

## Answers to RBI-DS1/Set-3

1. (c) A. Asymmetric spindle, B. Vegetative cell, C. Generative cell
2. (b) A – (iv), B – (iii), C – (ii), D – (i)
3. (b) A – Proinsulin, B – Insulin, C – C-peptide
4. (c)  $\frac{1}{4}$
5. (a) A, B and C
6. (b) Denmark – A, Canada – B, Panama – C
7. (d) 2pq
8. (d) C and D
9. (b) I<sup>A</sup>i, blood group A
10. (c) Frederick Sanger
11. (a) A – 5, B – 3, C – 2, D – 1
12. (a) In domesticated fowls, the sex of the offspring is dependent on the type of sperm fertilising the ovum.
13. (b) Both A and R are true, but R is not the correct explanation of A.
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16. (a) Both A and R are true, and R is the correct explanation of A.

17.	Klinefelter's Syndrome	Turner's Syndrome
	<ul style="list-style-type: none"> <li>– It is due to an extra copy of X-chromosome.</li> <li>– The afflicted individual is a male, with a karyotype (44A + XXY), i.e., 47 chromosomes.</li> <li>– The male individual shows more feminine traits like gynecomastia.</li> </ul>	<ul style="list-style-type: none"> <li>– It is due to monosomy (lack of one) of sex chromosome.</li> <li>– The afflicted individual is a female with a karyotype, (44A + XO), i.e., 45 chromosomes.</li> <li>– The secondary female sexual characters are poorly developed.</li> </ul>

18. – Myometrium is the middle muscular layer of the uterine wall, whose vigorous contractions at the end of gestation lead to parturition.
- Endometrium is the inner most glandular layer of the uterine wall that undergoes cyclical changes during menstrual cycle and implantation occurs in this; it also forms a part of the placenta.
19. (a) – Common roundworm causes Ascariasis.
- A healthy person gets infected through water, vegetables, food, etc. contaminated with the eggs of the parasite, which are excreted with the faeces by an infected person.
- (b) – Wuchereria causes filariasis, also called elephantiasis.
- The pathogen is transmitted through the bite of female *Culex* mosquitoes.
20. – Ti plasmid is isolated from *Agrobacterium tumefaciens*.
- The Ti plasmid of *Agrobacterium* is responsible for the transformation of plant cells into tumours.
  - So, it is modified into a non-pathogenic one but still usable to deliver the DNA; this disarmed plasmid of *Agrobacterium* is used as a cloning vector for transformation of plant cells.
21. Primary producers – 1, 2 and 3  
Primary consumers – 4 and 5  
Secondary consumers – 6, 7, 8  
Tertiary consumer – 9

**OR**

- (a) (i) Tropical region – Y; (ii) Temperate region – X.
- (b) Y will show high biodiversity for the following reasons:
- (i) Speciation is a function of time; the temperate regions were subjected to frequent glaciation in the past, while the tropics have remained relatively 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. (any two)

22. – The two gonadotropins involved in the menstrual cycle are (i) Follicle stimulating hormone and (ii) Luteinising hormone.
- The follicle stimulating hormone (FSH) stimulates the growth of primary follicle in the ovary into a mature Graafian follicle.
  - It also stimulates the secretion of estrogens by the developing follicle cells.
  - Rapid secretion of luteinising hormone (LH) during the middle of the menstrual cycle, also called LH surge, causes the rupture of Graafian follicle and the release of the ovum (secondary oocyte) in the process, called ovulation.
  - It also stimulates the formation of corpus luteum from the ruptured Graafian follicle and secretion of progesterone from it
  - The gonadotropins reach their peak levels in the middle of menstrual cycle, i.e., about the 14th day of the cycle.
23. Law of dominance and law of segregation are the two laws, Mendel derived from his monohybrid crosses.
- (i) Law of dominance explains that in a dissimilar pair of factors of a trait, one of them expresses itself (dominant) and the other remains hidden (recessive).
- It also explains the expression of both the traits in the  $F_2$  progeny, in a ratio of 3 : 1.
- (ii) Law of segregation states that the members of an allelic pair that remained together in the parent/ hybrid, segregate during gamete formation and enter different gametes.
- A homozygous parent produces all gametes that are similar while the heterozygous one produces two kinds of gametes, each having one allele for a trait.

24. (a) Alfred Wallace made the following conclusions:
- (i) New life forms arise and evolve in due course of time.
  - (ii) All the existing forms of life share certain similarities and common ancestors.
  - (iii) These ancestors lived at different periods in the history of earth.
  - (iv) The geological history closely correlates with the biological history.
- (b) – *Homo habilis* probably did not eat meat.  
– *Homo erectus* probably ate meat.
25. (a) HIV and Hepatitis-B can be transmitted by
- (i) sharing of injection needles, surgical instruments, etc. with an infected person.
  - (ii) transfusion of blood contaminated with HIV/ Hepatitis B virus.
  - (iii) an infected mother to the foetus through placenta. (any two)
- (b) – Early detection and proper treatment can completely cure STDs (except AIDS, hepatitis B and genital herpes.  
– If not treated properly, they can lead to disorders like
- (i) pelvic inflammatory disease (PID),
  - (ii) abortions,
  - (iii) cancer of reproductive tract,
  - (iv) still birth, etc.
26. (a) *Glomus*
- (b) – 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.
27. Totipotency is the property by which each plant cell can grow into a new plant.
- Advantages of micropropagation:**
- (i) By this method, thousands of plants can be raised in a short duration.
  - (ii) By culturing the meristems of even virus-infected plants, virus-free (healthy) plants can be raised.

- (iii) Since the plants are genetically identical, certain desirable characters can be continued through generations.
- (iv) Through somatic hybridisation, hybrids which otherwise cannot be produced, can be raised.

**OR**

(a) *cryIAb*

- (b) – When Bt toxin is ingested by an insect, it is converted into its active form when exposed to the alkaline pH in the gut which solubilises the crystals.
- The activated toxin binds to the surface of the epithelial cells of the midgut and creates pores.
- Water enters the cells and causes their swelling and lysis.
- Bt toxin does not kill the *Bacillus thuringiensis* because it exists as an inactive protoxin.

28. (a) – Alexander von Humboldt observed in the South American jungles that within a region, species richness increased with the increasing explored area, but only upto a certain limit.
- The relation between species richness and area for a wide variety of taxa turns out to be a rectangular hyperbola.
  - On a logarithmic scale, the relationship is a straight-line.

(b) S – Species richness

C – Y-intercept

Z – Slope of the line or Regression coefficient

A – Area (explored)

29. (a) Plasmids and bacteriophages have the ability to replicate/multiply within the bacterial cells independently of the chromosomal DNA of the bacterium; an alien piece of DNA ligated to them, can be multiplied equal to their copy numbers.

(b) (i) ori (ii) PvuII

(c) – G – amp<sup>R</sup> (ampicillin-resistance) gene and  
H – tet<sup>R</sup> (tetracycline-resistance) gene.

– It is because normal *E.coli* cells do not have resistance against antibiotics ampicillin or tetracycline.

**OR**

(c) – PstI (D) and PvuI (E) in amp<sup>R</sup> gene (G).

– BamHI (A) and Sall (B) in tet<sup>R</sup> gene (H).

30. (a) Predators are prudent in nature because if a predator is too efficient and over-exploits its prey, then the prey might become extinct and following it, the predator will also become extinct.

(b) It is due to absence of its natural predator.

(c) – Predators help in maintaining species diversity by reducing the intensity of competition among the prey species.

– In the rocky intertidal zones of the American Pacific Coast, the starfish *Pisaster* is a predator.

– In a field experiment, when all the starfish were removed from an enclosed area, more than ten species of invertebrates became extinct within a year, due to interspecific competition.

**OR**

(c) Caffeine, Quinine, Strychnine, Nicotine.

31. (a) – It was George Gamow, who suggested that the code must be made of three bases, in order to code for the twenty different amino acids, with only four bases; this would generate  $(4^3)$  or  $(4 \times 4 \times 4) = 64$  triplet codons, many more codons than required.

– Har Gobind Khorana could synthesize RNA molecules with definite combinations of bases (homopolymers and copolymers).

- Marshal Nirenberg made a cell-free system for protein synthesis, that helped in deciphering the code.
  - Ochoa discovered enzyme polynucleotide phosphorylase, that could polymerise RNA with definite sequences in a template-independent manner.
- (b) – The process of translation requires transfer of genetic information from a polymer of nucleotides to a polymer of amino acids.
- The genetic code could direct the sequence of amino acids during protein synthesis, *i.e.*, it shows the relationship between the sequence of nucleotides on *mRNA* and the sequence of amino acids in the polypeptide.

**OR**

**(a) Salient features of Human Genome**

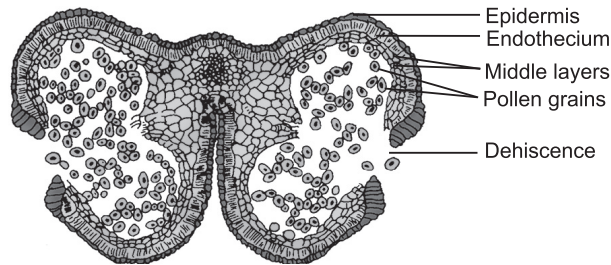
- (i) The human genome contains 3164.7 million nucleotides (base pairs).
- (ii) The size of the genes varies; an average gene consists of 3000 bases, while the largest gene, dystrophin consists of 2.4 million bases.
- (iii) The total number of genes is estimated to be 30000 and 99.9% of the nucleotides are the same in all humans.
- (iv) The functions of over 50% of the discovered genes are not known.
- (v) Only less than 2% of the genome codes for proteins.
- (vi) Repetitive segments make up a large portion of the human genome.
- (vii) Repetitive sequences throw light on chromosome structure and dynamics and evolution, though they are thought to have no direct coding functions.
- (viii) Chromosome 1 has 2968 genes and Y-chromosome has the least number (231 genes). (any six)

**(b) Significance of HGP**

- (i) With whole genome sequences and new high-throughput technologies, all the genes in a genome can be studied as to how tens of thousands of genes and the proteins work together in an organism.

- (ii) It will enable a radically new approach to the biological research.
- (iii) The SNPs provide information that help to find the chromosomal locations of the disease-associated genes.
- (iv) This will also help in tracing human history.

32. (a)



T.S. of a mature dehiscent anther

- (b) (i) Insect-pollinated flowers are large, colourful and showy; if flowers are small, they are clustered into inflorescence to make them conspicuous.
- (ii) The pollen grains and stigmatic surface are sticky.
- (iii) They are highly fragrant; flowers pollinated by flies and beetle have foul odours to attract them.
- (iv) To sustain animal visits, the flowers offer certain rewards like nectar, edible pollen and safe place for laying eggs.

**OR**

- (a) A – Spermatogonium
- (b) F – Sertoli cell; it nourishes the developing germ cells.
- (c) A – Spermatogonium  
B – Primary spermatocyte  
F – Sertoli cells
- (d) (i) Primary spermatocyte (B) undergoes meiosis I  
(ii) Secondary spermatocyte (C) undergoes meiosis II
- (e) – D undergoes spermiogenesis.  
– Spermiogenesis is the transformation of spermatids into motile spermatozoa.



33. (a) Sporozoites are injected into a human body by the bite of female *Anopheles*



Sporozoites reach the liver cells through blood



The parasite reproduces asexually in the liver cells and by bursting the liver cells, new cells are released into the blood



They enter the red blood cells (RBCs) and reproduce asexually



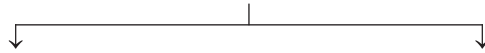
Cells of parasite are released into blood by the rupture of RBCs



The rupture of RBCs is associated with the release of haemozoin that causes fever, chill and shivering at periodic intervals of three or four days



New cells of the parasite enter new RBCs



Some continue the asexual reproduction and cause the cycles of fever.

Others enter the sexual stage and form gametocytes, which are picked up by the female *Anopheles* mosquito along with blood meal.

- (b) (i) Fluid-filled alveoli of lungs and difficulty in breathing, fever, cough.  
(ii) *Salmonella typhi*  
(iii) Common cold  
(iv) Blockage of intestinal passage, internal bleeding, muscular pain.

**OR**

(a) The main sources of biofertilisers are

- (i) Bacteria, (ii) Cyanobacteria, (iii) Fungi

- (i) **Bacteria**
    - *Azospirillum* and *Azotobacter* fix atmospheric nitrogen in the soil.
  - (ii) **Cyanobacteria**
    - *Oscillatoria*, *Nostoc* and *Anabaena* fix atmospheric nitrogen in the soil.
    - They add organic matter also to the soil.
  - (iii) **Fungi**
    - *Glomus* sp. forms mycorrhiza with the roots of higher plants and help in phosphate nutrition.
- (b) – The mechanical agitation and pumping of air in the aeration tank allows the vigorous growth of the useful aerobic microbes.
- The aerobic microbes form mesh-like structures called ‘flocs’.
  - During their growth, these microbes consume a major part of the organic matter in the sewage and reduce the BOD of the effluent, significantly, *i.e.*, they reduce the pollution potential of the sewage.