Sample Paper -05 (2016-17)
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. What is phenotype?
2. What is totipotency?
3. If the sequence of nitrogen bases of the coding strand of DNA in a transcription unit is:
   5' - A T G A A T G - 3'.
4. Explain the term emasculation.
5. What is Adaptive radiation?

Section B

6. Identify the diagram and label the parts.
7. What are the barriers that comprise Innate Immunity?
8. Complete the following table.

Drug name	Plant
Opiods	
Cannabinoids	
Cocaine	

9. What are the causative organisms of the following diseases
   (a) Typhoid
   (b) Malaria
10. Who were the scientists who helped formulate the genetic code

Or

What are the basic processes that lead to fluctuations in density of a given population.

Section C

11. Diagrammatically represent the structure of a mature embryo sac.
12. List the salient features of DNA double helix model.

Or

$p^2 + 2pq + q^2 = 1$Explain this equation.

13. Explain Griffith experiment.
14. Expand the following
    (a) EST
    (b) BAC

(c) YAC

15. Diagrammatically represent the replication of retrovirus.
16. Explain some methods of Molecular Diagnosis.
17. How can DNA fragments be separated on basis of size?
18. What are the reasons for the production of transgenic animals?
19. Explain biodiversity at all levels of biological organization.
20. How do the components of ecosystem function as a unit?
21. What are (a) Intine(b) locule
22. What are the states of dormancy in animals?
23. On world population day Rohit and his friends arranged an awareness campaign Programme in their locality. Some elderly people rebuked the children and asked them notto talk on such things in public. The children convinced the elders about the need for the programme and on understanding their point of view, they also joined the campaign.
    (a) What values did the elderly people and Rohit show on the occasion?
    (b) Why is such awareness programme necessary?
    (c) What role has the government played in controlling population explosion?

Section D

24. How does the pollen mother cell develop into mature pollen grain. Illustrate the stages with a labeled diagram

Or

Show diagrammatically stages of embryonic development from zygote up to implantation in humans

25. Who demonstrated the semi-conservative replication of DNA? Explain the procedure in detail.

Or

Describe the Fredrick Griffith's experiment to prove that DNA is the basic genetic material.

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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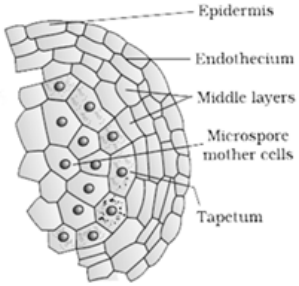
Answers

Section A

1. The external appearance of an organism is called phenotype.
2. Capacity of generating a whole plant from cell/explants is called totipotency.
3. 5' – AUGAAUG – 3'.
4. If the female parent bears bisexual flowers, removal of anthers from the flower bud before the anther dehisces using a pair of forceps is necessary. This step is referred to as emasculation.
5. This process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation

Section B

6. Structure of microsporangium showing wall layers



7. Innate immunity consists of four types of barriers. These are -
   (i) Physical barriers
   (ii) Physiological barriers
   (iii) Cellular barriers
   (iv)Cytokine barriers
8.

Drug name	Plant
Opiods	Poppy Plant *Papaver somniferum*
Cannabinoids	*Cannabis sativa*
Cocaine	Coca plant *Erythroxylum coca*

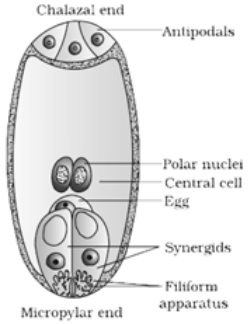
9. Causative organisms of the following diseases
   (a) Typhoid - *Salmonella typhi*
   (b) Malaria - *Plasmodium falciparum*
10. George Gamow, Hargobind Khorana and Marshall Nirenberg.

Or

The basic processes that lead to fluctuations in density of a given population are
(i) Natality
(ii) Mortality
(iii) Immigration
(iv) Emigration

Section C

11. Structure of a mature embryo sac.



12. The salient features of the Double-helix structure of DNA are as follows:
    (i) It is made of two polynucleotide chains, where the backbone is constituted by sugar-phosphate, and the bases project inside.
    (ii) The two chains have anti-parallel polarity. It means, if one chain has the polarity 5′–>3′, the other has 3′–>5′.
    (iii) The bases in two strands are paired through hydrogen bond (H-bonds) forming base pairs. Adenine forms two hydrogen bonds with Thymine from opposite strand and vice-versa. Similarly, Guanine is bonded with Cytosine with three H-bonds. As a result, always a purine comes opposite to a pyrimidine. This generates approximately uniform distance between the two strands of the helix.
    (iv) The two chains are coiled in a right-handed fashion. The pitch of the helix is 3.4 nm (a nanometre is one billionth of a metre, that is 10-9 m) and there are roughly 10 bp in each turn. Consequently, the distance between a bp in a helix is approximately equal to 0.34 nm.
    (v) The plane of one base pair stacks over the other in double helix. This, in addition to H-bonds, confers stability of the helical structure.

    Or

    The frequency of occurrence of alleles of a gene or a locus can be measured. This frequency is supposed to remain fixed and even remain the same through generations. This is the Hardy-Weinberg principle. This 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 q2, of Aa2pq. Hence, p2+2pq+q2=1. This is a binomial expansion of (p+q)2

13. When *Streptococcus pneumoniae* (pneumococcus) bacteria are grown on a culture plate, some produce smooth shiny colonies (S) while others produce rough colonies (R). This is because the S strain bacteria have a mucous (polysaccharide) coat, while R strain does not. Mice infected with the S strain (virulent) die from pneumonia infection but mice infected with the R strain do not develop pneumonia.
    S strain ——-> Inject into mice ——> Mice die
    R strain ——–> Inject into mice ——-> Mice live

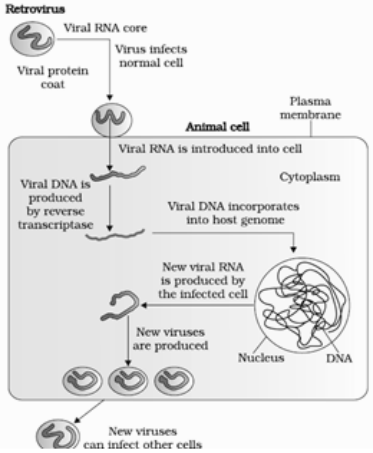
Griffith was able to kill bacteria by heating them. He observed that heat-killed S strain bacteria injected into mice did not kill them. When he injected a mixture of heat-killed S and live R bacteria, the mice died. Moreover, he recovered living S bacteria from the dead mice.

S strain(heat killed) ——-> Inject into mice ——> Mice live

S strain (heat killed) +R strain (live) ——–> Inject into mice ——-> Mice die

He concluded that the R strain bacteria had somehow been transformed by the heat-killed S strain bacteria. Some 'transforming principle', transferred from the heat-killed S strain, had enabled the R strain to synthesise a smooth polysaccharide coat and become virulent. This must be due to the transfer of the genetic material

14. (a) EST -Expressed sequence Tags
    (b) BAC - Bacterial Artificial chromosome
    (c) YAC - Yeast Artificial Chromosome.
15. The replication of retrovirus.

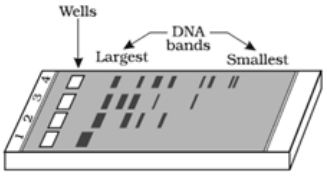


16. Recombinant DNA technology, Polymerase Chain Reaction (PCR) and Enzyme Linked Immuno-sorbent Assay (ELISA) are some of the techniques in Molecular Diagnosis.

    Presence of a pathogen (bacteria, viruses, etc.) is normally suspected only when the pathogen has produced a disease symptom. By this time the concentration of pathogen is already very high in the body. However, very low concentration of a bacteria or virus (at a time when the symptoms of the disease are not yet visible) can be detected by amplification of their nucleic acid by PCR. PCR is now routinely used to detect HIV in suspected AIDS patients. It is being used to detect mutations in genes in suspected cancer patients too. It is a powerful technique to identify many other genetic disorders.

    A single stranded DNA or RNA, tagged with a radioactive molecule (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 hence not appear on the photographic film, because the probe will not have complementarity with the mutated gene. ELISA is based on the principle of antigen-antibody interaction. Infection by pathogen can be detected by the presence of antigens (proteins, glycoproteins, etc.) or by detecting the antibodies synthesised against the pathogen.
17. 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.

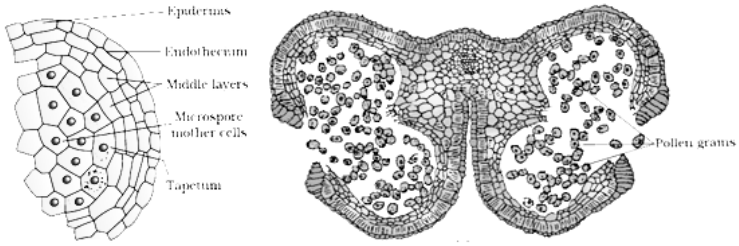


The separated DNA fragments can be visualised only after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation. The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution. The DNA fragments purified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

18. The reasons for the production of transgenic animals
    (a) Normal physiology and development: Transgenic animals can be specifically designed to allow the study of how genes are regulated, and how they affect the normal functions of the body and its development
    (b) Study of disease: Many transgenic animals are designed to increase our understanding of how genes contribute to the development of disease.
    (c) Biological products.
19. Biodiversity at all levels of biological organization
    (i) Genetic diversity: A single species might show high diversity at the genetic level over its distributional range. The genetic variation shown by the medicinal plant *Rauwolfiavomitoria* growing in different Himalayan ranges might be in terms of the potency and concentration of the active chemical (reserpine) that the plant produces. India has more than 50,000 genetically different strains of rice, and 1,000 varieties of mango.
    (ii) Species diversity: The diversity at the species level. For example, the Western Ghats have greater amphibian species diversity than the Eastern Ghats.
    (iii) Ecological diversity: At the ecosystem level, India, for instance, with its deserts, rain forests, mangroves, coral reefs, wetlands, estuaries, and alpine meadows has greater ecosystem diversity than a Scandinavian country like Norway.
20. The components of the ecosystem are seen to function as a unit by the following aspects:
    (i) Productivity;
    (ii) Decomposition;
        (a) Energy flow; and
        (b) Nutrient cycling.
21. Intine: The inner wall of the pollen grain is called the **intine.** It is a thin and continuous layer made up of cellulose and pectin
    Locule: The basal bulged part of the pistil is the **ovary.** Inside the ovary is the **ovarian cavity** (**locule)**. **The placenta** is located inside the ovarian cavity
22. In animals the states of dormancy are Hibernation and Aestivation. The familiar case of bears going into hibernation during winter. Aestivation snails and fish go into aestivation to avoid summer–related problems-heat and desiccation.
23. (a) Rohit and his friends show understanding of population explosion, team work and motivational capacity.
    (b) To understand the problem faced by the family and the nation due to increasing population, simultaneously the benefits of having a small family.
    (c) (i) Public awareness through mass media
        (ii) Education at all levels
        (iii) Family planning
        (iv) Increasing marriageable age (18 for girls, 21 for boys)

Section D

24. As the anther develops, the cells of the sporogenous tissue undergo meiotic divisions to form microspore tetrads. As each cell of the sporogenous tissue is capable of giving rise to a microspore tetrad. Each one is a potential pollen or microspore mother cell (PMC). The process of formation of microspores from a pollen mother cell through meiosis is called microsporogenesis. The microspores, as they are formed, are arranged in a cluster of four cells–the microspore tetrad. As the anthers mature and dehydrate, the microspores dissociate from each other and develop into pollen grains. Inside each microsporangium several thousands of microspores or pollen grains are formed that are released with the dehiscence of anther.



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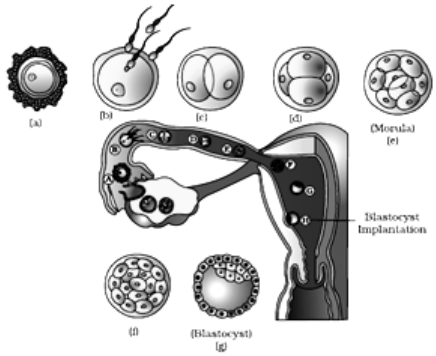
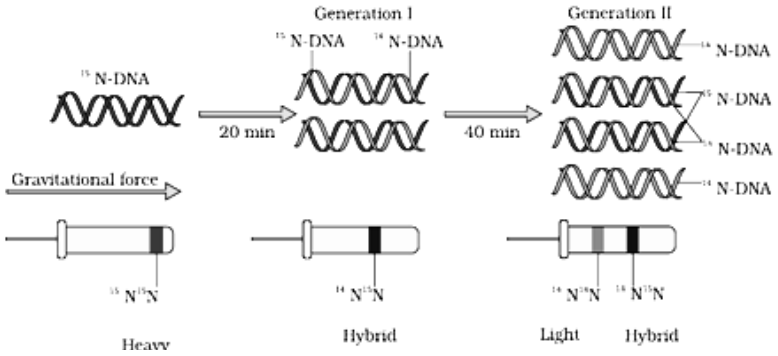


25. DNA replicates semi-conservatively. It was shown first in Escherichia coli and subsequently in higher organisms, such as plants and human cells. Meselson and Stahl proved the semi conservative replication
    (i) They grew E. coli in a medium containing 15NH4Cl (15N is the heavy isotope of nitrogen) as the only nitrogen source for many generations. The result was that 15N was incorporated into newly synthesised DNA (as well as other nitrogen containing compounds). This heavy DNA molecule could be distinguished from the normal DNA by centrifugation in a cesium chloride (CsCl) density gradient.
    (ii) Then they transferred the cells into a medium with normal 14NH4Cl and took samples at various definite time intervals as the cells multiplied, and extracted the DNA that remained as double-stranded helices. The various samples were separated independently on CsCl gradients to measure the densities of DNA.
    (iii) The DNA that was extracted from the culture one generation after the transfer from 15N to 14N medium [that is after 20 minutes; E. coli divides in 20 minutes] had a hybrid or intermediate density. DNA extracted from the culture after another generation [that is after 40 minutes, II generation] was composed of equal amounts of this hybrid DNA and of 'light' DNA.



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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:

(a) 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).
(b) The disease is controlled by a single pair of allele, HbA and HbS.
(c) Out of the three possible genotypes only homozygous individuals for HbS (HbSHbS) show the diseased phenotype.
(d) 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.
(e) 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.
(d) 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.
(e) 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.