CBSE Sample Paper -01 (solved)
Class 12 Biology

General Instructions:

(i) All questions are compulsory.

(ii) This question paper consists of four Sections A, B, C and D. Section A contains 5 questions of one mark each, Section B is of 5 questions of two marks each, Section C is of 12 questions of three marks each and 1 question of four mark and Section D is of 3 questions of five marks each.

(iii) There is no overall choice. However, an internal choice has been provided in one question of 2 marks, one question of 3 marks and all the three questions of 5 marks weightage. A student has to attempt only one of the alternatives in such questions.

(iv) Wherever necessary, the diagrams drawn should be neat and properly labelled.

Section A

1. A human zygote has XXY sex chromosomes along with 22 pairs of autosomes. What sex will the individual be?
2. Define linkage.
3. What is Brood Parasitism?
4. Which enzyme is known as 'molecular scissors'?
5. Expand ELISA.

Section B

6. Give an account of surgical sterilization methods in males and females.
7. What are biological response modifiers?
8. Which microbe converts milk to curd?

   OR

   What are histones?
9. What is soluble RNA? Illustrate.
10. What are the pre-fertilisation events in plants?

Section C

11. What are the primary lymphoid organs?
12. Elaborate the asexual mode of reproduction in the following:
    a) Chlamydomonas
    b) Hydra

c) yeast

13. What are the symptoms of the disease which is confirmed by a Widal test?

OR

What are the complexities involved in transcription of eukaryotic DNA?

14. What are the major causes of cancer?
15. How can DNA fragments be separated on basis of size?
16. The rate of decomposition of detritus is affected by the abiotic factors like availability of oxygen, pH of the soil substratum, temperature etc. Discuss.
17. What are the advantages of GM plants?
18. What are the requisites of a cloning vector?
19. Explain gene therapy with an example.
20. What are the factors that contribute to Population density?
21. What is the principle of Genetic equilibrium?
22. What is "The Evil Quartet"?
23. **Hanshal purchased one high milk yielding exotic breed of cow. Within a few years he earned lot of money by selling calves by using MOET. The mother cow met with a premature death. Raman objected to Hansal earning money by this way.**

a) What values in life did Raman possess?

b) Expand MOET.

c) Briefly describe the process.

Section D

24. Explain ecological succession.

OR

List the observations of Human Genome Project.

25. Explain and illustrate the development of the embryo sac.

OR

How are infertility problems overcome?

26. Elaborate on the key abiotic elements that contribute to the variation in habitats.

OR

Explain sickle cell anemia and its inheritance as a pedigree chart

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Answers

Section A

1. The individual will be male.
2. When two genes in a dihybrid cross are situated on the same chromosome, the proportion of parental gene combinations is much higher than the non-parental type. This physical association of genes on a chromosome is termed linkage.
3. The parasitic bird lays its eggs in the nest of its host and lets the host incubate them. During the course of evolution, the eggs of the parasitic bird have evolved to resemble the host's egg in size and colour to reduce the chances of the host bird detecting the foreign eggs and ejecting them from the nest.
4. Restriction enzymes.
5. Enzyme linked Immuno Sorbent Assay.

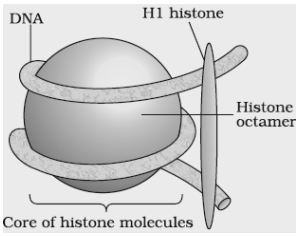
Section B

6. Surgical methods, also called **sterilization**, are generally advised for the male/female partner as a terminal method to prevent any more pregnancies. Surgical intervention blocks gamete transport and thereby prevents conception. Sterilization procedure in the male is called 'vasectomy 'and that in the female, 'tubectomy'. In vasectomy, a small part of the vas deferens is removed or tied up through a small incision on the scrotum whereas in tubectomy, a small part of the fallopian tube is removed or tied up through a small incision in the abdomen or through vagina.
7. Tumor cells have been shown to avoid detection and destruction by immune system. Therefore, the patients are given substances called biological response modifiers such as **interferon** which activates their immune system and helps in destroying the tumor.
8. Micro-organisms such as *Lactobacillus* and others commonly called **lactic acid bacteria (LAB)** grow in milk and convert it to curd. During growth, the LAB produce acids that coagulate and partially digest the milk proteins. A small amount of curd added to the fresh

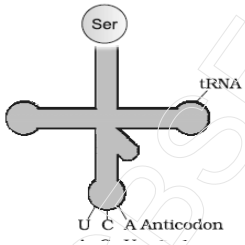
milk as inoculum or starter contain millions of LAB, which at suitable temperatures multiply, thus converting milk to curd.

OR

Histones are positively charged, basic proteins. They organize to form a unit of eight molecules called as histones octamer. The negatively charged DNA is wrapped around the positively charged histone octamer to form a structure called nucleosome.



9. Soluble RNA or tRNA is an adapter molecule that would on one hand reads the code and on other hand bind to specific amino acids thereby facilitating protein synthesis. The term was coined by Francis Crick.



10. Several hormonal and structural changes are initiated which lead to the differentiation and further development of the floral primordium. Inflorescences are formed which bear the floral buds and then the flowers. In the flower the male and female reproductive structures, the androecium and the gynoecium differentiate and develop.

Section C

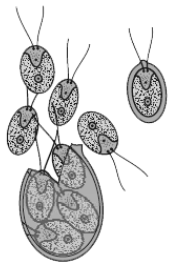
11. The primary lymphoid organs are **bone marrow** and **thymus** where immature lymphocytes differentiate into antigen-sensitive lymphocytes.

The bone marrow is the main lymphoid organ where all blood cells including lymphocytes are produced.

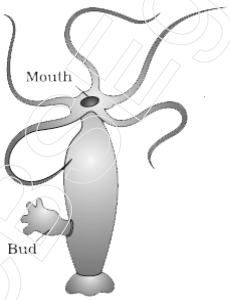
The thymus is a lobed organ located near the heart and beneath the breastbone. The thymus is quite large at the time of birth but keeps reducing in size with age and by the time puberty is attained it reduces to a very small size.

Both bone-marrow and thymus provide micro-environments for the development and maturation of T-lymphocytes.

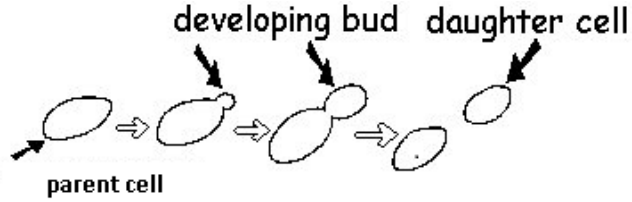
12. Chlamydomonas is an alga which reproduces by formation of zoospores which are microscopic motile structures.



Hydra reproduces by formation of buds which bud from the parent body.



Yeast, the division is unequal and small **buds** are produced that remain attached initially to the parent cell which, eventually gets separated and mature into new yeast organisms.



13. *Salmonella typhi* is a pathogenic bacterium which causes **typhoid** fever in human beings. These pathogens generally enter the small intestine through food and water contaminated with them and migrate to other organs through blood. Sustained high fever (39° to 40°C), weakness, stomach pain, constipation, headache and loss of appetite are some of the common symptoms of this disease. Intestinal perforation and death may occur in severe cases. Typhoid fever could be confirmed by Widal test.

OR

The complexities involved in transcription of eukaryotic DNA

a. There are at least three RNA polymerases in the nucleus (in addition to the RNA polymerase found in the organelles)
   - The RNA polymerase I transcribes rRNAs (28S, 18S, and 5.8S), whereas the
   - The RNA polymerase II transcribes precursor of mRNA, the heterogeneous nuclear RNA (hnRNA).
   - RNA polymerase III is responsible for transcription of tRNA, 5srRNA, and snRNAs (small nuclear RNAs)

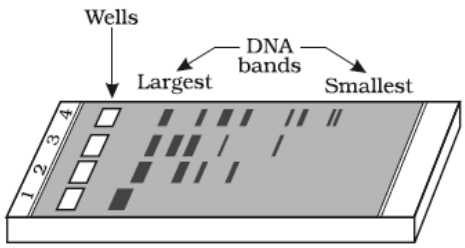
b. The primary transcripts contain both the exons and the introns and are non-functional. Hence, it is subjected to a process called splicing where the introns are removed and exons are joined in a defined order.

14. Transformation of normal cells into cancerous neoplastic cells may be induced by physical, chemical or biological agents called **carcinogens**. Ionising radiations like X-rays and gamma rays and non-ionizing radiations like UV cause DNA damage leading to neoplastic transformation. The chemical carcinogens present in tobacco smoke have been identified as a major cause of lung cancer. Cancer causing viruses called **oncogenic viruses** have genes called **viral oncogenes**. Furthermore, several genes called **cellular oncogenes** (*c-onc*) or **proto oncogenes** have been identified in normal cells which, when activated under certain conditions, could lead to oncogenic transformation of the cells.

15. The cutting of DNA by restriction endonucleases results in the fragments of DNA. These fragments can be separated by a technique known as gel electrophoresis. Since DNA fragments are negatively charged molecules they can be separated by forcing them to move towards the anode under an electric field through a medium/matrix. Nowadays the most commonly used matrix is agarose which is a natural polymer extracted from sea weeds.

The DNA fragments separate (resolve) according to their size through sieving effect provided by the agarose gel. Hence, the smaller the fragment size, the farther it moves.

The separated DNA fragments can be visualised only after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation. The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution. The DNA fragments purified in this way are used in constructing recombinant DNA by joining them with cloning vectors.



16. Decomposition is largely an oxygen-requiring process. The rate of decomposition is controlled by chemical composition of detritus and climatic factors. In a particular climatic condition, decomposition rate is slower if detritus is rich in lignin and chitin, and quicker, if detritus is rich in nitrogen and water-soluble substances like sugars. Temperature and soil moisture are the most important climatic factors that regulate decomposition through their effects on the activities of soil microbes. Warm and moist environment favour decomposition whereas low temperature and anaerobiosis inhibit decomposition resulting in build up of organic materials.

    The important steps in the process of decomposition are fragmentation, leaching, catabolism, humification and mineralization

17. Plants, bacteria, fungi and animals whose genes have been altered by manipulation are called Genetically Modified Organisms (GMO). GM plants have been useful in many ways. Genetic modification has:
    a. Made crops more tolerant to abiotic stresses (cold, drought, salt, heat).
    b. Reduced reliance on chemical pesticides (pest-resistant crops).
    c. Helped to reduce post harvest losses.
    d. Increased efficiency of mineral usage by plants (this prevents early exhaustion of fertility of soil).
    e. Enhanced nutritional value of food, e.g., Vitamin 'A' enriched rice.
    f. Create tailor-made plants to supply alternative resources to industries, in the form of starches, fuels and pharmaceuticals

18. Requisites of a cloning vector

a. **Origin of replication (ori):** This is a sequence from where replication starts and any piece of DNA when linked to this sequence can be made to replicate within the host cells.

b. **Selectable marker:** In addition to 'ori', the vector requires a selectable marker, which helps in identifying and eliminating nontransformants and selectively permitting the growth of the transformants.

c. **Cloning sites:** In order to link the alien DNA, the vector needs to have very few, preferably single,**recognition sites** for the commonly used restriction enzymes. Presence of more than one recognition sites within the vector will generate several fragments, which will complicate the gene cloning.

19. Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child/embryo. Here genes are inserted into a person's cells and tissues to treat a disease. Correction of a genetic defect involves delivery of a normal gene into the individual or embryo to take over the function of and compensate for the non-functional gene.

The first clinical gene therapy was given for adenosine deaminase (ADA) deficiency The disorder is caused due to the deletion of the gene for adenosine deaminase. In some children ADA deficiency can be cured by bone marrow transplantation; in others it can be treated by enzyme replacement therapy, in which functional ADA is given to the patient by injection. Both of these approaches are not completely curative.

Gene therapy includes

- Lymphocytes from the blood of the patient are grown in a culture outside the body.
- A functional ADA cDNA (using a retroviral vector) is then introduced into these lymphocytes, which are subsequently returned to the patient.
- as these cells are not immortal, the patient requires periodic infusion of such genetically engineered lymphocytes.
- If the gene isolate from marrow cells producing ADA is introduced into cells at early embryonic stages, it could be a permanent cure.

20. The density of a population in a given habitat during a given period, fluctuates due to changes in four basic processes.

a. ***Natality*** refers to the number of births during a given period in the population that are added to the initial density.

b. ***Mortality*** is the number of deaths in the population during a given period.

c. ***Immigration*** is the number of individuals of the same species that have come into the habitat from elsewhere during the time period under consideration.

d. ***Emigration*** is the number of individuals of the population who left the habitat and gone elsewhere during the time period under consideration.

21. Hardy -Weinberg principle says that allele frequencies in a population are stable and is constant from generation to generation. The gene pool (total genes and their alleles in a population) remains a constant. This is called genetic equilibrium.

Sum total of all the allelic frequencies is 1. Individual frequencies, for example, can be named p, q, etc. In a diploid, p and q represent the frequency of allele *A* and allele *a*. The frequency of *AA* individuals in a population is simply p2. The probability that an allele A with a frequency of p appear on both the chromosomes of a diploid individual is simply the product of the probabilities, i.e., p2. Similarly of aa is q^2, of Aa 2pq. Hence, $p^2+2pq+q^2=1$. This is a binomial expansion of $(p+q)^2$. When frequency measured, differs from expected values, the difference (direction) indicates the extent of evolutionary change.

22. Accelerated rates of species extinction are due to 4 main causes which is called the evil quartet. They are

a) Habitat loss and fragmentation

b) Over-exploitation

c) Alien species invasions

d) Co-extinctions.

23. a. Raman was bold, having love for animals. He had ethics and prudence.

b. Multiple Ovulation Embryo Transfer Technology.

c. The cow is administered hormones, with FSH-like activity, to induce Follicular maturation and super ovulation.

i. The animal is either mated with an elite bull or artificially inseminated.

ii. The fertilized eggs at 8–32 cells stages, are recovered non-surgically and transferred to surrogate mothers.

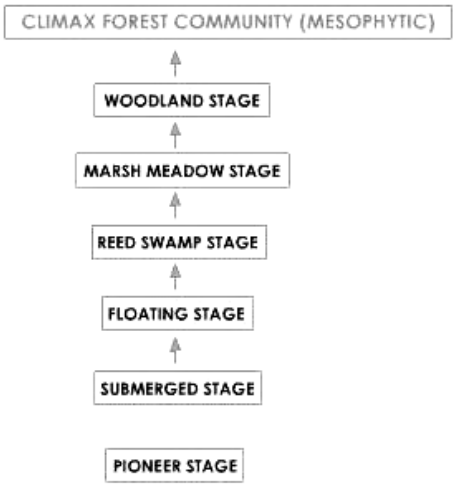
iii. The genetic mother is available for another round of super ovulation.

iv. This technology has been demonstrated for cattle, sheep, rabbits, buffaloes, mares, etc.

Section D

24. The gradual and fairly predictable change in the species composition of a given area is called Ecological **succession**. During succession some species colonise an area and their populations become more numerous, whereas populations of other species decline and even disappear. The entire sequence of communities that successively change in a given area are called **sere(s)**. The individual transitional communities are termed seral stages or seral communities. In the successive seral stages there is a change in the diversity of species of organisms, increase in the number of species and organisms as well as an increase in the total biomass. Succession is a process that starts where no living organisms are there – these could be areas where no living organisms ever existed, bare rock; or in areas that somehow, lost all the living organisms that existed there. The former is called primary succession, while the latter is termed secondary succession.

Examples of areas where primary succession occurs are newly cooled lava, bare rock, newly created pond or reservoir. The establishment of a new biotic community is generally slow. Before a biotic community of diverse organisms can become established, there must be soil. Depending mostly on the climate, it takes natural processes several hundred to several thousand years to produce fertile soil on bare rock. Secondary succession begins in areas where natural biotic communities have been destroyed such as in abandoned farm lands, burned or cut forests, lands that have been flooded. Since some soil or sediment is present, succession is faster than primary succession.



OR

The salient observations drawn from human genome project are-

i. The human genome contains 3164.7 million nucleotide bases.

ii. The average gene consists of 3000 bases, but sizes vary greatly, with the largest known human gene being dystrophin at 2.4 million bases.

iii. The total number of genes is estimated at 30,000–much lower than previous estimates of 80,000 to 1,40,000 genes. Almost all (99.9 per cent) nucleotide bases are exactly the same in all people.

iv. The functions are unknown for over 50 per cent of the discovered genes.

v. Less than 2 per cent of the genome codes for proteins.

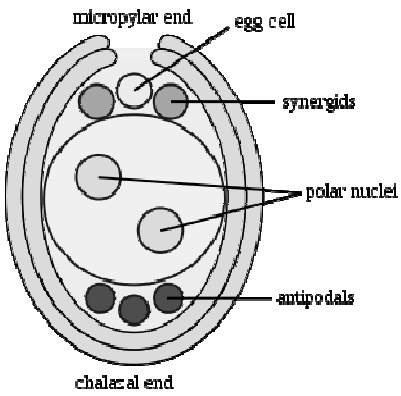
vi. Repeated sequences make up very large portion of the human genome.

vii. Repetitive sequences are stretches of DNA sequences that are repeated many times, sometimes hundred to thousand times. They are thought to have no direct coding functions, but they shed light on chromosome structure, dynamics and evolution.

viii. Chromosome 1 has most genes (2968), and the Y has the fewest (231).

ix. Scientists have identified about 1.4 million locations where singlebase DNA differences (SNPs –single nucleotide polymorphism, pronounced as 'snips') occur in humans. This information/promises to revolutionise the processes of finding chromosomal locations for disease-associated sequences and tracing human history.

25. The nucleus of the functional megaspore divides mitotically to form two nuclei which move to the opposite poles, forming the 2-nucleate embryo sac. Two more sequential mitotic nuclear divisions result in the formation of the 4-nucleate and later the 8-nucleate stages of the embryo sac. Nuclear divisions are not followed immediately by cell wall formation. After the 8-nucleate stage, cell walls are laid down leading to the



lls; the remaining two nuclei, called polar nuclei are situated below the egg apparatus in the large central cell. There is a characteristic distribution of the cells within the embryo sac. Three cells are grouped together at the micropylar end and constitute the egg apparatus. The egg apparatus, in turn, consists of two synergids and one egg cell. The synergids have special cellular thickenings at the micropylar tip called filiform apparatus, which play an important role in guiding the pollen tubes into the synergid. Three cells are at the chalazal end and are

called the antipodals. The large central cell has two polar nuclei. Thus, a typical angiosperm embryo sac, at maturity is 8-nucleate and 7-celled.

OR

Infertility problems are overcome by assisted reproductive technologies (ART).

a) In vitro fertilisation (IVF)–fertilisation outside the body in almost similar conditions as that in the body) followed by embryo transfer (ET) is one of such methods. In this method, popularly known as test tube baby programme, ova from the wife/donor (female) and sperms from the husband/donor (male) are collected and are induced to form zygote under simulated conditions in the laboratory.

b) The zygote or early embryos (with upto 8 blastomeres) could then be transferred into the fallopian tube (ZIFT–zygote intra fallopian transfer) and embryos with more than 8 blastomeres, into the uterus (IUT – intra uterine transfer), to complete its further development. Embryos formed by in-vivo fertilisation (fusion of gametes within the female) also could be used for such transfer to assist those females who cannot conceive.

c) Transfer of an ovum collected from a donor into the fallopian tube (GIFT – gamete intra fallopian transfer) of another female who cannot produce one, but can provide suitable environment for fertilisation and further development is another method attempted.

d) Intra cytoplasmic sperm injection (ICSI) is another specialised procedure to form an embryo in the laboratory in which a sperm is directly injected into the ovum.

e) Infertility cases either due to inability of the male partner to inseminate the female or due to very low sperm counts in the ejaculates, could be corrected by artificial insemination (AI) technique. In this technique, the semen collected either from the husband or a healthy donor is artificially introduced either into the vagina or into the uterus (IUI – intra-uterine insemination) of the female.

26. The salient observations drawn from human genome project are-

i. The human genome contains 3164.7 million nucleotide bases.

ii. The average gene consists of 3000 bases, but sizes vary greatly, with the largest known human gene being dystrophin at 2.4 million bases.

iii. The total number of genes is estimated at 30,000–much lower than previous estimates of 80,000 to 1,40,000 genes. Almost all (99.9 per cent) nucleotide bases are exactly the same in all people.

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ix. Scientists have identified about 1.4 million locations where singlebase DNA differences (SNPs –single nucleotide polymorphism, pronounced as 'snips') occur in humans. This information/promises to revolutionise the processes of finding chromosomal locations for disease-associated sequences and tracing human history.

26. The important ones are

Abiotic components- temperature, water, light and soil.

Biotic components – pathogens, parasites, predators and competitors.

Temperature- It affects the kinetics of enzymes and through it the basal metabolism, activity and other physiological functions of the organism. A few organisms can tolerate and thrive in a wide range of temperatures (eurythermal), but, a vast majority of them are restricted to a narrow range of temperatures (stenothermal). The levels of thermal tolerance of different species determine to a large extent their geographical distribution.

Water- Life is unsustainable without water. Its availability is so limited in deserts that only special adaptations make it possible to live there. The productivity and distribution of plants is heavily dependent on water. For aquatic organisms the quality (chemical composition, pH and salinity) of water becomes important.Some organisms are tolerant of a wide range of salinities others are restricted to a narrow range (stenohaline). Many freshwater animals cannot live for long in sea water and vice versa because of the osmotic problems, they would face.

Light- is required for

a) Photosynthesis

b) Flowering

c) Diurnal and seasonal migrations of organisms.

OR

Sickle cell anemia

- is an autosome linked recessive trait that can be transmitted from parents to the offspring when both the partners are carrier for the gene (or heterozygous).
- The disease is controlled by a single pair of allele, HbA and HbS.
- Out of the three possible genotypes only homozygous individuals for HbS (HbSHbS) show the diseased phenotype.
- Heterozygous (HbAHbS) individuals appear apparently unaffected but they are carrier of the disease as there is 50 per cent probability of transmission of the mutant gene to the progeny, thus exhibiting sickle-cell trait.
- The defect is caused by the substitution of Glutamic acid (Glu) by Valine (Val) at the sixth position of the beta globin chain of the haemoglobin molecule.
- The substitution of amino acid in the globin protein results due to the single base substitution at the sixth codon of the beta globin gene from GAG to GUG.
- The mutant haemoglobin molecule undergoes polymerisation under low oxygen tension causing the change in the shape of the RBC from biconcave disc to elongated sickle like structure.