CBSE
Class XII Biology
Board Paper 2014 – Outside Delhi (Set 1)

Time: 3 hrs **Total Marks: 70**

General Instructions:

1. All questions are compulsory.
2. This question paper consists of four Sections A, B, C and D. Section A contains 8 questions of one mark each; Section B is of 10 questions of two marks each Section C is of 9 questions of three marks each and Section D is of 3 questions of five marks each.
3. 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.
4. Wherever necessary, the diagrams drawn should be neat and properly labelled.

SECTION A

1. Name the part of the flower which the tassels of the corn- cob represent. [1]

2. Mention any two contrasting traits with respect to seeds in pea plant that were studied by Mendel. [1]

3. Why is secondary immune response more intense than the primary immune response in humans? [1]

4. Why is it not possible for an alien DNA to become part of a chromosome anywhere along its length and replicate normally? [1]

5. State the role of C peptide in human insulin. [1]

6. Name the enzymes that are used for the isolation of DNA from bacterial and fungal cells for recombinant DNA technology. [1]

7. State Gause's Competitive Exclusion Principle. [1]

8. Name the type of association that the genus *Glomus* exhibits with higher plants. [1]

SECTION B

9. Why are the human testes located outside the abdominal cavity? Name the pouch in which they are present. [2]

10. In Snapdragon, a cross between true-breeding red flowered (RR) plants and true-breeding white flowered (rr) plants showed a progeny of plants with all pink flowers. [2]

(a) The appearance of pink flowers is not known as blending. Why?
(b) What is this phenomenon known as?

11. With the help of one example, explain the phenomena of co-dominance and multiple allelism in human population. [2]

12. Write the scientific name of the fruit-fly. Why did Morgan prefer to work with fruit-flies for his experiments? State any three reasons. [2]

OR

Linkage and crossing-over of genes are alternatives of each other. Justify with the help of an example.

13. List the symptoms of Ascariasis. How does a healthy person acquire this infection? [2]

14. Explain the significant role of the genus *Nucleopolyhedrovirus* in an ecological sensitive area. [2]

15. How does a restriction nuclease function? Explain. [2]

16. How have transgenic animals proved to be beneficial in: [2]

(a) Production of biological products
(b) Chemical safety testing

17. Describe the mutual relationship between fig tree and wasp and comment on the phenomenon that operates in their relationship. [2]

18. Construct an age pyramid which reflects an expanding growth status of human population. [2]

SECTION C

19. Make a list of any three outbreeding devices that flowering plants have developed and explain how they help to encourage cross-pollination. [3]

OR

Why angiosperm anthers are called dithecous? Describe the structure of its microsporangium.

20. If implementation of better techniques and new strategies are required to provide more efficient care and assistance to people, then why is there a statutory ban on amniocentesis? Write the use of this technique and give reason to justify the ban. [3]

21. Why is pedigree analysis done in the study of human genetics? State the conclusions that can be drawn from it. [3]

22. Identify 'a', 'b', 'c','d', 'e' and 'f' in the table given below: [3]

No.	Syndrome	Cause	Characteristics of affected individuals	Sex Male/Female/Both
1.	Down's	Trisomy of 21	'a' (i) (ii)	'b'
2.	'c'	XXY	Overall masculine development.	'd'
3.	Turner's	45 with XO	'e' (i) (ii)	'f'

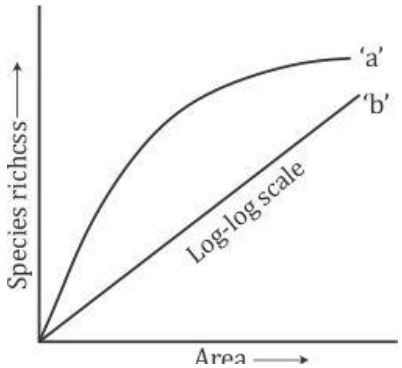
23. Community Service department of your school plans a visit to a slum area near the school with an objective to educate the slum dwellers with respect to health and hygiene.

[3]

(a) Why is there a need to organize such visits?

(b) Write the steps you will highlight, as a member of this department, in your interaction with them to enable them to lead a healthy life.

24. The following graph shows the species - area relationship. Answer the following questions as directed. [3]



(a) Name the naturalist who studied the kind of relationship shown in the graph. Write the observations made by him.

(b) Write the situations as discovered by the ecologists when the value of 'Z' (Slope of the line) lies between.
(i) 0.1 and 0.2
(ii) 0.6 and 1.2
What does 'Z' stand for?

(c) When would the slope of the line 'b' become steeper?

25. Name and describe the technique that helps in separating the DNA fragments formed by the use of restriction endonuclease. [3]

26. State the function of a reservoir in a nutrient cycle. Explain the simplified model of carbon cycle in nature. [3]

27. Since the origin of life on Earth, there were five episodes of mass extinction of species. [3]
(i) How is the 'Sixth Extinction', presently in progress, different from the previous episodes?
(ii) Who is mainly responsible for the 'Sixth Extinction'?
(iii) List any four points that can help to overcome this disaster.

SECTION D

28. [5]

(a) Where does fertilization occur in humans? Explain the events that occur during this process.

(b) A couple where both husband and wife are producing functional gametes, but the wife is still unable to conceive, is seeking medical aid. Describe any one method that you can suggest to this couple to become happy parents.

OR

(a) Explain the different ways apomictic seeds can develop, Give an example of each.

(b) Mention one advantage of apomictic seeds to farmers.

(c) Draw a labelled mature stage of a dicotyledonous embryo.

29. [5]

(a) Describe the various steps of Griffith's experiment that led to the conclusion of the 'Transforming Principle'.

(b) How did the chemical nature of the 'Transforming Principle' get established?

OR

Describe how the lac operon operates, both in the presence and absence of an inducer in E.coli.

30. With advancements in genetics, molecular biology and tissue culture, new traits have been incorporated into crop plants. Explain the main steps in breeding a new genetic variety of a crop. [5]

OR

(a) State the objective of animal breeding.

(b) List the importance and limitations of inbreeding. How can the limitations be overcome?

(c) Give an example of a new breed each of cattle and poultry.

CBSE
Class XII Biology (Theory)
Board Paper 2014 – Outside Delhi (Set 1)
SOLUTION

Time: 3 hrs **Total Marks: 70**

SECTION A

1. **Ans**. The tassels of the corn-cob represent the male part of a plant which produces pollen grains.

2. **Ans.** The contrasting traits with respect to seeds in pea plants are
   (i) Seed shape: Seed shape is round (dominant) or wrinkled (recessive).
   (ii) Seed colour: Seed colour is yellow (dominant) or green (recessive).

3. **Ans.** The secondary immune response is more intense than the primary immune response in humans because the memory B cells deal with the invading microbes by producing antibodies. The cells of the body remember that they have previously encountered this type of infection.

4. **Ans.** It is not possible for an alien DNA to become part of a chromosome anywhere along its length and replicate normally because the replication process begins at a particular spot called the origin of replication. Also, replication in eukaryotes occurs in the nucleus during the S phase of the cell cycle when the chromosomes are in their extended form.

5. **Ans.** Mammalian insulin is synthesised as a prohormone which undergoes processing to become a fully mature and functional insulin molecule. The prohormone contains an extra chain called C peptide which is removed during the conversion of prohormone to the mature hormone insulin.

6. **Ans**. Lysozyme is used for the isolation of DNA from bacterial cells and chitinase is used for the isolation of DNA from fungal cells.

7. **Ans.** Gause's competitive exclusion principle states that two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior species will be eliminated eventually.

8. **Ans.** *Glomus* exhibits symbiotic association with higher plants called mycorrhiza. The root of the plant provides food and shelter to the fungus, and in return, the fungus helps the plant in solubilisation and absorption of minerals, water uptake and protection against pathogenic fungi.

SECTION B

9. Ans. Human testes are located outside the abdominal cavity to avoid high abdominal temperature. The testes are suspended in a pouch called the scrotum.

10. Ans.

(a) When the red and white flower varieties of snapdragon are crossed, the F_1 progeny exhibits pink colour flowers. It is not known as blending inheritance because in blending inheritance, the characters are mixed in the offspring and do not segregate.

(b) This phenomenon is known as incomplete dominance.

11. Ans. Codominance: When both alleles of a pair are fully expressed in a heterozygote, the genes and trait are said to be codominant. Example: A person of blood group AB is an example of codominance where allele I^A for A-type blood is codominant with its allele I^B for B-type blood. The heterozygote (I^AI^B) expresses the characteristics of both A and B antigens.

Multiple allelism: It is a phenomenon which occurs when more than two alleles exist at a given locus of a chromosome. In a given individual, only two of these alleles occur, one derived from each parent. Example: The ABO blood typing in humans is an example of multiple allelism where alleles I^A, I^B and i produce the four phenotypes (A, B, AB and O) of blood groups.

12. Ans. The scientific name of fruit fly is *Drosophila melanogaster*. Morgan preferred to work with fruit fly for his experiments because

(i) It is simple and convenient to breed under laboratory conditions throughout the year.

(ii) Its generation time is only 10–12 days.

(iii) It breeds quickly and prolifically and so produces large progeny after each mating.

(iv) Its contrasting features are easily observable.

OR

Linkage and crossing over of genes are alternatives of each other. Linkage is the tendency of the genes present in the same chromosome to stay together during hereditary transmission, while crossing over is the mutual exchange of segments of non-sister chromatids of homologous chromosomes during the process of meiosis.

An example of linkage: A double dominant female *Drosophila* homozygous for red eyes and normal wings is crossed with a double recessive male *Drosophila* homozygous for purple eyes and vestigial wings. The F_1 flies are heterozygous red-eyed and normal winged. It is then test crossed with a double recessive male having purple eyes and vestigial wings. The F_2 generation comprises two types of flies—red-eyed, normal winged and purple eyed, vestigial winged in the ratio of 1:1. No recombinant types are formed because linkage is complete and no crossing over occurs.

An example of crossing over: A double dominant sweet pea plant homozygous for blue flowers and long pollen grains is crossed with a double recessive plant homozygous for red flowers and round pollen grains. The F_1 flies are heterozygous blue flowered and long pollen grains. It is then crossed with a double recessive plant having red flowers and round pollen grains. The F_2 generation of plants has a new combination of traits—blue flowers and round pollen grains and red flowers and long pollen grains. This is due to crossing over, i.e. separation of genes for flower colour and form of pollen grains during gamete formation.

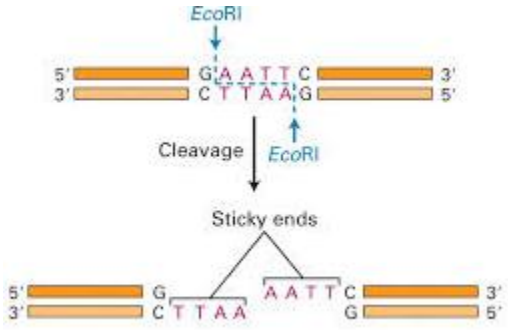
13. Ans. Symptoms of Ascariasis:

(i) Abdominal discomfort
(ii) Colic pain
(iii) Fever
(iv) Indigestion
(v) Diarrhoea
(vi) Vomiting

A healthy human being may acquire this infection directly and orally. It can occur through contaminated water, vegetables and fruits.

14. Ans. Nucleopolyhedroviruses are biological control agents which attack insects and other arthropods. These viruses are excellent candidates for species-specific crosses and have no negative impacts on plants and other organisms or even non-target insects.

15. Ans. Restriction endonuclease functions by recognising its specific sequence. It binds to the DNA and cuts each to the two strands of the double helix at specific points in their sugar phosphate backbones. These enzymes cut the strand of DNA between the same two bases on the opposite strands leaving a single-stranded portion at their ends. These overhanging stretches are called sticky ends on each strand. The enzyme DNA ligase functions depending on the stickiness of these ends. For example, the restriction endonuclease EcoRI found in the colon bacteria *E. coli* recognises the base sequence GAATTC in the DNA duplex and cuts its strands between G and A.



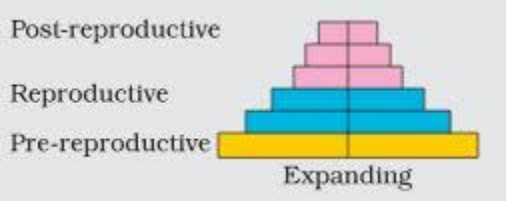
16. Ans.

(a) Biological products: Many human diseases are controlled by biological products. The transgenic animals which produce these products are introduced with DNA which codes for a particular product such as human protein (α-I-antitrypsin) for treating emphysema. In 1997, the first transgenic cow (Rosie) was produced. She was capable of secreting human protein-enriched milk. The milk contained the human alpha-lactalbumin and was nutritionally a more balanced product for human babies than cow milk.

(b) Chemical safety testing: Transgenic animals are tested to study the sensitivity of toxic substances. Toxicity testing in such animals helps obtain results in less time.

17. Ans. Mutualism exists between fig tree and its pollinator species, wasp, where both individuals are benefited. A fig species can be pollinated only by its partner wasp species and no other species. The female wasp uses the fruit as the egg laying site and the developing seeds within the fruit for nourishing its larvae. The wasp pollinates the fig inflorescence while finding egg-laying sites, and in turn, fig offers the wasp developing seeds as food for developing larvae.

18. Ans.



SECTION C

19. Ans. The outbreeding devices in flowering plants which encourage cross-pollination are

(i) Dicliny: Flowers are unisexual so that self-pollination is not possible. The plants may be monoecious bearing both male and female flowers (e.g. maize) or dioecious bearing male and female flowers on individual plants (e.g. mulberry, papaya).

(ii) Prepotency: Pollen grains of another flower germinate more rapidly over the stigma than the pollen grains of the same flower. Examples: Apple, grape

(iii) Self-sterility: Pollen grains of a flower do not germinate on the stigma of the same flower because of the presence of similar self-sterile genes. Examples: Tobacco, potato, crucifers

OR

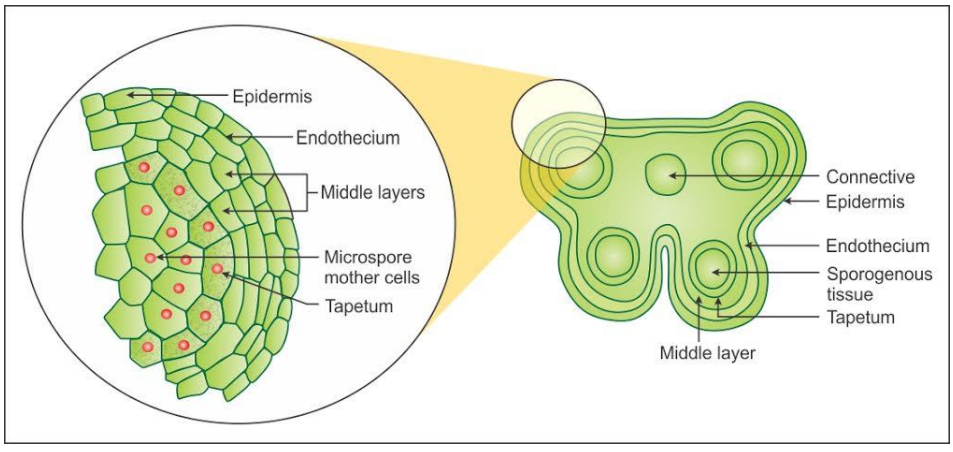
A typical angiosperm anther is broad, terminal and bilobed. Each lobe of the anther has two pollen sacs which fuse (at maturity) to form a single chamber called the thecus, so it is called dithecous.

A microsporangium is a cylindrical sac which appears circular in the transverse section. It contains the following parts:

(i) Outer wall
(ii) Central homogeneous sporogenous tissue
(iii) Epidermis
(iv) Endothecium
(v) 1–3 middle layers and tapetum

The outer three layers perform the function of protection in the younger anther and the mechanism of dehiscence in the ripe anther.

The endothecial cells develop fibrous thickening of α-cellulose on the inner and radial walls and die. The innermost layer is called the tapetum. It nourishes the developing pollen grain.



20. Ans.

(a) Yes, the test must be banned because of its misuse to determine the sex of the foetus. Because of the small family norm, every family wants a male child. The female foetus is destroyed. This has resulted in the decline in the female population which can create social problems for future generations.

(b) Many genetic disorders, if present, can be diagnosed by amniocentesis.

21. Ans. Pedigree analysis is done in the study of human genetics as

(i) It helps the genetic counsellors to guide the couples about the possibility of having children with genetic defects such as haemophilia.

(ii) It indicates that Mendel's principles are also applicable to human genetics with some modifications found out later such as quantitative inheritance, sex-linked characters and other linkages.

Pedigree analysis is the study of the pedigree for the transmission of particular traits and finding the possibility of the absence or presence of that trait in the homozygous or heterozygous state in a particular individual.

22. Ans.

No.	**Syndrome**	**Cause**	**Characteristics of affected individuals**	**Sex/Male/Female/Both**
1.	Down's	Trisomy of 21	(i) Broad forehead (ii) Permanently open mouth, protruding and furrowed tongue and projecting lower lip	Both
2.	Klinefelter's	XXY	Overall masculine development	Male
3.	Turner's	45 with XO	(i) Short statured females with webbed neck (ii) Body hair absent	Female

23. Ans.

(a) There is a need to organise such visits to make people aware of personal and public hygiene. Maintenance of personal and public hygiene is essential for prevention and control of many infectious diseases.

(b) Steps to be highlighted to enable them lead a healthy life are

(i) Intake of hygienic and balanced diet
(ii) Consumption of clean drinking water
(iii) Personal and community hygiene
(iv) Regular physical exercise
(v) Knowledge about diseases and their effects on the body
(vi) Immunisation against infectious diseases

(vii) Proper disposal of wastes and excreta
(viii) Control of vectors
(ix) Close contact with infected persons or their belongings should be avoided in case of air-borne diseases

24. Ans.

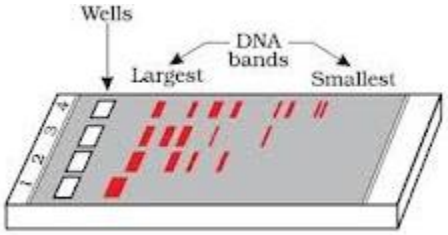
(a) The German naturalist and geographer Alexander von Humboldt studied the species–area relationship.
He found that species richness within a region increased with increasing area but up to a certain limit. The relationship between species richness and area turned out to be rectangular hyperbola for a wide variety of taxa.

(b)
(i) If the value of Z lies in the range of 0.1–0.2, then it is regardless of taxonomic group or region.
(ii) If the value of Z lies in the range of 0.6–1.2, then the slope of the line will be much steeper.
Z stands for the slope of the line or regression coefficient.

(c) If the species–area relationship is for very large areas such as the entire continent, then the slope of the line will be much steeper.

25. Ans. Gel electrophoresis is a technique of separating DNA fragments formed by the action of restriction endonucleases.

The fragments of DNA are placed in a typical agarose gel under an electric field. The DNA fragments move towards the anode as these fragments are negatively charged molecules. The DNA fragments separate according to their size through the sieving effect provided by the agarose gel. The smaller the fragment size, the farther it moves. The separated DNA fragments are stained with ethidium bromide followed by exposure to ultraviolet radiation. The DNA fragments are seen as orange-coloured and are cut out from the agarose gel and extracted from the gel piece. This step is called elution.



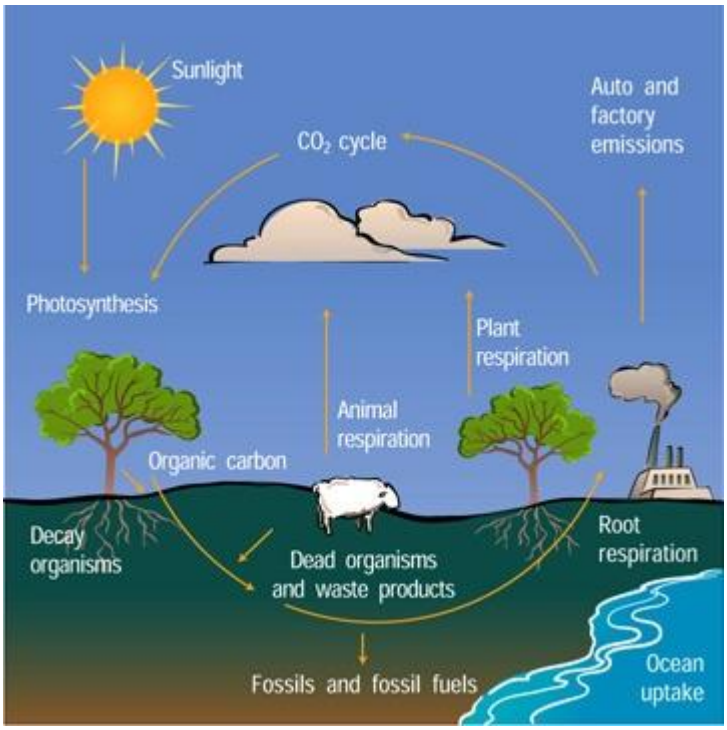
26. Ans. The function of the reservoir is to meet the deficit which occurs because of an imbalance in the rate of influx and efflux.
Carbon cycle in nature:
(i) The main source of carbon in this Universe is CO_2 which is dissolved in water and present in air (0.03–0.04%).
(ii) Plants take up carbon dioxide from the atmosphere and form organic compounds during photosynthesis. These organic compounds are transferred to animals as food.

(iii) The carbon dioxide returns to the atmosphere during respiration, decay and combustion of plants and animals.

(iv) The organic compounds of plants and animals are buried in the deep soil where they are acted upon by decomposers to change them to petroleum, coal, oil and carbonate rocks. These substances on their combustion release carbon dioxide in the atmosphere.

(v) Some carbon dioxide is found in the dissolved state in water. This gets converted to calcium carbonate in limestone. The weathering and combustion of carbonate-containing rocks or treatment of their minerals give CO_2.

(vi) The hot springs and volcanic eruptions also give out CO_2 in the atmosphere.



27. Ans.

(a) The current rate of extinction is 100–1000 times faster than pre-human times. It seems that the Earth is heading for the sixth extinction, but it would be anthropogenic.

It is believed that (a) Tropical forests are losing 2–5 species per hour or 14,000–40,000 species per year. (b) Ten high diversity localities of tropical forests covering 3,00,000 km^2 area are liable to lose 17,000 endemic plant species and 3,50,000 endemic plant species in the near future. (c) If the current rate of species extinction goes on unabated, then 50% of species are liable to die out by the end of the 21^{st} century.

(b) They are extinctions abetted by human activities such as settlements, hunting, overexploitation and habitat destruction. Colonisation of tropical Pacific islands by humans has resulted in the extinction of more than 2000 species of native birds. During the last 500 years, the Earth has lost some 784 species (IUCN, 2004). It includes 338 vertebrates, 359 invertebrates and 87 plants. Amphibians seem to be at higher risk of extinction.

(c)

(i) All the threatened species should be protected. Priority should be given to ones belonging to monotypic genera, endangered over vulnerable, vulnerable over rare and rare over other species.

(ii) All the possible varieties, old or new, of food forage and timber plants, livestock, aquaculture animals and microbes are conserved.

(iii) Wild relatives of all the economically important organisms should be identified and conserved in protected areas.

(iv) Critical habitats for feeding/breeding/resting/nursing of each species should be identified and safeguarded.

SECTION D

28. Ans.

(a) Fertilisation in humans occurs in the fallopian tube of the female reproductive system.

It is the process of fusion of a haploid sperm and a haploid ovum to form a diploid zygote. The process of fertilisation is completed under the following major steps:

(i) Attraction: During copulation (intercourse of coitus), millions of sperms are inserted into the vagina of the female through the penis. The sperms swim in the fluid mucous lining of the female genital tract at the rate of 1.5–3.0 mm per minute to reach the ovum in the upper part of the fallopian tube where fertilisation takes place. The ova are formed in the ovaries, which are released, into the abdominal cavity through a process called ovulation. One mature egg is released from the ovary on the 14–15-day of the menstrual cycle and that is picked off by the fimbriae of the ampulla of the fallopian tube. The ovum enters the fallopian tube and moves in it by the muscular contractions and ciliary action of the epithelium of the fallopian tube. The ovum secretes a chemical substance called fertilizin glycoprotein or mucopolysaccharide to attract the sperms. The sperms produce a chemical substance antifertilizin (protein). Each species produces a specific type of fertilizin and antifertilizin, and the reactions between them bring about the process of fertilisation.

(ii) Penetration of sperm into ovum: The human ovum is a rounded and non-motile structure surrounded by the vitelline membrane, zona pellucida and corona radiata. The radially arranged follicle cells of the corona radiata are attached together by a complex organic substance called hyaluronic acid (a mucopolysaccharide) which acts as barrier for the entry of sperms. The human sperm undergoes several changes so that it may be able to fertilise the ovum. This is called capacitation of sperm. The sperm attaches to the surface of the ovum near the animal pole and starts penetrating the various membranes of the egg. The acrosome of the sperm bursts and secretes sperm lysins containing an enzyme hyaluronidase to dissolve the adhesive substance and to disperse the cells of the corona radiata. Ultimately, with the help of sperm lysin, one sperm penetrates the layers of the corona radiata and zona pellucida in about 30 minutes.

(iii) Activation of the ovum: After the penetration of sperm, a series of changes are brought about in the egg cortex. The dark cortical granules appear below the cell membrane in the cortex which migrates through the plasma membrane. These granules get attached along the inner surface of vitelline membrane and make it thick. This thickened vitelline membrane is called the fertilisation membrane which prevents polyspermy by inhibiting the entry of other sperms.

(iv) Fusion of sperm and ovum nuclei: The sperm entry stimulates the ovum to undergo a second meiotic division for the removal of the last polar body. Usually the sperm head and middle piece enter the ovum through a definite path called the copulation path. The sperm nucleus acts as a male gamete and the egg nucleus as the female gamete. The centrioles of the middle

piece of sperm form the spindle and nuclear membranes of the sperm and the ovum breaks down. This process of mixing of the haploid sperm nucleus with the haploid egg nucleus is called amphimixis. The fusion product of sperm and egg pronuclei results in the formation of the diploid zygote which initiates pregnancy in females.

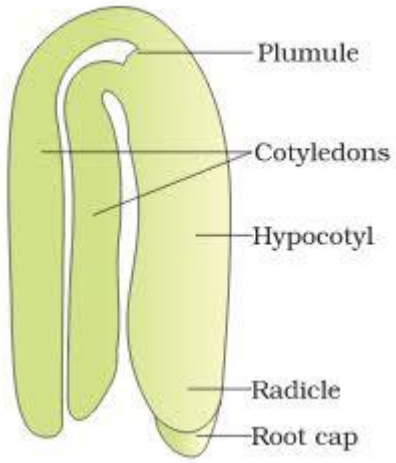
(b) *In vitro* fertilisation: In this method, fertilisation occurs outside the body and is followed by embryo transfer (ET). This technique is applied when the fallopian tube of the mother is blocked and she is unable to conceive. In this technique, the egg of a wife/donor is removed and fertilised (*in vitro*) by the husband/donor sperm outside her body under sterile conditions. The fertilised egg which reaches the 8-celled stage is transferred into the fallopian tube and the embryos with more than 8 blastomeres into the uterus to complete their further development.

OR

(a) Apomixis is the formation of new individuals through asexual reproduction without involving the formation and fusion of gametes.
The two common types of apomixis are recurrent agamospermy and adventive embryony.
(i) Recurrent agamospermy: Agamospermy is the formation of seed and has an embryo formed without meiosis and syngamy. It is of two types—noncurrent and recurrent. In noncurrent agamospermy, the embryo is haploid. Therefore, the seed having it is non-viable. In recurrent agamospermy, all the cells of the embryo sac are diploid as it is formed directly either from a nucellar cell (apospory) or diploid megaspore mother cell (diplospory). The diploid egg and other diploid cells of the embryo sac can grow into normal embryos. Embryo formation directly from the diploid egg without fertilisation is called diploid parthenogenesis. Examples: Rubus, apple, poa
(ii) Adventive embryony (sporophytic budding): Formation of an embryo directly from the diploid sporophytic cells such as the nucellus and the integument of the ovule is called adventive embryony. Examples: Citrus, *Opuntia*. During embryogenesis, an embryo develops from the zygote inside the embryo sac, and the embryo sac becomes an endosperm. An apomictic embryo, if developed, increases the number of embryos inside the seed, called polyembryony.
In gymnosperms, polyembryony can also occur because of cleavage of the growing embryo. It is called cleavage polyembryony. Occurrence of polyembryony because of fertilisation of more than one egg is called simple polyembryony. Formation of extra embryos through sporophytic budding is called adventive polyembryony. Polyembryony is quite common in onion, groundnut, mango, lemon and orange.

(b) Embryos formed through apomixes are generally free from infections.

(c)



29. Ans.

(a) S. F. Griffith demonstrated bacterial transformation experimentally by performing experiments on *Diplococcus pneumonia*. It has two distinct forms—one form secretes a polysaccharide capsule which gives the colonies a smooth appearance and another form is non-capsulated which gives the colonies a rough appearance. The capsule of the smooth form (S) is virulent and gives an infected animal the disease pneumonia, while the rough form (R) is not virulent.

The main steps are as follows:

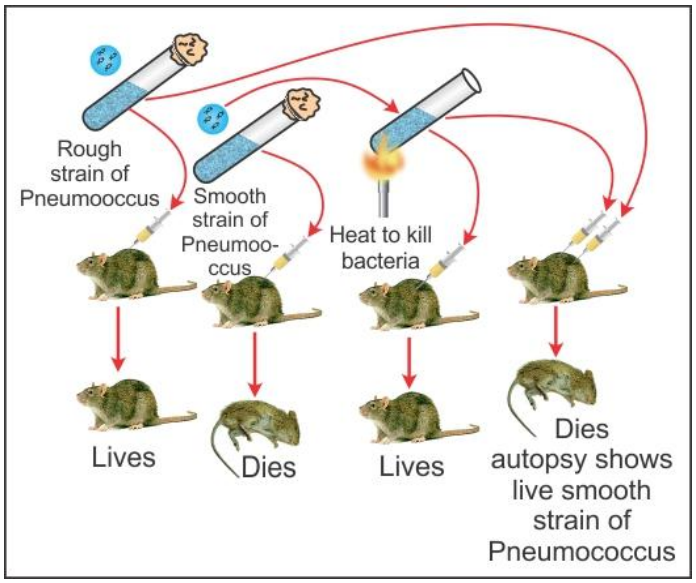
(i) Griffith conducted his experiments on *Diplococcus pneumonia* which causes pneumonia in mice. He injected the 'S' type living bacteria into mice and they died because of pneumonia.

(ii) He then injected live non-virulent bacteria (R) into mice and they did not suffer from pneumonia.

(iii) He then injected heat-killed virulent 'S' type bacteria into mice and they survived equally well.

(iv) Finally, he injected a mixture of heat-killed 'S' and live 'R' simultaneously. The mice died with the symptoms of pneumonia. Living S-type bacteria were recovered from their bodies.

The occurrence of the living S-type virulent bacteria is possible only by their formation from R-type non-virulent bacteria which pick up the trait of virulence from dead bacteria. This phenomenon is called Griffith effect or transformation. Thus, transformation is the transferring of characters from one strain to another using the DNA extract of the former.



(b) Oswald Avery, Colin MacLeod and Maclyn McCarty concluded that DNA is the hereditary material. They discovered that the protein-digesting enzymes (proteases) and RNA-digesting enzymes (RNases) did not affect transformation, so the transforming substance was not a protein or RNA. Digestion with DNase inhibits transformation; therefore, they concluded that DNA is the hereditary material.

OR

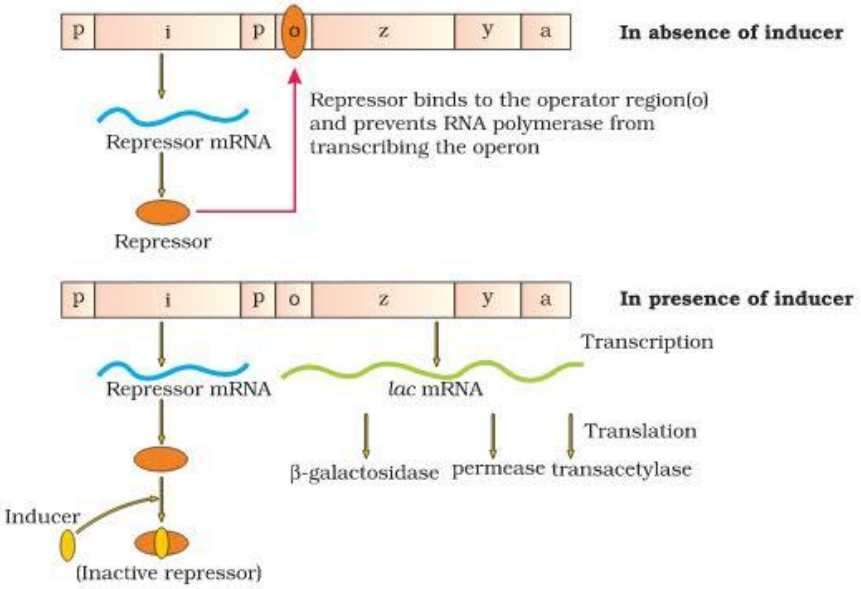
Lac operon consists of regulator gene, promoter gene, operatoral gene and structural gene.

The *E. coli* bacterium carries numerous genes and these genes turn on and off according to requirement. When these genes are turned on, they undergo enzymes which metabolise the new substrate. This phenomenon is known as induction and small molecules eliciting this induction are called inducers. In the lac operon, the presence of lactose acts as an inducer.

The lac operon contains a promoter, an operator and three closely related structural genes—z, y, a—coding for enzymes β-galactosidase, β-galactoside permease and β-galactoside transacetylase, respectively. β-galactoside permease pumps lactose into the cells, whereas β-galactosidase catalyses the conversion of lactose into glucose and galactose. These genes are not expressed in the absence of lactose. The promoter (P) for the operon is the site at which RNA polymerase binds to initiate transcription of the structural genes. The operator (O) is the site at which the protein repressor–the product of regulator gene binds. In the presence of a regulator protein, the RNA-polymerase is prevented from attaching to the promoter.

A regulator gene is a DNA segment independent of an operon and it synthesises a repressor protein. This protein combines with operator and makes it inactive. This prevents RNA polymerase from binding to the adjoining promoter (P) and from initiating transcription of the structural gene. Therefore, RNA polymerase is required to negotiate the operator before transcription can occur. The repressor binds to the operator in the absence of a metabolite (effector

molecule–lactose).
When an inducer or effector molecule-lactose is added to the system, it binds to the repressor to form a complex which is unable to bind the operator. The RNA polymerase enzyme now becomes free to bind to the promoter (P), and so the operator is switched on. This initiates the transcription of structural genes, producing the three polypeptides. These enzymes bring about the metabolism of lactose into glucose and galactose.



30. **Ans**. Main steps in breeding a new genetic variety of a crop:
    (i) Collection of variability: Germplasm is the total of all the alleles of the genes present in a crop and its related species. Collection and preservation of all the different wild varieties, species and relatives of the cultivated species is a pre-requisite for effective exploitation of natural genes available in a population. The entire collection of plants/seeds having all the diverse alleles for all genes in a given crop is called germplasm collection.
    (ii) Evaluation and selection of parents: The germplasm is evaluated to identify plants with desirable combination of characters. Selection of parents is picking up seeds of only those plants for multiplication which have the desired traits. The selected plants are multiplied and used in the process of hybridisation. Pure lines are created wherever desirable and possible.
    (iii) Cross hybridisation among the selected parents: Hybridisation is the most common method of creating genetic variation. Hybridisation is crossing of two or more types of plants to produce their traits together in the progeny which helps bring about useful genetic or heritable variations of two or more lines together.
    For example, high protein quality of one parent may need to be combined with disease resistance from another parent.
    (iv) Selection and testing of superior recombinants: The hybrids having desired characters are selected from the progeny and then self-pollinated for several generations to make them homozygous.
    (v) Testing, release and commercialisation of new cultivars: The selected

plants are then evaluated for their yield and other agronomic traits of quality and disease resistance by growing them in research fields under ideal fertiliser application, irrigation and other crop management practices. Testing is done in research fields for at least three growing seasons and then grown in different parts of the country. After thoroughly testing, the seeds of selected variety are recommended to the farmers for large-scale cultivation.

OR

(a) Objectives of animal breeding:
- (i) Improved growth rate
- (ii) Increased production of milk, meat, egg, wool
- (iii) Superior quality of milk, meat, eggs, wool
- (iv) Improved resistance to various diseases
- (v) Increased productive life
- (vi) Increased or, at least, acceptable reproduction rate

(b) When breeding is between animals of the same breed for 4–6 generations, it is called inbreeding.

Importance of inbreeding:

i. It helps in the accumulation of superior genes and elimination of undesirable genes.
ii. It develops a homozygous pureline in an animal; thus, it increases homozygosity to evolve a pureline in any animal.
iii. It exposes harmful recessive genes for undesirable characters which are eliminated by selection.

Limitation:
Continued inbreeding reduces fertility and even productivity. This is called inbreeding depression.

(c)
- (i) Karan Swiss and Sunandini are new breeds of cattle.
- (ii) White Leghorn and New Hampshire are improved breeds of chicken.