Intext Exercise 1

Question 1:
Why is diffusion insufficient to meet the oxygen requirements of multi-cellular organisms like humans?

Solution 1:
Multicellular organisms such as humans possess complex body designs. They have specialised cells and tissues for performing various necessary functions of the body such as intake of food and oxygen. Unlike unicellular organisms, all cells in a multicellular organism are not in direct contact with the outside environment. Therefore, diffusion cannot meet their oxygen requirements.

Question 2:
What criteria do we use to decide whether something is alive?

Solution 2:

Presence of life processes and the presence of a cellular structure is used to determine whether something is alive or not. The important life processes in living organisms are:
Nutrition, respiration, transportation, excretion, control and co-ordination, growth and reproduction

Question 3:
What are outside raw materials used for by an organism?

Solution 3:
An organism uses outside raw materials mostly in the form of food, water and oxygen. The raw materials are used by the organism for performing important functions in the body and vary according to the complexity of the organism and its environment.

1. Food is used for providing energy and nutrients for the cells in the body
2. Water is the most important medium in which cellular reactions take place. Water is also required for digestion and is the major constituent of blood and protoplasm
3. Oxygen is used for aerobic respiration so as to release energy stored in the food.

Question 4:
What processes would you consider essential for maintaining life?

Solution 4:
Life processes essential for maintaining life are nutrition, respiration, transportation, excretion and control and co-ordination

Intext Exercise 2

Question 1:
What are the differences between autotrophic nutrition and heterotrophic nutrition?

Solution 1:

Autotrophic nutrition	Heterotrophic nutrition
(i) Food is synthesized from simple inorganic raw materials such as CO2 and water.	(i) Food is obtained from complex organic sources such as plants or animals. This food is broken down with the help of enzymes.
(ii) Presence of green pigment (chlorophyll) is necessary.	(ii) No pigment is required in this type of nutrition.
(iii) Food is generally prepared in presence of sunlight (photosynthesis)	(iii) Food can be obtained at all times.
(iv) All green plants and some bacteria have this type of nutrition.	(iv) All animals and fungi have this type of nutrition.

Question 2:
Where do plants get each of the raw materials required for photosynthesis?

Solution 2:
The following raw materials are required for photosynthesis: carbon dioxide, water, sunlight, chlorophyll.
• CO2 enters from the atmosphere through stomata.
• Water is absorbed from the soil by the plant roots.

• Sunlight, an important component to manufacture food, is absorbed by the chlorophyll and other green parts of the plants.

- Chlorophyll is present is all green parts of the plants but mainly leaves.

Question 3:

What is the role of the acid in our stomach?

Solution 3:

The hydrochloric acid present in our stomach dissolves bits of food and creates an acidic medium.

In this acidic medium, enzyme pepsinogen is converted to pepsin, which is a protein-digesting enzyme and can function optimally only in acidic pH. The acid also kills microorganisms that enter the stomach along with food.

Question 4:

What is the function of digestive enzymes?

Solution 4:

Digestive enzymes such as amylase, lipase, pepsin, trypsin, etc. help in the breaking down of complex food into simpler molecules which can be easily absorbed by the cells of the body. These enzymes act as biocatalysts speeding up the rate of breakdown of complex food. In absence of these enzymes a single meal would take a very long time to digest.

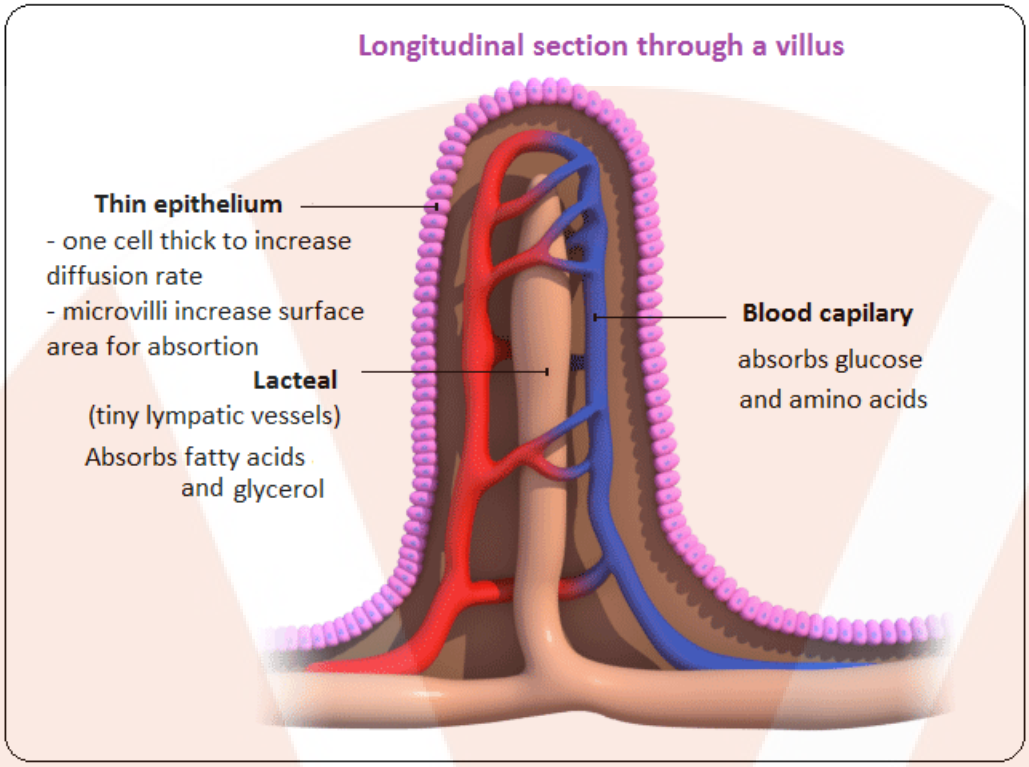
Question 5:

How is the small intestine designed to absorb digested food?

Solution 5:

The small intestine has millions of tiny finger-like projections called villi. These villi increase the

surface area for more efficient food absorption. The villi are covered with a single-cell thick layer of epithelium to allow easy absorption of food from the intestine to the blood and lymph vessels. Within these villi, many blood vessels and a lymph vessel (lacteal) are present that absorb the digested food and carry it to the blood stream. From the blood stream, the absorbed food is delivered to each and every cell of the body.



Enlarged view of a villus

Additionally, the small intestine is highly convoluted and lengthy. This further increases the surface area for absorption.

Intext Exercise 3

Question 1:

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

Solution 1:

Terrestrial organisms take up oxygen from the atmosphere whereas aquatic animals need to utilize oxygen present in the water. Air contains more O2 as compared to water. Since the content of O2 in air is high, the terrestrial animals do not have to breathe faster to get more oxygen. Also, unlike aquatic animals, terrestrial animals do not have to show various adaptations for better gaseous exchange between blood and water.

Question 2:

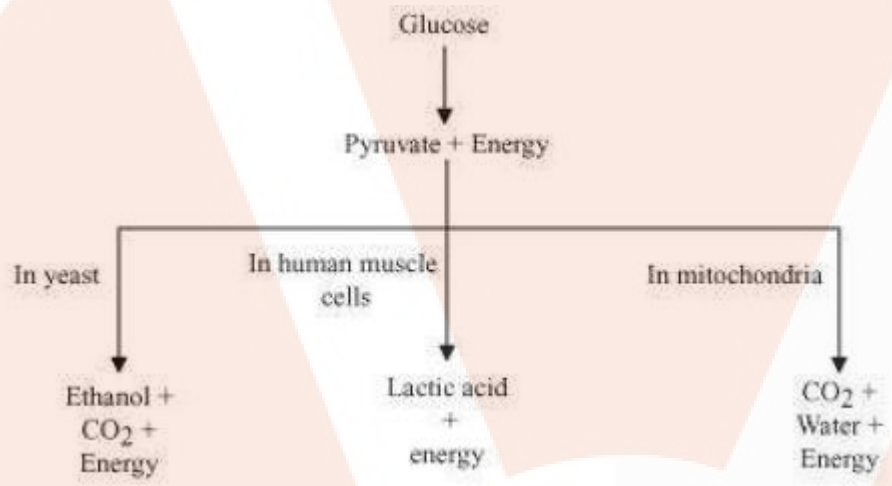
What are the different ways in which glucose is oxidized to provide energy in various organisms?

Solution 2:

Glucose is first broken down in the cell cytoplasm into a three carbon molecule called pyruvate in a process called as glycolysis.

Pyruvate is further broken down by different ways to provide energy.

The breakdown of glucose by different pathways can be illustrated as follows.



In yeast and human muscle cells, the incomplete breakdown of pyruvate can occur in the absence of oxygen in the cytoplasm to form ethanol and lactic acid respectively (anaerobic respiration) whereas in mitochondria, the complete breakdown of pyruvate occurs in the presence of oxygen (aerobic respiration). Aerobic respiration releases more energy due to complete breakdown of pyruvate.

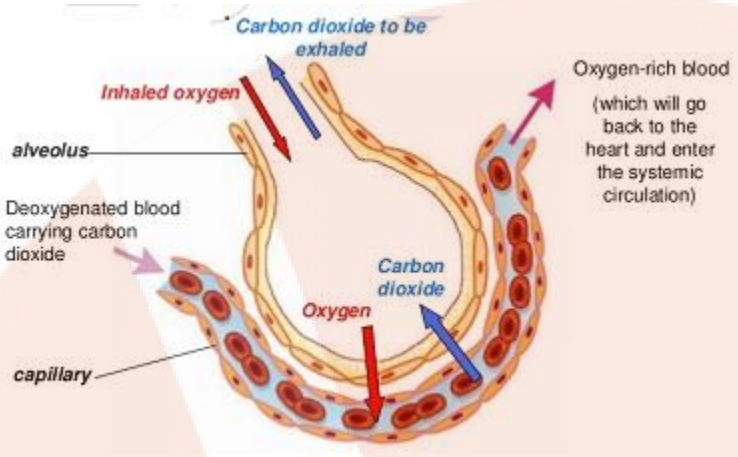
Question 3:

How is oxygen and carbon dioxide transported in human beings?

Solution 3:

Oxygen and carbon dioxide are transported in human beings through blood. The red pigment hemoglobin present in the erythrocytes transports oxygen molecule to all the body cells for cellular respiration. The hemoglobin pigment gets attached to O2 molecules that are obtained through breathing. It thus forms oxy-hemoglobin and the blood becomes oxygenated. This oxygenated blood is then distributed to all the body cells by the heart. After giving away O2 to the body cells, blood takes away CO2 which is the end product of cellular respiration. Now the blood becomes de-oxygenated.

Since hemoglobin pigment has less affinity for CO2, CO2 is mainly transported in the dissolved form. This de-oxygenated blood gives CO2 to lung alveoli and takes O2 in return.



Transportation of O_2 and CO_2 in blood

Question 4:

How are the lungs designed in human beings to maximize the area for exchange of gases?

Solution 4:

The exchange of gases takes place between the blood of the capillaries that surround the alveoli and the gases present in the alveoli. Thus, alveoli are the site for exchange of gases. Each lung contains 300-350 million alveoli. These numerous alveoli increase the surface area for gaseous exchange making the process of respiration more efficient The lungs get filled up with air during the process of inhalation as ribs are lifted up and diaphragm is flattened.

The air that is rushed inside the lungs fills the numerous alveoli present in the lungs.

.

Intext Exercise 4

Question 1:

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

Solution 1:

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

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

Being a fluid connective tissue, **blood** helps in the transport of oxygen, nutrients, CO_2, nitrogenous wastes,and hormones. Blood also is a main component in our immune system due to the presence and action of the WBCs. The presence of platelets causes clotting of blood which is essential for repairing damaged blood vessels. Additionally the transport of blood helps in maintaining body temperature.

The **blood vessels** (arteries, veins, and capillaries) carry blood either away from the heart to various organs or from various organs back to the heart.

Arteries carry blood away from the heart to other parts of the body. All arteries except pulmonary artery carry oxygenated blood.

Veins carry blood to the heart from various parts of the body. All veins except pulmonary vein carry deoxygenated blood.

Capillaries are the site of exchange of materials between blood and tissues. The exchange occurs across the single-cell thick wall of the capillary vessels.

Question 2:

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

Solution 2:

Warm-blooded animals such as birds and mammals maintain a constant body temperature by cooling themselves when they are in a hotter environment and by warming their bodies when they are in a cooler environment. They need to utilize glucose as required to maintain homeostasis with respect to body temperature. Hence, these animals require more oxygen (O_2) for more efficient cellular respiration so that they can produce more energy to maintain their body temperature. Thus, it is necessary for them to separate oxygenated and de-oxygenated blood, so that their circulatory system is more efficient and can maintain their constant body temperature.

Question 3:

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

Solution 3:

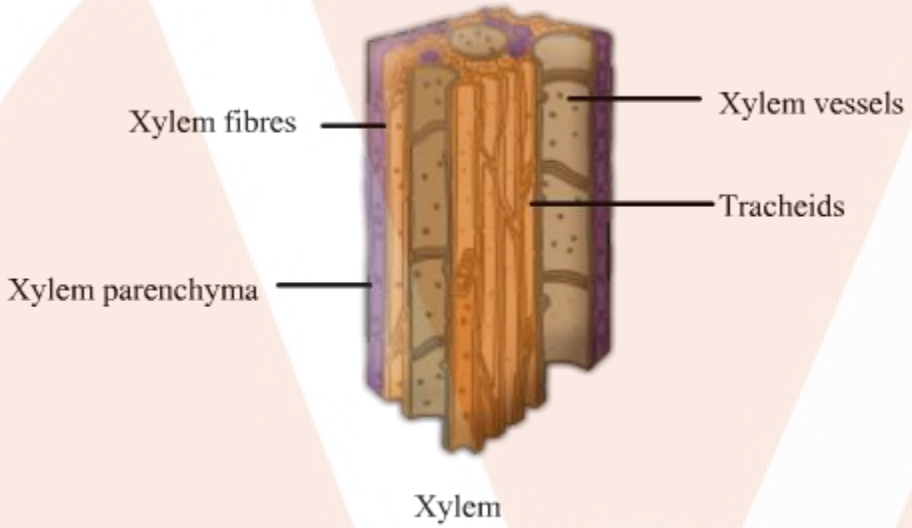
In highly organised plants, there are two different types of conducting tissues − xylem and phloem. Xylem conducts water and minerals obtained from the soil (via roots) to the rest of the plant. Phloem transports food materials from the leaves to different parts of the plant body.

Question 4:

How are water and minerals transported in plants?

Solution 4:

The components of xylem tissue (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. Water enters the plants through root pressure and osmosis. Transpiration creates a suction pressure, as a result of which water is pulled up into the xylem vessels. Then there is a steady movement of water from the root xylem to all the plant parts through the interconnected water-conducting channels.



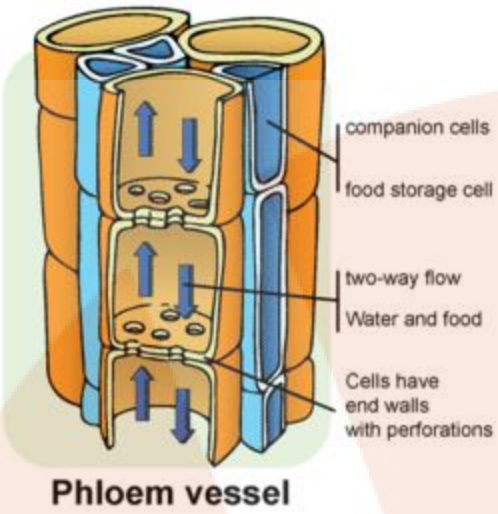
Components of xylem tissue

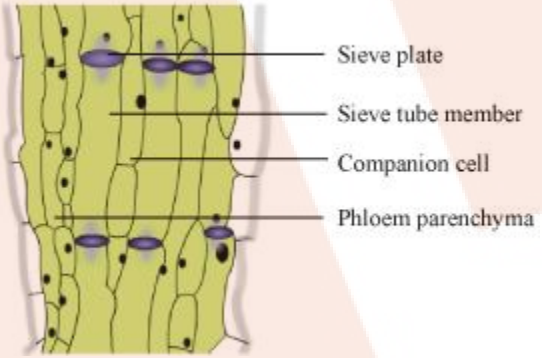
Question 5:

How is food transported in plants?

Solution 5:

Phloem transports food materials from the leaves to different parts of the plant body. The transportation of food in phloem is achieved by utilizing energy from ATP. As a result of this, the osmotic pressure in the tissue increases causing water to move into it. This pressure moves the material in the phloem to the tissues which have less pressure. This is helpful in moving materials according to the needs of the plant. For example, the food material, such as sucrose, is transported into the phloem tissue using ATP energy.





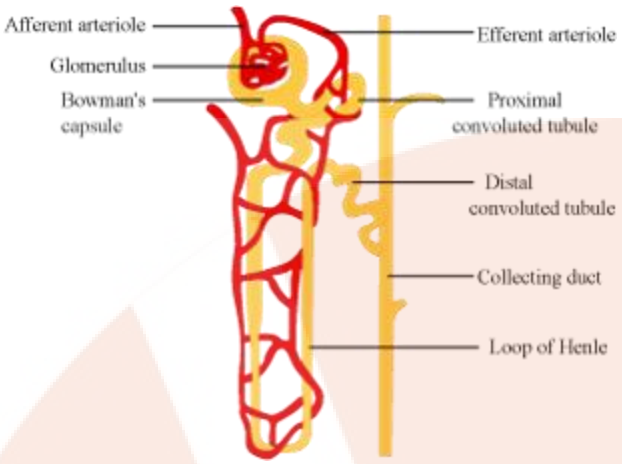
Intext Exercise 5

Question 1:

Describe the structure and functioning of nephrons.

Solution 1:

Nephrons are the basic filtering units of kidneys. Each kidney possesses large number of nephrons, approximately 1-1.5 million. The main components of the nephron are glomerulus, Bowman's capsule, and a long renal tubule.



Structure of a nephron

Functioning of a nephron:

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

Question 2:

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

Solution 2:

Plants can get rid of excess of water by transpiration. Waste materials may be stored in the cell vacuoles or as gum and resin, especially in old xylem. It is also stored in the leaves that later fall off. Waste products of photosynthesis (oxygen) and respiration (carbon dioxide) are released by diffusion through stomata.

Question 3:

How is the amount of urine produced regulated?

Solution 3:
The amount of urine produced depends on the amount of excess water and dissolved wastes present in the body. If there is excess water present in the bodythen less water is reabsorbed and more water is lost from the body and vice-versa. Some other factors such as habitat of an organism and hormone such as Antidiuretic hormone (ADH) also regulates the amount of urine produced.

NCERT Exercise

Question 1:
The kidneys in human beings are a part of the system for
(a) nutrition.
(b) respiration.
(c) excretion.
(d) transportation.

Solution 1:
(c) In human beings, the kidneys are a part of the system for excretion.

Question 2:
The xylem in plants are responsible for
(a) transport of water.
(b) transport of food.
(c) transport of amino acids.
(d) transport of oxygen.

Solution 2:
(a) In a plant, the xylem is responsible for transport of water.

Question 3:
The autotrophic mode of nutrition requires
(a) carbon dioxide and water.
(b) chlorophyll.
(c) sunlight.
(d) all of the above.

Solution 3:
(d) The autotrophic mode of nutrition requires carbon dioxide, water, chlorophyll and sunlight.

Question 4:
The breakdown of pyruvate to give carbon dioxide, water and energy takes place in
(a) cytoplasm.
(b) mitochondria.
(c) chloroplast.
(d) nucleus.

Solution 4:
(b) The breakdown of pyruvate to give carbon dioxide, water and energy takes place in mitochondria.

Question 5:
How are fats digested in our bodies? Where does this process take place?

Solution 5:
Fats are present in the form of large globules in the small intestine. The small intestine gets the secretions in the form of bile juice and pancreatic juice respectively from the liver and the pancreas. The bile salts (from the liver) break down the large fat globules into smaller globules so that the pancreatic enzymes (lipases) can easily act on them. This is referred to as emulsification of fats The bile juice also neutralizes the acidic pH of the chyme to allow the pancreatic and intestinal enzymes to act. It takes place in the small intestine.

Question 6:
What is the role of saliva in the digestion of food?

Solution 6:
Saliva is secreted by the salivary glands, located under the tongue. It moistens the food for easy chewing and swallowing. It contains a digestive enzyme called salivary amylase, which breaks down starch into sugar.

Question 7:
What are the necessary conditions for autotrophic nutrition and what are its by-products?

Solution 7:
Autotrophic nutrition takes place through the process of photosynthesis. Carbon dioxide, water, chlorophyll pigment, and sunlight are the necessary conditions required for autotrophic nutrition. Carbohydrates (food) and O2 are the by-products of photosynthesis.

$$6CO_2 + 6H_2O \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} C_6H_{12}O_6 + 6O_2$$

Question 8:

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

Solution 8:

Aerobic respiration	Anaerobic respiration
1. It occurs in the presence of O2	1. It occurs in the absence of O2.
2. It involves the exchange of gases between the organism and the outside environment.	2. Exchange of gases is absent.
3. It occurs in cytoplasm and mitochondria.	3. It occurs only in cytoplasm.
4. It always releases CO2 and H2O.	4. End products vary.
5. It yields 36 ATPs. 6. It results in complete oxidation of glucose	5. It yields only 2 ATPs. 6. It results in incomplete oxidation of glucose

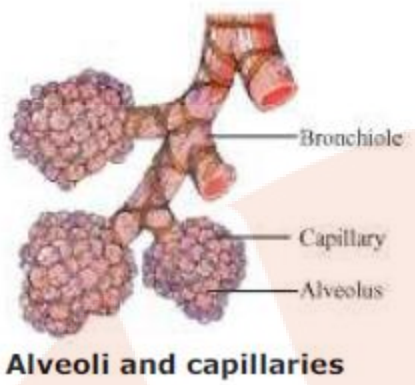
Anaerobic respiration occurs in the roots of some waterlogged plants, some parasitic worms, animal muscles, and some micro-organisms such as yeasts and bacteria.

Question 9:

How are the alveoli designed to maximise the exchange of gases?

Solution 9:

The alveoli are the small balloon-like structures present in the lungs. The walls of the alveoli consist of extensive network of blood vessels. Each lung contains 300–350 million alveoli, making it a total of approximately 700 million in both the lungs. The alveolar surface when spread out covers about 80 m^2 area. This large surface area makes the gaseous exchange more efficient.



Alveoli and capillaries

Question 10:

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

Solution 10:

Haemoglobin is the respiratory pigment that transports oxygen to the body cells for cellular respiration. Therefore, deficiency of haemoglobin in blood can affect the oxygen supplying capacity of blood. This can lead to deficiency of oxygen in the body cells. It can also lead to a disease called anaemia.

Question 11:

Describe double circulation in human beings. Why is it necessary?

Solution 11:

Double circulation is the mechanism in which blood is passed through the heart twice in a single cycle of circulation. There are two components in double circulation- pulmonary circulation and systemic circulation.

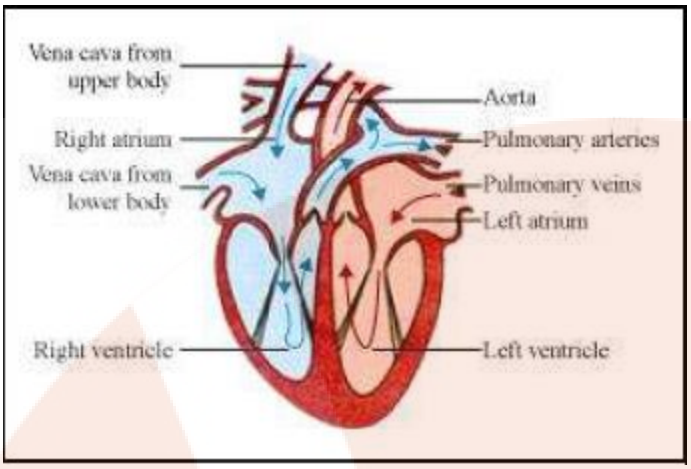
In pulmonary circulation the blood is circulated between heart and the lungs.

In systemic circulation the blood is circulated between the heart and the rest of the body

The human heart is divided into four chambers − the right atrium, the right ventricle, the left atrium, and the left ventricle.

Flow of blood in the heart:

· The heart has superior and inferior vena cava, which carries de-oxygenated blood from the upper and lower regions of the body respectively and supplies this de-oxygenated blood to the right atrium of the heart.



Flow of blood in the human heart

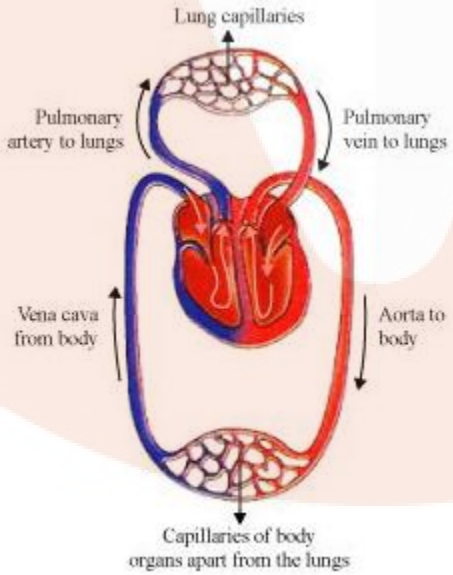
· The right atrium then contracts and passes the de-oxygenated blood to the right ventricle, through an auriculo-ventricular aperture.

· Then the right ventricle contracts and passes the de-oxygenated blood into the two pulmonary arteries, which pumps it to the lungs where the blood becomes oxygenated.

From the lungs, the pulmonary veins transport the oxygenated blood to the left atrium of the heart.

· Then the left atrium contracts and through the auriculo-ventricular aperture, the oxygenated blood enters the left ventricle.

· The blood passes to aorta from the left ventricle. The aorta gives rise to many arteries that distribute the oxygenated blood to all the regions of the body.



Schematic diagram of blood circulation in humans
Therefore, the blood goes twice through the heart. This is known as double circulation.

Importance of double circulation:
The separation of oxygenated and de-oxygenated blood allows a more efficient supply of oxygen to the body cells. This efficient system of oxygen supply is very useful in warm-blooded animals such as human beings.

Warm-blooded animals have to maintain a constant body temperature by cooling themselves when they are in a hotter environment and by warming their bodies when they are in a cooler environment. Hence, they require more O2 for more respiration so that they can produce more energy to maintain their body temperature. Thus, the circulatory system of humans is more efficient because of the double circulatory heart.

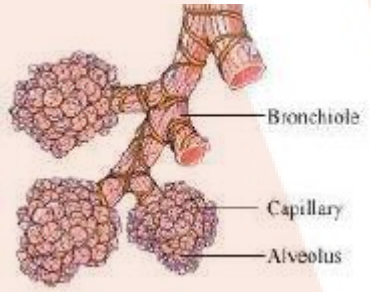
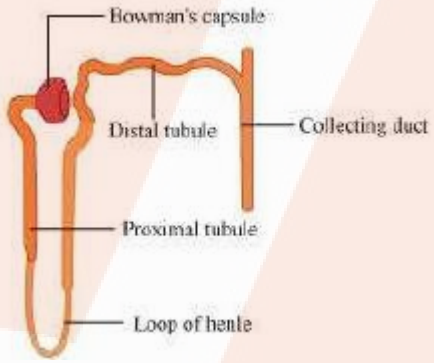
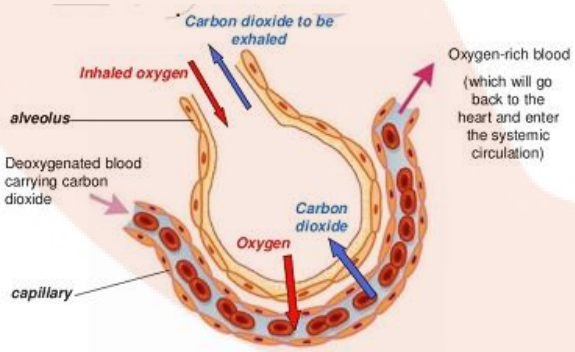
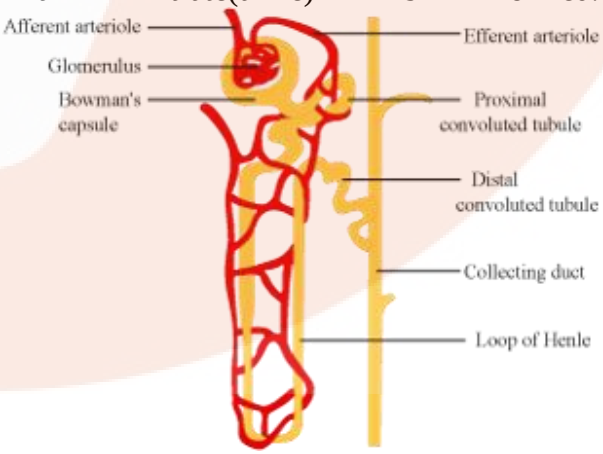
Question 12:
What are the differences between the transport of materials in xylem and phloem?

Solution 12:

Transport of materials in xylem	Transport of materials in Phloem
(i) Xylem tissue helps in the transport of water and minerals.	(i) Phloem tissue helps in the transport of food.
(ii) Water is transported only in the upward direction from roots to all other plant parts.	(ii) Food is transported in both upward and downward directions.
(iii) Transport in xylem occurs with the help of simple physical forces such as transpiration pull	(iii) Transport of food in phloem requires energy in the form of ATP.

Question 13:
Compare the functioning of alveoli in the lungs and nephrons in the kidneys with respect to their structure and functioning.

Solution 13:

Alveoli	Nephron
Structure (i) Alveoli are tiny balloon-like structures present inside the lungs. (ii) The walls of the alveoli are one cell thick and it contains an extensive network of blood capillaries.	Structure (i) Nephrons are tubular structures present inside the kidneys. (ii) Nephrons are made of glomerulus, bowman's capsule, and a long renal tube. It also contains a cluster of thin-walled capillaries.
	
Function (i) The exchange of O2 and CO2 takes place between the blood of the capillaries that surround the alveoli and the gases present in the alveoli. There is no selective reabsorption in alveoli 	Function (i) Nephron functions in filtering the blood to remove wastes. In the initial filtration in the nephron all solutes and a lot of water are filtered out. The essential molecules like amino acids, sodium salts, glucose and water are then selectively reabsorbed before the final filtrate(urine) is formed. 

(ii) Alveoli are the site of gaseous exchange for respiration	(ii) Nephrons are the basic filtration unit for excretion.