

Biology 2018**SET I**

Time allowed : 3 hours

Maximum marks : 70

SECTION-A

1. Write the dual purpose served by Deoxyribonucleoside triphosphates in polymerisation. [1]

Answer : Deoxyribonucleoside triphosphate acts as a substrate in polymerisation. It also provides energy from the terminal two phosphates.

2. Name two diseases whose spread can be controlled by the eradication of *Aedes* mosquitoes. [1]

Answer : Dengue and Chikungunya.

3. How do cytokine barriers provide innate immunity in humans ? [1]

Answer : The virus infected cells secrete Interferon proteins, which protects non-infected cells from further viral infection and innate immunity in humans is provided.

4. Write the names of the following : [1]

- (a) A 15 mya primate that was ape-like.
(b) A 2 mya primate that lived in East African grasslands.

Answer : (a) Dryopithecus was ape-like.

(b) Australopithecines or *Homo habilis* lived in East African Grasslands.

5. Mention the chemical change that proinsulin undergoes, to be able to act as mature insulin. [1]

Answer : Removal of C-peptide from proinsulin helps to produce mature insulin.

SECTION B

6. Your advice is sought to improve the nitrogen content of the soil to be used for cultivation of a non-leguminous terrestrial crop. [2]

(a) Recommend two microbes that can enrich the soil with nitrogen.

(b) Why do leguminous crops not require such enrichment of the soil ?

Answer : (a) *Azospirillum* or *Azotobacter* are two microbes that can enrich the soil with nitrogen.

(b) They can fix atmospheric N_2 due to the presence of Rhizobium in their root nodules,

thus they do not require such enrichment of the soil.

7. With the help of an algebraic equation, how did Hardy-Weinberg explain that in a given population the frequency of occurrence of alleles of a gene is supposed to remain the same through generations ? [2]

OR

Although a prokaryotic cell has no defined nucleus, yet DNA is not scattered throughout the cell. Explain.

Answer : In a population of diploid organisms, If frequency of allele $A = p$

And frequency of allele $a = q$, then the expected genotype frequency under random mating are :

$AA = P^2$ (for AA homozygotes)

$Aa = q^2$ (for aa homozygotes)

$Aa = 2pq$ (for Aa heterozygotes)

In the absence of selection, mutation, genetic drift or other forces, p and q are constant through generations.

Therefore $p^2 + 2pq + q^2 = 1$

OR

DNA is negatively charged. The positively charged proteins hold it in places, in large loops in a region called nucleoid. Hence, DNA is not scattered in the cytoplasm of a prokaryotic cell.

8. How did a citizen group called Friends of Arcata Marsh, Arcata California, USA, help to improve water quality of the marshland using Integrated Waste Water Treatment ? Explain in four steps. [2]

Answer : Integrated Waste Water Treatment by FOAM involves the following four steps :

- Initially water is treated by conventional methods such as sedimentation, filtration and chlorination.
- Water is made to flow through six connected marshes.
- The water in marshes is seeded with appropriate plants, algae, fungi and bacteria.
- This helps to neutralise or assimilate the pollutants and also remove heavy metals.

9. You have obtained a high yielding variety of tomato. Name and explain the procedure that ensures retention of the desired characteristics repeatedly in large populations of future generations of the tomato crop. [2]

Answer : The procedure that ensures retention of desired characteristics in a large population is tissue culture, micropropagation or somaclonal propagation.

In this procedure, any part of a plant or explant is taken and grown in a test tube or vessel under sterile conditions, in a special nutrient medium containing a carbon source such as sucrose, inorganic salts, vitamins, amino acids as well as growth regulators.

10. (a) Name the source plant of heroin drug. How is it obtained from the plant ?
 (b) Write the effects of heroin on the human body. [2]

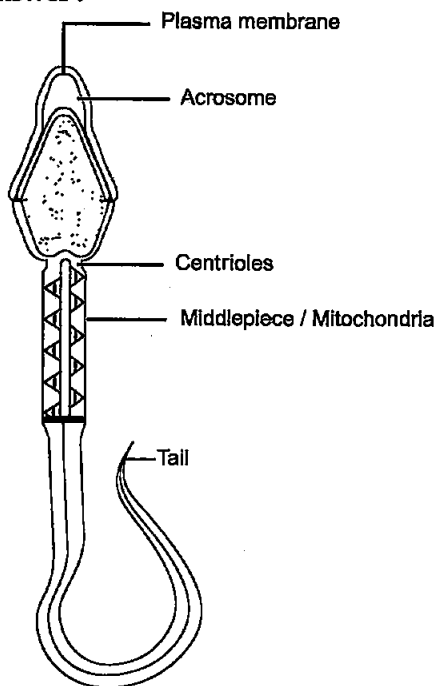
Answer :

- (a) *Papaver somniferum* or poppy plant. It is extracted from the latex of the plant containing morphine. Acetylation of morphine yields heroin.
 (b) It acts as a depressant and slows down body functions.

SECTION-C

11. Draw a diagram of a mature human sperm. Label any three parts and write their functions. [3]

Answer :



1. **Plasma Membrane :** Envelope of the sperm.
2. **Acrosome :** Filled with enzymes that help in the entry of sperm nucleus into the ovum.
3. **Mitochondria :** It is an energy source for swimming.

12. (a) Expand VNTR and describe its role in DNA fingerprinting.
 (b) List any two applications of DNA fingerprinting technique. [3]

Answer : (a) VNTR—Variable Number of Tandem Repeats. It is used as a probe because of its high degree of polymorphism.

(b) 1. DNA fingerprinting is used for paternity testing through the use of PCR technique which produces the genetic fingerprint and is highly specific for each individual.

2. It is used in the Data security where DNA regions used for individual identification are specific isolated genetic loci in the non-coding regions of the genomic DNA.

13. Differentiate between Parthenocarpy and Parthenogenesis. Give one example of each. [3]

Answer :

S. No.	Parthenocarpy	Parthenogenesis
(i)	It is the formation of fruit without fertilisation.	Ovum develops into a new organism without fertilisation.
(ii)	It is the normal process shown by plants.	It is the method of asexual reproduction.
(iii)	It always produces seedless fruits. Example : Banana	It produces haploid organisms. Example : Turkey

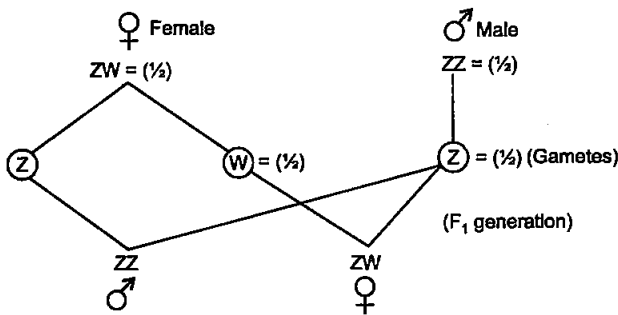
14. Medically it is advised to all young mothers that breastfeeding is the best for their newborn babies. Do you agree ? Give reasons in support of your answer. [3]

Answer : Yes, I agree with the statement.

1. Breastfeeding provides nutrition (Calcium, fats, lactose etc.)
2. It also provides passive immunity to the newborn by producing antibodies such as IgA in the colostrum.
3. It protects the baby against infections such as diabetes and cancer.

15. Explain the mechanism of 'sex determination' in birds. How does it differ from that of human beings? [3]

Answer : In birds—ZZ-ZW type



In Birds the females are heterogametic (ZW) and produce two types of gametes whereas in Humans the males are heterogametic (XY) and produce two types of gametes.

16. (a) How has the development of bioreactor helped in biotechnology ?

(b) Name the most commonly used bioreactor and describe its working. [3]

Answer : (a) A larger biomass or large volume of culture can be processed leading to higher yields of desired specific products (proteins or enzymes), under controlled conditions.

(b) Stirring type of bioreactor is most commonly used.

Working :

- Mixing of reactor contents evenly with an agitator system or a stirrer.
- Facilitates O₂ availability.
- Temperature, pH and Foam are controlled under optimum conditions.

17. Explain the roles of the following with the help of an example each in recombinant DNA technology : [3]

(a) Restriction Enzymes

(b) Plasmids

(a) Restriction Enzymes—1. It recognises a specific sequence of base pairs or palindromes and cuts the DNA strand at a specific site.

e.g., EcoRI/Hind II etc.

2. It is apparently evolved as a primitive immune system in bacteria.

(b) Plasmids—1. It acts as a vector. It is also responsible for cloning of desired alien or

foreign gene. e.g., pBR322, plasmid of salmonella, plasmid of Agrobacterium or Ti-plasmid etc.

2. They are most commonly used in DNA technology to optimize their use as vectors in DNA cloning.

18. Explain out-breeding, out-crossing and cross-breeding practices in animal husbandry. [3]

Answer : Out-breeding—Breeding of unrelated animals which may be between individuals of the same breed or between individuals of different species.

Out-crossing—A kind of out-breeding in which animals are mated within the same breed but having no common ancestors on either side of their pedigree upto 4–6 generations.

Cross-breeding—Another type of outbreeding in which superior males of one breed are mated with superior females of another breed.

19. (a) Organic farmers prefer biological control of diseases and pests to the use of chemicals for the same purpose. Justify. [3]

(b) Give an example of a bacterium, a fungus and an insect that are used as biocontrol agents.

Answer : (a) Organic farmers prefer biological control of diseases and pests to the use of chemicals for the same purpose due to the following reasons :

- Biological control of diseases and pests reduces dependence on toxic chemicals.
- These chemicals being biodegradable do not accumulate or pollute the environment.
- They protect or conserves non-target organisms since they are species-specific.

(b) Bacterium—*Bacillus thuringiensis*

Fungus—*Trichoderma*

Insect—Ladybird

20. (a) Differentiate between analogous and homologous structures. [3]

(b) Select and write analogous structures from the list given below :

(i) Wings of butterfly and birds

(ii) Vertebrate hearts

(iii) Tendrils of bougainvillea and cucurbita

(iv) Tubers of sweet potato and potato

Answer : (a)

S. No.	Analogous Organs	Homologous Organs
(i)	Anatomically dissimilar though perform similar function.	Anatomically similar but perform different functions.
(ii)	They are a result of convergent evolution. Example : Wings of Butterfly and Birds.	They are a result of divergent evolution. Example : Wings of Bat and Fore limb of horse.

(b) (i) Wings of butterfly and Birds.

(ii) Tuber of sweet potato and potato.

21. (a) "India has greater ecosystem diversity than Norway." Do you agree with the statement? Give reasons in support of your answer.

(b) Write the difference between genetic biodiversity and species biodiversity that exist at all the levels of biological organisation. [3]

OR

Explain the effect on the characteristics of a river when urban sewage is discharged into it.

Answer : (a) Yes, I agree with the statement.

S.No.	India/Tropical Region	Norway/ Temperate Region
(i)	It is less seasonal, more constant and more predictable.	More seasonal, less constant and less predictable.
(ii)	Promote niche specialisation leading to greater biodiversity.	Does not promote niche specialisation leading to low biodiversity.
(iii)	Species diversity increases as we move towards equator.	Species diversity decreases as we move away from equator.
(iv)	More number of species exist.	Less number of species exist.

(b)

S. No.	Genetic Biodiversity	Species Biodiversity
(i)	Diversity within a species over its distributional range.	Diversity at a species level.
(ii)	It is trait of the species.	It is trait of the community.
(iii)	It influences adaptability and distribution of species found in an area.	It influences biotic interactions and stability of the community.

OR

When urban sewage is discharged in a river, there is rise in organic matter which leads to increased microbial activity. It results in decreased DO and rise in BOD which leads to fish mortality, algae bloom, colour change, foul odour and increase in toxicity.

22. How has the use of *Agrobacterium* as vectors helped in controlling *Meloidogyne incognita* infestation in tobacco plants ? Explain in correct sequence. [3]

Answer : 1. Using *Agrobacterium* vector, nematode specific genes are introduced into the host plant.

2. Both sense and antisense strands of m-RNA are produced.

3. Double stranded RNA (ds RNA) is formed.

4. dsRNA initiates RNA interference.

5. It prevents translation of mRNA resulting in silencing of mRNA of parasite or nematode.

6. This causes parasite to die.

SECTION-D

23. Looking at the deteriorating air quality because of air pollution in many cities of the country, the citizens are very much worried and concerned about their health. The doctors have declared health emergency in the cities where the air quality is very severely poor.

(a) Mention any two major causes of air pollution.

(b) Write any two harmful effects of air pollution to plants and humans.

(c) As a captain of your school Eco-club, suggest any two programmes you would

plan to organise in the school so as to bring awareness among the students on how to check air pollution in and around the school. [4]

Answer : (a) Major causes of air pollution are :

1. Vehicular discharge and dust.
2. Smoke from industries and thermal plants.

(b) 1. Reduces the yield of crops.
2. Retardation of the growth of plants.

(c) 1. Plantation drive.
2. Awareness through posters.

SECTION-E

24. (a) Describe any two devices in a flowering plant which prevent both autogamy and geitonogamy.

(b) Explain the events upto double fertilisation after the pollen tube enters one of the synergids in an ovule of an angiosperm. [5]

OR

(a) Explain menstrual cycle in human females.

(b) How can the scientific understanding of the menstrual cycle of human females help as a contraceptive measure ?

Answer : (a) 1. Dioecy or production of unisexual flowers in different plants.

2. Self-incompatibility.

There are two devices in a flowering plant which prevent both autogamy and geitonogamy.

(b) The pollen tube releases two male gametes in the cytoplasm of a synergid.

1. One male gamete fuses with the egg cell (nuclei), resulting in a diploid zygote.
2. The other male gamete fuses with the polar nuclei (triple fusion), to form a triploid Primary Endosperm Cell (PEC).

OR

(a) Menstrual cycle in Human females–

1. **Menstrual Phase** : Menstrual flow occurs between day 1-day 5 due to breakdown of the endometrial lining of the uterus, when fertilisation does not occur.

2. **Follicular Phase** : Primary follicles grow to mature Graafian follicles and the endometrium regenerates through proliferation because of

changes induced by the pituitary and ovarian hormones.

3. **Ovulatory Phase** : Because of LH surge around the 14th day, the Graafian Follicle gets ruptured to release the secondary oocyte.

4. **Lutial Phase** : The ruptured Graafian Follicle transforms into Corpus Luteum which secretes large amount of progesterone essential for maintaining endometrium.

(b) Scientific understanding of the menstrual cycle of human females helps as a contraceptive measure, ovulation occurs during the mid cycle, the chances of fertilisation are very high. Hence the couples should abstain from coitus between day 10-17.

25. (a) Write the scientific name of the organism Thomas Hunt Morgan and his colleagues worked with for their experiments. Explain the correlation between linkage and recombination with respect to genes as studied by them.

(b) How did Sturtevant explain gene mapping while working with Morgan ? [5]

OR

(a) State the 'Central dogma' as proposed by Francis Crick. Are there any exceptions to it ? Support your answer with a reason and an example.

(b) Explain how the biochemical characterisation (nature) of 'Transforming Principle' was determined, which was not defined from Griffith's experiments.

Answer : (a) *Drosophila melanogaster* was the organism on which Thomas Hunt Morgan and his colleagues worked with for their experiments.

1. Thomas Hunt Morgan and his colleagues observed that two genes located closely on a chromosome did not segregate independently of each other. The F_2 ratio deviated significantly from 9 : 3 : 3 : 1.

2. Tightly linked genes tend to show lesser recombination frequency of parental traits and higher frequency of parental types.

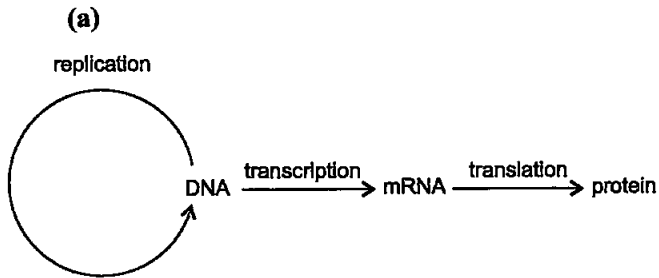
3. Loosely linked genes show higher percentage of recombinant frequency of parental traits and lower frequency percentage of parental type.

4. They concluded that the genes present on the same chromosome are said to be linked and the

recombinant frequency depends on the relative distance on the chromosome.

(b) Sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes and mapped their positions on the chromosome while working with Morgan.

OR



Yes, there are exceptions to it. In some viruses, flow of information is in the reverse direction by reverse transcription. *e.g.*, HIV also, some virus species are so primitive that they use only RNA \rightarrow proteins, having not developed DNA. With the discovery of prions, a new exception to the central dogma has been discovered,

Protein \longrightarrow Protein.

OR

(b) Protein, DNA and RNA were purified from heat killed S-strain of *Streptococcus*.

1. Protein + Protease \longrightarrow transformation occurred (R cell to S type).
2. RNA + RNAase \longrightarrow transformation occurred (R cell to S type).
3. DNA + DNAase \longrightarrow transformation inhibited.

Hence DNA alone is the transforming material.

26. (a) Following are the responses of different animals to various abiotic factors. Describe each one with the help of an example.

- (i) Regulate
- (ii) Conform
- (iii) Migrate
- (iv) Suspend

(b) If 8 individuals in a population of 80 butterflies die in a week, calculate the

death rate of population of butterflies during that period. [5]

OR

- (a) What is a trophic level in an ecosystem? What is 'standing crop' with reference to it?
- (b) Explain the role of the 'first trophic level' in an ecosystem.
- (c) How is the detritus food chain connected with the grazing food chain in a natural ecosystem?

Answer : (a) (i) Regulate : To maintain constant internal temperature or osmotic concentration by homeostasis *e.g.*, birds, mammals etc.

(ii) Conform : Do not maintain constant internal temperature or osmotic concentration. No homeostasis occurs *e.g.*, any animal other than birds or mammals.

(iii) Migrate : Temporary movement of organisms from stresses of a habitat to hospitable area and return when stressful period is over. *e.g.*, Birds from Siberia.

(iv) Suspend : Reducing or minimising the metabolic activities during unfavourable conditions *e.g.*, Polar bear hibernate or fish, amphibian and snails aestivate.

$$(b) \text{ Death rate} = \frac{\text{Number of deaths}}{\text{Total population}} = \frac{dN}{dt}$$

Death rate = $8/80 = 0.1$ individuals per butterfly per week.

OR

(a) Trophic level is the specific place of an organism in a food chain and the standing crop is the biomass at each trophic level at a particular time.

(b) 1. The first trophic level has producers or autotrophs which trap solar energy to produce food for other trophic levels by photosynthesis.

2. Organic compounds formed in this process are very essential in the process of building of bodies and also help in releasing energy.

(c) Organisms of the Detritus Food Chain (DFC) are the prey to Grazing Food Chain (GFC). The dead remains of GFC are decomposed into simple inorganic substances and absorbed by DFC organisms.