CBSE Sample Paper -07
Class 12 Biology
(Questions)

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.   Define isogametes

2.   What is the number of chromosome in human zygote?

3.   What are purines and pyrimidines?

4.   What is adaptive radiation?

5.   What is germplasmcollection.

Section B

6.   Write the transcription product sequence for

   a)   5' ATGCACTGATCCAA 3'

   b)   3'GTACGTACGTAC 5'

7.   Give the diagram of the dogflower experiment.

8.   What are the types of acquired immunity?

Or

What are biological response modifiers?

9.   What is out crossing?

10.   Name the genes that encode the Bttoxi.

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 theprogramme 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.   Give the journey of sperm formation with diagram. What are the hormones involved?

OR

How are infertility problems overcome?

25.   Explain Mendel's dihybrid cross with diagram.

OR

26.   Explain with diagram the experiment that proved that DNA is the genetic material.

OR

How do you represent the food and energy relationships between organisms
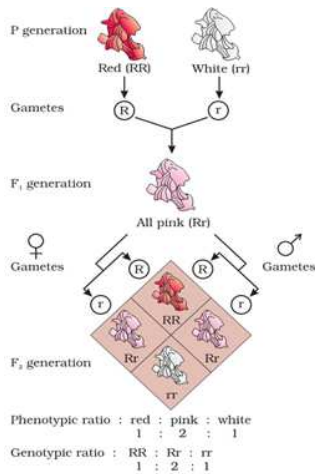
Answers

Section A

1. In some algae the two gametes are so similar in appearance that it is not possible to categorise them into male and female gametes. Eg Chlamydomonas.

2. 46.

3. A nucleotide has three components – a nitrogenous base, a pentose sugar (ribose in case of RNA, and deoxyribose for DNA), and a phosphate group. There are two types of nitrogenous bases – Purines (Adenine and Guanine), and Pyrimidines (Cytosine, Uracil and Thymine).

4. The 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**. Darwin's finches represent one of the best examples of this phenomenon

5. The entire collection (of plants/seeds) having all the diverse alleles for all genes in a given crop is called germplasmcollection.

Section B

6. The transcription product sequence is

    a)   3' TACGTGACTAGGTT 5'

             5' AUGCACUGAUCCAA 3'

    b)   5'CATGCATGCATG 3'

             5' CAUGCAUGCAUG 3'

7. Diagram of the dogflower experiment

Phenotypic ratio : red : pink : white
1 : 2 : 1
Genotypic ratio : RR : Rr : rr
1 : 2 : 1

8. Antibody mediated immunity or humoral immune response by the production of antibodies against antigens.Cell mediated immunity initiated by T lymphocytes.
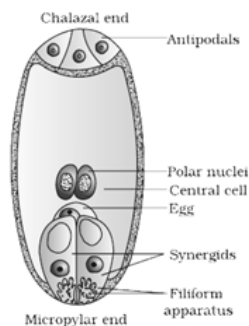
Or

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.

9. The practice of mating of animals within the same breed, but having no common ancestors on either side of their pedigree up to 4-6 generations. The offspring of such a mating is known as an out-cross.

10. The toxin is coded by a gene named cry .The toxins encoded by the genes *cryIAc*and*cryIIAb*control the cotton bollworms, that of *cryIAb*controls corn borer.

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 locuscan be measured. This frequency is supposed to remain fixedand 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.
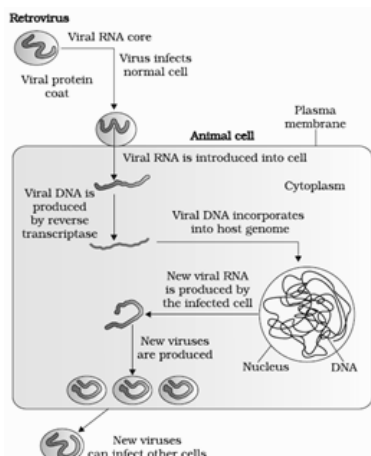
S strain(heat killed) ——-> Inject into mice ——> Mice live

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.

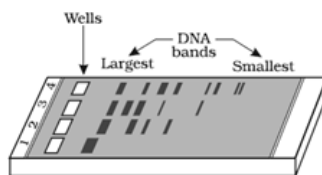15.   The replication of retrovirus.

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.
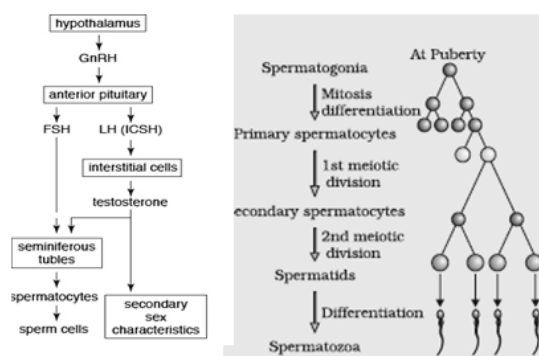

The separated DNA fragments can be visualised only after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation. The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution. The DNA fragments purified 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;

(iv) Energy flow; and

(v)   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 andmotivational capacity.

b.   To understand the problem faced by the family and the nation due to increasingpopulation, 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. In testis, the immature male germ cells (spermatogonia) produce sperms by spermatogenesis that begins at puberty. The spermatogonia (sing. spermatogonium) present on the inside wall of seminiferous tubules multiply by mitotic division and increase in numbers. Each spermatogonium is diploid and contains 46 chromosomes. Some of the spermatogonia called primary spermatocytes periodically undergo meiosis. A primary spermatocyte completes the first meiotic division (reduction division) leading to formation of two equal, haploid cells called secondary spermatocytes, which have only 23 chromosomes each. The secondary spermatocytes undergo the second meiotic division to produce four equal, haploid spermatids. The spermatids are transformed into spermatozoa (sperms) by the process called spermiogenesis. After spermiogenesis, sperm heads become embedded in the Sertoli cells, and are finally released from the seminiferous tubules by the process called spermiation.

OR

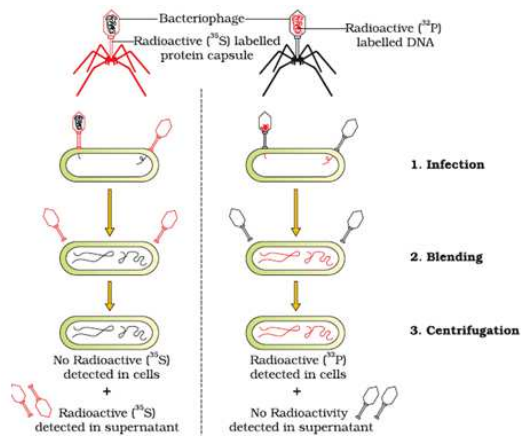Infertility problems are overcome by assisted reproductive technologies (ART).

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.

25. A dihybrid cross describes a mating experiment between two organisms that are identically hybrid for two traits. A hybrid organism is one that is heterozygous, which means that is carries two different alleles at a particular genetic position, or locus. Therefore, a dihybrid organism is one that is heterozygous at two different genetic loci. In 1865, Gregor Mendel performed dihybrid crosses on pea plants and discovered a fundamental law of genetics called the Law of Independent Assortment. Mendel began his experiments by first crossing two homozygous parental organisms that differed with respect to two traits. An organism that is homozygous for a specific trait carries two identical alleles at a particular genetic locus.

Mendel chose to cross a pea plant that was homozygous and dominant for round (RR), yellow (YY) seeds with a pea plant that was homozygous and recessive for wrinkled (rr), green (yy) seeds, represented by the following notation:RRYY x rryy

Organisms in this initial cross are called the parental, or P generation. The offspring of the RRYY x rryy cross, which is called the F1 generation, were all heterozygous plants with round, yellow seeds and the genotype RrYy.

Next, Mendel crossed two plants from the F1 generation. This step is the dihybrid cross, and it is represented as:RrYy x RrYy

Mendel observed that the F2 progeny of his dihybrid cross had a 9:3:3:1 ratio and produced nine plants with round, yellow seeds, three plants with round, green seeds, three plants with wrinkled, yellow seeds and one plant with wrinkled, green seeds. From his experiment, Mendel observed that the pairs of traits in the parental generation sorted independently from one another, from one generation to the next.

First generation

P1 phenotype	round yellow	x	wrinkled green	
P1 genotype	RRYY		rryy	
P1 gametes	(RY)		(ry)	

fertilisation

♀ gametes \ ♂ gametes	ry
RY	RrYy

F1 genotype — RrYy

F1 phenotype — all round yellow

Second generation

F1 phenotype	round yellow	x	round yellow	
F1 genotype	RrYy		RrYy	
F1 gametes	(RY), (Ry), (rY), (ry)		(RY), (Ry), (rY), (ry)	

fertilisation

♂ gametes

♀ gametes	RY	Ry	rY	ry
RY	RRYY	RRYy	RrYY	RrYy
Ry	RRyY	RRyy	RrYy	Rryy
rY	RrYY	RrYy	rrYY	rrYy
ry	RrYy	Rryy	rrYy	rryy

F2 phenotype	round yellow	round green	wrinkled yellow	wrinkled green
F2 genotype	RRYY RRYy RrYY RrYy	RRyy Rryy	rrYY rrYy	rryy
F2 ratio	9	3	3	1

Or

Hershey and Chase grew some viruses on a medium that contained radioactive phosphorus and some others on medium that contained radioactive sulfur. Viruses grown in the presence of radioactive phosphorus contained radioactive DNA but not radioactive protein because DNA contains phosphorus but protein does not. Similarly, viruses grown on radioactive sulfur contained radioactive protein but not radioactive DNA because DNA does not contain sulfur. Radioactive phages were allowed to attach to E. coli bacteria. Then, as the infection proceeded, the viral coats were removed from the bacteria by agitating them in a blender. The virus particles were separated from the bacteria by spinning them in a centrifuge. Bacteria which were infected with viruses that had radioactive DNA were radioactive, indicating that DNA was the material that passed from the virus to the bacteria. Bacteria that were infected with viruses that had radioactive proteins were not radioactive. This indicates that proteins did not enter the bacteria from the viruses. DNA is therefore the genetic material that is passed from virus to bacteria

26. The food or energy relationship is expressed in terms of number, biomass or energy. The base of each pyramid represents the producers or the first trophic level while the apex represents tertiary or top level consumer. The three ecological pyramids that are usually studied are (a) pyramid of number; (b) pyramid of biomass and (c) pyramid of energy

Any calculations of energy content, biomass, or numbers has to include all organisms at that trophic level. No generalisations we make will be true if we take only a few individuals at any trophic level into account. Also a given organism may occupy more than one trophic level simultaneously. One must remember that the trophic level represents a functional level, not a species as such. A given species may occupy more than one trophic level in the same ecosystem at the same time; for example, a sparrow is a primary consumer when it eats seeds, fruits, peas, and a secondary consumer when it eats insects and worms.
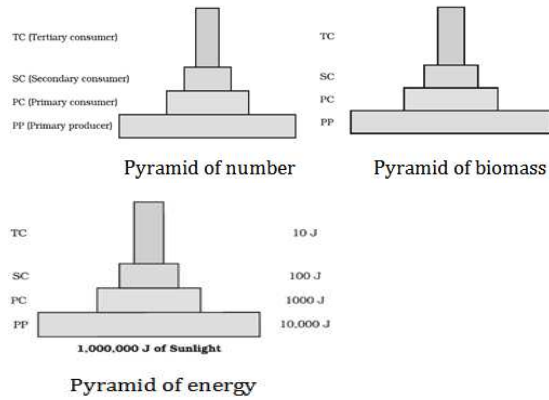
In most ecosystems, all the pyramids, of number, of energy and biomass are upright, i.e., producers are more in number and biomass than the herbivores, and herbivores are more in number and biomass than the carnivores. Also energy at a lower trophic level is always more than at a higher level.

The pyramid of biomass in sea is also generally inverted because the biomass of fishes far exceeds that of phytoplankton.

Pyramid of energy is always upright, can never be inverted, because when energy flows from a particular trophic level to the next trophic level, some energy is always lost as heat at each step.

Each bar in the energypyramid indicates the amount of energy present at each trophic level in a given time or annually per unit areathere are certain limitations of ecological pyramids such as it does not take into account the same species belonging to two or more

trophic levels. It assumes a simple food chain, something that almost never exists in nature; it does not accommodate a food web. Moreover, saprophytes are not given any place in ecological pyramids even though they play a vital role in the ecosystem.

Pyramid of number   Pyramid of biomass

Pyramid of energy

OR

Growth models of population.

a) Exponential growth

When resources in the habitat are unlimited, each species has the ability to realise fully its innate potential to grow in number. Then the population grows in an exponential or geometric fashion. If in a population of size N, the birth rates are represented as b and death rates as d, then the increase or decrease in N during a unit time period t (dN/dt) will be

dN/dt= (b – d) × N

Let (b–d) = r, then

dN/dt = rN

The r in this equation is called the 'intrinsic rate of natural increase' and is a very important parameter chosen for assessing impacts of any biotic or abiotic factor on population growth.

The above equation describes the exponential or geometric growth pattern of a population and results in a J-shaped curve when we plot N in relation to time. the integral form of the exponential growth equation can be derived as

$N_t = N_0 e^{rt}$ where

N_t = Population density after time t

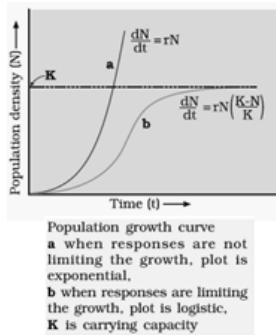N_o = Population density at time zero

r = intrinsic rate of natural increase

e = the base of natural logarithms (2.71828)

Any species growing exponentially under unlimited resource conditions can reach enormous population densities in a short time.

b) Logistic growth

No population of any species in nature has at its disposal unlimited resources to permit exponential growth. This leads to competition between individuals for limited resources. Eventually, the 'fittest' individual will survive and reproduce.

Population growth curve
a when responses are not limiting the growth, plot is exponential,
b when responses are limiting the growth, plot is logistic,
K is carrying capacity

A given habitat has enough resources to support a maximum possible number, beyond which no further growth is possible. This limit is called as nature's carrying capacity (K) for that species in that habitat.

A population growing in a habitat with limited resources show initially a lag phase, followed by phases of acceleration and deceleration and finally an asymptote, when the population density reaches the carrying capacity. A plot of N in relation to time (t) results in a sigmoid curve. This type of population growth is called Verhulst-Pearl Logistic Growth and is described by the following equation:

$$dN/dt = rN\left(\frac{K - N}{K}\right)$$

Where N = Population density at time t

r = Intrinsic rate of natural increase

K = Carrying capacity

Since resources for growth for most animal populations are finite and become limiting sooner or later, the logistic growth model is considered a more realistic one.