

Solution
BIOLOGY
Class 12 - Biology
Section A

1. Select and write the correct answer:

- (i) **(b)** vestigial
Explanation: {
vestigial
- (ii) **(b)** Ethylene
Explanation: {
Ethylene
- (iii) **(c)** Agrobacterium tumefaciens
Explanation: {
Agrobacterium tumefaciens
- (iv) **(a)** 75 ml
Explanation: {
75 ml
- (v) **(a)** Insulin
Explanation: {
Insulin
- (vi) **(b)** fragmentation
Explanation: {
fragmentation
- (vii) **(d)** Statement D is incorrect.
Explanation: {
Water potential of pure water is always zero.
- (viii) **(b)** intra-specific struggle
Explanation: {
intra-specific struggle
- (ix) **(b)** Himgiri
Explanation: {
Himgiri
- (x) **(d)** Coca
Explanation: {
Coca

2. Answer the following:

- (i) i. Autosomal dominant traits: Widow's peak and Huntington's disease
ii. Autosomal recessive traits: Phenylketonuria (PKU), Cystic fibrosis and Sickle cell anaemia.
- (ii) Unconditional reflexes are sneezing, coughing, yawning, hiccupping.
- (iii) Parthenocarpy is the condition in which fruit is developed without the process of fertilization.
- (iv) Water has high specific heat, high heat of vaporization and high heat of fusion. Due to this, it acts as thermal buffer.
- (v) Pioneer species is the species which invades a bare area and initiates the succession.
- (vi) IAA: Indole-3-acetic acid
- (vii) A. Testis
B. Vas deferens
C. Seminal vesicle
D. Prostate gland
- (viii) Splicing is the process that removes introns from RNA.

- i. Deforestation takes place by conversion of forest to agricultural land so as to feed the growing human population.
 - ii. Trees are cut for timber, firewood, for keeping cattle in farm and for other purposes.
12. Motor cranial nerves are as follows: Oculomotor (III), Pathetic (IV), Abducens (VI), Spinal accessory (XI) and Hypoglossal (XII).
13. i. Imbibition is swelling up of hydrophilic colloids due to adsorption of water.
 ii. The root hair cell wall is made up of pectic compounds and cellulose which are hydrophilic colloids. During imbibition, water molecules get tightly adsorbed without the formation of solution. Imbibition continues till the equilibrium is reached. In other words; water moves along the concentration gradient: Water is absorbed by root hair cell through imbibition, diffusion and osmosis, sequentially.
14. i. Degeneracy of the genetic code is explained by Wobble hypothesis.
 ii. Usually single amino acid is encoded by single codon. However, some amino acids are encoded by more than one codon.
 iii. Here, the first two bases in different codons are identical but the third one, varies.
 e.g. Cysteine has two codons, while isoleucine has three codons.

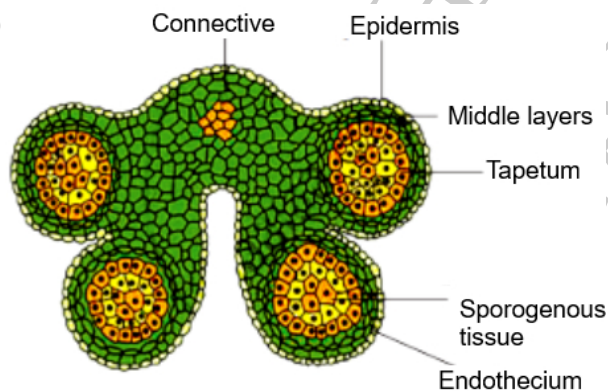
Section C

15. **Following are the characteristics of Neanderthal man:**

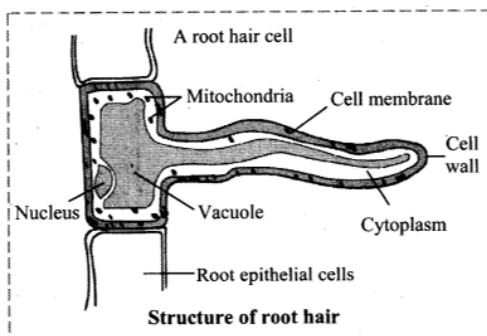
- i. They were advance prehistoric man.
- ii. Their fossils were collected from Neanderthal valley, Germany.
- iii. They existed in late Pleistocene epoch about 100000 to 400000 years ago.
- iv. Cranial capacity of Neanderthal Man was 1400 cc.
- v. These were short and had heavy built.
- vi. They had short prominent brow ridges, the skull bones were thick, forehead was low and slanting, the jaw was deeper than that of modern man with no chin. They had outwardly curved thigh bones
- vii. They were quite intelligent to use and construct flint tools.
- viii. They buried their dead bodies.

16. Answer the following:

- (i) Formation of embryo(s) through asexual reproduction without formation of gametes and the act of fertilization is called as Apomixis.
- (ii)



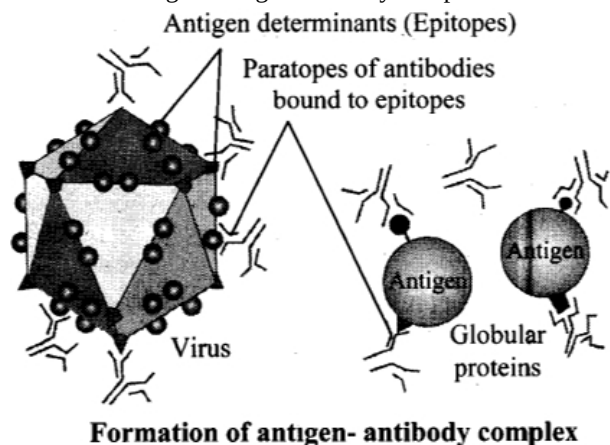
- 17. i. Water has high specific heat, high heat of vaporization and high heat of fusion. Due to this, it acts as thermal buffer.
- ii.



- a. Root hair is cytoplasmic extension (prolongation) of epiblema cell.
- b. Each root hair may be approximately 1 to 10 mm long and tube like structure.
- c. It is colourless, unbranched, short-lived (ephemeral) and very delicate.

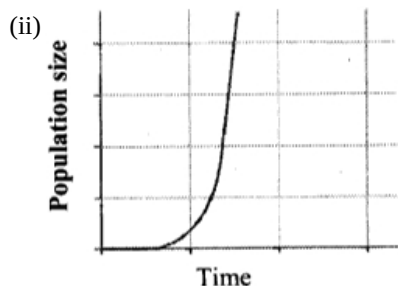
- d. It has a large central vacuole surrounded by thin film of cytoplasm, plasma membrane and thin cell wall, which is two layered.
- e. Outer layer is composed of pectin and inner layer is made up of cellulose.
- f. Cell wall of a root hair is freely permeable but plasma membrane is selectively permeable.

18. i. Each antibody is specific for a particular antigen.
- ii. Combining sites of antigen, called antigenic determinants (epitopes) react with the corresponding antigen binding sites of antibodies called paratopes.
 - iii. The antigen binding sites (paratopes) are located on the variable regions of the antibody.
 - iv. Small variations in the variable regions make each antibody highly specific for a particular antigen.
 - v. The variable region enables the antibody to recognize the specific antigen and bind to specific antigen in a lock and key manner forming an antigen-antibody complex.



19. Answer the following:

- (i) Emigration is the number of individuals of the population who left the habitat during the time period.



The given diagram represents exponential or geometric growth curve.

20. a. **Composition of Biogas:** Biogas is a mixture of methane CH_4 (50 – 60%), CO_2 (30 – 40%), $H_2 S$ (0 – 3%) and other gases (CO , N_2 , H_2) in traces.

b. **Advantages of biogas:**

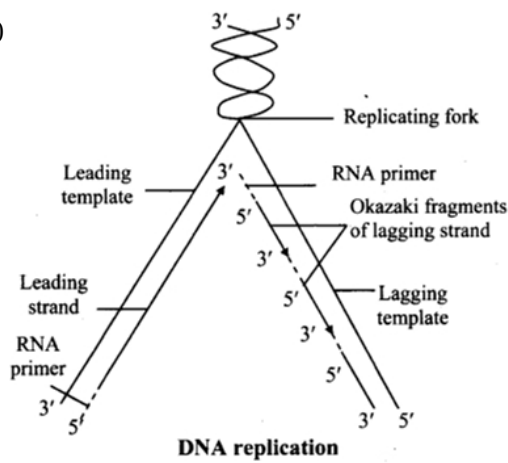
- i. It is a cheap, safe and renewable source of energy.
- ii. It can be easily generated, stored and transported.
- iii. It can be used for domestic lighting, cooking, street lighting as well as small scale industries.
- iv. It burns with blue flame and without smoke.
- v. It helps to improve sanitation of the surrounding.
- vi. It is eco-friendly and does not cause pollution and imbalance of the environment.
- vii. Sludge which is left over is used as a fertilizer.

21. i. Ethylene is the only gaseous growth regulator.

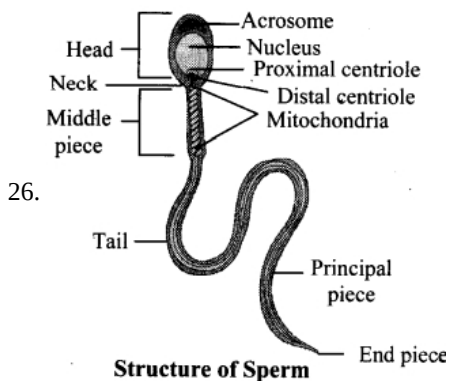
ii. Following are the physiological effects and applications of ethylene:

- a. It promotes ripening of fruits like bananas, apples and mangoes.
- b. It stimulates initiation of lateral roots in plants and breaks the dormancy of bud and seed.
- c. It accelerates the abscission activity in leaves, flowers and fruits by forming of abscission layer.
- d. Ethylene inhibits the growth of lateral buds and causes apical dominance and retards flowering.
- e. It is associated with the enhancement of process of senescence of plants organs.
- f. It inhibits flowering in most of the plants except pineapple.
- g. It causes epinasty (drooping) of leaves and flowers.
- h. It increases activity of chlorophyllase enzyme causing degreening effect in banana and Citrus fruits.

(ii)



25. A. Lymphatic vessels coming from the intestine contains absorbed fats, thus they are milky in appearance.
B. i. Monocytes enlarge and differentiate into macrophages at the site of infection.
ii. They engulf micro-organisms and remove dead cells of the body. Hence they are called as scavengers.
C. The wall of left ventricle is thicker than the right ventricle as it has to pump blood to all parts of the body at greater pressure.
D. Valves are present in the veins to prevent backward flow of the blood.
E. All veins carry deoxygenated blood except the pulmonary vein which is responsible for carrying oxygenated blood from the lungs to the left atrium of the heart.



26.

Structure of Sperm

For structure of human sperm:

Human sperm:

Sperm is the male gamete. It is a motile, microscopic and elongated cell.

The sperm is divisible into three parts: Head, middle piece and tail.

- a. **Head:** The sperm head is oval in shape and contains haploid nucleus.

Above the nucleus, there is a cap like structure called acrosome which is formed from the Golgi body. Acrosome contains hydrolytic enzymes like hyaluronidase and proteolytic enzymes like zona lysins and corona penetrating enzymes.

- b. **Neck:** It is a very short region having two centrioles i.e. proximal centriole and distal centriole.

- c. **Middle piece:** It has an axial filament surrounded by 10-14 spiral turns of mitochondria (Nebenkern). It produces energy necessary for the movement of sperm.

- d. **Tail:** It is a long, slender and tapering part containing cytoplasm and fine thread i.e. axial filament.

The axial filament arises from the distal centriole and travels throughout the length of tail. It is partly surrounded by plasma membrane (main piece).

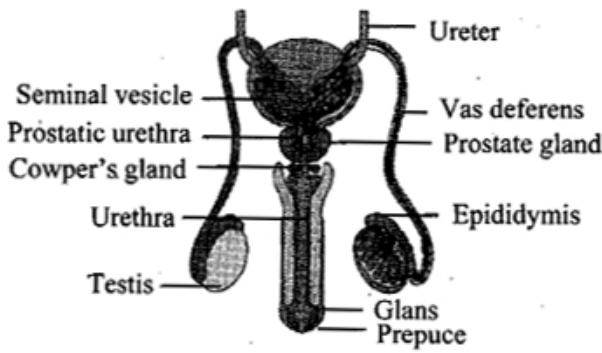
The part without plasma membrane is called end piece.

Section D

27. Answer the following:

- (i) Other name for Dentist's nerve: Trigeminal nerve.
(ii) Motor cranial nerves are as follows: Oculomotor (III), Pathetic (IV), Abducens (VI), Spinal accessory (XI) and Hypoglossal (XII).
(iii) Thymus is a prominent gland at birth but gets gradually atrophied in the adult.

28.



Human Male Reproductive System

The male reproductive system consists of the testes, accessory ducts, accessory glands and external genitalia i.e. Scrotum and Penis.

i. Primary sex organs: Testes

- Testes are a pair of primary sex organs which are mesodermal in origin and they produce sperms.
- They are located outside the abdomen in a pouch called scrotum.
- Testes develop in the abdominal cavity (early foetal life) and later descend into the scrotal sac through a passage called inguinal canal.
- They are suspended in the scrotal sac by the spermatic cord.
- Testes are connected to the wall of scrotum by short fibromuscular band called gubernaculum.
- They are oval in shape, about 4 to 5 cm long, 2 to 3 cm wide and 3 cm thick.
- The outermost covering of the testis is formed of dense fibrous membrane called tunica albuginea.

ii. Accessory sex organs: It includes accessory ducts, accessory glands.

a. Accessory ducts:

- Rete testis:** The seminiferous tubules of the testis at the posterior surface form a network of tubules called rete testis. The rete testis open into vasa efferentia.
- Vasa efferentia:** Vasa efferentia are 12-20 fine tubules arising from the rete testis and join to the epididymis. They carry sperms from the testis and open into epididymis.
- Epididymis:** It is a long and highly coiled tube which is differentiated into an upper caput-, middle corpus- and lower cauda epididymis. The sperms undergo maturation in the epididymis.
- Vasa deferens:** The vas deferens travels upto the abdominal cavity and loops over the ureter to open into the urethra. Vas deferens joins the seminal vesicle to form ejaculatory duct.
- Ejaculatory ducts:** The ejaculatory duct passes through the prostate gland and opens into the urethra.
- Urethra/urinogenital duct:** The urethra provides a common passage for the urine and semen. In males the urethra is long and extends through the penis. It opens to the outside by an opening called the urethral meatus or urethral orifice.

b. Accessory glands: Seminal vesicles, prostate gland and cowper's glands are the accessory glands associated with the male reproductive system. They secrete substances that protect the gametes and facilitate their movement.

iii. External genitalia:

- Penis:** The penis is the male copulatory organ. It is cylindrical and muscular with three bundles of erectile tissue: a pair of postero-lateral tissue called corpora cavemosa and a median corpus spongiosum. The swollen tip of the penis is called glans penis. It is covered by a loose fold of skin called foreskin or prepuce.
- Scrotum:** It is a loose pouch of pigmented skin lying behind the penis and is divided into a right and left scrotal sac by a septum of tunica dartos made of smooth muscle fibres. The foetal testes are guided into and retained in the scrotum by a short fibro muscular band called gubernaculum. The cremaster and dartos muscles of scrotum help in drawing testes close or away from the body. This helps in maintaining the temperature of the testis 2-3°C lower than the normal body temperature, necessary for spermatogenesis.

29. Answer the following:

(i)		Open circulation	Closed circulation
No.	Points		
i.	Blood pressure	The blood flows with low pressure.	The blood flows with high pressure.
ii.	Exchange	Exchange of material takes place directly	Exchange of material between blood and body

of material between blood and cells or tissues of the body. tissues is through intermediate fluid called lymph.

(ii) QRS complex represents ventricular depolarization.

(iii) In human pharynx, there is a set of lymphoid organs called **tonsils**.

30. The steps involved in recombinant DNA technology are as follows:

i. Isolation of DNA (gene) from the donor organism:

- a. The desired gene to be cloned is obtained from the source organism (donor).
- b. Initially the cells of the donor organism are sheared with the blender and treated with suitable detergent.
- c. Genetic material from the donor is isolated and purified using several techniques.
- d. Isolated DNA can be spooled on to a glass rod.

ii. Cutting of desired gene:

- a. Isolated purified DNA is then cleaved by using restriction enzymes i.e. restriction endonucleases.
- b. These enzymes cleave DNA at restriction sites and break the DNA into fragments.
- c. There are several types of restriction endonucleases.
- d. Cleaved DNA fragments have cohesive, sticky, staggered ends or blunt ends.
- e. From cleaved DNA fragments, a fragment containing desired gene is isolated and selected for cloning. This is now called foreign DNA or passenger DNA.
- f. A desired gene can also be obtained directly from genomic library or cDNA library.

iii. Insertion of desired foreign gene into a cloning vector (vehicle DNA):

- a. The foreign DNA or passenger DNA is now inserted into a cloning vector or vehicle DNA.
- b. The most commonly used cloning vectors are plasmids of bacteria and the bacteriophage viruses like lambda phage and M13.
- c. The most commonly used plasmid is pBR 322 .
- d. Plasmids are isolated from the vector organisms i.e. bacterium.
- e. By using same restriction enzyme (which is used in the isolation of the desired gene from the donor), plasmid i.e. vector DNA is cleaved.
- f. Now by using enzyme DNA ligase, foreign DNA is inserted/ integrated into the vector DNA.
- g. The combination of vector DNA and foreign DNA is now called Recombinant DNA or Chimeric DNA and the technology is referred to as rDNA technology.

iv. Transfer of rDNA into suitable competent host or cloning organism:

- a. Finally the recombinant DNA is transferred for expression into a competent host cell which is usually a bacterium.
- b. Host cell takes up naked rDNA by process of 'transformation' and incorporates into its own chromosomal DNA which finally expresses the trait controlled by passenger DNA.
- c. The transfer of rDNA into a bacterial cell is assisted by divalent Ca^{++} .
- d. The cloning organisms used in plant biotechnology are E. coli and Agrobacterium tumefaciens.
- e. The host/ competent cell which has taken up rDNA is now called transformed cell.
- f. Foreign DNA can also be transferred directly into the naked cell or protoplast of the competent host cell, without using vector.
- g. This is done by using techniques like electroporation, microinjection, lipofection, shot gun, ultra-sonification, biolistic method, etc. But in plant biotechnology the transformation is through Ti plasmids of *A. tumefaciens*.

v. Selection of the transformed host cell:

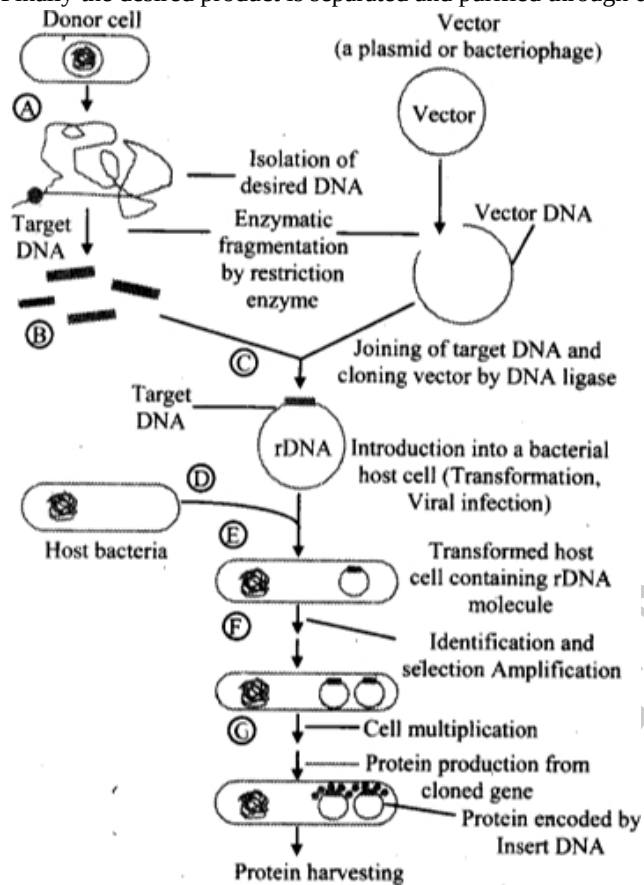
- a. The transformation process generates a mixed population of transformed (recombinant) and non-transformed (non-recombinant) host cells.
- b. For isolation of recombinant cell from nonrecombinant cell, marker gene of plasmid vector is employed.
- c. For example, pBR322 plasmid vector contains different marker gene (Ampicillin resistant gene and Tetracycline resistant gene).
- d. When PstI restriction enzyme is used, it knocks out Ampicillin resistant gene from the plasmid, so that the recombinant cell becomes sensitive to Ampicillin.

vi. Multiplication of transformed host cell:

- a. Once transformed, host cells are separated by the screening process.
- b. In this step the transformed host cells are introduced into fresh culture media.
- c. At this stage the host cells multiply along with the replication of the recombinant DNA carried by them.

vii. **Expression of the gene to obtain the desired product:**

- The next step involves the production of desired products like alcohol, enzymes, antibiotics, etc.
- Finally the desired product is separated and purified through downstream processing using suitable bioreactor.



31. Genetic diversity is an essential factor for evolution by natural selection. Continued self-pollination results in the inbreeding depression. Thus, plants have developed many devices to encourage cross pollination. The examples of outbreeding devices are as follows:

- Unisexuality:** In this, the plant bears either male or female flowers. It is also called as dioecism. As flowers are unisexual, self-pollination is not possible. Plants are dioecious, e.g. Mulberry, Papaya.
- Dichogamy:** In this, anthers and stigmas mature at different times in a bisexual flower due to which self-pollination is prevented. It can be further divided into two types:
 - Protandry:** In this type, anthers mature first, but the stigma of the same flower is not receptive at that time. e.g. in the disc florets of sunflower.
 - Protogyny:** In this type, stigma of carpel matures earlier than anthers of the same flower. e.g. Gloriosa.
- Prepotency:** In this, pollen grains of other flowers germinate rapidly over the stigma than the pollen grains from the same flower, e.g. Apple.
- Heterostyly (heteromorphy):** Plants like Primula (Primrose) produce two or three types of flowers in which stigmas and anthers are placed at different levels (heterostyly and heteroanthly). This prevents the pollens from reaching the stigma and pollinating it. In heteromorphic flowers, pollen grains produced from anther pollinate stigmas produced at the same level. Thus self-pollination is not possible in such cases.
- Herkogamy:** It is a mechanical device to prevent self-pollination in a bisexual flower. In plants, natural physical barrier is present between two sex organs and avoid contact of pollen with stigma of same flower, in e.g. Calotropis, pentangular stigma is positioned above the level of anthers (pollinia).
- Self-incompatibility (self-sterility):** This is a genetic mechanism due to which the germination of pollen on stigma of the same flower is inhibited, e.g. Tobacco, Thea.