ii) Hybridisation of selected parents.
- (iii) Selection and evaluation of the hybrids.
- (iv) Testing and release of new varieties.

(b) Explants– The parts of a plant taken out for regenerating whole plants in special nutrient media under sterile conditions in the laboratory, are called explants.

Totipotency is the property of cells responsible for growth of explants into new entire plants.

23. (a) – Since DDT can neither be metabolised nor excreted, it is just passed on to the next (higher) trophic level.

- Hence, the concentration keeps on increasing as it travels along the food chain.
- This phenomenon is called biomagnification.

(b) – In the bird populations, the high concentration of DDT interferes with calcium metabolism and causes thinning of egg shells and their premature breaking; as a consequence, there is a decline in the bird populations.

(c) – It should be emphasised that

(i) use of DDT must be stopped (ii) biological control methods be followed:

- Awareness must be created that
 - (i) Many disorders can be caused in human beings as the milk/egg we consume can have a high concentration of toxicant as it travels along the food chain from plants to cows/chicks.

(ii) The polluted soil may become uncultivable.

24. Development of zygote

- As the zygote moves through the isthmus towards the uterus, it undergoes mitotic divisions, called cleavage, to form 2, 4, 8, 16 daughter cells, called blastomeres.
- The embryo with 8-16 blastomeres, is called a morula.
- The cells of the morula continue to divide and the morula transforms into a blastocyst.

- The blastomeres are arranged into an outer layer, called trophoblast and an inner group of cells, called inner cell mass, attached to the trophoblast at one end.
- At this stage, the blastocyst becomes implanted in the uterus.

Implantation

- The trophoblast layer gets attached to the endometrium of the uterus.
- The uterine cells divide rapidly and cover the blastocyst.
- Consequently, the blastocyst becomes embedded in the endometrium of uterus, i.e. implantation has occurred.

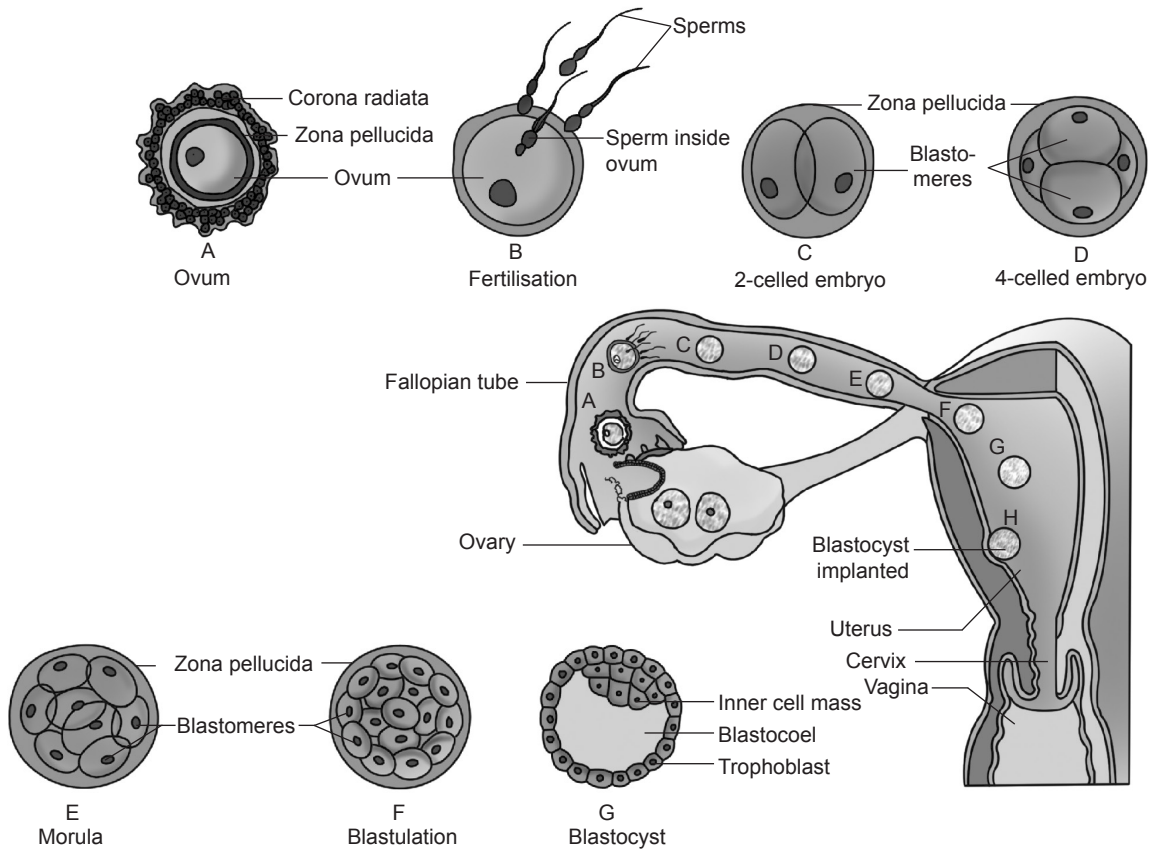


Fig. Stages of Embryonic development upto Implantation

Or

(a) Development of Pollen grain:

- Microsporocytes undergo mitotic divisions to increase the number of functional microspore mother cells.
- Each microspore mother cell undergoes meiosis to form a microspore tetrad.
- All the four microspores remain enclosed in a common wall.

- As the anther matures and dehydrates, they start separating from one another and each develops into a pollen grain.
- The nucleus undergoes a mitotic division resulting in the formation of a large vegetative cell and a small generative cell.
- The spore develops a wall of two layers—the outer exine of sporopollenin and inner intine of pectin and cellulose.
- At this stage, the pollen grains are liberated; but in some cereals the generative cell undergoes mitosis and the pollen grain is 3-celled, at the time of liberation.

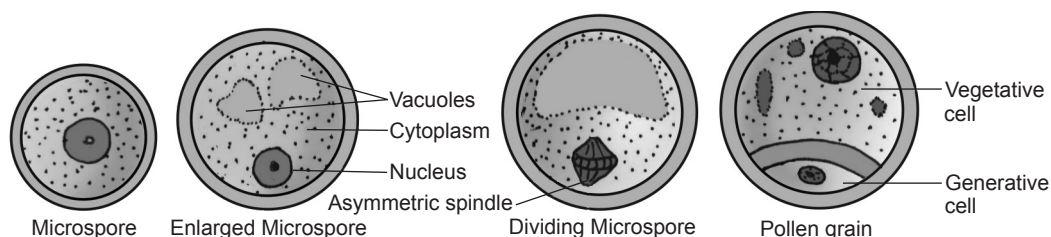
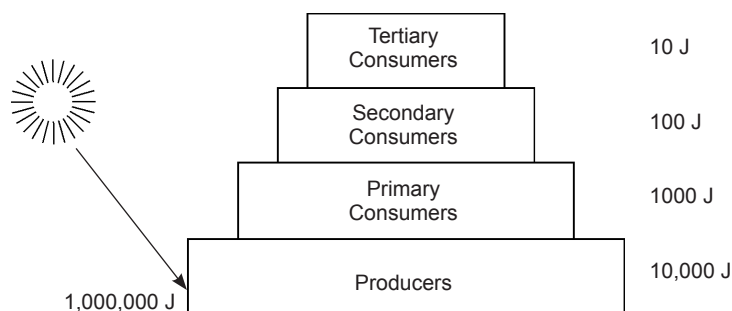


Fig. Development of Pollen Grain

(b) Pollen grains can be best preserved as fossils because:

- The sporopollenin of the exine can withstand high temperatures.
- It is resistant to action of strong acids and alkali.
- No enzyme that can degrade sporopollenin is known so far.

25. (a)



(b) Humus is a dark-coloured amorphous substance formed by humefication during decomposition.

- It is highly resistant to microbial action.
- It is colloidal in nature.

(c) Standing crop is measured in terms of:

- biomass (mass of living organisms) per unit area
- number per unit area

Or

(a)

Predators	Parasites
<ul style="list-style-type: none">- They are the larger animals which kill and consume the smaller animal (prey).- They are highly mobile.- Their reproductive capacity is slow.- They do not live on/inside the body of the prey.	<ul style="list-style-type: none">- These are the smaller organisms (than the host) and do not kill or consume the host.- They are less mobile or non-mobile.- Their reproductive capacity is high.- They live on/inside the body of the host.

(b) The adaptations includes:

- (i) increasing the breathing rate
- (ii) increased production of red blood cells
- (iii) decreasing the binding capacity of haemoglobin.

(c) Phytophagous insects feed on the plant sap and other parts of the plants.

- 26.** – In eukaryotes, transcription involves three RNA polymerases and there is clear cut division of labour.
- RNA polymerase I transcribes the ribosomal RNAs (28S, 18S, and 5.8S).
 - RNA polymerase II transcribes hnRNA, the precursor of mRNA.
 - RNA polymerase III transcribes tRNA, 5S rRNA and small nuclear RNAs (Sn RNAs).
 - The polymerase binds to the promoter and in association with the initiation factors, initiates transcription.
 - It also facilitates the opening of the two strands and catalyses elongation in the 5' → 3' direction by using the ribonucleotides as substrate.
 - When RNA polymerase falls on a termination sequence, it effects termination of transcription in association with certain termination factors.
 - The primary transcripts contain both the coding sequences, exons and the non-coding sequences, introns, and hence are non-functional.
 - They are subjected to a process, called splicing in which the introns are removed and the exons are joined in a defined order.
 - hnRNA undergoes two additional processes, after splicing; they are capping and tailing.
 - In capping, methyl guanosine phosphate is added at the 5' end and in tailing, about 200-300 adenylate residues are added at the 3' end.
 - Now the mRNA is fully processed and is ready for transport.

Or

Sequencing of a Genome

- The methods involve two major approaches:
 - (i) One approach called Expressed Sequence Tags (ESTs), focuses on identifying all the genes that are expressed as RNAs.
 - (ii) Second approach called Sequence Annotation, is to simply sequence the whole set of genome, that includes all the coding and non-coding sequences and then assigning functions to different regions in the sequence.
- The total DNA from the cell is isolated and converted into random fragments of relatively smaller sizes.
- These fragments are then cloned in suitable hosts using specialised vectors; the commonly used hosts are bacteria and yeast and the vectors are bacterial artificial chromosomes (BAC) and yeast artificial chromosomes (YAC).
- The fragments are then sequenced using automated DNA sequences.
- The sequences are then arranged on the basis of certain overlapping regions present in them; this requires the generation of overlapping fragments for sequencing.
- Specialised computer programmes are developed for alignment of the sequences.
- These sequences are annotated and assigned to the respective chromosomes.