

# Answers to RBI/Set-3

## SECTION-A

1. (a) A – 4, B – 3, C – 2, D – 1
2. (a) Alkaline pH in the gut
3. (b)  $dN/dt = rN$
4. (d)
5. (d) Aa × aa
6. (b) R – S – Q – P
7. (c) The primary treatment involve physical processes like sequential filtration and sedimentation. All the solids that settle during the primary treatment constitute the primary sludge.
8. (c) 

<b>Terrestrial Ecosystem</b>	<b>Aquatic Ecosystem</b>
Detritus	Grazing
9. (b) decrease in antibodies
10. (c) B - C - A
11. (d)
12. (d)
13. (c) A is true but R is false.
14. (a) Both A and R are true and R is the correct explanation of A.
15. (c) A is true but R is false.
16. (a) Both A and R are true and R is the correct explanation of A.

## SECTION-B

17. (a) **ADA deficiency:**
  - It is caused by the deletion of the gene coding for adenosine deaminase.
  - The enzyme is crucial for the functioning of the immune system; hence the immune system gets affected.
- (b) Vector – A retroviral vector  
Recipient cells – Lymphocytes.
18. (a) He could not get the desired results because:
  - (i) temperature is kept at 80 °C instead of 800 °C
  - (ii) oxygen is used in place of H<sub>2</sub>.

- (b) – Urey and Miller observed the formation of amino acids.
- They concluded that life originated abiogenetically from pre-existing organic molecules, whose formation must have been preceded by chemical evolution.
19. (a) – *Anopheles* mosquito is the vector of malaria.
- *Aedes* mosquito is the vector of chikungunya.
- (b) Haemozoin causes the chill and high fever recurring at periodic intervals (of 3-4 days).
20. – Zygote Intra Fallopian Transfer (ZIFT) is a boon to the couple where the female cannot conceive naturally.
- In this method, ova from the wife or donor female and sperms from the husband or male donor are collected.
  - They are induced to fuse and form zygote under simulated laboratory conditions.
  - The embryo with more than 8-blastomers can be transferred into the uterus for further development.
21. (a) – Productivity refers to the rate of biomass production.
- Gross primary productivity is the rate of production of organic matter during photosynthesis.
  - Net primary productivity is the biomass available for consumption by herbivores and decomposers; it is gross primary productivity minus the respiratory losses, is net primary productivity,  
*i.e.*,  $GPP - R = NPP$ .
  - Secondary productivity is the rate of formation of new organic matter by consumers; they depend on the net primary productivity as the source.

**OR**

- (b) – The colloidal nature of humus makes it a reservoir of nutrients; it is highly resistant to microbial action and undergoes decomposition at an extremely slow rate.
- Humus undergoes mineralisation, *i.e.*, it is degraded by microbes and inorganic nutrients are released.

## SECTION-C

22. (a) X is testis. It is located outside the abdominal cavity in the scrotum.  
 (b) Y is seminal vesicle. Its secretion along with the secretions of other reproductive glands, forms the seminal plasma.  
 (c) Z is epididymis. It temporarily stores the spermatozoa and transports it to vas deferens.

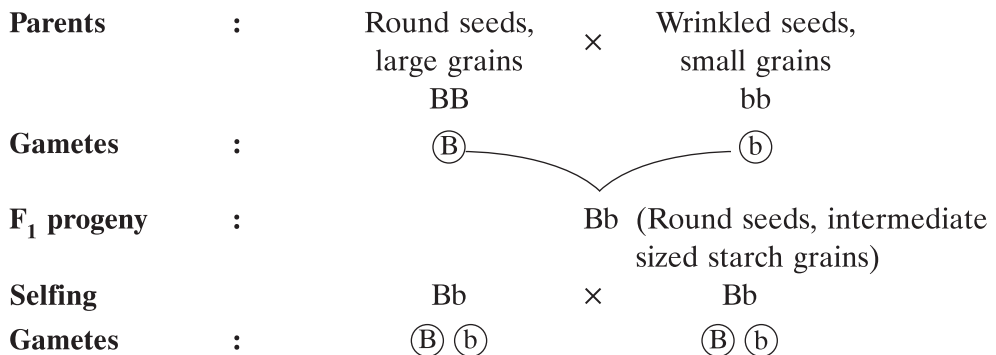
**23. Modes of pollination in a chasmogamous flower**

- (i) **Autogamy:** It refers to the transfer of pollen grains from the anther to the stigma of the same flower.  
 (ii) **Geitonogamy:** It refers to the transfer of pollen grains from the anthers of flower to the stigma of another flower of the same plant.  
 (iii) **Xenogamy:** It refers to the transfer of pollen grains from the anthers of a flower to the stigma of another flower on a different plant of the same species.
24. – Both *Drosophila* and grasshopper show male heterogamety, i.e., the males produce two different types of gametes with reference to sex chromosome.

**Difference**

<i>Drosophila</i>	Grasshopper
– In <i>Drosophila</i> , males are XY. – Males and females have the same number of chromosomes. – Males produces 50% of gametes with one X-chromosome and 50% of gametes with one Y-chromosome.	– In grasshopper, the males are XO. – Males have one chromosome less than that of females. – Males produce 50% of the gametes with one X-chromosome and 50% with no sex chromosome.

25. – The cross is as follows:



<b>F<sub>2</sub> progeny</b>	:	<b>B</b>	<b>b</b>
		<b>BB</b> Round seeds, large grains	<b>Bb</b> Round seeds, Intermediate grains
	<b>B</b>		
	<b>b</b>	<b>Bb</b> Round seeds, intermediate grains	<b>bb</b> Wrinkled seeds, small grains

- It is a case of pleiotropy where a single gene controls two traits, the seed shape and the size of starch grains.
- The inheritance shows incomplete dominance for one of the traits, *i.e.*, size of starch grains, hence, the phenotypic ratio and genotypic ratio are as follows:

Round seeds, large starch grains	:	Round seeds, intermediate starch grains	:	Wrinkled seeds, small starch grains
<b>BB</b>	:	<b>Bb</b>	:	<b>bb</b>
<b>1</b>	:	<b>2</b>	:	<b>1</b>

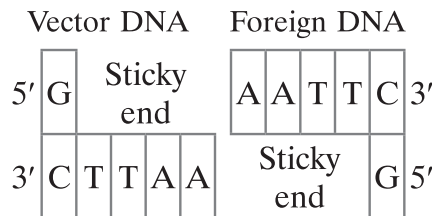
## 26. Charging of tRNA

- The amino acids are activated in the presence of ATP and linked to their cognate tRNA; this process is called charging of tRNA or amino acylation of tRNA.
- This process is necessary in translation as the formation of peptide bond between the amino acids is favoured energetically, when they are brought together.
- It is essential for translation as the activation of amino acids by ATP provides the energy for the formation of peptide bond.

27. (a) (i) Palindromic sequence and the site where EcoRI cuts it (indicated by the arrows).



(ii) Sticky ends



**OR**

- (b) (i) The two methodologies are:
1. Expressed Sequence Tags (ESTs)–it focuses on identifying all the genes that are expressed as RNAs.
  2. Sequence Annotation–it aims at sequencing the whole set of genome that includes all the coding sequences and non-coding sequences and then assigning functions to different regions in the sequence.

(ii) Yeast artificial chromosome.

– It is used as the vector.

28. (a) – *Trichoderma polysporum* is the source organism.

– It is used as an immunosuppressive agent for organ transplant patients to prevent the rejection of the graft.

(b) – *Streptococcus* is the source organism.

– It is used as a clot buster, to remove the clots from the blood vessels of patients who have suffered myocardial infarction.

(c) – *Monascus purpureus* is the source organism.

– It is a blood cholesterol-lowering agent.

**SECTION-D**

29. (a) – A is denaturation.

– D is extension (of the primer).

(b) – C-DNA polymerase

– It is a thermostable enzyme, called Taq polymerase, which can withstand the high temperature used for the denaturation of DNA; hence, can be used for repeated amplification.

– It is obtained from the bacterium *Thermus aquaticus*.

(c) (i) Uses of PCR in molecular diagnostics:

1. It is used to detect the presence of a pathogen when the concentration of bacteria or viruses is very low, *i.e.*, much before the symptoms appear.

2. It is routinely used in the detection of HIV in suspected AIDS patients.

3. It is used to detect mutations in genes in suspected cancer patients.

4. It is a powerful technique to identify many genetic disorders. (*any two*)

**OR**

(c) (ii) B – Primers; they are chemically oligonucleotides.

30. (a) B-lymphocytes and T-lymphocytes
- (b) Because the antibodies are circulating in the body fluids, (humor-body fluid), antibody-mediated immunity, is called humoral immune response.
- (c) (i) 1. Our immune system is able to distinguish between ‘self’ and ‘non-self’ cells/molecules.  
2. Cell-mediated immunity and T-lymphocytes are involved in it.

OR

(c) (ii)	Active Immunity	Passive Immunity
	<ul style="list-style-type: none"> <li>– When antibodies are produced by our B-cells in response to the antigen, it is called active immunity.</li> <li>– It lasts for longer period (even lifetime), e.g. immunity against polio, chickenpox, etc. developed by vaccination.</li> </ul>	<ul style="list-style-type: none"> <li>– When preformed antibodies are injected into the body for defence, it is called passive immunity</li> <li>– It lasts for shorter period, e.g. immunity developed against rabies, tetanus, etc.</li> </ul>

#### SECTION-E

31. (a) (i) 240 pollen grains; each ovule requires one pollen grain for fertilisation.  
(ii) 240 ovules; each ovule becomes a seed and 240 ovules become 240 seeds.  
(iii) 240 megaspore mother cells; though each megaspore mother cell forms four megaspores by meiosis, only one megaspore forms the female gametophyte in an ovule.  
(iv) 60 microspore mother cells; each microspore mother cell undergoes meiosis to form four microspores, each of which forms a pollen grain.  
(v) 480 male gametes; each ovule requires two male gametes for fertilisation (double fertilisation).

OR

- (b) (i) – It is a case of polyembryony; *i.e.*, the occurrence of more than one embryo in a seed.  
– In orange, some of the nucellar cells around the embryo sac, start dividing, protude into the embryo sac and develop into embryos, *i.e.*, apomictic embryos are formed without fertilisation.
- (ii) – All the apomictic embryos are genetically similar among themselves and to the female parent as they have developed from the nucellar cells and involved only mitotic divisions.

- The zygotic embryo in the same seed will be genetically different from these apomictic embryos, as it has developed from the zygote, which is formed by fusion of gametes from two different parents.
32. (a) (i) – Frederick Griffith (1928) performed the experiments on Bacterial transformation with *Streptococcus pneumoniae*, the bacterium that causes pneumonia.
- He observed two strains of this bacterium, one forming smooth shiny colonies with capsule (S-type) and the other forming rough colonies without capsule (R-type).
  - The S-type cells are virulent while the R-type cells are non-virulent.
  - When live S-type cells were injected into the mice, they suffered from pneumonia and died.  
S strain → Injected into mice → Mice died
  - When live R-type cells were injected into the mice, the disease did not appear and the mice survived.  
R strain → Injected into mice → Mice lived
  - When heat-killed S-type cells were injected, the disease did not appear.  
S strain → Injected into mice → Mice lived  
(Heat-killed)
  - When heat-killed S-type cells were mixed with live R-type cells and injected into the mice, the mice died of pneumonia and live S-type cells were isolated from the body of the mice.  
S strain (Heat-killed) + R strain (live) → Injected into mice → Mice died
  - He concluded that the R-strain had somehow been transformed by the heat-killed S-strain bacteria into virulent S-strain, which must be due to the transfer of genetic material, the transforming principle.
- (ii) – Avery, MacLeod and McCarty purified biochemicals like proteins, DNA and RNA from the heat-killed S-cells.
- When these fractions were added individually to the culture of live R-cells, DNA was able to cause transformation of R-cells into S-cells.
  - They also found that protein-digesting enzymes and RNA-digesting enzymes did not affect transformation, indicating that transforming substance is not a protein or RNA.
  - Digestion with DNase did inhibit transformation; this suggests that the DNA caused transformation.

OR

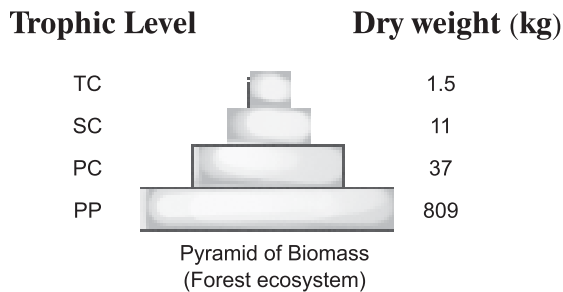
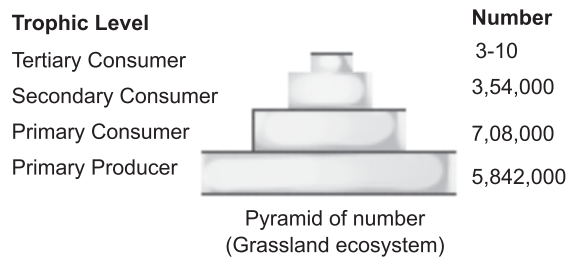
- (b) (i) DNA polymorphism, *i.e.* variation at genetic level, refers to the occurrence of inheritable mutations at a frequency greater than 0.01 in a population.
- The probability of such variations is more in the non-coding sequences.
  - DNA fingerprinting involves identification of differences in some specific sequences of DNA, called repetitive DNA, because a short segment of DNA is repeated many times in these regions.
  - The variable number of tandem repeats shows a high degree of polymorphism.
  - Since DNA from every tissue of an individual shows the same degree of polymorphism, it forms the basis of DNA fingerprinting.
  - Since the polymorphism is also inheritable, it is useful in identifying the biological father of an individual.
- (ii) DNA polymorphism arises due to mutations, which occur more in the non-coding sequences.
33. (a) (i) – India is located in the tropical region and has a greater ecological diversity with its deserts, coral reefs, mangroves, tropical rainforests, wetlands, estuaries, etc.
- Norway is a Scandinavian country located in the temperate region has very little ecological diversity.
- (ii) **Biodiversity Loss**
1. **Habitat loss and fragmentation**
    - It is the primary cause for extinction.
    - The tropical rain forests initially covered 14% of the land surface of the earth, but now they cover only 6% of land area.
    - Total loss of a habitat deprives many animals and plants of their homes and they face extinction.
    - When a large habitat becomes fragmented animals requiring large territories and those with certain migratory habits start decreasing.
  2. **Over-exploitation**
    - When nature is overexploited by man for the natural resources, many species become extinct.
  3. **Invasion by Alien Species**
    - The alien species become invasive and compete with native species and cause extinction of indigenous species.

#### 4. Co-extinction

- Co-extinction is a phenomenon in which when a species becomes extinct, the plant and animal species associated with it in an obligatory manner, also become extinct. (any three)

OR

- (b) An ecological pyramid is the graphic representation of the number, food/energy relationship or biomass of the different trophic levels of a food chain at a given time.
- In general the pyramids of number, of biomass and of energy are upright.
  - It is because the producers are more in number and biomass than the herbivores and the herbivores are more in number and biomass than the carnivores.
  - The pyramid of energy in any ecosystem is always upright because energy at the producer level is the highest and decreases at successive higher trophic levels; when energy flows from one trophic level to the next, higher trophic level, some amount of energy is lost as heat and only 10% of the energy is transferred.





Pyramid of Energy  
(Grassland ecosystem)