Answers to RBI/Set-2

SECTION–A

1. (*c*) B and C

2. (*a*) (*i*) – (D), (*ii*) – (B), (*iii*) – (A)

3. (*c*) AAvv and Aavv

4. (*c*) Wine and beer are produced without distillation whereas whisky, brandy and rum are produced with distillation of the fermented broth.

5. (*b*)

6. (*a*) A – B $3' \rightarrow 5'$, E – F $5' \rightarrow 3'$

7. (*b*) RNA polymerase II – snRNA and hnRNA

8. (*a*) A. CUG, B. GCA

9. (*b*) DNase inhibited transformation.

10. (*b*)

11. (*c*) 50%

Parents: Father (Colourblind) X^CY × Mother (Carrier) XX^C

Gametes: X^C, Y and X, X^C

Progeny:

	X	X^C
X^C	XX^C Carrier female	X^CX^C Colourblind female
Y	XY Normal male	X^CY Colourblind male

12. (*c*) Bacteria and fungi

13. (*b*) Both A and R are true and R is not the correct explanation of A.

14. (*a*) Both A and R are true and R is the correct explanation of A.

15. (*c*) A is true but R is fals

16. (*a*) Both A and R are true and R is the correct explanation of A.

SECTION–B

17. A – Heroin, B – Cardiovascular system, C – Cocaine, D – Central nervous system

18. (*a*) A – Estrogen

B – Progesterone

(*b*) – Hormone A (estrogen) is secreted by the follicle cells during the follicular phase of menstrual cycle.

– Hormone B (progesterone) is secreted by corpus luteum that is formed after ovulation in the luteal phase of menstrual cycle.

19. – A 'selectable marker' helps in identifying the recombinants/transformants from the non-recombinants.

– The genes encoding resistance to antibiotics such as tetracycline and ampicillin in pBR322, are considered suitable selectable markers for *E.coli*, as normal cells do not have resistance to these antibiotics.

20. (*a*) The length of DNA is calculated by multiplying the total number of base pairs with the distance between two consecutive base pairs, which is 0.34 nm or 0.34×10^{-9} m.

(*b*) It will have $1.36/0.34 \times 10^{-6}$ bp, *i.e.*, 4.0×10^{6} bp.

21. (*a*) – The processes which occur in an ecosystem create disorderliness.

– The ecosystems need a continuous supply of energy for the production of such molecules, which are needed to counteract the universal tendency of increasing disorderliness, and bring back the equilibrium.

OR

(*b*) (*i*) The standing crop is expressed in terms of fresh weight or dry weight, i.e., biomass or in terms of number in a unit area.

(*ii*) **Limitations of ecological pyramids:**

1. They do not take into account the same species belonging to two or more trophic levels.
2. It assumes a simple food chain, whereas in nature it does not exist.
3. Saprophytes/decomposers are not given any place in ecological pyramids. (*any two*)

SECTION–C

22. (*a*) – The given statement is false.
– Flocs reduce pollution by decomposing and consuming the major part of the organic matter present in water and decreases its BOD.

(*b*) – The given statement is false.
– Mycorrhiza is a type of symbiotic relationship in which both plants and fungi benefit from each other.

23. (*a*) – Francis Crick proposed an adapter molecule.
– It is transfer RNA (tRNA)

(*b*) (*i*) It is called an adapter molecule, because it reads the code on mRNA on one hand and binds to a specific amino acid on the other hand.
(*ii*) By its anticodon, it recognises the codon and leaves the amino acid coded by the mRNA at the site of protein synthesis.

(*c*) – 23S rRNA is ribozyme.
– It catalyses the formation of peptide bond in bacteria.

24. (*a*) No; the pollen grains of different species remain viable for different periods of time.

e.g. pollen grains of cereals remain viable for less than 30 minutes after release whereas some members of Rosaceae, Leguminosae and Solanaceae retain the pollen viability for months.

(*b*) – In the pollen banks, pollen grains are stored in liquid nitrogen (at –196°C).
– Such stored pollen grains can be used for breeding programmes whenever necessary.

25. (*a*) – Some insects and frogs are cryptically-coloured (camouflaged) to avoid detection by their predators.
– The Monarch butterfly is highly distasteful to its predator (bird) because of a special chemical that it has acquired during its caterpillar stage.

(*b*) (*i*) Parasitism (*ii*) Predation (*iii*) Mutualism (*iv*) Commensalism

26. Transition of a primary follicle into a Graafian follicle

– One primary follicle in the ovary grows and becomes a fully mature Graafian follicle during the follicular phase of menstrual cycle.
– The primary follicle becomes surrounded by more granulosa cells and a theca and transforms into a secondary follicle.
– The secondary follicle transforms into a tertiary follicle with the development of a fluid-filled cavity, called antrum around the primary oocyte.
– In the tertiary follicle the theca becomes differentiated into an outer layer, the theca externa and an inner layer, the theca interna.

– At this stage, the primary oocyte grows and completes meiosis I and forms a secondary oocyte and the first polar body.
– The tertiary follicle grows further to become a Graafian follicle; the secondary oocyte secretes a new membrane, called zona pullucida, around it.

27. (*a*) **Introduction of rDNA into host cell**

(*i*) **Micro-injection**

– In this method, the recombinant DNA is directly injected into the nucleus of an animal cell.

(*ii*) **Gene gun/Biolistics**

– In this method, used for plant cells, the cells are bombarded with high velocity microparticles of gold or tungsten coated with DNA.

(*iii*) **Heat shock method**

– In this method, the rDNA is forced into the competent cell by incubating the cell with rDNA on ice followed by placing them briefly at 42 °C (heat shock) and then putting them back on ice.

OR

(*b*) – Bioreactors are the large vessels in which the raw materials are biologically converted into specific products in large quantities, i.e. on commercial scale.

– The bioreactors provide optimum conditions of (*i*) pH, (*ii*) substrate concentration, (*iii*) mineral salts, (*iv*) vitamins, (*v*) temperature and (*vi*) oxygen. (*any five*)

28. RNA is the first genetic material because:

(*i*) RNA can directly code for the synthesis of proteins and hence, can easily express the character; it is the genetic material in many viruses.

(*ii*) RNA can also act as a catalyst; there are some important biochemical reactions in living systems that are catalysed by RNAs and not proteins.

(*iii*) Many essential life processes like splicing, translation, etc. have evolved around RNA.

SECTION–D

29. (*a*) $p^2 + 2pq + q^2 = 1$

(*b*) – It was directional selection.

– In this more individuals acquire a value other than the mean character value, but no variant is completely wiped out.

– In the mixed population, the melanic form was able to camouflage with the dark background and escape from the predators.

(*c*) (*i*) A: Stabilising selection

B: Disruptive selection.

OR

(*c*) (*ii*) Disturbance in genetic equilibrium, *i.e.*, change in the frequency of alleles in a population indicates an evolutionary change.

30. (*a*) The mucus coating of the epithelium lining the gastrointestinal, urinogenital and respiratory tracts.

(*b*) Physiological barriers:

(*i*) Saliva in the mouth

(*ii*) Acid in the stomach

(*iii*) Tear in the eyes (*any two*)

(*c*) (*i*) – The virus-infected cells secrete proteins, called interferons, which protect the non-infected cells from viral infections.

– It constitutes cytokine barrier.

OR

(*c*) (*ii*) – Macrophages form cellular barrier.

– They phagocytose and destroy the pathogens/antigens.

SECTION–E

31. (*a*) (*i*) Prokaryotes are not given any number because:

1. The conventional taxonomic methods are not suitable/sufficient for identifying these microbes.
2. Many of these cannot be cultured under laboratory conditions.
3. Biochemical and molecular biology techniques would put their diversity into millions.

(*ii*) – *Rauwolffia vomitoria* produces reserpine.

– It shows genetic diversity in terms of the potency and concentration of the chemical, reserpine in plants growing in different Himalayan ranges.

OR

(*b*) (*i*) 1. X – The species richness, within a given region, increases with the increasing of explored area, but up to a certain limit; the relationship between species richness and area explored, for a wide variety of species turns out to be a rectangular parabola and is represented as S (species richness) = CA^Z.

Y – On a logarithmic scale, the relationship becomes a straight line and is described by the equation,

$\log S = \log C + Z \log A$

(S – Species richness, C – *y*-intercept, Z-regression coefficient and A is area)

2. – The slope of the line is represented by Z, the regression coefficient.
   – The normal range of Z–value is 0.1 to 0.2.
3. A much steeper slope (of Z value 1.15) will be observed for frugivorous birds and mammals in a tropical forest.

(*ii*) – Since plants cannot move away from their predators (herbivores) and harsh environmental conditions, many of them have become extinct.
– But animals can move away from the harmful/unfavourable environments or their predators and hence evolution of favourable characters has taken place in them.

32. (*a*) (*i*) The seminal analysis determines the number of sperms in an ejaculate, their morphology and motility.

(*ii*) It indicates slow rate of maturation of follicles in the ovary.

(*iii*) Intra-cytoplasmic sperm injection (ICSI) and Intra-uterine transfer (IUT).
– ICSI is a specialised procedure to form an embryo in the laboratory, in which a sperm is directly injected into the ovum.
– IUT involves the transfer of embryo with more than eight blastomeres into the uterus of the recipient female

(*iv*) During ovulatory phase of menstrual cycle.

(*v*) Progesterone

OR

(*b*) (*i*) 1. Periodic abstinence and
2. Coitus interruptus (withdrawal method) are two natural methods of birth control.

Periodic abstinence

– In this method, the couples avoid or abstain from coitus from day 10 to 17 of the menstrual cycle.
– This is the fertile period when ovulation can occur and chances of fertilisation and pregnancy are high; hence, abstaining from

coitus during this period can prevent pregnancy.

Coitus interruptus (Withdrawal method)

– In this method, the male partner withdraws his penis from the vagina before ejaculation.

– As insemination is avoided, pregnancy may be avoided.

(*ii*) **Positive application:**

– Any genetic disorder of the foetus can be detected.

Negative application:

– It is misused for sex determination and female foeticide.

33. (*a*) (*i*) 1. Species A

2. Species B

(*ii*) – B*acillus thuringiensis* is the source organism.

– *cryIAb* is the gene.

(*iii*) Since the corn borer species B is not affected by the Bt toxin, the farmers can grow Bt corn or non Bt corn.

(*iv*) **Advantages of GM Plants:**

– Genetic modification has made the crops more tolerant to abiotic stresses like cold, heat, drought, salinity, etc.

– It has reduced the dependence of crops on chemical pesticides as they are made pest-resistant.

– Post-harvest losses are much reduced.

– As the plants have increased efficiency of mineral usage, the early exhaustion of fertility of soil is prevented.

– Food produced from GM (Genetically Modified) crops has enhanced nutritional value.

– Genetic modification has been used to create tailor-made plants to supply resources such as starch, fuels, pharmaceuticals, etc. to industries.

(*any four*)

OR

(*b*) (*i*) 1. Polymerase chain reaction (PCR).

2. Enzyme linked immunosorbent assay (ELISA).

3. Recombinant DNA (rDNA) technology. (*any two*)

(*ii*) 1. Enzyme-linked immunosorbent assay.

2. It works on the principle of antigen-antibody interaction.
3. Infection by a pathogen can be detected by
   - the presence of antigens like proteins, glycoproteins, etc.
   - the presence of antibodies synthesised against the pathogen in our body.

(*iii*) – A probe is a single-stranded DNA or RNA tagged with a radioactive molecule.

– The probe is allowed to hybridise to its complementary DNA in a clone of cells, followed by detection using autoradiography.

– The clone having the mutated gene will not appear in the photographic film, because the probe will not be complementary to the mutated DNA.