

Answers to RBI-DS1/Set-3

SECTION-A

1. (c) The generative cell does not have food reserve. It has a dense cytoplasm and a small round nucleus and floats in the cytoplasm of the vegetative cell.
2. (a) Contraceptive pills have to be taken daily for a period of 21 days, starting within the first five days of menstrual cycle after a gap of 7 days (during menstruation), it has to be repeated till next menstruation.

Lactational amenorrhoea method of birth control has been reported to be effective only upto a maximum period of six months following parturition.

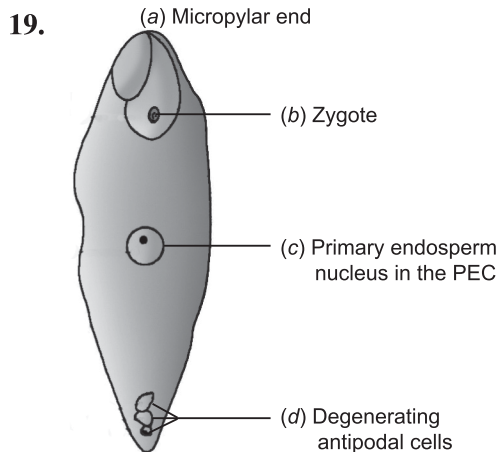
3. (b) **Parents** : Father × Mother
 (Blood group A) (Blood group B)
 $I^A i$ $I^B i$
Gametes : $(I^A), (i)$ $(I^B), (i)$
Progeny : I^A i

I^B	$I^A I^B$ (Blood group AB)	$I^B i$ (Blood group B)
i	$I^A i$ (Blood group A)	ii (Blood group O)

4. (c) About 200 base pairs are present in each nucleosome and the distance between two base pairs is 0.34 nm.
5. (b) A. Lactic acid, B. Vitamin B₁₂
6. (b) silencing of a specific mRNA due to complementary dsRNA
7. (c) A. Insects, B. Molluscs
8. (a) gross primary productivity
9. (d) Thymus
10. (c)
11. (d)
12. (a) A-2, B-3, C-4, D-1
13. (d) A is False but R is true.
14. (b) Both A and R are true and R is not the correct explanation of A.
15. (b) Both A and R are true and R is not the correct explanation of A.
16. (a) Both A and R are true and R is the correct explanation of A.

SECTION-B

17. P – Heroin, Q – Cardiovascular system, R – Cocaine, S – Central nervous system
18. – Pedigree analysis is an analysis of the distribution and movement of traits in a series of generations of a family.
- It is an important method to study human genetics.
 - Genetic disorders occurring in a family can be identified and the movement of the trait in the future generations can be predicted.



20. The two core techniques are:

(i) Genetic engineering

- This includes the techniques to alter the chemistry of genetic material (DNA/RNA), to introduce these into host organisms and thereby change the phenotype of the host organism.

(ii) Bioprocess engineering

- This refers to the maintenance of sterile ambience in the chemical engineering processes to enable growth of only the desired microbe or eukaryotic cell in large quantities for the manufacture of products like enzymes, antibiotics, vaccines, etc.

21. (a) Biodiversity must be conserved as it plays an important role in many ecosystem services.

- (i) Spiritually or philosophically, we have to realise that every species has an intrinsic value, though it may not be of any economic value to us currently.
- (ii) Morally, we have a duty to care for the well-being of the species and pass on our biological legacy in good order to future generations.

OR

- (b) – The slope of regression lines are amazingly similar regardless of the taxonomic group or the region; it lies in the range of 0.1 to 0.2.
- The line is much steeper (with Z values being in the range of 0.6 to 1.2), if one analyses the species–area relationships for very large areas like the entire continent; it indicates more species richness.

SECTION–C

22. (a) – The mature Graafian follicle ruptures and releases the ovum (secondary oocyte); this process, is called ovulation.
- (b) – The level of estrogen decreases
- The level of progesterone increases and reaches its peak level
- (c) – If fertilisation has not occurred, the level of progesterone decreases as the corpus luteum regresses.
- In the absence of progesterone, the endometrium disintegrates along with its blood vessels; hence, menstruation occurs.
23. – The surgical method of birth control in males is called vasectomy.
- In this method, a portion of vas deferens is removed or ligated, through a small incision in the scrotum.
 - The surgical method of birth control in females is called tubectomy.
 - In this method, a portion of fallopian tube is removed or ligated through a small incision in the abdomen or through the vagina.

Advantage

- These are fool-proof methods that are highly effective.

Disadvantage

- Their reversibility is very poor.

24. (a) – In mutation A, the change in the codon GAG to GAA does not change the amino acid coded, i.e. both GAG and GAA code for amino acid, glutamic acid; hence, there is no change in the haemoglobin structure.
- In mutation B, the codon GAG is changed to GUG, where GUG codes for valine, while the original codon GAG codes for glutamic acid; hence, there is a change in the haemoglobin structure and it leads to sickle-cell anaemia.
- (b) When the defective haemoglobin undergoes polymerisation under low oxygen tension, the RBCs become sickle-shaped.

25. (a) The food resources are unlimited in curve (*p*) and limited in curve (*q*).
(b) Curve (*p*).
(c) The dotted line represents the carrying capacity.

Carrying capacity refers to the maximum number of individuals (or size of a population) that a given environment can support, beyond which further growth is not possible.

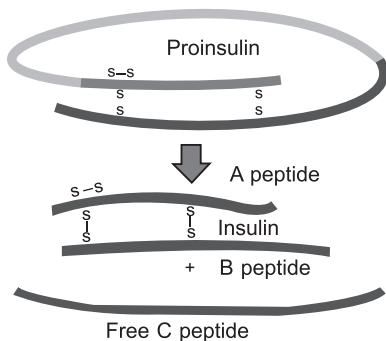
26. Industrial Melanism:

- In England, in a collection of moths made in 1850, i.e. before industrial revolution, there were more white-winged 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, i.e. in 1920, there were more dark-winged moths, i.e. the proportion was reversed.
- The explanation given for this observation was that predators will spot a moth against a contrasting background.
- 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.
- During the post-industrialisation period, the tree 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.
- This change in population is a classic case of natural selection.
- The selective advantage shifted from light to dark moths due to environmental change caused by industrialisation.
- It shows that nature selects traits that provide better survival and reproduction in a given environment.

27. (a) (i)

Somaclones	Somatic hybrids
– Somaclones are produced by tissue culture and micropropagation, i.e. production of a large number of plants through tissue culture.	– Somatic hybrids are produced by protoplast fusion and then growing the hybrid protoplasts.
– All the plants are genetically identical among themselves and also to the plant from which they are produced. e.g. somaclones of tomato, banana, apple etc. are produced.	– The plants are genetically dissimilar among themselves and also from the parent plants. e.g. pomato is a somatic hybrid between potato and tomato.

(ii)



OR

- (b) (i) – Animals whose DNA has been manipulated to possess and express one or more foreign gene(s), are called ‘transgenic’
- Mice are used for testing vaccine safety.
 - Polio is the disease.
- (ii) – Enzyme-linked Immunosorbent Assay.
- Acquired immunodeficiency syndrome (AIDS) can be detected by using it.
 - It works on the principle of antigen-antibody interaction; the disease can be detected either by the antigens of the pathogen or the antibodies produced by our body in response to the antigen.

28. (a) (i) Cyanobacteria can fix atmospheric nitrogen in the soil.

(ii) They also add organic matter to the soil to increase soil fertility.

- (b) The two institutes are:
- (i) Indian Agricultural Research Institute (IARI)
 - (ii) Khadi and Village Industries Commission (KVIC)

SECTION-D

29. (a) During anaphase I of meiosis; the phenomenon is called disjunction.
- (b) Mendel's work remained unrecognised for the following reasons:
- (i) His work could not be widely publicised as communication was not easy.
 - (ii) His concept of 'factors' as stable and discrete units that controlled the expression of traits and that the pair of alleles which did not blend with each other, were not accepted by his contemporaries as the explanation of variation.
 - (iii) Mendel's approach of using mathematical logic to explain the biological phenomena was new and unacceptable to many biologists.
 - (iv) Though Mendel's work suggested that factors were discrete units, he could not provide any physical proof for the existence of factors or prove what they are made of. (any two)
- (c) (i) T.H. Morgan; he worked on *Drosophila melanogaster*.

OR

- (c) (ii) Walter Sutton and Theodor Boveri proposed the chromosomal theory of inheritance.
30. (a) The municipal waste water, is called sewage.
- (b) Aerobic and anaerobic heterotrophic microbes, i.e., bacteria and fungi.
- (c) (i) – Primary treatment and secondary treatment.
– Primary sewage treatment is a physical process and secondary treatment is a biological process.

OR

- (c) (ii) Activated sludge is the sediment of 'flocs', i.e. aerobic bacteria and fungi.

Uses:

1. A small part is pumped back into aeration tank as inoculum.
2. A major part is pumped into anaerobic sludge digester, where biogas (methane, carbon dioxide and hydrogen sulphide) is produced by the anaerobic digestion of the flocs. (any one)

SECTION–E

31. (a) (i) – A is chasmogamous flower
– Autogamy, geitonogamy and xenogamy can occur in it.
(ii) – B is cleistogamous flower.
– Only autogamy can occur in it
(iii) – *Oxalis* and *Viola*
(iv) 1. Flower B
2. Flower A

OR

- (b) (i) (1) a – Spermatogonia
b – Interstitial cells or Leydig cells
c – Spermatozoa.
(2) a – Spermatogonia produce the spermatozoa (sperms).
d – Sertoli cells provide nutrition to the germ cells.
(ii) – Chorionic villi appear just after implantation.
– They appear as finger-like projections on the trophoblast and become interdigitated with the surrounding maternal uterine tissues and form the foetal part of the placenta.
– Placenta facilitates the supply of oxygen and nutrients to the foetus and helps in removal of excretory products; it also secretes certain hormones which are necessary for foetal growth and maintenance of pregnancy.
32. (a) (i) *Streptococcus pneumoniae*.
– R-cells are those cells that form rough colonies, without a capsule and are non-virulent, i.e., they did not cause pneumonia.
– S-cells are those cells that form smooth colonies, protected by a capsule and are virulent, i.e., they caused the disease, pneumonia.
– He showed that DNA is the transforming principle.
(ii) A. Mice died of pneumonia.
B. Mice lived and did not suffer from pneumonia.
(iii) Frederick Griffith performed the steps (1), (2) and (3).
(iv) – This indicates that DNA is the transforming principle.
– When DNase is added to the medium, the DNA of the heat-killed cells gets digested and is unable to carry out the transformation.

OR

- (b) (i) A is template strand.
B is coding strand.
- The strand with 3' → 5' polarity is the template strand and the strand with 5' → 3' polarity is the coding strand.
 - It is the presence of a promoter in the transcription unit that defines the coding and template strands.
 - It is present towards the 5' end (upstream of structural gene) of the coding strand.
- (ii) – Sigma factor functions as the initiation factor; when the RNA-polymerase binds to it transiently, transcription is initiated.
- Rho factor functions as the termination factor; when the RNA polymerase binds to it transiently, termination of transcription is effected.
- (iii) – RNA polymerase I transcribes 28S, 18S and 5.8S rRNAs.
- RNA polymerase III transcribes *t*RNA, 5S rRNA and snRNA.
33. (a) (i) 1. – 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 and removed by spooling.
2. – The recipient bacterial cell is made 'competent' to take up the recombinant DNA by treatment with a specific concentration of calcium ions.
- The recombinant DNA is then forced into such cells by heat shock treatment, i.e. by incubating the cells with recombinant DNA on ice, followed by placing them briefly at 42°C (heat shock) and then putting them back on ice; this enables bacteria to take up the recombinant DNA.
- (ii) 1. A-BamHI, B-PstI, C-amp^R
2. A and B are the recognition sites for the restriction enzymes.
3. The *rop* gene codes for the proteins involved in the replication of the plasmid.

OR

- (b) (i) – The purified DNA molecule containing the desired gene is incubated with the specific restriction endonuclease, at optimal conditions of pH, temperature, etc. of that enzyme.
- Similarly, the vector DNA is also incubated with the same restriction endonuclease under optimal conditions.
 - This results into cutting of the DNA into fragments.
- (ii) – Gel electrophoresis is used to separate the DNA fragments produced by restriction digestion.
- The DNA fragments resolve according to their sizes, through the sieving effect provided by the agarose gel.
- (iii) – The resultant fragments are joined to the vector by use of DNA ligases, which form hydrogen bonds between their complementary cut counterparts.