**1. Why is diffusion insufficient to meet the oxygen requirements of multicellular organisms like humans?**

**Solution:**

Multi-cellular organisms like humans have very big bodies and require a lot of oxygen to diffuse into the body quickly in order to meet the oxygen requirement. Diffusion is a slow process which will take a lot of time to circulate oxygen to all the body cells. Because of its slow nature, diffusion is insufficient to meet the oxygen requirements of multicellular organisms like humans.

**2. What criteria do we use to decide whether something is alive?**

**Solution:**

Walking, breathing, growth and other visible changes can be used to determine whether something is alive or dead. However, some living things will have changes that are not visible to our eye; Hence, the presence of the life process is a fundamental criterion to decide whether something is alive.

**3. What are outside raw materials used for by an organism?**

**Solution:**

The outside raw material is used by organisms for food and oxygen. Raw materials’ requirement varies on the complexity of the organism and the environment it is living.

**4. What processes would you consider essential for maintaining life?**

**Solution:**

Life processes such as respiration, digestion, excretion, circulation and transportation are essential for maintaining life.

**2. Where do plants get each of the raw materials required for photosynthesis?**

**Solution:**

Plants require the following raw material for photosynthesis:

1. CO2 is obtained from the atmosphere through stomata
2. Water is absorbed by plant roots from the soil.
3. Sunlight is an essential raw material for photosynthesis
4. Nutrients are obtained by soil by plant roots

**3. What is the role of the acid in our stomach?**

**Solution:**

HCl present in the stomach dissolves food particles and creates an acidic medium. In an acidic environment, protein-digesting enzymes, pepsinogen, are converted into pepsin. HCl in the stomach also acts as a protective barrier against many disease-causing pathogens.

**4. What is the function of digestive enzymes?**

**Solution:**

Digestive enzymes break complex food molecules into simpler ones. This will make the food absorption process easy and effective. Absorbed food is transported to all parts of the body by the blood.

**5. How is the small intestine designed to absorb digested food?**

**Solution:**

The small intestine has small projections called microvilli, which increase the surface volume, making the absorption more effective. Within the villi, there are numerous blood vessels that absorb digested food and carry it to the bloodstream. Blood transports food to each part of our body.

**1. What advantage over an aquatic organism does a terrestrial organism have with regard to obtaining oxygen for respiration?**

**Solution:**

Terrestrial organisms breathe by using atmospheric oxygen, whereas aquatic organisms take oxygen dissolved in water. The oxygen level is high in the atmosphere when compared to oxygen in the water. Hence, terrestrial organisms need not breathe fast to obtain organisms, whereas aquatic organisms need to breathe faster to get the required oxygen.

**3. How are oxygen and carbon dioxide transported in human beings?**

**Solution:**

Oxygen and Carbon dioxide are transported in human beings via the bloodstream. Oxygen is carried to the cells, whereas carbon dioxide is carried away from the cells. The exchange of gases takes place between the alveoli of the lungs and the surrounding blood capillaries.  Oxygen is absorbed by the blood capillaries from the lungs’ alveoli by diffusion, while carbon dioxide is absorbed by the lungs’ alveoli from the blood capillaries by diffusion.

**4. How are the lungs designed in human beings to maximise the area for the exchange of gases?**

**Solution:**

* The lungs are an important part of the body. The passage inside the lungs divides into smaller and smaller tubes, which finally terminate in balloon-like structures called alveoli.
* The alveoli provide a surface where the exchange of gases can take place. The walls of the alveoli usually contain an extensive network of blood vessels. We know that when we breathe in, we lift our ribs, flatten our diaphragm and the chest cavity becomes larger.
* Because of this action, the air is sucked into the lungs and fills up the expanded alveoli.
* The blood brings the essential carbon dioxide from the rest of the body and supplies it to the alveoli; the oxygen in the alveolar air is taken up by the blood in the alveolar blood vessels to be transported to all other cells of the body. During the normal breathing cycle, when air is taken in and let out, the lungs always contain a residual volume of air so that there is sufficient time for oxygen to be absorbed and carbon dioxide to be released.

**1. What are the components of the transport system in human beings? What are the functions of these components?**

**Solution:**

The heart, blood and blood vessels are the main components of the transport system in human beings.

**Functions of these components**

**Heart**

The heart pumps oxygenated blood throughout the body. It receives deoxygenated blood from the various body parts and sends impure blood to the lungs for oxygenation.

**Blood**

Blood transports oxygen, nutrients, CO2, and nitrogenous wastes.

**Blood vessels**

Blood vessels, arteries and veins carry blood to all parts of the body.

**2. Why is it necessary to separate oxygenated and deoxygenated blood in mammals and birds?**

**Solution:**

Mammals and birds are warm-blooded animals which keep their body temperature constant irrespective of the environment they live. This process requires a lot of oxygen for more cellular respiration so that warm-blooded animals produce more energy to balance their body temperature. Hence, it is very important for warm-blooded animals to separate oxygenated and deoxygenated blood to keep their circulatory system efficient.

**3. What are the components of the transport system in highly organised plants?**

**Solution:**

There are two types of conducting tissues in highly organised plants that carry out the transport system 1) Xylem 2) Phloem. Xylem conduct water and minerals from roots to the rest of the plant parts. Similarly, Phloem transports food materials from the leaf to other parts of the plant.

**4. How are water and minerals transported in plants?**

**Solution:**

Xylem parts of the tracheids and vessels of roots, stems and leaves are interconnected to form a continuous system of water-conducting channels that reaches all parts of the plant. Transpiration creates a suction pressure which forces water into the xylem cells of roots. After this, there will be a steady movement of water from the root xylem to all parts of the plant connected through conducting interconnected water-conducting channels.

**5. How is food transported in plants?**

**Solution:**

Food is transported in plants by a special organ called the phloem. Phloem transports food materials from leaves to different parts of a plant. Transportation of food in phloem is achieved by the expenditure of energy from ATP. This increases osmotic pressure in the tissue, causing water to move. This pressure moves material in the Phloem to the tissues with less pressure. This helps in the transportation of food materials as per the needs. Example, Sucrose

**1. Describe the structure and functioning of nephrons.**

**Solution:**

Nephrons are the filtration units of the kidney, which are large in numbers. Some substances in the initial filtrate, such as glucose, amino acids, salts and a major amount of water, are selectively re-absorbed as the urine flows along the tube.

The main components of Nephrons are

Glomerulus

Bowman’s Capsule

Long Renal Tube

**Functioning of Nephron**

* The blood enters the kidney through the renal artery, which branches into many capillaries associated with the glomerulus.
* The water and solute are transferred to the nephron at Bowman’s capsule.
* In the proximal tubule, substances such as amino acids, glucose, and salts are selectively reabsorbed, and unwanted molecules are added to the urine.
* The filtrate then moves down into the loop of Henle, where more water is absorbed. From here, the filtrate moves upwards into the distal tubule and finally to the collecting duct. The collecting duct collects urine from many nephrons.
* The urine formed in each kidney enters a long tube called the ureter. From the ureter, it gets transported to the urinary bladder and then into the urethra.

**2. What are the methods used by plants to get rid of excretory products?**

**Solution:**

Plants can get rid of excess water by transpiration.

For other wastes, plants use the fact that many of their tissues consist of dead cells and that they can even lose some parts, such as leaves. Many plant waste products are stored in cellular vacuoles. Waste products may be stored in leaves that fall off.

Other waste products are stored as resins and gums, especially in old xylem. Plants also excrete some waste substances into the soil around them.

**3. How is the amount of urine produced regulated?**

**Solution:**

The amount of urine produced depends on the amount of excess water and dissolved waste present in the body. Other factors may be the environment and the ADH hormone, which regulates the production of urine.

**5. How are fats digested in our bodies? Where does this process take place?**

**Solution:**

* The small intestine is the place for the complete digestion of carbohydrates, fats and proteins. It receives the secretions of the liver and pancreas for this purpose.
* The food coming from the stomach is usually acidic in nature, and it has to be made alkaline so that pancreatic enzymes can act on it. Bile juice produced in the liver accomplishes this process.
* Fats are usually present in the intestine in the form of larger globules, which makes it difficult for enzymes to act on them. The bile salts help in breaking down larger globules into smaller globules. The pancreas helps in secreting pancreatic juice, which contains enzymes like trypsin for digesting proteins and lipase for breaking down emulsified fats.
* The walls of the small intestine contain glands, which secrete intestinal juice. The enzymes present in it finally convert the proteins to amino acids, complex carbohydrates into glucose and finally, fats into fatty acids and glycerol.

**6. What is the role of saliva in the digestion of food?**

**Solution:**

The food we intake is complex in nature; if it is to be absorbed from the alimentary canal, then it has to be broken into smaller molecules. This process is mainly done with the help of biological catalysts called enzymes. The saliva contains an enzyme called salivary amylase that breaks down starch, which is a complex molecule to give sugar. The food is mixed thoroughly with saliva and moved around the mouth while chewing the muscular tongue. Hence, saliva plays a pivotal role in the digestion and absorption of food.

**7. What are the necessary conditions for autotrophic nutrition, and what are its byproducts?**

**Solution:**

* The energy and carbon requirements of the autotrophic organism are obtained by the process of photosynthesis.
* It is defined as the process by which autotrophs take in substances from the outside surroundings and convert them into stored forms of energy.
* This substance is taken in the form of carbon dioxide and water, which are converted into carbohydrates in the presence of sunlight and chlorophyll.
* The main purpose of carbohydrates is to provide energy to the plant. The carbohydrates are not utilised immediately, but they are stored in the form of starch, which serves as an internal energy reserve.
* The stored energy can be used as and when required by the plant.

**8. What are the differences between aerobic and anaerobic respiration? Name some organisms that use the anaerobic mode of respiration.**

**Solution:**

**Aerobic respiration**

* The process takes place in the presence of free oxygen.
* The products of aerobic respiration are CO2, water and energy.
* The first step of aerobic respiration (glycolysis) takes place in the cytoplasm, while the next step takes place in mitochondria.
* The process of aerobic respiration takes place in all higher organisms.
* In this process, complete oxidation of glucose takes place.

**Anaerobic respiration**

* The process takes place in the absence of free oxygen.
* The products of anaerobic respiration are ethyl alcohol, CO2and a little energy.
* Even in anaerobic respiration, the first step takes place in the cytoplasm, while the next step takes place in mitochondria.
* In this process, the glucose molecules are incompletely broken down.
* The process of anaerobic respiration takes place in lower organisms like yeast, some species of bacteria and parasites like tapeworms.

**9. How are the alveoli designed to maximise the exchange of gases?**

**Solution:**

* The lung is an important part of the body. The passage inside the lungs divides into smaller and smaller tubes, which finally terminate in balloon-like structures called alveoli.
* The alveoli provide a surface where the exchange of gases can take place. The walls of the alveoli usually contain an extensive network of blood vessels. We know that when we breathe in, we lift our ribs, flatten our diaphragm and the chest cavity becomes larger.
* Because of this action, the air is sucked into the lungs and fills up the expanded alveoli.
* The blood brings the essential carbon dioxide from the rest of the body and supplies it to the alveoli; the oxygen in the alveolar air is taken up by the blood in the alveolar blood vessels to be transported to all other cells of the body. During the normal breathing cycle, when air is taken in and let out, the lungs always contain a residual volume of air so that there is sufficient time for oxygen to be absorbed and carbon dioxide to be released.

**10. What would be the consequences of a deficiency of haemoglobin in our bodies?**

**Solution:**

Haemoglobin is a protein responsible for the transportation of oxygen to the body cells for cellular respiration. A deficiency of Haemoglobin can affect the oxygen-carrying capacity of RBCs. This lead to a lack of oxygen in our body cells. Haemoglobin deficiency leads to a disease called anaemia.

**11. Describe the double circulation of blood in human beings. Why is it necessary?**

**Solution:**

Double circulation means, in a single cycle, blood goes twice in the heart. The process helps in separating oxygenated and deoxygenated blood to maintain a constant body temperature.

The double circulatory system of blood includes

* Pulmonary circulation
* Systemic circulation.

**Pulmonary circulation**

The right ventricle pumps deoxygenated blood into the lungs, where it is oxygenated. The oxygenated blood is brought back to the left atrium, and from there, it is pumped into the left ventricle. Finally, blood goes into the aorta for systemic circulation.

**Systemic circulation**

The oxygenated blood is pumped to various parts of the body from the left ventricle. The deoxygenated blood from different parts of the body passes through the vena cava to reach the right atrium. The right atrium transfers the blood into the right ventricle.

**1. What is the difference between a reflex action and walking?**

**Solution:**

Reflex actions are the involuntary actions that occur in response to stimuli. They occur without involvement of conscious areas of brain. All the reflex actions are unconscious actions. Reflex action involves the brain and spinal cord of central nervous systems.

On the other hand, voluntary actions are those which occur under the control of cerebellum of the brain. Walking is learnt as we grow. Walking is controlled by the brain and is consciously used whenever required.

**2. What happens at the synapse between two neurons?**

**Solution:**

At the synapse between two neurons, electric signals are converted into chemicals that can easily cross over the gap and pass on the chemical messenger to the next neuron where it is converted back to electrical signal.

**3. Which part of the brain maintains the posture and equilibrium of the body?**

**Solution:**

Cerebellum, which is a part of the brain, is responsible for controlling the motor functioning. Hence, it is the part engaged in the maintenance of posture and equilibrium of the body.

**4. How do we detect the smell of an agarbatti (incense stick)?**

**Solution:**

The smell of an agarbatti is detected by the nose. The olfactory receptors present in the nose sends electrical signal to the fore brain. The fore brain interprets this signal as the smell of the incense stick.

**5. What is the role of the brain in reflex action?**

**Solution:**

Reflex actions are formed instantaneously in response to a stimulus that has no time to think. For instance, the sensory nerves that detect heat are connected to the nerves that move the muscles of the hand. Such a connection of detecting the signal from the nerves (input) and responding to it quickly (output) is known as reflex arc.

Reflex action are generated in spinal cord and the information also reaches brain. This helps the brain to record this event and remember it for future use.  Brain helps the person to get awareness of the stimulus and prevent the danger posed by the situation in the future.

**1. What are plant hormones?**

**Solution:**

Plant hormones are the organic substances produced at certain sites of a plant and are translocated to other parts based on the requirement. Plant hormones help to coordinate growth, development and responses to the environment. Ex: Auxin’s Gibberlin’s, cytokines, abscisic acid and ethylene.

**3. Give an example of a plant hormone that promotes growth.**

**Solution:**

Auxins and Gibberlins are the hormone responsible for the growth of plant.

Auxins are responsible for the cell elongation in shoot and also regulate growth.

Gibberlin is responsible for stem elongation and germination.

**4. How do auxins promote the growth of a tendril around a support?**

**Solution:**

Auxins are the plant hormones produced at the tips of shoots and roots. Auxins are present at the tip of tendrils. When tendrils are attached around any support, their growth is slowed down as auxins are sensitive to touch. This makes them move to the other side of the tip to get support; this makes the other side grow faster than the side of tendril in contact with the support and the tendril bends towards the support.

**1. How does chemical coordination take place in animals?**

**Solution:**

Chemical coordination takes place in animals with the help of chemical messengers called hormones. Hormones are the chemicals that are secreted by specific endocrine glands. Hormones regulate the growth, development and homeostasis of the animals.

**2. Why is the use of iodized salt advisable?**

**Solution:**

Usage of iodized salt is advisable to avoid the deficiency of iodine. If the intake of iodine is low, the release of thyroxine from the thyroid gland will be decreased. This affects fat, carbohydrate and protein metabolism. Thus, a person may have goitre if the intake of iodine is lowered.

**3. How does our body respond when adrenaline is secreted into the blood?**

**Solution:**

Adrenaline is a hormone secreted when a person is frightened or mentally disturbed. When Adrenaline reaches the heart, heartbeat will increase to increase blood supply to our muscles. Adrenaline also increases the breathing rate because of contraction of diaphragm and the rib muscles. Adrenaline rush also increases blood pressure and allows entry of more glucose into blood. All these occur when our body responds to the secretion of adrenaline into our blood.

**4. Why are some patients of diabetes treated by giving injections of insulin?**

**Solution:**

Diabetes is a condition where the pancreatic cells of a person stops producing or reduces the production of insulin hormone. Insulin regulates blood glucose by converting extra glucose to glycogen. When insulin is not produced adequately, a person’s blood glucose level is affected and this leads to adverse effects. In order to maintain the insulin and blood glucose levels, diabetes patients are treated with injections of insulin.

**4. What is the function of receptors in our body? Think of situations where receptors do not work properly. What problems are likely to arise?**

**Solution:**

Receptors are present throughout our body – mainly in sense organs. Receptors collect the information about changes that happen around us and send the signal/information to the brain which responds to the change detected. When receptors do not work properly, the environmental stimuli are not able to create nerve impulses and body does not respond.

**6. How does phototropism occur in plants?**

**Solution:**

Directional movement and growth of plant in response to light is called as phototropism. Phototropism occurs due to increased auxin on the dark side and decreased auxin on the illuminated side. Because of presence of more auxin, a leaf in the darker side grows faster causing it to bend towards the source of light.

**7. Which signals will get disrupted in case of a spinal cord injury?**

**Solution:**

In case of a spinal cord injury, signals coming from the nerves, as well as the signals coming to the receptors, will be disrupted. Both these signals meet in a bundle in the spinal cord. Hence, both these signals get disrupted.

**8. How does chemical coordination occur in plants?**

**Solution:**

Plant growth, development and responses to the environment is controlled and coordinated by a special class of chemical substances known as hormones. Hormones are produced in one part of the plant and are transported to all the needy parts of the plant. The five major types of phytohormones are auxins, gibberellins, cytokinins, abscisic acid, and ethylene. These phytohormones are either growth promoters (such as auxins, gibberellins, cytokinins, and ethylene) or growth inhibitors such as abscisic acid.

**9. What is the need for a system of control and coordination in an organism?**

**Solution:**

There are various organs in an organism. These organs must be carefully controlled and coordinated for the survival of an organism. In the body of an organism, various fluids are secreted from the glands of the endocrine system. These hormones are responsible for the overall growth and development of an organism. All other daily decisions that include voluntary and involuntary actions are controlled by the central nervous system (CNS).

Coordination is needed for all human activities we perform. Our nervous system receives information from surroundings which is processed and a response is elicited. The endocrine system (hormonal system) helps in integrating various metabolic activities like reproduction, development, and all reflex actions (cope up with various give up situations).

The hormonal system in plants helps in process of photosynthesis; they need carbon dioxide, water and sunlight. The stomatal opening in leaves opens up to allow in carbon dioxide gas, the roots bend towards water, the stem grows towards sunlight, and the tendrils in climbing plants are supported by the hormonal system of the plant body.

Thus, we need a control and coordination system in an organism.

**1. What is the importance of DNA copying in reproduction?**

**Solution:**

DNA – Deoxyribonucleic acid is the genetic material that is present in the cells of all organisms. DNA carries genetic information from one generation to the other, and this helps in producing organisms of its own types. DNA copying is a must for inheriting the traits from parents. Any variations in DNA copying will give rise to origin of new species.

**2. Why is the variation beneficial to the species but not necessarily for the individual?**

**Solution:**

The reason why the variation is beneficial to the species rather than individuals is because sometimes the climatic changes have a drastic effect on the species, which makes their survival difficult. For examples, if the temperature of the water body increases, there might be certain species of microorganisms which might die. This may result in disturbance in the environment. So, variation is beneficial to species and not for the individuals.

**1. How does binary fission differ from multiple fission?**

**Solution:**

When a single cell divides into two equal halves, it is known as binary fission. Bacteria and amoeba are examples of binary fission.

When a single cell divides into multiple daughter cells at the same time, it is known as multiple fission. Algae and sporozoans are examples of multiple fission.

**2. How will an organism be benefited if it reproduces through spores?**

**Solution:**

Following are the ways through which an organism will be benefited if it reproduces through spores:

* Number of spores produced in one sporangium would be large.
* In order to avoid competition at one place, spores can be distributed to faraway places with the help of air.
* In order to prevent dehydration under unfavorable conditions, the spores are covered by thick walls.

**3. Can you think of reasons why more complex organisms cannot give rise to new individuals through regeneration?**

**Solution:**

Organisms at higher complex levels cannot give rise to new individuals through regeneration because they have organization of their organs system at different levels. All these organ systems are interconnected and work in full coordination. They can regenerate a few of their lost body parts like skin, blood, muscles, etc. but can’t give rise to new individuals.

**4. Why is vegetative propagation practised for growing some types of plants?**

**Solution:**

Following are the advantages of practising vegetative propagation for growing some types of plants:

* Crops like orange, banana, pineapple do not have viable seeds, so vegetative propagation can be used.
* It is a rapid, cheap and easier method to grow crops.
* It can be used in places where seed germination fails.
* A good quality of variety can be preserved.

**5. Why is DNA copying an essential part of the process of reproduction?**

**Solution:**

DNA copying is an essential part of the process of reproduction because it carries the genetic information from the parents to offspring. A copy of DNA is produced through some chemical reactions resulting in two copies of DNA. Along with the additional cellular structure, DNA copying also takes place, which is then followed by cell division into two cells.

**1. How is the process of pollination different from fertilization?**

**Solution:**

Pollination is defined as the process of transfer of pollens from anther to stigma. The process takes place with the help of pollinators like air, water and some insects.

Fertilization is defined as the fusion of male and female gametes. It takes place in the ovule and leads to the formation of zygote.

**2. What is the role of the seminal vesicles and the prostate gland?**

**Solution:**

Lubrication of sperms and providing of a fluid medium for the easy transportation of sperms takes place with the help of secretions from the seminal vesicles and the prostate gland. These secretions also provide nutrients in the form of fructose, calcium and some enzymes.

**3. What are the changes seen in girls at the time of puberty?**

**Solution:**

Following are the changes seen in girls at the time of puberty:

* Hair growth appears in genital area.
* Hair growth in other areas like underarms, face, hands and legs.
* The size of uterus and ovary increases.
* The size of the breast increases followed by darkening of the nipple skin that is present at the tip of the breast.
* Beginning of menstrual cycle.
* Appearance of pimples, as there is more oil secretion from the skin.

**4. How does the embryo get nourishment inside the mother’s body?**

**Solution:**

The lining of the uterus thickens after fertilization. The blood flow is good so as to nourish the growing embryo. Placenta is a special tissue which is embedded in the uterine wall and helps the embryo get the nourishment from the mother’s tissue. Placenta has villi on the embryo side and blood space on the mother’s side. This spacing provides a large area between the mother and the embryo and also for waste removal.

**5. If a woman is using a Copper-T, will it help in protecting her from sexually transmitted diseases?**

**Solution:**

No, the usage of copper-T cannot stop the contact of body fluids. Hence, it cannot protect her from getting sexually transmitted diseases.

**4. What are the advantages of sexual reproduction over asexual reproduction?**

**Solution:**

Following are the advantages of sexual reproduction:

* The offspring has the characters of both the parents.
* The survival of the species is ensured as there are more variations.
* The offspring can easily adapt to environmental changes.
* It also improves the health of humans.

**5. What are the functions performed by the testis in human beings?**

**Solution:**

Following are the functions performed by the testis in human beings:

* Apart from the production of sperms, it also produces the male hormone known as androgens.
* They also produce hormone called testosterone, which is responsible for secondary sexual characters in boys.

**6. Why does menstruation occur?**

**Solution:**

Menstruation is the normal bleeding of the vaginal line, which starts at puberty and lasts till menopause. During this period, the body prepares itself for pregnancy.

Every month an egg is released from one of the ovaries at the same time when the uterus prepares itself for the fertilized egg. The inner lining of the uterus gets thickened and is supplied with a sufficient amount of blood for the embryo. Since there is no interaction between the egg and the sperms, the fertilization of egg doesn’t takes place. So when the egg doesn’t get fertilized, the uterus lining breaks down slowly resulting in menstruation.

**8. What are the different methods of contraception?**

**Solution:**

Following are the different methods of contraception:

* Natural method: In this method, the main focus is to avoid the meeting of sperms and ovum. This can be achieved by avoiding the mating from 10th to 17th day of the menstrual cycle. During this period, there are high chances of fertilization as ovulation is expected.
* Barrier method: In this method, the meeting of sperms and ovum is avoided by using a barrier. These barriers are available for males as well as for females. Condoms for both male and female, diaphragms for female, cervical cap and contraceptive sponge for females.
* Oral contraceptives: In this methods, pills are taken orally. These pills contain small portion of hormones that block the eggs so that fertilization doesn’t takes place.
* Implants and surgical method: In this method, contraceptive devices like copper-T or a loop can be used to block the meeting of sperms and ovum. In surgical method, the fallopian tubes are blocked in females to stop the flow of eggs and vas deference is blocked in men to stop the flow of sperms.

**9. How are the modes for reproduction different in unicellular and multicellular organisms?**

**Solution:**

The different modes of reproduction in unicellular organisms are fission, budding, etc. Here, the cell divides into two daughter cells and this process of cell division continues.

Whereas, in multicellular organisms there is a different organ system for reproduction. The different modes of reproduction in multicellular organisms are vegetative propagation, spore formation, etc.

In more complex organisms like humans and animals, reproduction is through sexual reproduction.

**10. How does reproduction help in providing stability to populations of species?**

**Solution:**

Reproduction is the process of producing the same kind of species by the existing species. This is done so as to maintain the population of that species and also to take forward their species to the next generations. Stability is maintained by keeping a check of rate of births and rate of deaths.

**11. What could be the reason for adopting contraceptive methods?**

**Solution:**

Following are the reasons for adopting contraceptive methods:

* To control population
* To avoid unplanned pregnancy
* To avoid transfer of sexually transmitted diseases

**1. If a trait A exists in 10% of a population of an asexually reproducing species and trait B exists in 60% of the same population, which trait is likely to have arisen earlier?**

Solution:

Trait B is more probable to arise early as this trait has already been existing and replicating in a larger percentage of the population as compared to trait A.

**2. How does the creation of variations in a species promote survival?**

Solution:

Genetic variations enable the species to better adapt to changes in its environment. Moreover, it is an important force in evolution as it allows the frequency of alleles to increase or decrease through natural selection. These variations will determine the difference between extinction or continuation of the species.

**1. How do Mendel’s experiments show that traits may be dominant or recessive?**

Solution:

Mendel showed that the traits could either be dominant or recessive through his experiments that focused on the mono-hybrid cross. The experiment involved him crossing tall (TT) pea plants with dwarf (tt) pea plants. The resultant plants which formed after fertilisation represented the F1 (or filial) generation. All the F1 plants were tall. Mendel then proceeded to self-pollinate the filial generation plants, and the result was that 1/4th of the plants obtained in the F2 generation were dwarfs. From this experiment, Mendel concluded that the F1 tall plants were not true-breeding; instead, they carried the traits for both tall and dwarf heights. A portion of the plants was tall due to the fact that the traits for tallness were dominant over the traits for dwarfness. This cements the notion that traits can either be dominant or recessive.

**2. How do Mendel’s experiments show that traits are inherited independently?**

Solution:

Mendel’s experiments show that traits are inherited independently through his dihybrid cross experiment. The experiment involved him using two traits – namely, seed shape and seed colour. The colour yellow (YY) is dominant over green (yy), while the round shape (RR) is dominant over the wrinkled shape (rr). The F2 progeny of the dihybrid cross resulted in a phenotypic ratio of 9:3:3:1; therefore, 9 plants with round yellow (RRYY) seeds, 3 plants with round green (RRyy) seeds and 3 plants with wrinkled yellow (rrYY) seeds and one with wrinkled green seeds (rryy). He further observed that the wrinkled greens and the round yellow are parental combinations while the round green and wrinkled yellow are new. A dihybrid cross between two seeds with dominant traits (RRYY) and non-dominant traits (rryy) resulted in the production of 4 types of gametes (RY, Ry, rY and ry). This means each of the gametes segregates independently of the other, and each with a frequency of 25% of the total gametes produced.

**3. A man with blood group A marries a woman with blood group O, and their daughter has blood group O. Is this information enough to tell you which of the traits – blood group A or O – is dominant? Why or why not?**

Solution:

Given information is not enough to tell us which characteristics are dominant – blood group A or O. Blood type A is always dominant in ABO blood, and blood type O is always recessive. Here, the father’s blood group may be genotypically AA (homozygous) or AO (heterozygous), whereas that of the mother can be OA or OO.

**4. How is the sex of the child determined in human beings?**

Solution:

The sex of the child in humans is determined by the males. Males have XY chromosomes, while females have XX chromosomes. Hence, if:

* The male’s X chromosomes combine with the female’s X chromosomes, the mother gives birth to a girl
* The male’s Y chromosome combines with the female’s X chromosome, the mother gives birth to a boy

**1. What are the different ways in which individuals with a particular trait may increase in a population?**

Solution:

* An individual attribute could increase a population in the following 2 ways:
* (a) **Natural selection:** If an attribute is useful to a population, it’ll increase naturally.
* For example, mosquitoes which are resilient against a particular pesticide will pass on their genes so that future generations become resistant as well. The mosquitoes which are affected by the pesticide die out.
* (b) **Genetic drift:**If a species faces a catastrophic event where most of the population is wiped out, the surviving population can pass on their traits to the following generations. This may result in a rise in the attribute within the population.

**2. Why are traits acquired during the lifetime of an individual not inherited?**

Solution:

* Traits acquired during a lifetime cannot be inherited by successive generations as the changes do not reflect in the DNA of the germ cells. For instance, a football player cannot pass on his skills to his offspring as they are limited to non-reproductive cells only.

**3. Why are the small numbers of surviving tigers a cause of worry from the point of view of genetics?**

Solution:

* As the size of the tiger population decreases, the genetic pool of the species decreases too. This results in a limitation on the variations which will be introduced within the genetic makeup of the tigers. This lack of variation will result in serious implications. For example, if an illness spreads within the tiger population, it can potentially wipe out the whole population, possibly causing their extinction.

**1. What factors could lead to the rise of a new species?**

Solution:

* Factors that would result in a new species are as follows:
* (a) Mutation
* (b) Genetic drift
* (c) Natural selection
* (d) Geographical isolation
* (e) Generative isolation for prolonged periods
* (f) Environmental factors on the isolated populations
* (g) Quantum of genetic variant transmissible from one generation to the following generation

**2. Will geographical isolation be a major factor in the speciation of a self-pollinating plant species? Why or why not?**

Solution:

* In the pollination of plant species, geographical isolation is usually not a major factor, as no new trait will become part of the genetic makeup of a self-pollinating plant species. However, there are some possibilities of some environmental changes which could result in some variations.

**3. Will geographical isolation be a major factor in the speciation of an organism that reproduces asexually? Why or why not?**

Solution:

* In the case of asexually reproducing organisms, geographical isolation can’t be considered a factor. This is due to the fact that meiosis does not occur during asexual modes of reproduction.

**1. Give an example of characteristics being used to determine how close two species are in evolutionary terms.**

Solution:

* Let us take the instance of humans and chimpanzees. Chimpanzees are able to express a wide range of emotions, such as busting out in laughter or smiling – this trait was once thought to be a feature exclusive to humans. The smile can be linked to the activation of the brain’s limbic system, where the orbicularis oculi muscle involuntarily contracts and raises the cheeks, forming wrinkles around the eyes. This implies that the smile is a true and genuine smile. Interestingly, this type of reflex has a name – the Duchenne smile. Moreover, research has shown that chimpanzees share 98.6% of our DNA – This means that humans and chimpanzees shared a common ancestor aeons ago. It is also important to note that chimpanzees are the closest living relatives to humans.

**2. Can the wing of a butterfly and the wing of a bat be considered homologous organs? Why or why not?**

Solution:

* The wing of a butterfly and the wing of a bat cannot be considered homologous organs as they do not share a common ancestor. Even though both structures aid in flying, they have evolved separately. To prove this, the wings of a butterfly are composed of two chitinous membranes, whereas the wings of a bat are composed of a bony skeleton, complete with blood vessels. Hence, these aren’t homologous organs but rather analogous organs.

**3. What are fossils? What do they tell us about the process of evolution?**

Solution:

* Fossils are the preserved remains of animals or plants, or other organisms that died out millions of years ago. These fossils tell us about a lot of extinct animals and also give insights into how evolution might have occurred. Fossils can be used to understand how an organism would have lived and what it may have looked like. More importantly, we can correlate with fossils as well as extant organisms to understand their relationships. For instance, scientists were able to recover protein sequences from a dinosaur called the T-rex, which confirmed its avian lineage. This means birds are the extant relatives of (avian) dinosaurs. Moreover, the pattern of fossil distribution gives us an idea of the time in history when various species were formed or become extinct.

**1. Why are human beings who look so different from each other in terms of size, colour and looks said to belong to the same species?**

Solution:

* While human beings do vary in colour and general appearance, their genetic makeup is identical to any other human. One of the speculations put forth for our drastic changes is due to evolutionary pressure, where the need to be easily recognised pushed us towards having widely different faces.

**2. In evolutionary terms, can we say which among bacteria, spiders, fish and chimpanzees have a ‘better’ body design? Why or why not?**

Solution:

* Body designs are the result of environmental needs and pressure. Hence, we can’t conclude that one organism has a better body compared to another. For instance, fish have evolved a streamlined design as it is best suited for an aquatic environment. On the other hand, a spider or a chimpanzee might be ill-equipped to survive in such aquatic environments.

**4. A study found that children with light-coloured eyes are likely to have parents with light-coloured eyes. On this basis, can we say anything about whether the light eye colour trait is dominant or recessive? Why or why not?**

Solution:

* Knowledge of at least 3 generations is required to find if an attribute is dominant or recessive. Hence, it is not possible to identify if the given trait is dominant or recessive.

**5. How are the areas of study – evolution and classification – interlinked?**

Solution:

* Classification and evolution are two related fields of biology. Evolution pertains to how organisms evolve, and classification deals with finding out how two species are related to each other. For example, evolution and fossil evidence point to the fact that *Australopithecus afarensis* is considered one of our earliest ancestors. And classification tells us that *Australopithecus afarensis* belongs to the genus Homo, which is also the same genus as modern humans.

**6. Explain the terms analogous and homologous organs with examples.**

Solution:

* Homologous organs are those organs that have the basic structural design as well as the origin; however, they serve different functions. For example, the forelimbs of humans and the wings of bats are anatomically similar.
* Analogous organs are those organs that have a different structural design as well as origin; however, they perform similar functions. For example, the wings of birds and insects.

**8. Explain the importance of fossils in deciding evolutionary relationships.**

Solution:

* Fossils give evidence about:
* (a) The organism and their paleobiology
* (b) Even the behaviour of an organism can be deduced to some extent (for example, palaeontologists) have unearthed a site with more than 10,000 skeletons of a dinosaur called Hadrosaurus. This implies that the dinosaur lived in herds.
* (c) Fossils also provide insight into the evolutionary history of animals and plants (for instance, palaeontologists have discovered that whales had evolved from goat-sized land-dwelling animals called Pakicetus).

**9. What evidence do we have for the origin of life from inanimate matter?**

Solution:

* The evidence on the origin of life from inanimate matter was provided by Stanley L. Miller and Harold C. Urey’s experiment, which was conducted in 1953. They created an artificial environment which was reminiscent of the early earth’s atmosphere – it contained ammonia, hydrogen and other gases which were thought to have existed during primordial earth.
* This concoction of gases was kept at a temperature slightly below 100 ° C. Additionally, sparks were generated to simulate lightning, which was also thought to be common during that period. At the end of the experiment, he was able to create 11 out of the 20 amino acids which are required for life.

**10. Explain how sexual reproduction gives rise to more viable variations than asexual reproduction. How does this affect the evolution of those organisms that reproduce sexually?**

Solution:

* Sexual reproduction causes a lot of viable variations because of the following reasons:
* (a) Error in copying of DNA (though it was rare)
* (b) Random segregation of paternal and maternal chromosomes at the time of sex cell formation.
* (c) Exchange of genetic material between homologous chromosomes during the formation of gametes.
* (d) Accumulation of variations occurred because of reproduction over generation after generation, and choice naturally created wide diversity.
* (e) In the case of asexual reproduction, variation is severely limited as there is only one parent involved. Hence, the offspring is genetically similar to the parent

**11. How is the equal genetic contribution of male and female parents ensured in the progeny?**

Solution:

* Equal genetic contribution of male and female parents is ensured in progeny through the inheritance of equal numbers of chromosomes from both parents. There are 23 pairs of chromosomes, but not all are paired. The 22 pairs are called autosomes, while the remaining 1 pair is called the sex chromosomes (represented as X and Y.)
* Females have two sets of X-chromosomes, while males have one X-chromosome and one Y-chromosome.
* During the process of reproduction, fertilisation takes place, where the male gamete fuses with the female gamete, and it results in the formation of a diploid zygote. Furthermore, the zygote receives an equal contribution of genetic material from both parents. The male contributes 22 autosomes plus one X or Y chromosome. The female contributes 22 autosomes plus one X-chromosome.

**12. Only variations that confer an advantage to an individual organism will survive in a population. Do you agree with this statement? Why or why not?**

Solution:

* The statement holds true – only variations provide an advantage to individual organisms that will survive in a population. For example, variations that lead to the increase in heat resistance in bacteria are very useful for survival if they find themselves in an environment where there is a sudden increase in ambient temperature. This will determine the difference between life and death for the bacteria.

**1. What are the trophic levels? Give an example of a food chain and state the different trophic levels in it.**

Solution:

In the food chain, the transfer of food or energy takes place at various levels, and these levels are known as trophic levels.

Example:

Grass → Goat → Man

In the food chain,

* Grass represents the first trophic level.
* The goat represents the second trophic level.
* Man represents the third trophic level.

**2. What is the role of decomposers in the ecosystem?**

Solution:

The following are the roles of decomposers in the ecosystem:

* They act as a cleansing agent of the environment by decomposing dead plants and animals.
* They help in recycling nutrients.
* They provide space for new beings in the biosphere by decomposing the dead.
* They help in putting back the various elements into water, soil and air for the reuse of producers like crop plants.

**1. Why are some substances biodegradable and some non-biodegradable?**

Solution:

The reason why some substances are biodegradable and some are non-biodegradable is because the microorganisms, like bacteria, and decomposers, like saprophytes, have a specific role to play. They can break down only natural products like paper, wood, etc., but they cannot break down human-made products like plastics. Based on this, some substances are biodegradable and some are non-biodegradable.

**Q2. Give any two ways in which biodegradable substances would affect the environment.**

Solution:

The following are the ways in which biodegradable substances would affect the environment:

* They keep the environment clean as they are easily decomposed.
* They can easily go through the geochemical cycle with the help of decomposers.

**3. Give any two ways in which non-biodegradable substances would affect the environment.**

Solution:

The following are the ways in which non-biodegradable substances would affect the environment:

* They cause air, soil and water pollution.
* They may cause bio-magnification in the food chain resulting in the end of humans.

**1. What is ozone, and how does it affect the ecosystem?**

Solution:

Ozone is a molecule formed by the three atoms of oxygen and is known as an isotope of oxygen. The main function of the ozone layer is to provide protection to the earth’s surface from the harmful UV rays of the sun. These rays are harmful to living organisms and may result in skin cancer.

**2. How can you help in reducing the problem of waste disposal? Give any two methods.**

Solution:

The following are the ways to reduce the problem of waste disposal:

* 3 Rs: By following the 3 Rs, one can reduce the problem of waste disposal. The 3 Rs are reduce, recycle and reuse. Reducing the usage of private vehicles and opting for public transport can reduce air pollution. Recycling and reusing plastics is also a way to reduce waste disposal.
* Preparation of compost: All biodegradable wastes, like kitchen waste, can be dumped in the compost.

**4. What will happen if we kill all the organisms at one trophic level?**

Solution:

If we kill all the organisms in one trophic level, the food supply to the next level will stop, resulting in an imbalance of the ecosystem. As a result, animals in the higher levels will die, making the growth of animals in the lower trophic level increase in an enormous way. All of this will affect the overall balance in the ecosystem.

**5. Will the impact of removing all the organisms in the trophic level be different for different trophic levels? Can the organisms of any trophic level be removed without causing any damage to the ecosystem?**

Solution:

Yes, the impact of removing all the organisms in a trophic level will be different for different trophic levels. For example, if all the producers are removed, there is a chance of death or migration of the primary consumers, which will upset the trophic levels. This is the same for all levels. Therefore, the removal of organisms at any level would upset the whole ecosystem as the food chain is disturbed. The survival of the higher-level animals is completely dependent on the animals at the lower levels.

**6. What is biological magnification? Will the levels of this magnification be different at different levels of the ecosystem?**

Solution:

Biological magnification can be defined as the progressive increase in the concentration of non-biodegradable wastes in the food chain. As there is an increase in the magnification at the successive trophic levels of the ecosystems, all the other levels do get affected, and the concentration may vary when compared to the first level.

**7. What are the problems caused by the non-biodegradable wastes that we generate?**

Solution:

The following are the problems caused by non-biodegradable wastes:

* These substances cannot be decomposed by microorganisms.
* As the quantity increases, dumping becomes a problem.
* Non-biodegradable wastes, like heavy metals, may enter the food chain at the upper trophic levels.
* They may escape to the groundwater, which causes soil infertility and disturbance in the pH of the soil.

**8. If all the waste we generate is biodegradable, will this have no impact on the environment?**

Solution:

Biodegradable wastes are decomposed by the microorganisms into simpler substances which can be used by the producers as raw materials. But the following are the effects of too many biodegradable wastes:

* As the decomposition of biodegradable wastes is slow, they produce an awful smell, and when inhaled by humans, it can be harmful.
* The dumping areas can be a place where harmful organisms may start to breed, which can be harmful to humans as well as plants and animals.
* An increase in the number of aquatic organisms may result in the depletion of oxygen.

**9. Why is damage to the ozone layer a cause for concern? What steps are being taken to limit this damage?**

Solution:

The ozone layer is a protective cover for the earth. It prevents harmful UV rays from entering the earth as these rays are harmful and can result in skin cancer. But, air pollutants like chlorofluorocarbons (CFCs) are the main reason for the depletion of the ozone layer. Too much of UV rays are harmful to plants as they affect photosynthesis and destroy planktons and decomposers. These are the reasons why the damage to the ozone layer is a cause of concern.

As a step to limit this, many developing and developed countries have signed and are obeying the directions of UNEP (United Nations Environment Programme) to freeze or limit the production and usage of CFCs.