

Answers to RSPL/1

1. (i) There is great synchrony between the two sexes, i.e. they release the mature gametes simultaneously.
(ii) They release a large number of gametes in the surrounding medium (water) to enhance the chances of syngamy.
2. *Atropa* and *Datura*
3. Gamete Intra-fallopian Transfer (GIFT).
4. – Standing crop refers to the mass of living material in a trophic level at a given time.
– Standing crop is measured in terms of biomass (mass of living organisms).
5. **Advantages:**
(i) There is no need for emasculation (as in the case of bisexual flowers).
(ii) The two plants are genetically different; hence, new combinations can be expected.
6. (a) 5' AUGGUACGUACGGUAUAGCGU 3'
(b) – It will code for five amino acids because the sixth codon is a stop/termination codon that does not code for any amino acid.
7. (a) Separation and purification.
(b) (i) Proteases
(ii) Ribonucleases
8. – BamHI will be selected, because the gene, tet^R is located in the BamHI site.
– EcoRI site does not have the tet^R gene; hence, it cannot be used.

Or

- (a) Biopiracy; it refers to the unauthorised use of bioresources and traditional knowledge related to bioresources for commercial benefit by certain organisations or multinational companies without proper consent from the country or compensatory payment to people concerned.
- (b) – India has framed laws to prevent such unauthorised exploitation of the bioresources and traditional knowledge.
– The Indian Parliament has cleared the second amendment of the Indian patents Bill, which takes into consideration such issues like patent terms, emergency provisions and research and development initiatives.

9. Differences:

J-shaped growth curve	S-shaped growth curve
<ul style="list-style-type: none">– The growth curve is J-shaped, when the resources are unlimited.– It is not realistic, because the resources are finite and become limiting sooner or later.	<ul style="list-style-type: none">– The growth curve is S-shaped, when the resources are limited.– It is more realistic because carrying capacity is reached when the resources become limiting.

10. (a) Genotype of the F_1 plants is Rr.

- It is due to incomplete dominance, where neither of the alleles of a gene is completely dominant over the other.

(b) It is not a case of blending inheritance, since the two parental traits appear without any change in the F_2 progeny.

11. Structure of tRNA:

- The secondary structure of tRNA looks like a clover leaf, while in actual structure, it is a compact molecule that looks like an inverted L.
- It has an amino acid acceptor end, i.e., the 3' end, where it binds to a specific amino acid; each tRNA is specific for an amino acid.
- The molecule becomes looped and there are three loops.
- The anticodon loop has a sequence of three bases, that is complementary to the codon of the particular amino acid, it carries.
- For initiation, there is a specific tRNA, called the initiator tRNA.

Functions:

- Each tRNA transports a specific amino acid to the site of translation.
- It reads the codon of mRNA and binds to it following base complementarity through hydrogen bonds (adapter).

12. – Pest-resistant cotton plants have been raised through recombinant DNA technology using the genes from the bacterium, *Bacillus thuringiensis*, which produces Bt-toxin.

- The genes encoding the toxin, i.e. *cryIAc* and *cryIIAb*, have been isolated from the bacterium and incorporated into cotton plants.
- The genes code for the insecticidal crystal protein, Cry, 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 of the insect.
- The toxin binds to the surface of the midgut epithelial cells.
- In these cells, it creates pores that cause swelling and lysis of the cell and eventually kills the insect pest.

13. (i) Speciation is a function of time; the temperate regions were subjected to frequent glaciation in the past, while the tropics have remained undisturbed and hence had longer time to evolve more species diversity.
- (ii) The tropical environments are less seasonal and relatively more constant and more predictable than temperate regions; speciation has been promoted/favoured by such constant environments and hence, there is greater species diversity.
- (iii) There is more solar radiation available in the tropical region; this contributes directly to more productivity and indirectly to greater species diversity.
14. (a) (i) Acquired immunity is pathogen-specific.
- (ii) It is characterised by memory.
- (iii) It can distinguish between 'self' and 'non-self' cells/molecules.
- (b) Amoebiasis.
- (c) α -interferon activates the immune system and helps in destroying the tumour.
15. – After entering the body of a person, the virus enters the macrophages.
- The viral genome (RNA) undergoes replication (reverse transcription) to become viral DNA with the help of reverse transcriptase.
 - The viral DNA gets incorporated into the DNA of the cells and directs these cells to produce virus particles.
 - The macrophages function as HIV factory and produce a number of HIV particles.
 - These HIV particles 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.
 - This process is repeated and there is a progressive decrease in the number of helper T-cells; hence, there is immune deficiency.

Or

- MOET technology involves two mothers:
 - (i) The genetic mother, where super ovulation is effected and the ova are fertilised
 - (ii) The surrogate mother, where the embryo (8-32 celled stage) is transferred and development is completed.

Steps in MOET Technology:

- A cow is administered hormones with FSH-like activity to induce follicular maturation and super-ovulation, i.e. instead of one egg, 6-8 eggs are produced per cycle.
- The animal is either mated with an elite bull or artificially inseminated.
- The fertilised eggs are recovered at the 8-32 celled stages, non-surgically.
- They are then transferred to surrogate mothers.
- The genetic mother is available for another round of superovulation.

16. (a) (i) Klinefelter's syndrome/Turner's syndrome.
(ii) Down's syndrome.
- (b) (i) It is a sex-linked trait, as it is passed on from the male to female and female to male in successive generations.
(ii) Colour blindness/haemophilia.
(iii) XX^c (colour blindness) or XX^h (haemophilia)

17. The two types of microbes are:
(i) The aerobic heterotrophs (fungi and bacteria) and
(ii) The anaerobic heterotrophs (fungi and bacteria).

Role of aerobic microbes:

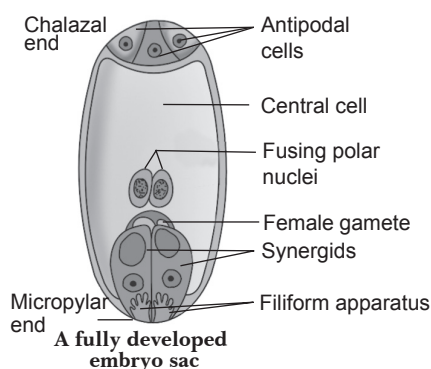
- The primary effluent is pumped into aeration tanks, where it is agitated mechanically and air is pumped into it.
- The aerobic microbes grow vigorously and form flocs, i.e., masses of bacteria associated with fungal hyphae.
- During their growth, the microbes consume a major part of the organic matter; hence the biochemical oxygen demand (BOD) is significantly reduced.

Role of anaerobic microbes:

- In the anaerobic sludge digester, the bacteria and fungi of activated sludge are digested by the anaerobic microbes; this digestion produces a mixture of gases that form biogas.

18. A— Chasmogamous flower.
B— Cleistogamous flower.
- In flower A, autogamy, geitonogamy and xenogamy can occur.
 - In flower B, only autogamy can occur.

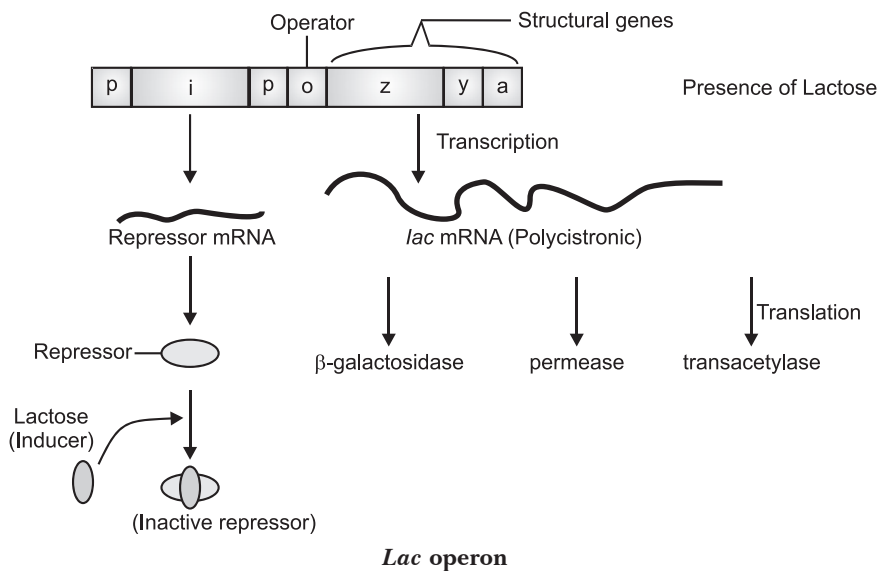
19. (a)



- (b) Since the embryo sac is formed by only one of the megaspores, its formation is described as monosporic.

20. (a) (i) Loss of unnecessary sense organs.
(ii) Presence of hooks/adhesive organs and suckers.
(iii) Loss of digestive system.
(iv) High reproductive capacity
- (b) – During the course of evolution, the cost and benefits of maintaining homeostasis are considered.
– Only in those cases, where it is advantageous, the organisms have become regulators and others have remained as conformers.

21.



22. (a) The three basic steps include:
- (i) Identification of DNA with desirable genes.
 - (ii) Introduction of the identified DNA into the host.
 - (iii) Maintenance of introduced DNA in the host and transfer of the DNA to its progeny.
- (b) The source is *Thermus aquaticus*, a bacterium.
- The *Taq* polymerase is thermostable and withstands the high temperature used in denaturation; hence, it can be used for making multiple copies of DNA.
23. (a) The legume crops enrich the soil with nitrogenous compounds, as their roots make symbiotic association with the *Rhizobium* bacterium, that fixes atmospheric nitrogen.
- (b) *Nostoc* acts as a biofertiliser and improves soil fertility in paddy fields by:
- (i) fixing atmospheric nitrogen in the soil.
 - (ii) adding organic matter to the soil through their photosynthesis.
- (c) Sharing his knowledge with the farmer helps to improve soil fertility of the field and thus shows his concern for the villager.

24. 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.

Or

- (a) – All these organs in different species have similar anatomical structure, though they perform different functions.
- These structures have developed as a result of divergent evolution, i.e., the evolutionary process in which the same structure has developed along different directions as adaptations to different needs.
 - They are homologous structures and homology indicates common ancestry.
 - The thorn of *Bougainvillea* and tendril of *Cucurbita* are homologous structures in plants.

(b)

Darwinian Concept	de Vries Concept
<ul style="list-style-type: none">– According to Darwin, speciation occurs with the accumulation of minor heritable variations.– Evolution was gradual and occurs through a number of generations.– Variations are small and directional.	<ul style="list-style-type: none">– According to de Vries, mutations arising suddenly in a population, are responsible for speciation.– Evolution occurs in a large single-step mutation (saltation).– Mutations are random and directionless.

25. (a)

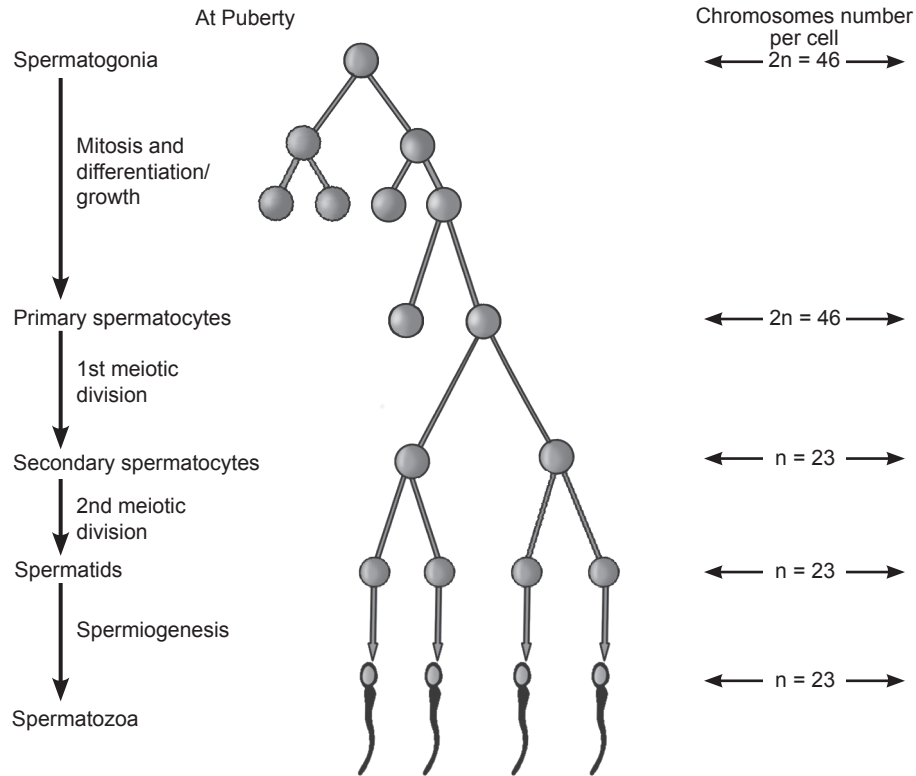
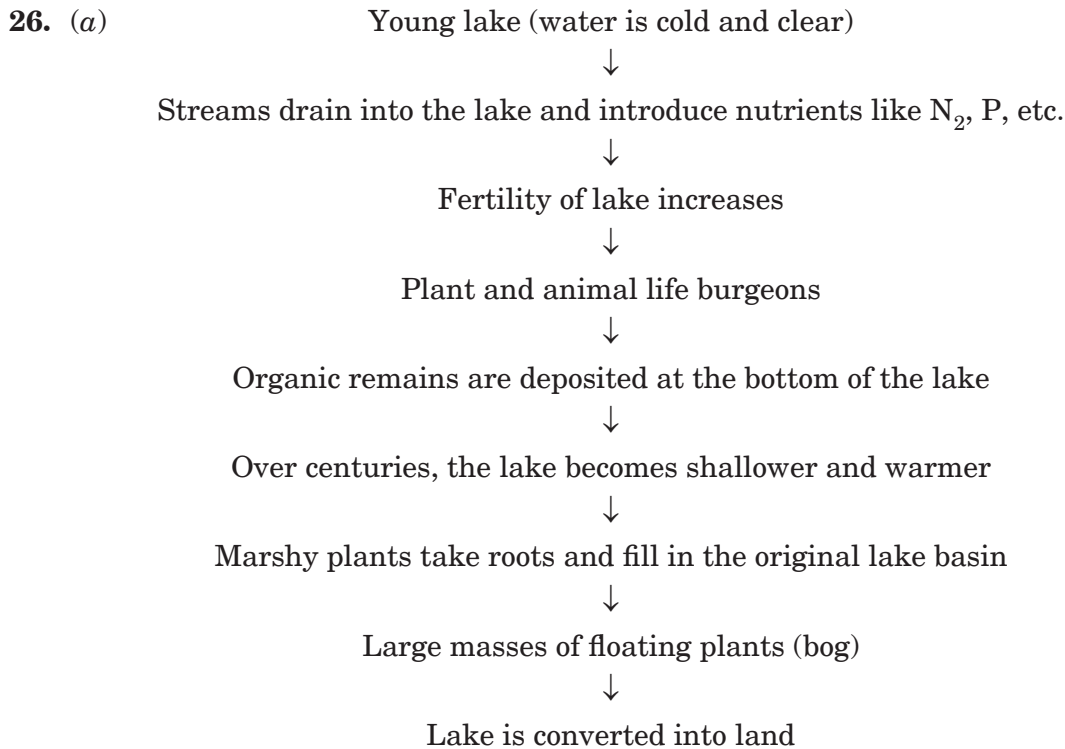


Fig. Spermatogenesis

- Spermatogenesis is the process of formation of spermatozoa in the seminiferous tubules of testes.
 - The spermatogonia present on the inner lining of seminiferous tubules multiply by mitotic divisions and increase in number.
 - Some of them undergo growth and become the primary spermatocytes.
 - Each primary spermatocyte undergoes meiosis I and forms two haploid secondary spermatocytes.
 - The secondary spermatocytes undergo meiosis II and form four equal sized haploid spermatids.
 - The spermatids become transformed into the spermatozoa by the process of spermiogenesis.
 - After spermiogenesis, the sperm heads are embedded in the Sertoli cells and are later released from the seminiferous tubules.
- (b) The changes induced in the zona pellucida of the ovum by the sperm coming in contact with it, block the entry of any other sperm and ensures the entry of only one sperm.

Or

- (a) – The mature Graafian follicle ruptures and releases the ovum (secondary oocyte); this process is called ovulation.
- Following this, in the luteal/secretory phase, the ruptured follicle is transformed into corpus luteum.
- Corpus luteum secretes large quantity of progesterone
- Luteinising hormone (LH) is responsible for the events mentioned above.
- (b) (i) It is a blastocyst
- (ii) 'a' is trophoblast
 - It forms the foetal part of placenta.
- (iii) Inner cell mass differentiates into the primary germ layers, i.e., endoderm, mesoderm and ectoderm
- (iv) Stem cells are located in the inner cell mass



- (b) El Nino effect refers to the odd climatic changes that occur due to a rise in global mean temperature.
- It leads to an increased melting of polar ice caps as well as other snow caps on mountains like Himalaya, which results in a rise in sea level that can submerge many coastal areas causing loss of biodiversity.
- Even the very high temperature can lead to extinction of those species which cannot cope with it.

Or

- (a) Three modern methods of *ex situ* conservation are:
- (i) Gametes of threatened species of animals are preserved in viable and fertile condition for long periods using cryopreservation techniques.
 - (ii) Eggs can be fertilised *in vitro* (outside the animal body) using the gametes stored by cryopreservation.
 - (iii) Tissue culture and micropropagation help in raising a number of threatened species of plants in large numbers in a short span of time.
 - (iv) Seeds of different genetic varieties/strains of economically or commercially important plant species are stored in seed banks for very long periods.
- (b) Sacred groves are the last refuges of many rare and threatened plants; all the trees and wildlife within are venerated and gives protection.
- (c) Ramsar sites are the protected wetland areas.