

# Answers to RSPL/2

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## SECTION-A

1. The phenotypic ratio would be 1 : 1 : 1 : 1. Test Cross.
2. *Coelacanth* (Latimeria).
3. Tissue culture. The plants produced are genetically identical among themselves and to the original plant from which they have been grown.
4. Transgenic mice is used for testing the safety of polio vaccine.
5. High concentration of DDT affect calcium metabolism of birds.  
It causes thinning of egg shell and the premature breaking of eggs which kills the embryos and leads to a decline in bird population.

## SECTION-B

6. Hybrid characters segregate in every generation and are not maintained. The production of hybrid seed is costly and is too expensive for the farmers. If the hybrids are made from apomicts seeds there will be no segregation of characters in the seeds and seeds can be collected from the plants, generation after generation and it can be used for raising new plants.
7. tRNA is an adapter molecule, which is meant for transferring amino acids to ribosomes for synthesis of polypeptides. tRNA carry specific amino acids at particular points during polypeptide synthesis as per codons of mRNA, and the codons are recognised by anticodons of tRNAs. Thus, the coded information from DNA is translated by bringing amino acids in a particular sequence.
8. Histamine is produced by mast cells and serves as an important part of our body immune name which cause blood vessels to dilate when we come into contact with an allergen (pollen etc.), histamine is released at the site of contact.  
Drug: Antihistamine, steroids/adrenaline.
9. (a) *Lactobacillus*: Lactic acid (product), helps in partial digestion of milk protein.  
(b) *Saccharomyus cerevisiae*: Ethanol (product) for fermentation
10. Significance of biodiversity conservation:
  - (a) Conserved species can be used to restore degraded land, reintroduce species into wild and restock depleted populations.
  - (b) Ready source of genetic material is provided to breeders and genetic engineers.

OR

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 which results in a rise in sea level that can submerge many coastal areas causing loss of biodiversity.

### SECTION-C

11. – The ovule is attached to the placenta by a short stalk called **funicle**.

– The junction between the funicle and ovule is called **hilum**.

– Ovule is surrounded by one or two protective envelopes called integuments which leave a small opening called **micropyle** at the tip of the ovule.

– The primordium of the ovule grows into a mass of cells, forming the cells of the nucellus.

– The basal part of the ovule is called **chalaza**.

– Cells of the nucleus are rich in reserve food materials.

– There is a single embryo sac which has developed from a megaspore.

– The embryo sac contains the following cells:

Three antipodal cells at the chalaza end.

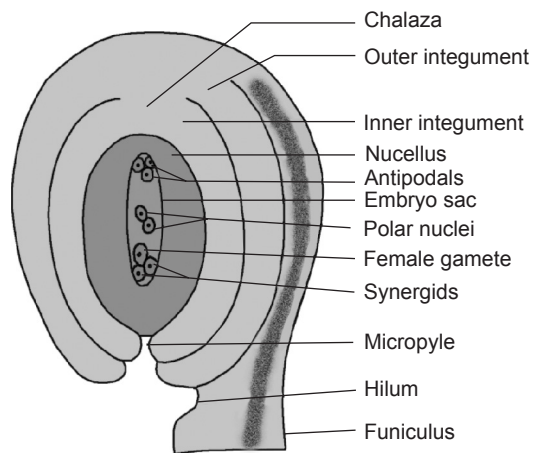
Three cells at the micropylar end, which consists of two synergids and a female gamete.

– Two nuclei in the central cell, called polar nuclei, which fuse to form a diploid secondary nucleus.

12. It is caused by a **recessive mutant allele**. The affected individual lacks an enzyme that catalyses the conversion of the amino acid phenylalanine to tyrosine but the amino acid is metabolised into phenyl pyruvate and other derivatives. Accumulation of these chemicals in the brain results in mental retardation. These are also found in the urine as they are not absorbed by the kidney tubules and are excreted out of the body.

13. In eukaryotes, the hnRNA has coding sequences, called **exons** as well as non-coding sequences called **introns**. It undergoes a process called **splicing** in which the introns are removed and the exons are joined together in a particular manner, to form the functional mRNA.

– In prokaryotes, the mRNA is polycistronic i.e codes for more than one polypeptide. The information is continuous and no splicing is required.



Anatropous ovule

**14. Convergent evolution:** It is the evolutionary process in which anatomically various organs in different groups of organisms evolve towards the same function. Analogous organs are the result of convergent evolution, e.g. Sweet potato (Modification of root) and potato (modification of stem) are analogous, as they both are tuberous that stores food materials.

**Divergent evolution:** It is the evolutionary process in which the same structure develops in different directions in various groups of organisms as adaptations to different needs. Homologous organs are the result of divergent evolution, e.g. human hands are homologous to the wings of a bird, as their basic structure is similar.

**15. Inbreeding depression:** Loss of vigour associated with inbreeding is due to increase in homozygosity in recessive alleles. Continued inbreeding reduces fertility and productivity in organisms.

Advantages:

- (a) Inbreeding is necessary to evolve purelines in any animal as it increases homozygosity.
- (b) It helps in accumulation of superior genes and elimination of less desirable ones.

**OR**

- (a) CT (computed tomography) and MRI (magnetic resonance imaging) are very useful to detect cancers of the internal organs. Computed tomography uses X-rays to generate a three dimensional image of the internals of an object. MRI uses strong magnetic fields and non-ionising radiations to detect pathological and physiological changes in the living tissues.
- (b) It activates the immune system and helps in destroying the tumour.

**16. MOET-Multiple Ovulation Embryo Transfer**

Steps:

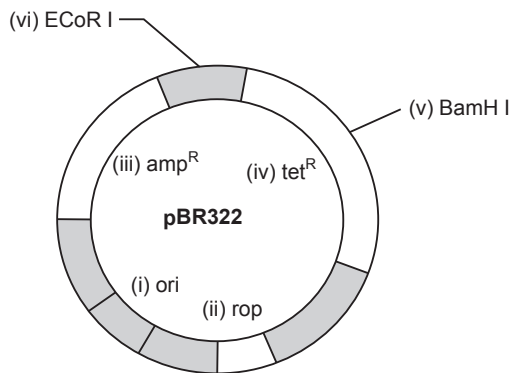
A cow is administered hormones to induce follicular maturation and super ovulation (6-8 eggs are produced per cycle). The animal is artificially inseminated or mated with an elite bull. The fertilised eggs are recovered at the 8-32 celled stages, non surgically. They are then transferred to surrogate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

**17. Milk coagulates as bacteria produce acids and partially digest the milk proteins.**

Lactic acid bacteria improves the nutritional quality by increasing vitamin B12.

- 18.**
- (a) Cloning vectors help easy linking of foreign DNA and selection of recombinants from non-recombinants and therefore are necessary for genetic engineering.
  - (b) The strand of DNA are cut by restriction enzymes a little away from the centre of the palindrome site but between the same two bases in both the strands. This creates single stranded stretches overhanging at the ends of the palindrome; they are called **sticky ends**.

19.



20. **Transgenic** animals are those animals that have had their DNA manipulated to possess and express a foreign gene.

The two ways in which such animals are beneficial to human are:

- (a) Transgenic mice are being used for testing the safety of polio vaccine.
- (b) Transgenic cow, Rosie produced human protein enriched milk which contained alpha-lactalbumin, a more balanced product for human babies than natural cow milk.

21. **Commensalism:** The egrets are often seen along with grazing cattle because the cattle stir up and flush out insects from the vegetation that might be difficult for the egrets to find and catch. Thus, the egrets are benefited while the cattle are neither benefited nor harmed.

22. (a) Only 10% of energy flows from a particular trophic level to next trophic level and remaining energy is always lost as heat at each step. Therefore, in the pyramid of energy, the trophic level decreases at each step as each bar indicates the amount of energy present at each trophic level.

(b)	Grazing food chain (GFC)	Detritus food chain (DFC)
(i)	Transfer of energy starts from the producers.	Transfer of energy starts from dead organic matter.
(ii)	As compared to DFC, less energy flows through this chain.	Comparatively more energy flows through this chain.

#### SECTION-D

23. (a) Amniocentesis test.

(b) It has been banned in India as it led to female foeticide because identification of foetus sex was detected from amniotic fluid instead focussing on detection of any chromosomal abnormality. The sex of the foetus was also revealed and if it was found to be female foetus, it was aborted immediately.

(c) **Positive aspect:** Genetic diseases like Down's syndrome, Klinefelter's syndrome can be identified and that foetus can be terminated medically as these babies born will not be able to lead a normal life.

**Negative aspect:** It led to female foeticide and the population of male to female ratio become unbalanced in India.

(d) The ban should be lifted because the test enables detection of some genetic defects and birth of such abnormal children would be a curse. At the same time, the importance of girl child in the society should be advertised and government should take up strict action to implement it. Deduction in number of girls would lead to to a dissatisfied society, sex abuse etc.

### SECTION-E

24. – **Fertilisation** occurs in the ampullary-isthmic junction of the fallopian tube.
- When a sperm comes in contact with the ovum it induces changes in the **zona pellucida** that block the entry of additional sperms.
  - The secretions of the **acrosome** help the sperm to enter the cytoplasm of the ovum by dissolving the zona pellucida and plasma membrane. The entry of sperm into the cytoplasm induces completion of meiosis II.
  - Fusion occurs between the nucleus of ootid and that of sperm to form a diploid zygote.
  - The zygote undergoes mitotic divisions as it starts moving from the isthmus in the fallopian tube. The daughter cells are called **blastomeres** and embryo with 8-16 cells is called **morula** which continue to divide and form a **blastocyst**. The blastocyst moves towards the uterus during this process.
  - The blastomeres in a blastocyst are arranged into an outer layer of trophoblast and an inner group of cells called inner cell mass attached to the trophoblast at one end.
  - The **trophoblast** layer becomes attached to the endometrium of the uterus and uterine cells divide repeatedly to cover the blastocyst. The blastocyst is now embedded in the endometrium i.e implantation has occurred.

### OR

The pollen tube releases the two male gametes into the cytoplasm of a synergid. One of the male gamete moves towards the female gamete and fuses with it; this fusion is called **syngamy** and it results in the formation of a zygote. The second male gamete moves towards the two polar nuclei in the central cell. The two polar nuclei fuse to form a secondary nucleus and the second male gamete fuses with this secondary nucleus in the central cell, this fusion is called **triple fusion** and it results in the formation of a triploid primary endosperm nucleus. Since two fusions syngamy and triple fusion occur in an ovule, the phenomenon is known as **double fertilisation** in angiosperms.

**Post fertilisation events:** The primary endosperm nucleus develops into the endosperm. Zygote develops into the embryo. Antipodals and synergids degenerate. The integuments develop into the seed coat and ovule becomes transformed into a seed.

25. **Inheritance** of flower colour in garden pea shows true dominance and the  $F_1$  hybrid expresses one of the parental characters i.e dominant trait and  $F_2$  generation shows both dominant and recessive traits in the ratio of 3 : 1.

Whereas in snapdragon, it shows incomplete dominance, a phenomenon in which neither of the two alleles is completely dominant over the other and the hybrid formed is intermediate between the two. Red is homozygous dominant, white is homozygous recessive while the hybrid flower is of intermediate colour that is pink.

**Inheritance of flower colour in garden pea:**

Parents	:	Purple flowered	X	White flowered
		PP	X	pp
Gametes	:	P		p
$F_1$ generation	:		Pp	
Selfing	:	Pp	X	Pp
$F_2$ progeny	:	PP, Pp, Pp, pp		

The phenotypic ratio is 3 Purple flowered : 1 white flowered

The genotypic ratio is 1PP : 2Pp : 1pp

**Inheritance of flower colour in snapdragon:**

Parents	:	Red flowered	X	White flowered
		RR	X	rr
Gametes	:	R		r
$F_1$ generation	:		Rr	
Selfing	:	Rr	X	Rr
$F_2$ progeny	:	RR, Rr, Rr, rr		

The phenotypic and genotypic ratios are the same

1 red flower, 1 white flower and 2 pink flower

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

OR

The methods involving two major approaches:

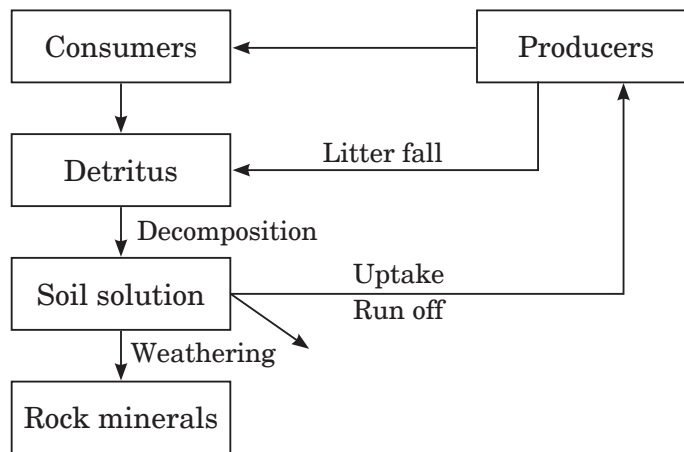
The two major approaches are **Expressed Sequence Tags** and **Sequence Annotation**.

- These fragments are then cloned in suitable hosts using specialised vectors. The vectors are Bacterial Artificial Chromosomes (BAC) and Yeast Artificial Chromosomes (YAC) and the commonly used hosts are bacteria and yeast.
- The fragments are then sequenced using automated DNA sequences.

- The sequences were arranged based on some overlapping region and these sequences were also aligned.

- Specialised computer programmes are developed for alignment of the sequences.
- These sequences are annotated and assigned to the respective chromosomes.

26.



Importance of phosphorous in living organisms:

- It is a constituent of cellular energy currency and biomembrane.
- Needed for making shell, bones, teeth.

The differences between carbon and phosphorus cycle are:

Phosphorus cycle	Carbon cycle
(i) Phosphorus cycle is a sedimentary cycle whose reservoir is mainly the rocks whereas.	(i) Carbon cycle is a gaseous cycle whose reservoir is the atmosphere and the ocean.
(ii) Atmospheric input of phosphorus through rainfall is much smaller.	(ii) Atmospheric inputs of carbon through rainfall is considerable.
(iii) Gaseous exchanges of phosphorous between organism and environment are negligible.	(iii) Sufficient gaseous exchanges between organism and environment.

**OR**

- (a)
- |                  |                   |
|------------------|-------------------|
| 1. Consumers     | 2. Detritus       |
| 3. Soil solution | 4. Rock minerals  |
| 5. Producers     | 6. Litter fall    |
| 7. Decomposition | 8. Uptake/run off |
| 9. Weathering    |                   |

(b) The differences between carbon and phosphorus cycle are:

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