

Biology Question Paper for Class 12 CBSE 2018

Set-3 (Solved)

Section-A

(1 mark each)

Q.1. How do cytokine barriers provide innate immunity in humans?

A.1. The cytokines modulate the immune system in response to the infection and protect the non-infected cells from further infection.

Q.2. Write the dual function of deoxyribonucleoside triphosphates in the polymerisation.

A.2. The functions of deoxyribonucleoside triphosphates are as follows:

- They act as substrates for DNA synthesis.
- They provide energy for the polymerisation reaction.
- They are the necessary components of the PCR mixes.

Q.3. Write the names of the following:

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

A.3. (a) Dryopithecus

(b) Australopithecines

Q.4. Mention the chemical change that proinsulin undergoes, to be able to act as mature insulin.

A.4. After the C-peptide is cleaved, the two pairs of basic residues (lysine-64 and arginine-65, arginine-31 and arginine-32) are removed by the carboxypeptidase. The C-peptide is the central portion of proinsulin. The primary sequence of proinsulin goes in the order "B-C-A".

Q.5. Name two diseases whose spread can be controlled by the eradication of Aedes mosquitoes.

A.5. Dengue and Chikungunya.

Section-B

(2 marks each)

Q.6. How did a citizen group called Friends of the Arcata Marsh, Arcata, California, USA, help to improve the water quality of marshland using integrated wastewater system? Explain in four steps.

A.6. The integrated wastewater treatment has been practised in the town of Arcata, on the northern coast of California. The treatment is carried out in four steps:

Step 1: Conventional sedimentation, filtering, and chlorine treatment are carried out to remove the physical impurities.

Step 2: A series of six connected marshes were developed over 60 hectares of marshland.

Step 3: Plants, algae, fungi, and bacteria were grown in 60 hectares of marshland which neutralizes, absorbs and assimilates the pollutants.

Step 4: Water flows through the marshes and gets purified naturally.

Q.7. Your advice is sought to improve the nitrogen content of the soil to be used for cultivation of a non-leguminous terrestrial crop.

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

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

A.7.

(a) Nostoc and Anabaena can enrich the soil with nitrogen.

(b) The leguminous plants have root nodules where the bacteria Rhizobium reside. These bacteria fix atmospheric nitrogen into the soil directly.

Q.8. 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 the future generation of the tomato crop.

A.8. High yielding varieties of tomato can be obtained by tissue culture and micropropagation techniques.

The procedure is as follows:

- The meristematic cells are collected from the apex.
- It is grown in the agar medium.
- The growth regulators like Indole-3-Acetic-Acid are added.
- The media comprises mineral salts, a reduced carbon source (sucrose), and a few vitamins (thiamine).

Q.9. (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.

A.9.

(a) *Papaver somniferum* (Poppy plant) is the source of the heroin. It is obtained from the latex of the poppy plant.

(b) The effects of heroin drug on the human body are:

- It depresses breathing.
- It slows down body functions.

Q.10. With the help of an algebraic equation, how did Hardy-Wienberg explain that in a given population the frequency of occurrence of alleles of a gene is supposed to remain the same through generations?

OR

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

A.10. Hardy Weinberg Principle:

The allele frequencies of a population remain stable from generation to generation.

This law is represented through a binomial expansion $(p+q)^2$

The equation $p^2+2pq+q^2=1$

Where,

p- frequency of allele A,

q- frequency of allele a,

p^2 - frequency of allele AA (homozygous) individuals,

q^2 - frequency of allele aa (homozygous) individuals,

$2pq$ - frequency of allele Aa (heterozygous) individuals.

The sum total of all the allelic frequencies is equal to 1.

Any disturbance in the genetic equilibrium results in evolution.

OR

Ans. The chromatin fibres are present around the undefined nucleus. The prokaryotic cells fold the fibres and form nucleosome. This is why the DNA doesn't get scattered inside the cell.

Section-C

(3 marks each)

Q.11. (a) Differentiate between homologous and analogous structures.

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

- (i) Wings of butterflies and birds
- (ii) Vertebrate Hearts
- (iii) Tendrils of Bougainvillea and Cucurbita
- (iv) Tubers of sweet potato and potato

A.11.

(a)

Homologous Structures:	Heterologous Structures:
<p>The structures which have similar anatomy but perform different functions are known as homologous structures. This pattern indicates divergent evolution.</p> <p>For eg., the arms of a human, the wings of a bird or bat.</p>	<p>The structures which have different anatomy but perform similar functions are known as heterologous structures. This pattern indicates convergent evolution.</p> <p>For eg., organs of the body.</p>

(b)

- (i) These are analogous structures. Though different in structures, both are meant for flying
- (ii) These are homologous structures. They have similar origins and perform similar functions.
- (iii) These are homologous structures. They have similar origin and structures but perform different functions.
- (iv) These are analogous structures. They are different structures, one originating from the stem, the other from the root, respectively. However, the functions are the same.

Q.12. How has the use of Agrobacterium as vectors helped in controlling Meloidogyne incognita infestation in tobacco plants? Explain in the correct sequence.

A.12. The Agrobacterium has helped in controlling the nematode Meloidogyne incognita infestation in the tobacco plants in the following ways.

- Vectors are selected and the specific nematode gene is inserted in it. This is known as a recombinant plasmid.
- The recombinant plasmids are introduced into competent cells.
- The transformed Agrobacterium cells undergo screening to select the cells to infect the tobacco plants.

- The desired DNA fragment is inserted into the tobacco plant.
- This leads to the silencing of the essential housekeeping gene of *Meloidogyne incognita* pest by RNAi.

Q.13. (a) “India has a greater ecosystem diversity than Norway.” Do you agree with the statement? Give reasons in support of your answer.

(b) Write the differences between genetic biodiversity and species biodiversity that exists at all levels of biological organisation.

OR

Explain the effects of characteristics of the river when urban sewage is discharged into it.

A.13.

(a) Biodiversity is defined as the combined diversity at all levels of biological organisation. India with a large number of deserts, forests, wetlands, estuaries, has a greater ecosystem diversity than Norway.

(b) The differences between genetic biodiversity and species biodiversity are mentioned below:

Genetic Biodiversity	Species Biodiversity
Related to the number of genes and their alleles found in the organism.	Related to the number and distribution of species found in an area.
The trait of the species.	The trait of the community.
Influences adaptability and distribution of species in diverse habitats.	Influences biotic interactions and stability of the community.

OR

Ans. When urban sewage is discharged, rivers exhibit the following characteristics:

- The domestic sewage contains biodegradable organic matter which is decomposed by the microorganisms. The amount of biodegradable organic matter can be estimated by measuring the Biochemical Oxygen Demand (BOD).
- The microorganisms involved in decomposition consume a lot of oxygen which results in the decline in the dissolved oxygen. This causes the death of fish and aquatic organisms.

- The nutrient concentration in water results in the growth of planktons, which consequently lead to the deterioration of the water body.

Q.14. Explain the mechanism of sex determination in birds. How does it differ from that of human beings?

A.14. In birds, the sex chromosomes are designated as “Z” and “W”. A female has Z and W chromosomes, whereas males have a pair of Z chromosomes besides the autosomes.

The sex-determining chromosomes in humans are designated as X and Y. Out of the 23 pairs of chromosomes, Human beings have 1 pair of sex chromosomes and 22 pairs of autosomes.

XX chromosomes are present in females while XY chromosomes are found in males.

Two types of chromosomes are produced during spermatogenesis. 2.5% of the total chromosomes carry X chromosomes, while 50% carries Y chromosomes.

If the ovum is fertilized with the X chromosome a female is born, and if the ovum is fertilized with the Y chromosome a male is born.

Q.15. Explain out-breeding, out-crossing, and cross-breed husbandry.

A.15.

Out-Breeding: The breeding of unrelated animals is known as out-breeding. It may be breeding between different breeds (cross-breeding), or between individuals of the same breed with no common ancestors for 4-6 generations, or between different species (interspecific hybridization).

Out-Crossing: In this, the animals of the same breed are allowed to mate together. They have no common ancestors. It is the best breeding method for animals that exhibit low milk production and low growth rate in beef cattle.

Cross-Breed Husbandry: In this method, the superior males and females of different breeds are crossed together. This allows the desired characteristics of the two different breeds to combine.

Q.16. (a) Organic farmers prefer biological control of diseases and pests to the use of chemicals for the same purpose. Justify.

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

A.16.

(a) The method of controlling pests that relies on natural predation rather than introduced chemicals is gaining popularity in agriculture these days. For a landscape to be sustainable, it is important to have varieties in a landscape. Therefore, the organic farmers have devised ways in which the pests are not eradicated completely but a check is kept within the ecosystem.

On the contrary, conventional farming practices eliminate both useful and harmful life forms with the use of chemicals. Without the harmful pests, useful pests can also not survive because they feed on the harmful pests for their survival. Therefore, the organic farmers prefer biological control of diseases and pests to the chemicals.

- (b) **Bacterium-** Bacillus thuringiensis for controlling caterpillars of butterflies.
Fungus- Trichoderma used in the treatment of plant diseases.
Insect- Ladybird to control aphids, and Dragonflies for mosquitoes.

Q.17. (a) How has the development of bioreactor helped in biotechnology?

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

A.17.

(a) Bioreactors are large vessels in which raw materials are biologically converted into specific products. The cultures with very small volume could not yield appreciable quantities of products. Therefore, bioreactors were developed to produce large volumes of cultures.

(b) The most commonly used bioreactors are stirred tank reactors.

- The stirred tank reactors are cylindrical vessels with a curve base to facilitate the mixing of the contents in the reactor.
- The stirrer helps in even mixing and makes oxygen available throughout the bioreactor.
- The bioreactor is provided with an agitator system, an oxygen delivery system, and a foam control system.
- It is also provided with a temperature control system, a pH control system, and sampling ports so that small volumes of the culture can be withdrawn periodically.

Q.18. Explain the role of the following with the help of an example each in recombinant DNA technology.

(a) Restriction Enzymes

(b) Plasmids

A.18.

(a) **Restriction Enzymes-** These enzymes belong to the family nucleases which cleave the phosphodiester bonds of the nucleic acids at specific positions.

Since they cut the DNA at a specific recognition site, they are used to isolate the desired gene from the donor DNA. **For eg.**, EcoR1 which is obtained from the R strain of E.coli bacteria and that cuts the DNA at specific palindromic recognition site.



(b) **Plasmids**- Plasmids are extrachromosomal, circular, autonomous double-stranded DNA of bacteria.

- They are small and self-replicating, therefore, used as cloning vectors.
- The antibiotic resistance genes in a few plasmids are used as marker genes to differentiate between recombinant and non-recombinant plasmids.
- The plasmids are ligated with the desired genes and transformed into a host cell to obtain the desired results.

For eg., pBR322, pUC

Q.19. Differentiate between parthenocarpy and parthenogenesis. Give one example of each.

A.19. In all the angiosperms, the flowers pollinate and fertilize to produce fruits. However, in a few plants, the fruiting occurs without fertilization or before fertilization. This process of fruit production from the unfertilized ovules is known as parthenocarpy. These fruits do not contain any seeds.

Parthenogenesis is the process in which the unfertilized ovum grows into a complete individual, especially in the lower plants and some vertebrates. It is a type of asexual reproduction. Organisms like rotifers, lizards, honeybees and birds exhibit this type of reproduction.

Q.20. Medically, it is advised to all the young mothers that breastfeeding is the best for newborn babies. Do you agree? Give reasons in support of your answer.

A.20. The mammary glands start producing milk when the pregnancy ends. The lactation produced in the initial days of childbirth is called **colostrum**. This milk contains several antibodies. This helps in developing resistance among the newborns. It also contains several vitamins and minerals essential for newborn babies.

Q.21. Draw the diagram of mature human sperm. Label any three parts and write their functions.

A.21. The following three parts are mentioned in the diagram:

- Middle Piece: The numerous mitochondria present in the middle piece produce energy for the movement of the tail.
- Acrosome: The acrosome is filled with hydrolytic enzymes that help in the fertilization of the ovum.
- Tail: It facilitates sperm mobility which is essential for fertilization.

Q.22. (a) Expand VNTR and describe its role in DNA fingerprinting.

(b) List any two applications of DNA fingerprinting technique.

A.22.

(a) **VNTR** or Variable Number of Tandem Repeats belong to a class of satellite DNA known as the mini-satellite. A small DNA sequence is arranged tandemly in many copy numbers. The copy number is different in different chromosomes of an individual. A very high degree of polymorphism is exhibited by the number of repeats. Consequently, the size of the VNTR also varies in size.

When hybridised with the VNTR probe, many bands of different sizes are obtained by the autoradiogram. These bands exhibit a characteristic pattern for an individual DNA. It is different in different individuals of a population. The polymerase chain reaction has increased the sensitivity of this technique.

(b) The applications of DNA fingerprinting are:

- Determining genetic diversities.
- Determining the population.

Section-D

(4 marks each)

Q.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 a health emergency in the cities where the air quality is very severely poor.

- Mention any two major causes of air pollution.
- Write any two harmful effects of pollution on plants and humans.
- As a captain of your school eco-club, suggest any two programmes you would plan to organize in the school so as to bring awareness among the students on how to check air pollution in and around the school.

A.23.

(a) The two causes of air pollution are:

- The burning of fossil fuels

- Industrial effluents

(b) The harmful effects of air pollution are:

- It affects the respiratory system of humans.
- It reduces the growth and yield of the crops and causes premature death of the plants.

(c) The two programmes to spread awareness regarding air pollution among the students would be:

- Tree plantation programmes to curb pollution.
- Encourage the use of an eco-friendly mode of transport such as bicycle instead of buses and autos.

Section-E

(5 marks each)

Q.24.

- 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.**
- How did Sturtevant explain gene mapping while working with Morgan?**

OR

- State the central dogma as proposed by Francis Crick. Are there any exceptions to it? Support your answer with a reason and an example.**
- Explain how the biochemical characterization (nature) of “Transforming Principle” was determined, which was not defined from Griffith’s experiments.**

A.24.

(a) The organism experimented on by Morgan was *Drosophila melanogaster*. Several dihybrid crosses were carried out in *Drosophila* to study genes that were sex-linked.

The yellow-bodied, white-eyed females were crossed with brown-bodied, red-eyed males and then intercrossed with the F1 progeny. It was observed that the two genes did not segregate independently. The F2 ratio also deviated from 9:3:3:1. The group of biologists knew that the genes were located on the X-chromosome. They saw that when two genes are present on the same chromosome in a dihybrid cross, the proportion of parental gene combinations are higher than the non-parental combinations. Morgan analysed that it was due to the linkage of two genes.

(b) The recombination between two gene pairs on the same chromosome was used as a measure of the distance between genes, and their positions on the chromosome were mapped. These genetic maps are extensively used as the starting point in the sequencing of the whole genome.

OR

(a) The central dogma in molecular biology was proposed by Francis' Crick. It states that genetic information flows from DNA→RNA→Proteins. DNA undergoes transcription to form mRNA. The mRNA is translated to form proteins. In a few viruses, the central dogma is reversed, i.e., from RNA to DNA. This is known as Reverse Transcription. This is seen in Retroviruses.

(b) In 1928, Fredrick Griffith witnessed a transformation in bacteria in a series of experiments with *Streptococcus pneumoniae*. A living organism had changed in its physical form during the course of the experiment. He concluded that the heat-killed S-strain bacteria had transformed the R-strain bacteria. The transforming principle transferred from the heat-killed S-strain had facilitated the synthesis of a smooth polysaccharide coat by the R-strain and made it virulent. The reason assumed is the transfer of the genetic material. However, his experiments could not explain the biochemical nature of genetic material.

The biochemical nature of transforming principle in Griffith's experiment was determined by Oswald Avery, Colin Macleod, Maclyn McCarty. The biochemicals from the heat-killed S-strains were purified to observe which ones could transform live R-strains into S-strains. It was discovered that the DNA from the S-strain alone was responsible for the transformation of R-strain. It was also observed that transforming substances were not proteins or RNA. The fact that the digestion with DNase inhibits transformation, confirmed that the fact that DNA caused the transformation.

Q.25.

(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 a population of butterflies during that period.

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 the natural ecosystem?

A.25.

(a)

(i) **Regulate:** Some organisms regulate their body temperatures and maintain homeostasis. The mechanism of regulating body temperature is similar in all mammals. The body temperature remains constant at 37 °C. When the outside temperature is higher than our body temperature we sweat immensely thereby maintaining our body temperature. Similarly, during winters, we shiver. This maintains our body temperature.

(ii) **Conform:** In many animals, the body temperature changes with the ambient temperature. These animals are known as conformers. Heat loss or heat gain depends upon the surface area. Since small animals have a larger surface area relative to their volume their body loses heat quickly when it is cold outside. Eg., Hummingbirds

(iii) **Migrate:** During the stress, the organisms move away temporarily to a more hospitable area and return when the stress situation is over. For eg., Thousands of birds migrate from Siberia and northern regions to the Keolado National Park Bharatpur, during the winters.

(iv) **Suspend:** Some animals do not migrate during the stress periods, but escape to avoid stress by ceasing all activities that consume energy. For eg., Bears hibernate during winters.

(b) Death rate: Number of deaths per 1000 individuals of a population

$$\text{Death rate} = \frac{8}{80} = 0.1$$

OR

(a) The organisms occupy a place in the surroundings according to their feeding relationship with other organisms. They occupy a specific place in the food chain based on the source of their nutrition. This is known as a trophic level.

There is a certain mass of living material at each trophic level at a particular time. This is called a “Standing Crop”. It is measured as the mass of the living organisms (biomass) or the number in a unit area.

(b) The producers form the first trophic level. These organisms do not feed on any other level. These organisms require only sunlight and water for their survival. All other trophic levels depend on this level of energy.

(c) The grazing food chain is depicted as under:

Secondary Consumers→Primary Consumers→Producers in Detritus Food Chain: It begins with dead organic matter. It is composed of decomposers which includes heterotrophic organisms like fungi, bacteria, etc. The detritus food chain may be connected to the grazing food chain at some levels in a way that the organisms in the detritus food chain are prey to the organisms in the grazing food chain. This interconnection of food chain forms the food web.

Q.26.

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

(b) Explain the events up to double fertilization after the pollen tube enters one of the synergids in an ovule of an angiosperm.

OR

(a) Explain the menstrual cycle in human females.

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

A.26.

(a)

Autogamy is the transfer of pollen grains from the anther to the stigma of the same flower.

Geitonogamy is the transfer of pollen grains from the anther to the stigma of another flower of the same plant.

The following two devices prevent both autogamy and geitonogamy:

Self-Incompatibility- This mechanism prevents self-pollen from fertilizing the ovules by inhibiting pollen germination or pollen tube growth in the pistil.

Dioecious Plants- The male and female flowers are present on different plants.

(b)

The events of double fertilization after the pollen tube enters one of the synergids are as follows:

- After reaching the ovary, the pollen tube enters the ovule through the micropyle and enters one of the synergids through filiform apparatus.
- Two male gametes are then released by the pollen tube into the cytoplasm of the synergid.
- One of the male gametes fuses with the nucleus of the egg cell resulting in the formation of zygote. This is known as Syngamy.
- The other male gamete moves towards the two polar nuclei and fuses to form triploid primary endosperm nucleus (PEN). Three haploid nuclei fuse together in a process known as triple fusion.
- After fertilization PEN becomes the primary endosperm cell which develops into an endosperm while the zygote develops into an embryo.

OR

(a) The menstrual cycle is the process of ovulation and menstruation in females. The first menstruation begins at puberty and is known as menarche. The cycle of events from one menstruation to the next one is called the menstrual cycle. The cycle is repeated every 28 days.

The events in a menstrual cycle are described as under:

- **Menstrual Phase-** Menstruation occurs only when the released ovum is not fertilized. The menstrual flow is due to the shedding of the uterine lining. This lasts for about 3-5 days. Its blood vessels form a liquid that comes out of the vagina.
- **Follicular Phase-** This phase lasts for about 8-10 days. The primary follicles mature into the Graafian Follicle. Also, the endometrium of the uterus regenerates through proliferation, simultaneously. The secretion of Luteinizing hormone and Follicle Stimulating hormone also increases at this phase.
- **Ovulatory Phase-** The ovum releases at this phase and it lasts for only a day.
- **Luteal Phase-** There is an urge for Luteinizing hormone. The remnants of Graafian Follicle transform as corpus luteum and start secreting progesterone. It lasts for 13 days.

(b) The scientific understanding of the menstrual cycle of human females is very important as a contraceptive measure. It helps in the following ways:

- A week before and a week after the menstrual bleeding is considered to be the best period for sexual intercourse. This is because:

The ovulation occurs on the 14th day of the cycle and the ovum does not survive for more than two days.

The sperms also do not survive for more than 3 days.

This reduces the chances of conceiving to about 80%.

- The pills should be started within the first five days of the menstrual cycle. This inhibits ovulation and implantation and also prevents the entry of the sperms.

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