Biology
Question Paper
2019 (Set-1)

General Instructions :

*(i) There are total **27** questions and **four** sections in the question paper. **All** questions are compulsory.*

*(ii) Section **A** contains questions number **1** to **5**, very short answer type questions of **one** mark each.*

*(iii) Section **B** contains questions number **6** to **12**, short answer type **I** questions of **two** marks each.*

*(iv) Section **C** contains questions number **13** to **24**, short answer type **II** questions of **three** marks each.*

*(v) Section **D** contains question number **25 to 27**, long answer type questions of **five** marks each.*

*(vii) There is no overall choice in the question paper, however, an internal choice is provided in **two** questions of **one** mark, **two** questions of **two** marks, four questions of **three** marks and all the **three** questions of **five** marks. In these questions, an examinee is to attempt any **one** of the **two** given alternatives.*

(vii) Wherever necessary, the diagram drawn should be neat and properly labelled.

Question 1
State from where do the signals for parturition originate in human females.

SOLUTION:

The signals for parturition in human females originate from the fully developed foetus and the placenta.

Question 2
Name the pattern of inheritance where F_1 phenotype

(a) resembles only one of the two parents.
(b) does not resemble either of the two parents and is in between the two.

SOLUTION:

(a) Complete dominance
(b) Incomplete dominance

Question 3
According to the Hardy-Weinberg principle, the allele frequency of a population remains constant. How do you interpret the change of frequency of alleles in a population ?

OR

Coelacanth was caught in South Africa. State the significance of discovery of *Coelacanth* in the evolutionary history of vertebrates.

SOLUTION:

If the Hardy-Weinberg equillibrium/genetic equillibrium is disturbed it would result in evolution. In other words, change in frequency of alleles can be interpreted by evolution. Gene flow, genetic drift, mutation etc. are some of the disturbances which may lead to change in allele frequency.

OR

Coelacanth was a fish was caught in south Africa in 1938, which was thought to be extinct. These animals were called lobefins which evolved into first amphibians that lived on both land and water. These are considered to be the ancestors of modern days frogs and salamanders.

Question 4
State the functions of mast cells in allergy response.

OR

State the function of interpherons.

SOLUTION:

Mast cells belong to the category of white blood cells which contain granules. They play an important role in mediating inflammatory responses such as hypersensitivity and allergic responses. Their granules contain chemicals like histamine and heparin which help them in mediating these inflammatory responses.

OR

Interferons are proteins secreted by virus-infected cells. They provide immunity by protecting the non-infected cells from viral infection.

Question 5
What is the cell that receives a recombinant gene called?

SOLUTION:

A cell that receives a recombinant gene is called a transformed cell.

Question 6
Name a disorder a human suffers from as a result of monosomy of the sex chromosome. Give the karyotype and write the symptoms.
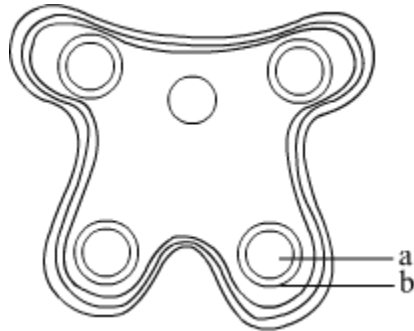
SOLUTION:

Turner's Syndrome is a result of monosomy of the sex chromosome in humans.
Its karyotype is XO i.e. 45 chromosomes.
Symptoms -short stature
  - lack of the development of the ovaries
  - lack of secondary sexual characteristics

Question 7
In the T.S. of a mature anther given below, identify "a" and "b" and mention their functions.

OR

What is cleistogamy ? Write one advantage and one disadvantage of it, to the plant.

SOLUTION:

"a" - Sporogenous tissue - During development of the anther, the cells of the sporogenous tissue undergo meiotic divisions to form microspore tetrads.
"b" - Tapetum - It is the innermost layer surrounding the microsporangium. It plays an important role in providing nourishment to the developing pollen grains.

OR

Cleistogamous flowers are flowers which do not open at all. Cleistogamy refers to the self pollination which occurs in unopened flowers.

Advantage of cleistogamy:
Cleistogamous flowers produce assured seed-set even in the absence of pollinators. In other words it can be said that cleistogamous plant can propagate itself under unfavourable condition.
Disadvantage of cleistogamy:
Cleistogamous flowers undergo self pollination occurs which reduces the chances of variation and evolution of genetically superior progeny.

Question 8
State the role of thymus as a lymphoid organ. Name the cells that are released from it and mention their function.

SOLUTION:

Thymus is one the primary lymphoid organ of the immune system. Maturation of lymphocytes occurs in the thymus. T-cells produced in the bone marrow get matured in the thymus and are released from here.
T- cells do not themselves produce antibodies, but help B-cells to produce them. They are also responsible for cell-mediated immune response (CMI).

Question 9
"Artificial insemination helps overcome several problems of normal mating in cattle". Do you agree? Support your answer with any three reason.

SOLUTION:

Yes, artificial insemination helps overcome several problems of normal mating in cattle for example -
semen from a single bull of superior breed can be used to inseminate several cows at the same point of time.

- it helps in overcoming the problem of transportation of animals.
- the semen can be stored at freezing temperatures for future use.

Question 10
Name and explain the interaction that is seen between clownfish and sea anemones.

SOLUTION:

The type of interaction between 'clown' fish and sea anemone is called commensalism. Commensalism is the interaction where one partner gets benefited while the other one is not affected in any way.
In this case, clown fish gets protection and hence it is benefited while sea anemone is not affected in the course of interaction.

Question 11
Write the relationship between productivity, gross primary productivity, net primary productivity and secondary productivity.

SOLUTION:

Productivity: It is the rate of production of biomass at any trophic level at any given interval of time.

Gross productivity: It is the rate of production of organic matter by green plants per unit time per unit area. In other words, it is the total amount of productivity.

Net primary productivity: It is the difference between gross primary productivity and the loss due to respiration. Net primary productivity is the difference of gross primary productivity and respiratory loss.
NPP = GPP - R

Secondary productivity is the rate of formation of organic matter by consumers.

Question 12
Justify the need for signing of 'Montreal Protocol' by the participating nations in 1987.

SOLUTION:

Montreal Protocol was signed in 1987 in Montreal, Canada. The reason behind signing this protocol was to control the emission of CFC's and other ozone depleting chemicals. These chemicals are responsible for the depletion of ozone layer and result in the development of ozone hole. Disruption in the ozone layer can have deleterious effect on all the living beings and the environment.

Question 13
Emasculation and bagging are the two important steps carried during artificial hybridisation to obtain superior varieties of desired plants. Explain giving reasons, in which types of flowers and at what stages are the two processes carried out.

OR

State what is apomixis. Write its significance. How can it be commercially used ?

SOLUTION:

Emasculation and bagging are carried out in bisexual flowers (possess both stamen and carpels within the same inflorescence).
Emasculation means the removal of anther from the flower buds and this is done before the anther dehisces. Dehiscense results in the release of pollen which may then reach the stigma and lead to germination of the pollen.

Bagging can be done in both bisexual and unisexual flowers. In case of bisexual flowers, emasculation is followed by bagging. The emasculated flowers are covered with a bag made up of butter paper to prevent the contamination of its stigma with unwanted pollen.
As the stigma of the bagged flower becomes receptive, the flowers are unbagged and dusted with mature pollen grains from anthers of male parent. They are again rebagged and the fruits are allowed to redevelop.

OR

Apomixis is a form of asexual reproduction in which embryo is formed without meiosis and fusion of haploid gametes. It can take place through diploid sporophytic cells of ovule or from an unfertilised egg (parthenogenesis) itself.

Significance:
Certain species of plants belong to Asteraceae, and grasses exclusively use the phenomenon of apomixis for producing seeds.

Commercial applications of apomixis:
1. By apomixis, hybrid varieties of seeds can be produced, which will provide higher and better yield.
2. Apomixis prevents the loss of specific characteristics in the hybrid plants.
3. Apomixis is a cost-effective method of producing seeds.

Question 14
(a) Draw a sectional view of human ovary. Label the following parts :
(i) Primary Follicle
(ii) Secondary oocyte
(iii) Graafian follicle
(iv) Corpus luteum
(b) Name the hormones influencing follicular development of corpus luteum.

OR

(a) Draw an L.S. of pistil showing pollen tube entering into the embryo sac. Label the following :
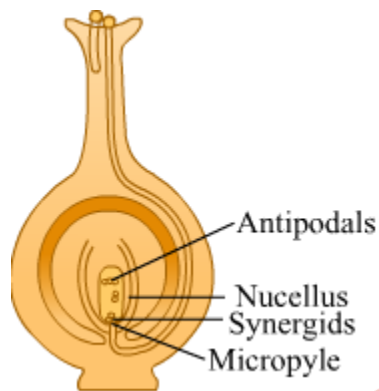(i) Nucellus
(ii) Antipodals
(iii) Synergids
(iv) Micropyle
(b) Write the functions of the following :
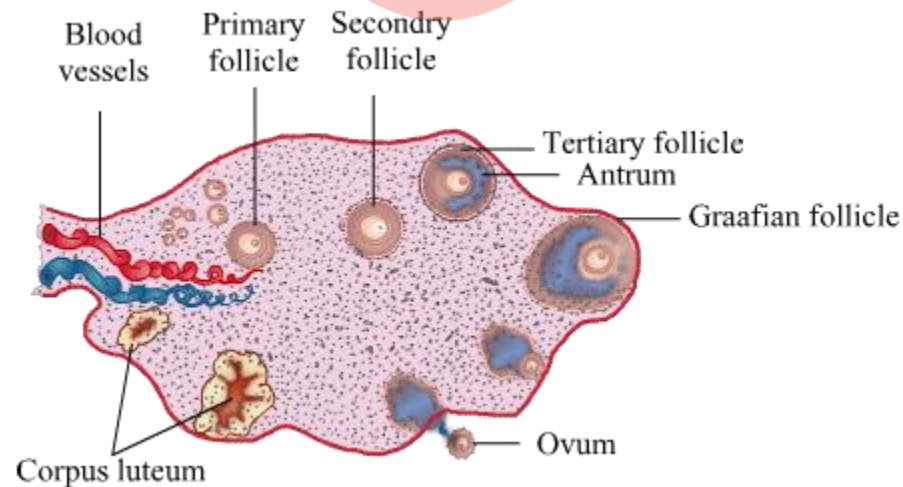(i) Synergids
(ii) Micropyle

SOLUTION:

(a)

(b) The hormones which which influene the follicular development of corpus luteum are FSH and LH.
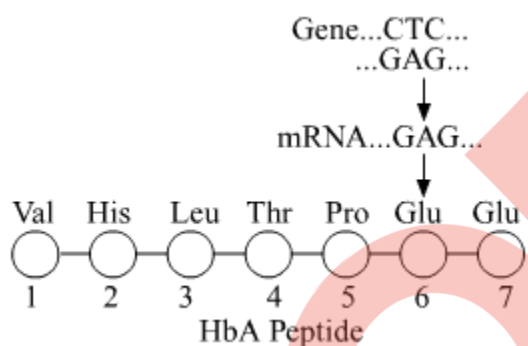
OR

(a)

(b)

(i) Synergids - These cells are present in the female gametophyte and are essential for reproduction in angiosperms. during the process of fertilisation, the pollen tube enters into the synergids, ceases growth, ruptures, and finally releases its two sperm cells into this cell.

Synergids also have special cellular thickening at its micropylar tips giving rise to the filiform apparatus.

(ii) Micropyle - The small pore present just beneath the hilum is called micropyle of a seed. It has several roles like -

providing the passage for entry of pollen tube assists in absorption of water which helps in seed germination.

Question 15

Given below is the representation of a relevant part of amino acid composition of the β-chain of haemoglobin, related to the shape of human red blood cells.

Gene...CTC...
...GAG...
↓
mRNA...GAG...
↓

| Val | His | Leu | Thr | Pro | Glu | Glu |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

HbA Peptide

(a) Is this representation of the sequence of amino acids indicating a normal human or a sufferer from a certain blood related genetic disease? Give reason in support of your answer.

(b) Why is the disease referred to as a Mendelian disorder ? Explain.

OR

Name the kind of diseases/disorders and any two symptoms that are likely to occur in humans if

(a) Mutation in the gene that codes for an enzyme phenylalanine hydroxylase occurs.

(b) The karyotype is XXY.

SOLUTION:

(a) The sequence of amino acids in the above representation indicates a normal human. In, the above representation, the 6th position is occupied by glutamic acid. But if the glutamic acid is substituted by valine at the 6th position, the person is said to be suffering from sickle cell anemia. It is a disorder in which red blood cells assume an abnormal, sickle-like shape. Such mutant haemoglobin molecule undergoes

polymerisation under low oxygen tension to change the shape of red blood cells.

(b) Mendelian disorder are determined by the alteration or mutation in the single gene. In this disease as well, there is a mutation in a single gene, that too only at the 6th position.

OR

(a) Phenylketonuria is the disease caused due to the mutation in gene that codes for an enzyme phenylalanine hydroxylase.
symptoms:
seizures
stunted growth
skin rashes
small head size

(b) XXY - Klinefelter's syndrome
Symptoms:
Enlarged breast tissue (gynecomastia)
Overall masculine development
Longer legs, shorter torso
Sterile indivisuals

Question 16
Name the technique and the property of plant cells that can help to grow somaclones of certain desired variety of apple. Explain how somaclones of apple can be obtained in the lab so as to get the desired variety on a large scale.

SOLUTION:
The technique which helps to grow somaclones is called micro-propogation and the property of plant cells which help us to do so is totipotency.
Totipotency is the capacity to generate a whole plant from any cell/explants under sterile conditions in special nutrient media.
Plants that are genetically identical to original plants from which they are grown are called somaclones.
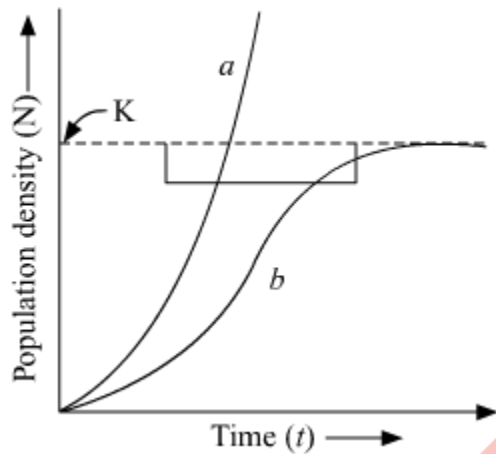
The somaclones of apples can be obtained in labs by following the below mentioned steps:

- A small part of the apple plant can be taken out and grown in special nutrient media.

- This nutrient media should have all the components required for the growth of the plant for example, salts, vitamins, minerals, amino acids, hormones etc.

- All this needs to be done in a sterile environment in the laboratory.

- This would help us to obtain somaclones of the apple plant in a very short duration.

Question 17
Study the graph given below and answer the question that follow :

(i) The curve '*b*' is described by the following equation :

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

What does '*K*' stand for in this equation ? Mention its significance.

(ii) Which one of the two curves is considered a more realistic one for most of the animal populations?

(iii) Which curve would depict the population of a species of deer if there are no predators in the habitat ? Why is it so?

SOLUTION:
(i) '*K*' stands for Carrying capacity. Carrying capacity represents the maximum population size an environment can support.
(ii) Curve 'b' represents the more realistic curve for an animal population. It is called the logistic growth model.
(iii) Curve 'a' would depict the population of a species of deer if there are no predators in the habitat. In the absence of predators, the population of deer would grow enormously in a short duration of time.

Question 18

"A very small sample of tissue or even a drop of blood can help determine paternity."
Provide a scientific explanation to substantiate how it is possible.

SOLUTION:

A very small sample of DNA obtained from tissue or even a drop of blood can serve as a source for paternity testing. By using the techniques of PCR and DNA fingerprinting, we can determine the paternity of any individual.

The steps are as follows –

- The first step includes extraction of DNA from the cells or blood.
- The DNA molecules are then broken into small fragments which contain variable number of tandem repeats (VNTR's).
- The DNA fragments are then separated by gel electrophoresis.
- These DNA fragments are multiplied using PCR.
- They are then converted into single stranded DNA by treatment with alkaline chemicals.
- It is followed by transferring these fragments to nylon membrane.
- The nylon membrane is exposed to X-ray film which creates dark coloured bands called fingerprints.
- These fingerprints can then be used to determine paternity.

Question 19

Explain the phenomena of dominance, multiple allelism and co-dominance taking human ABO blood group as an example.

SOLUTION:

The inheritance of **ABO blood groups** in humans exhibits dominance, codominance and multiple allelism. In humans, the ABO blood groups are controlled by a gene called gene 'I'. It has three alleles, namely I^A, I^B and i.

Dominance - The alles I^A and I^B are dominant over the allele i. I^A and I^B produce antigens A and B respectively, however allele i does not produce any antigen.

Co-dominance: If both I^A and I^B are present in an individual, then they both are expressed because of the phenomenon of co-dominance.

Multiple allelism: Since the blood grouping is governed by more than two alleles, it is a good example of multiple allelism.

Table Showing the Genetic Basis of Blood Groups in Human Population is given as follows:

Allele from Parent 1	Allele from Parent 2	Genotype of offspring	Blood-types of offspring
I^A	I^A	$I^A I^A$	A
I^A	I^B	$I^A I^B$	AB
I^A	i	$I^A i$	A
I^B	I^A	$I^A I^B$	AB
I^B	I^B	$I^B I^B$	B
I^B	i	$I^B i$	B
i	i	$i\,i$	O

Question 20
Name the genus to which baculoviruses belong. Describe their role in the integrated pest management programmes.

SOLUTION:

Baculoviruses belong to the genus Nucleopolyhedrovirus.
Baculoviruses act as biological control agents, which are spices-specific and narrow spectrum. They attack insects and other arthropods but do not have a negative impact on plants, mammals, birds, fish, and other beneficial insects. As a result, beneficial insects are conserved and harmful pests attacked. This makes them useful in the Integrated Pest Management (IPM) programme.

Question 21
Give reasons why :
(a) DNA cannot pass into a host cell through the cell membrane.
(b) Proteases are added during isolation of DNA for genetic engineering.
(c) Single cloning site is preferred in a vector.

SOLUTION:

(a) We know that cell membranes are made up of phospholipid bilayers which means it has both hydrophillic and hydrophobic regions. DNA being a hydrophillic molecule will face a problem in passing through the hydrophobic regions of the plasma membrane. It is an extremely energy consuming process. This is the reason why host cells are made competent to take up the DNA.

(b) For genetic engineering processes, it is important that the isolated DNA is free of any other biomolecules and is in its purest form.
The DNA is intertwined around basic proteins called histones. During isolation of the DNA, it is treated with proteases (enzymes which degrade proteins) to remove any such proteins which may interfere with the genetic engineering processes.

(c) Cloning sites are short segments of DNA which contain sites for restriction enzymes. Single cloning site is preferred in a vector because multiple cloning sites would result in generation of several fragments thus complicating the process.

Question 22
State the medicinal value and the bioactive molecules produced by *Penicillium notatum*, *Monascus purpureus* and *Trichoderma polysporum*.

SOLUTION:

Penicillium notatum: It produces an antibiotic penicillin which was the first discovered and widely used antibiotic.
Monascus purpurues: It produces a group of drugs called statins that are used to lower the cholesterol in body.
Trichoderma polysporum: It produces cyclosporin A which is used as an immunosuppressive agent.

Question 23
Describe the roles of (a) high temperature, (b) primers, and (c) bacterium *Thermus aquaticus* in carrying the process of polymerase chain reaction.

OR

How does β-galactosidase coding sequence act as a selectable marker? Why is it a preferred selectable marker to antibiotic resistance genes ? Explain.

SOLUTION:

(a) High temperature - The first step of PCR is denaturation. In this step, high temperature is required for denaturation of the DNA strands i.e. separating the double stranded DNA into single strands. Since the two strands are held together by hydrogen bonding, a high temperature is required to break down these bonds and separate the two strands.

(b) Primers - Primers are small chemically synthesized oligonucleotides that are complimentory to the regions of DNA. They are required for the in vitro synthesis of DNA molecules during PCR.

(c) Bacterium *Thermus aquaticus* - Bacterium *Thermus aquaticus* produces an enzyme called Taq polymerase, which is resistant to denaturation by heat treatment. This enzyme is used to amplify a specific DNA fragment in polymerase chain reaction (PCR) technique. The enzyme utilises building blocks [dNTPs (deoxynucleotides)] to extend the primer.

OR

Selective marker is used in the selection of recombinants on the basis of ability to produce colour in the presence of chromogenic substrate. β-galactosidase is an enzyme that converts galactose into lactose. In this, a recombinant DNA is inserted within the coding sequence of enzyme, β-galactosidase, which result into inactivation of enzyme referred to as "insertional inactivation". As a result of this, non-recombinants will produce blue-coloured colonies while the recombinants will produce colour-less colonies.

The coding sequence for the enzyme β-galactosidase is preferred over antibiotic resistance genes because recombinants can be easily visualised and the process is less cumbersome.

Question 24
Answer the following questions based on Meselson and Stahl's experiment on *E. coli* :
(a) Write the name of the chemical substance used as the only source of nitrogen in the experiment.
(b) Why did they allow the synthesis of the light and the heavy DNA molecules in the organism?
(c) How did they distinguish the heavy DNA molecules from the light DNA molecules ? Explain.
(d) Write the conclusion the scientists arrived at, at the end of the experiment.
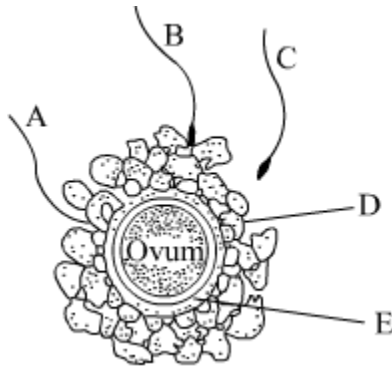
SOLUTION:

(a) NH_4Cl was used as the only source of nitrogen in the experiment.

(b) They allowed the synthesis of light and heavy DNA molecules in order to create observable differences in parent and newly synthesized DNA strands based on differences in the density.

(c) They distinguished the heavy DNA molecules from the light DNA molecules by centrifuging in CsCl density gradient. This method helps to separate DNA molecules into bands by spinning them at high speeds in the presence of another molecule, such as cesium chloride. It forms a density gradient from the top to the bottom of the spinning tube.

(d) At the end of the experiment, Meselson and Stahl concluded that DNA showed semi conservative mode of replication which means each strand in a DNA molecule serves as a template for synthesis of a new, complementary strand.

Question 25
Describe the process of megasporogenesis upto fully developed embryo sac formation in an angiosperm.

OR

Given below is the diagram of a human ovum surrounded by a few sperms. Study the diagram and answer the following questions :
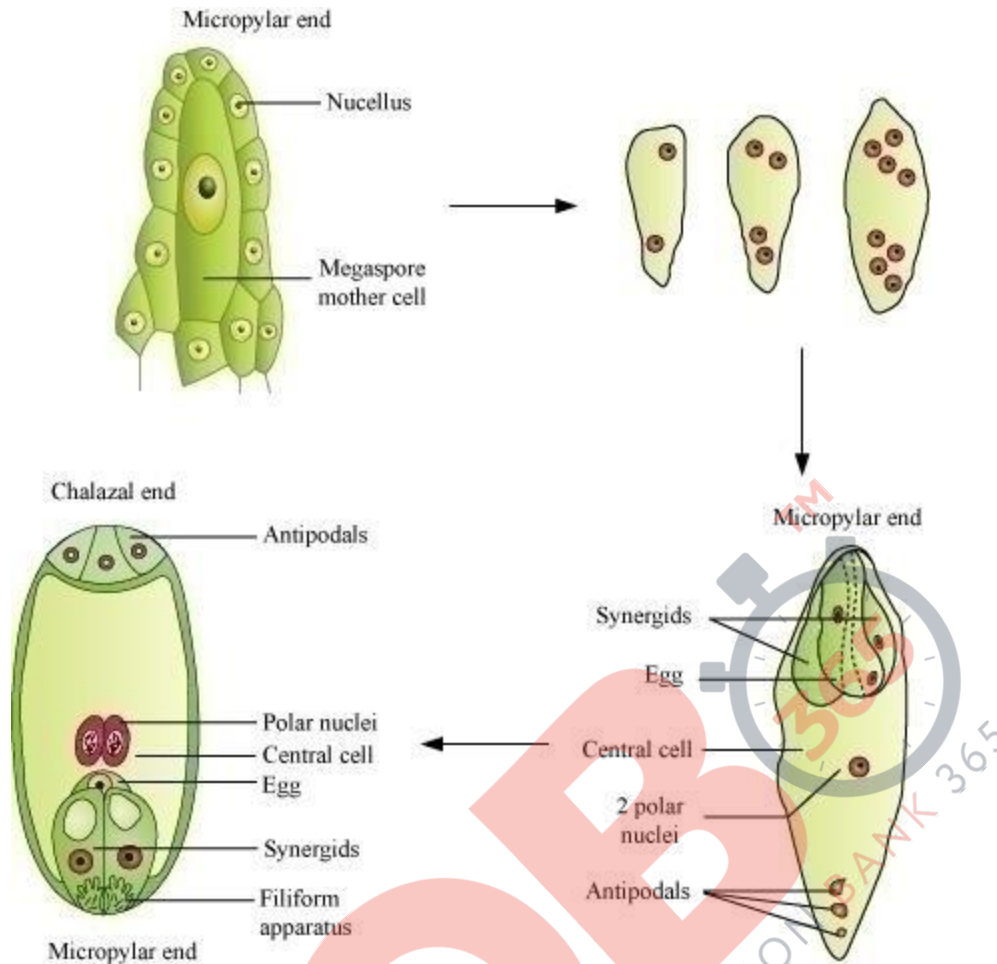

(a) Which one of the sperms would reach the ovum earlier ?

(b) Identify 'D' and 'E'. Mention the role of 'E'.

(c) Mention what helps the entry of sperm into the ovum and write the changes occurring in the ovum during the process.

(d) Name the specific region in the female reproductive system where the event represented in the diagram takes place.

SOLUTION:

The process of fromation of megaspores from the megaspore mother cell is called megasporogenesis. The megaspore mother cell undergoes mitosis to form two nuclei which migrate to opposite poles, forming a 2-nucleate embryo sac.

Further mitotic divisions lead to the formation of 4-nucleate and 8-nucleate stages of the embryo sac. In these mitotic divisions, nuclear division is not followed by cell division. After the 8-nucleate stage, cell walls are laid down and a typical female gametophyte or embryo sac is formed.

Among the eight nuclei, six are enclosed by cell walls and organised into cells, while the remaining two nuclei (called polar nuclei) are situated below the egg apparatus in a large central cell. Out of the six cells, three are grouped at the micropylar end, and constitute the egg apparatus made up of two synergids and one egg cell. The other three cells are located at the chalazal end, and are called antipodals. Thus, a typical angiosperm embryo sac after maturity is 8-nucleated and 7-celled.

Micropylar end
— Nucellus
— Megaspore mother cell

Chalazal end
— Antipodals

Micropylar end
Synergids
Egg
Central cell
2 polar nuclei
Antipodals

— Polar nuclei
— Central cell
— Egg
— Synergids
— Filiform apparatus

Micropylar end

OR

(a) Sperm A will reach the ovum fastest.
(b) D - Cells of the corona radiata
   E - Zona pellucida
The zona pellucida layers plays several roles such as –
- it supports the communication between oocytes and follicle cells during oogenesis
- it protects the oocytes, eggs, and embryos during development
- it regulates interactions between ovulated eggs and free-swimming sperm during and following fertilization

(c) The anterior portion of the head of the sperm is covered by a cap like structure called acrosome. This acrosome is filled with enzymes which help in fertilisation of the ovum. As a sperm comes in contact with the zona pellucida layer, it induces changes in the layer and blocks the entry of other sperms. The enzymes of the acrosome help the entry of the sperm into the cytoplasm of the ovum.

(d) This event of fertilisation occurs in the ampullary region of the fallopian tube.

Question 26

Study the schematic representation of the genes involved in the *lac* operon given below and answer the questions that follow :

p	i	p	o	z	y	a

(a) Identify and name the regulatory gene in this operon. Explain its role in 'switching off' the operon.
(b) Why is the *lac* operon's regulation referred to as negative regulation ?
(c) Name the inducer molecule and the products of the genes 'z' and '*y*' of the operon. Write the functions of these gene products.

OR

(a) How does the Hardy-Wienberg equation explain genetic equilibrium ?
(b) Describe how this equilibrium is disturbed that may lead to founder effect.

SOLUTION:

(a) The regulatory gene in this operon is *i* gene. The operon is switched off in the absence of the inducer, lactose. In the absence of lactose, the repressor gene is constitutively synthesized from the repressor gene. This active repressor protein binds to the operator gene of the operon and prevents the RNA polymerase to initiate the process of transcription.

(b) The regulation of lac operon is controlled by a repressor which is responsible for switching on and off the operon. When repressor binds to the operator, the operon is switched off and transcription is stopped, the reason why it is called negative regulation.

(c) Lactose is called the inducer molecule.
Gene 'z' codes for beta-galactosidase, which is responsible for the hydrolysis of lactose into galactose and glucose.
Gene 'y' codes for permease which increases the permeability of the cell to lactose.

OR

(a) The Hardy-Weinberg equation is a mathematical equation that can be used to calculate the genetic variation of a population at equilibrium.
The Hardy-Weinberg equation is expressed as:
$p^2 + 2pq + q^2 = 1$
where p is the frequency of the "A" allele and q is the frequency of the "a" allele in the population.

In the equation, p^2 represents the frequency of the homozygous genotype AA, q^2 represents the frequency of the homozygous genotype aa, and 2pq represents the frequency of the heterozygous genotype Aa.
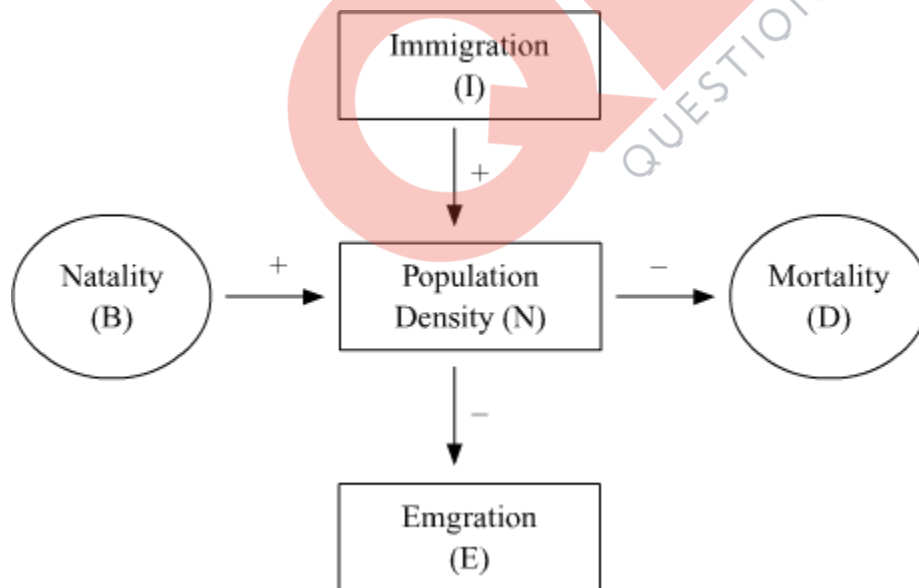
In addition, the sum of the allele frequencies for all the alleles at the locus must be 1, so $(p + q)^2 = 1$. If the p and q allele frequencies are known, then the frequencies of the three genotypes may be calculated using the Hardy-Weinberg equation.

In population genetics studies, the Hardy-Weinberg equation can be used to measure whether the observed genotype frequencies in a population differ from the frequencies predicted by the equation. If there is any difference in the frequencies, it indicates the extent of evolutionary change.

(b) The equillibrium may get disturbed due to genetic drift which may lead to founder effect. Genetic drift refers to the changes in allele frequencies that occur only by chance events. At times the change in allele frequency can be so different in the new of sample of population, that they can become a different species all together. The originally drifted population becomes the founder and such an effect is called the founder effect.

Question 27
(a) Study the flow chart given below and complete the equation that follows by identifying 1, 2, 3 and 4.

$N_{t+1} = N_t + \{(1+ 2) - (3 + 4)\}$
(b) Mention the different ways by which the population density of different species can be measured.

OR

(a) 'The pyramid of energy is always upright.' Explain

(b) Explain with the help of labelled diagrams, the difference between an upright pyramid of biomass and an inverted pyramid of biomass.

SOLUTION:

(a) $N_{t+1} = N_t + \{(B+ I) - (D + E)\}$

(b) The population density of different species can be measured by:

(1) Quadrat method: It is a method that involves the use of square of particular dimensions to measure the number of organisms.

Example: The number of Parthenium plants in a given area can be measured using the quadrat method.

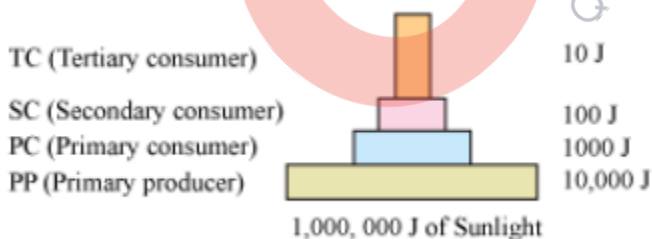(2) Direct observation: It involves the counting of organisms in the given area.

Example: In order to determine the number of bacteria growing in a Petri dish, their colonies are counted.

(3) Indirect method: In this method, there is no need to count the organisms individually.

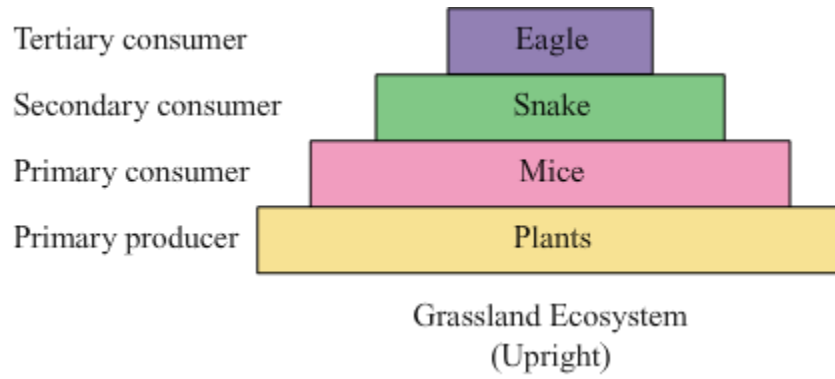Example: The number of fishes caught per trap gives the measure of their total density in a given water body.

OR

(a) The pyramid of energy represents the total amount of energy consumed by each trophic level in a given food chain. An energy pyramid is always upright because the total amount of energy available for utilisation in the top levels is less than the energy available in the lower levels. This happens because according to the 10% law of energy transfer, only 10% of the total energy is transferred from one trophic level to another.

(b) The pyramid of biomass is a graphical representation of the total amount of living matter present at each trophic level of an ecosystem. The pyramid of biomass can be both upright and inverted.

The pyramid of biomass is upright in grasslands and forest ecosystems because the amount of biomass present at the producer level is higher than at the top carnivore level.

Grassland Ecosystem
(Upright)

The pyramid of biomass is inverted in a pond ecosystem as the biomass of fishes exceeds the biomass of zooplankton (upon which they feed).

Pond Ecosystem
(Inverted)