Madhya Pradesh Medical Science University, Jabalpur

First Year B.Sc. Nursing Examination Feb – 2018 (Main)

Anatomy & Physiology

Section – A

Q1. Describe the structure of

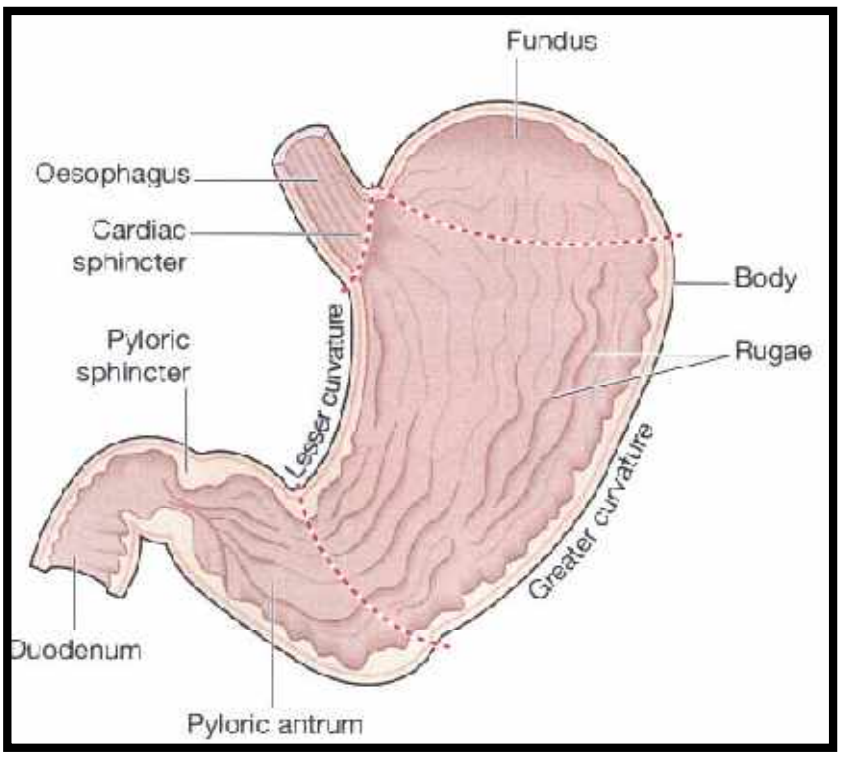
a) Stomach
b) Kidney

Answer (a) Structure of Stomach

The stomach is a J-shaped dilated portion of the alimentary tract situated in the epigastric, umbilical and left hypochondriac regions of the abdominal cavity.

The stomach is continuous with the oesophagus at the cardiac sphincter and with the duodenum at the pyloric sphincter. It has two curvatures. The lesser curvature is short, lies on the posterior surface of the stomach and is the downwards continuation of the posterior wall of the oesophagus.

Where the oesophagus joins the stomach the anterior region angles acutely upwards, curves downwards forming the greater curvature then slightly upwards towards the pyloric sphincter



Stomach is composed of three layers of smooth muscle fibres:

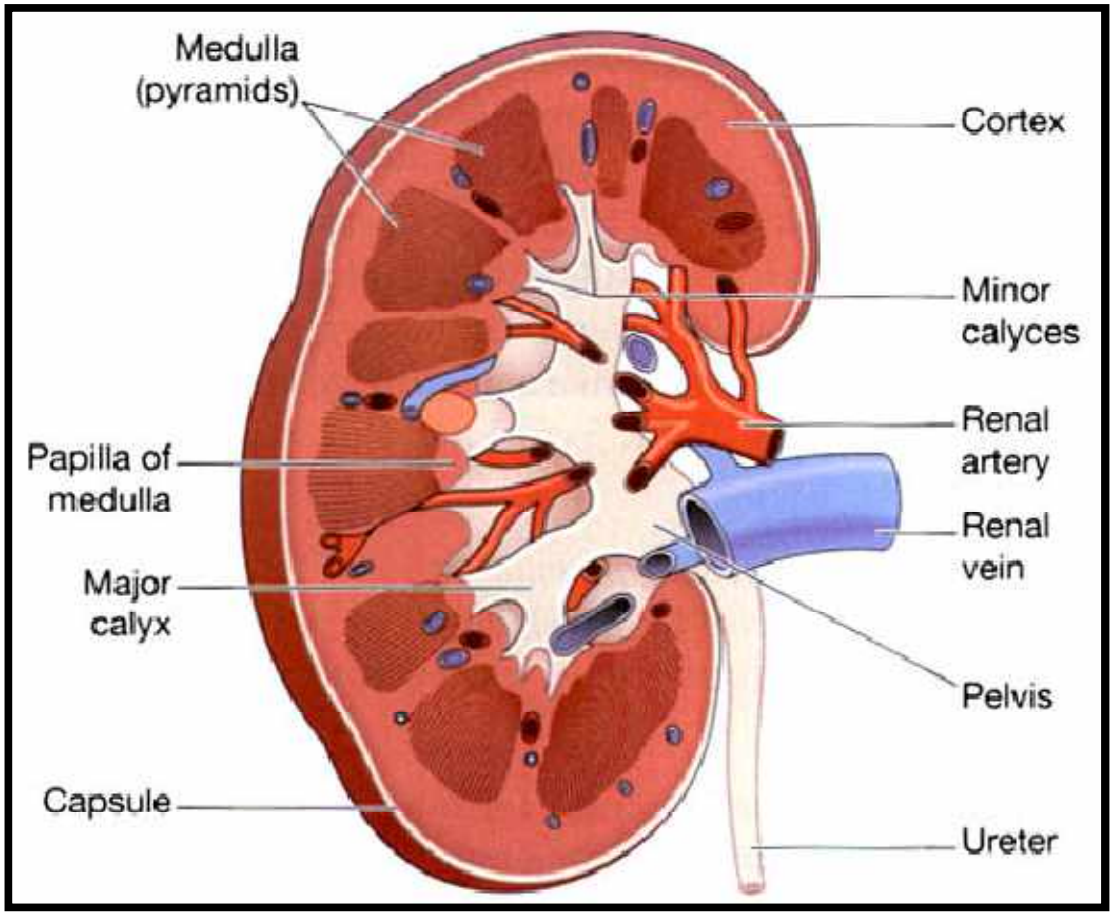
1. An outer layer of longitudinal fibres
2. A middle layer of circular fibres
3. An inner layer of oblique fibres.

Answer (b): The structure of Kidney

The kidney is composed of about 1 million functional units, the nephrons, and a smaller number of collecting tubules.

There are three areas of tissue which can be viewed with the naked eyes:

- A fibrous capsule, surrounding the kidney
- Cortex, a reddish-brown layer of tissue and outside the pyramids
- Medulla, the innermost layer, consisting of pale conical-shaped striations, the renal pyramids.



The hilum is the concave medial border of the kidney where the renal blood and lymph vessels, the ureter and nerves enter. The renal pelvis is the funnel-shaped structure which acts

as a receptacle for the urine formed by the kidney. It has a number of distal branches called calyces, each of which surrounds the apex of a renal pyramid.

Urine formed in the kidney passes through a papilla at the apex of a pyramid into a minor calyx, then into a major calyx before passing through the pelvis into the ureter.

Q2.

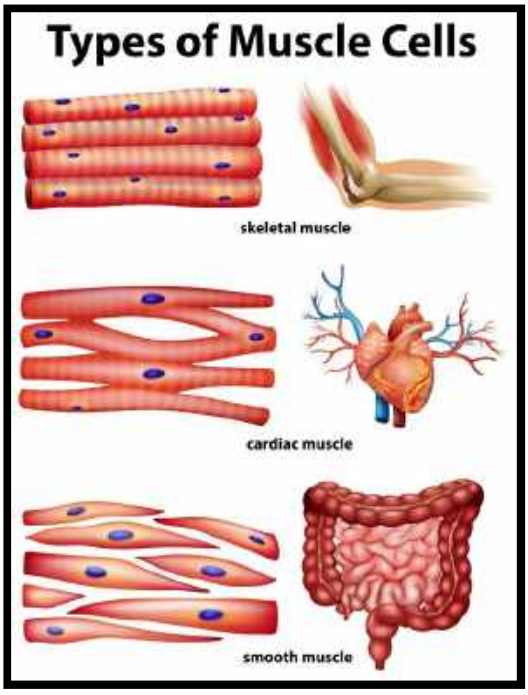
a. Define muscle
b. Write the type of muscle

Answer A:

Definition: Muscle is the tissue of the body which primarily functions as a source of power.

- Ross and Wilson

Answer B: Type of Muscle

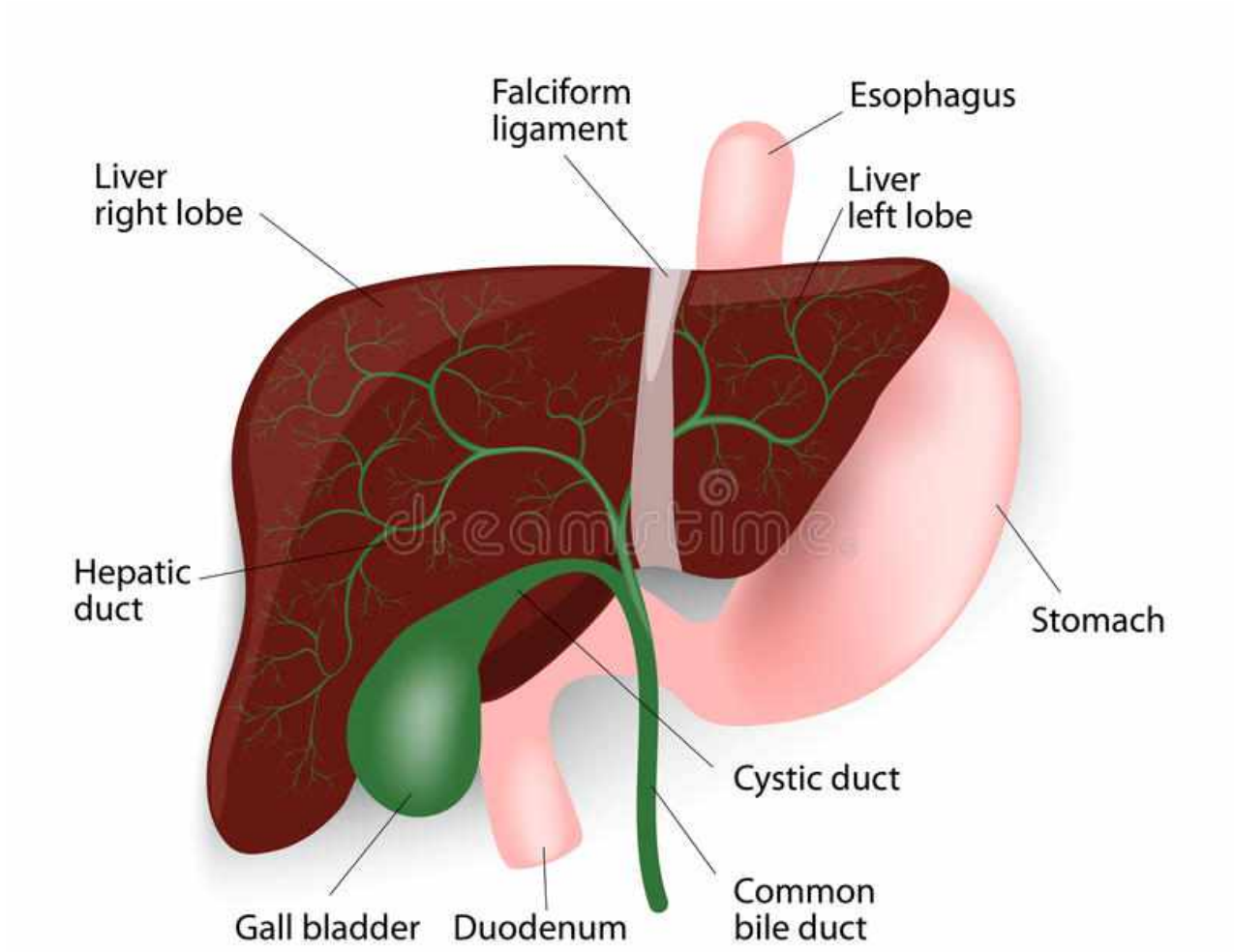


Draw labeled diagram

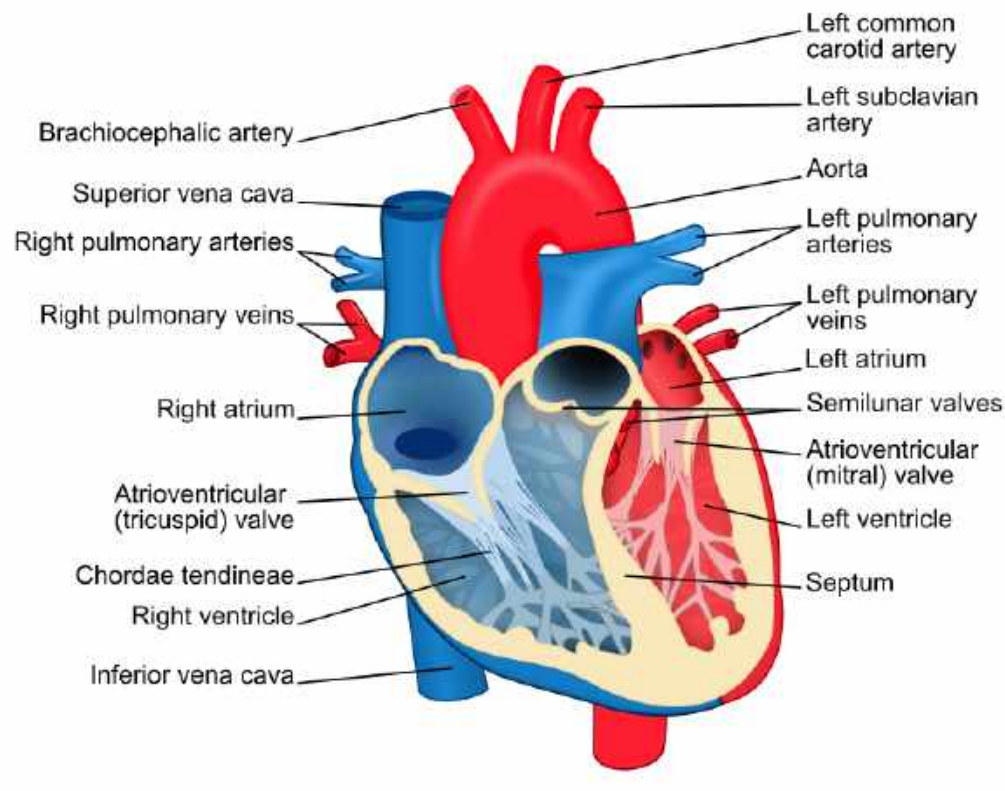
Q3.

a. Liver
b. Heart
c. Urinary bladder

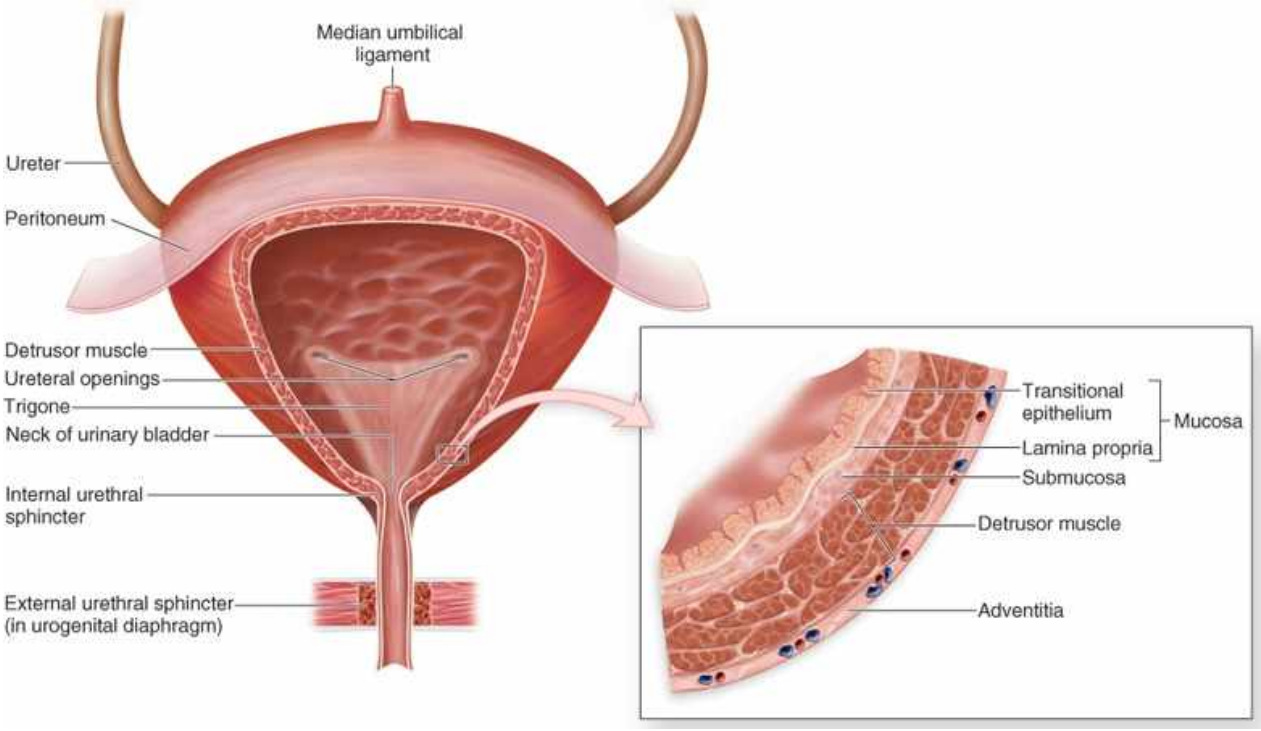
Answer A: Labeled diagram of Liver



Answer B: Labeled diagram of Heart



Answer C: Labeled diagram of Urinary Bladder



Short Note

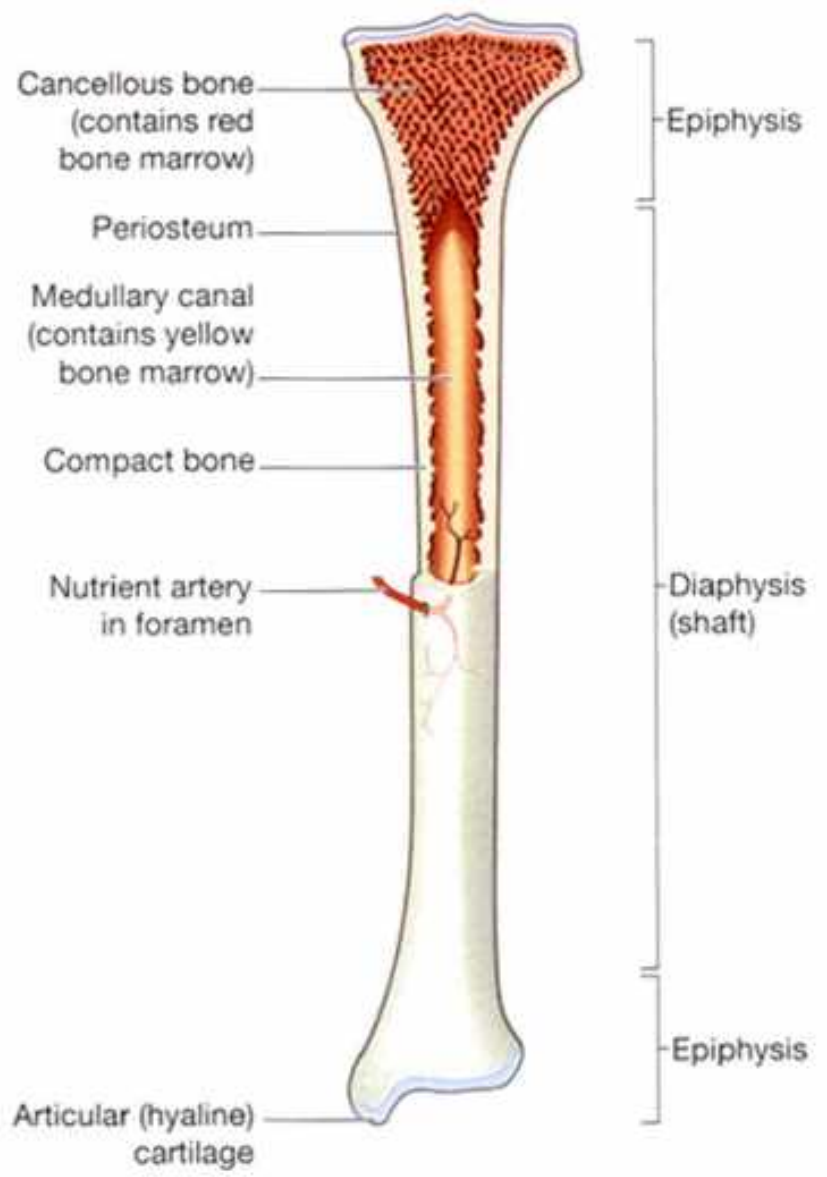
a. Bones
b. Cells
c. Brain
d. Eye

Answer (A): Bones

Bone is a strong and durable type of connective tissue.

It consists of:

- Water (25%)
- Organic constituents including osteoid and bone cells (25%)
- Inorganic constituents, calcium phosphate (50%).

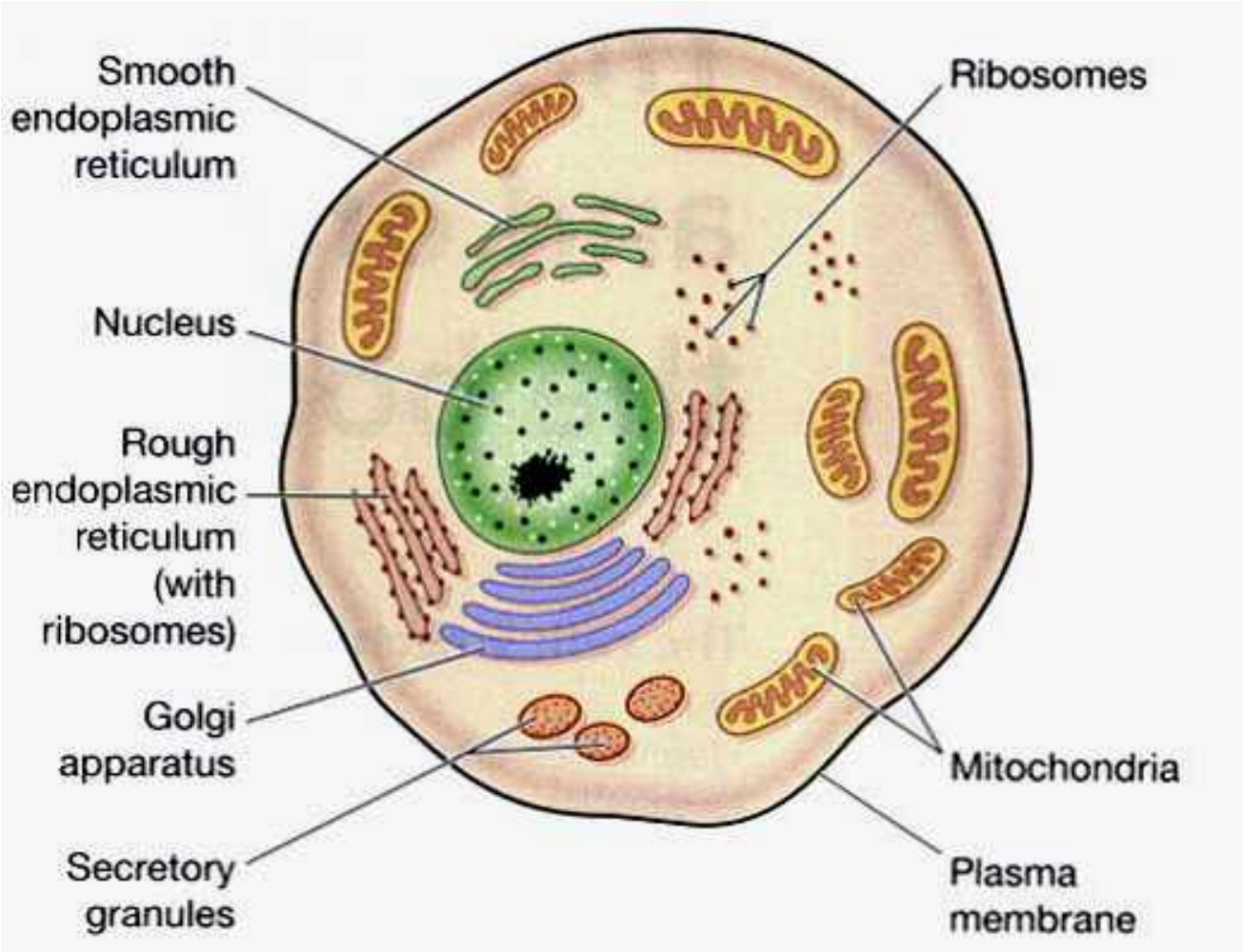


Bones have a diaphysis or shaft and two epiphyses. The diaphysis is composed of compact bone with a central medullary canal, containing fatty yellow bone marrow. The epiphyses consist of an outer covering of compact bone with cancellous bone inside. The diaphysis and epiphyses are separated by epiphyseal cartilages, which ossify when growth is complete. Thickening of a bone occurs by the deposition of new bone tissue under the periosteum.

Answer (B): Cells

Cells are the smallest functional units of the body. They are grouped together to form tissues, each of which has a specialised function.

Cells are often called the "building blocks of life". The study of cells is called cell biology. Cells consist of cytoplasm enclosed within a membrane, which contains many biomolecules such as proteins and nucleic acids.



Answer (C): Brain

The human brain is the command center for the human nervous system. It receives signals from the body's sensory organs and outputs information to the muscles. The human brain has the same basic structure as other mammal brains but is larger in relation to body size than any other brains.

The brain consists of the cerebrum, the brainstem and the cerebellum. It controls most of the activities of the body, processing, integrating, and coordinating the information it receives from the sense organs, and making decisions as to the instructions sent to the rest of the body.

The brain is contained in, and protected by, the skull bones of the head. The cerebrum is the largest part of the human brain. It is divided into two cerebral hemispheres. The cerebral cortex is an outer layer of grey matter, covering the core of white matter. The cortex is split into the neocortex and the much smaller allocortex. The neocortex is made up of six neuronal layers, while the allocortex has three or four. Each hemisphere is conventionally divided into four lobes – the frontal, temporal, parietal, and occipital lobes.

The parts are

- Cerebrum
- Midbrain
- Pons
- Medulla oblongata
- Cerebellum

Answer (D): Eye

The human eye is an organ which reacts to light and pressure. It is a sense organ, the mammalian eye allows vision. Human eyes help to provide a three dimensional, moving image, normally coloured in daylight. Rod and cone cells in the retina allow conscious light perception and vision including color differentiation and the perception of depth. The human eye can differentiate between about 10 million colors and is possibly capable of detecting a single photon.

The eye is not shaped like a perfect sphere, rather it is a fused two-piece unit, composed of the anterior segment and the posterior segment. The anterior segment is made up of the cornea, iris and lens. The cornea is transparent and more curved, and is linked to the larger

posterior segment, composed of the vitreous, retina, choroid and the outer white shell called the sclera.

The iris is the pigmented circular structure concentrically surrounding the center of the eye, the pupil, which appears to be black. The size of the pupil, which controls the amount of light entering the eye, is adjusted by the iris' dilator and sphincter muscles.

The eye is made up of three coats, or layers, enclosing various anatomical structures. The outermost layer, known as the fibrous tunic, is composed of the cornea and sclera. The middle layer, known as the vascular tunic or uvea, consists of the choroid, ciliary body, pigmented epithelium and iris. The innermost is the retina, which gets its oxygenation from the blood vessels of the choroid (posteriorly) as well as the retinal vessels (anteriorly).

The spaces of the eye are filled with the aqueous humour anteriorly, between the cornea and lens, and the vitreous body, a jelly-like substance, behind the lens, filling the entire posterior cavity. The aqueous humour is a clear watery fluid that is contained in two areas: the anterior chamber between the cornea and the iris, and the posterior chamber between the iris and the lens.

Section – B

Q1. Match the following

Column-A	**Column-B**
Oxytocin	Thermo regulation
Mitochondria	Largest serous membrane
Spleen	Eye
Olfactory	Large extremities
Peritoneum	Power house of the cell
Hypothalamus	Posterior pituitary
Acromegaly	Sense of smell
Lateral rectus	Phagocytosis

Answer 1:

Column-A	Column-B
Oxytocin	Posterior pituitary
Mitochondria	Power house of the cell
Spleen	Phagocytosis
Olfactory	Sense of smell
Peritoneum	Largest serous membrane
Hypothalamus	Thermo regulation
Acromegaly	Large extremities
Lateral rectus	Eye

Short Notes

Q2.

a. Menstrual cycle
b. Functions of large intestine
c. Conducting system of heart

Answer (A): Menstrual cycle

The menstrual cycle is the regular natural change that occurs in the female reproductive system that makes pregnancy possible. The cycle is required for the production of oocytes, and for the preparation of the uterus for pregnancy. The menstrual cycle is governed by hormonal changes. These changes can be altered by using hormonal birth control to prevent pregnancy.

The first period usually begins between twelve and fifteen years of age, a point in time known as menarche. They may occasionally start as early as eight, and this onset may still be normal.

The typical length of time between the first day of one period and the first day of the next is 21 to 45 days in young women and 21 to 35 days in adults (an average of 28 days). Menstruation stops occurring after menopause which usually occurs between 45 and 55 years of age. Bleeding usually lasts around 2 to 7 days.

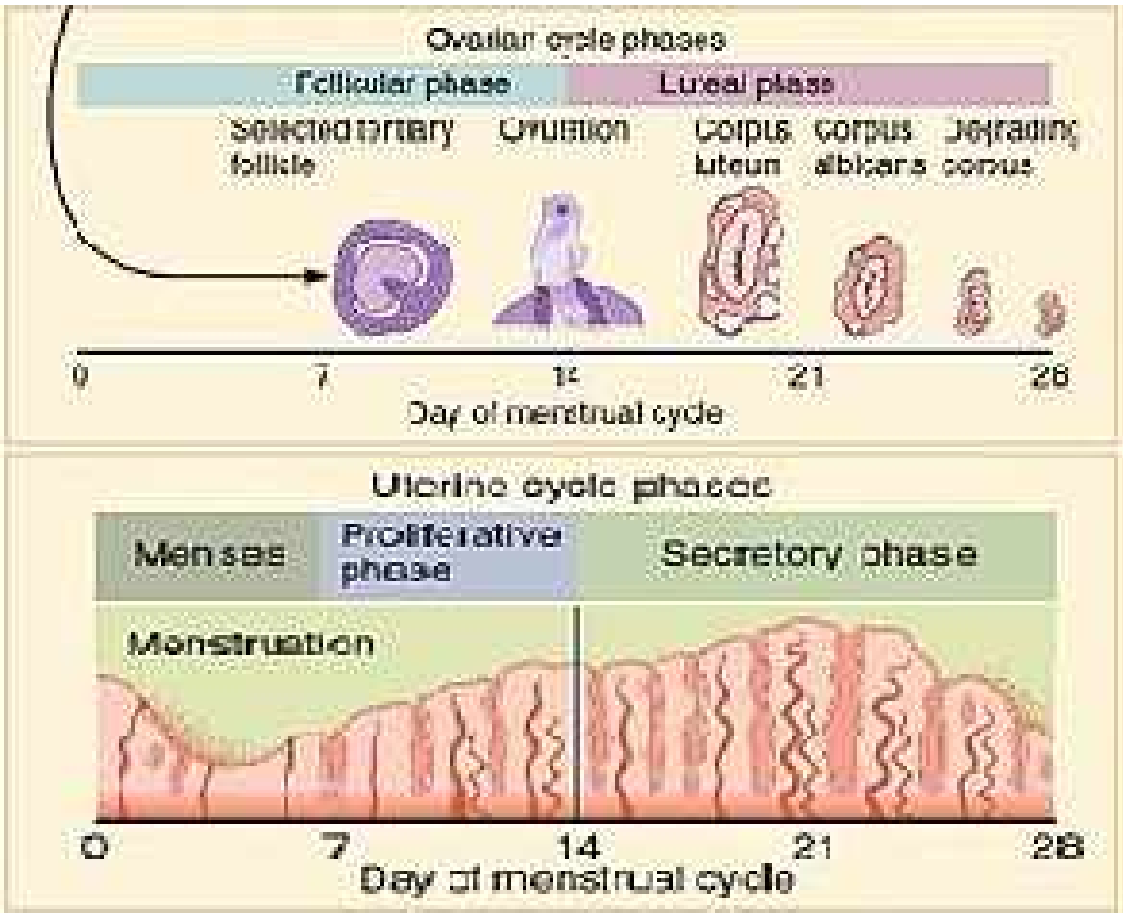
Menstrual cycle can be divided into three phases based on events in the ovary (ovarian cycle) or in the uterus (uterine cycle).

The ovarian cycle consist:

1. Follicular phase
2. Ovulation phase
3. Luteal phase

The uterine cycle is divided into:

1. Menstruation
2. Proliferative phase
3. Secretory phase



Answer (B): Functions of large intestine

The colon is the last part of the digestive system. It extracts water and salt from solid wastes before they are eliminated from the body and is the site in which flora-aided (largely bacterial) fermentation of unabsorbed material occurs.

The colon consists of five sections: the cecum plus the ascending colon, the transverse colon, the descending colon, the sigmoid colon, and the rectum.

Sections of the colon are:

- The ascending colon including the cecum and appendix
- The transverse colon including the colic flexures and transverse mesocolon
- The descending colon
- The sigmoid colon – the s-shaped region of the large intestine
- The rectum

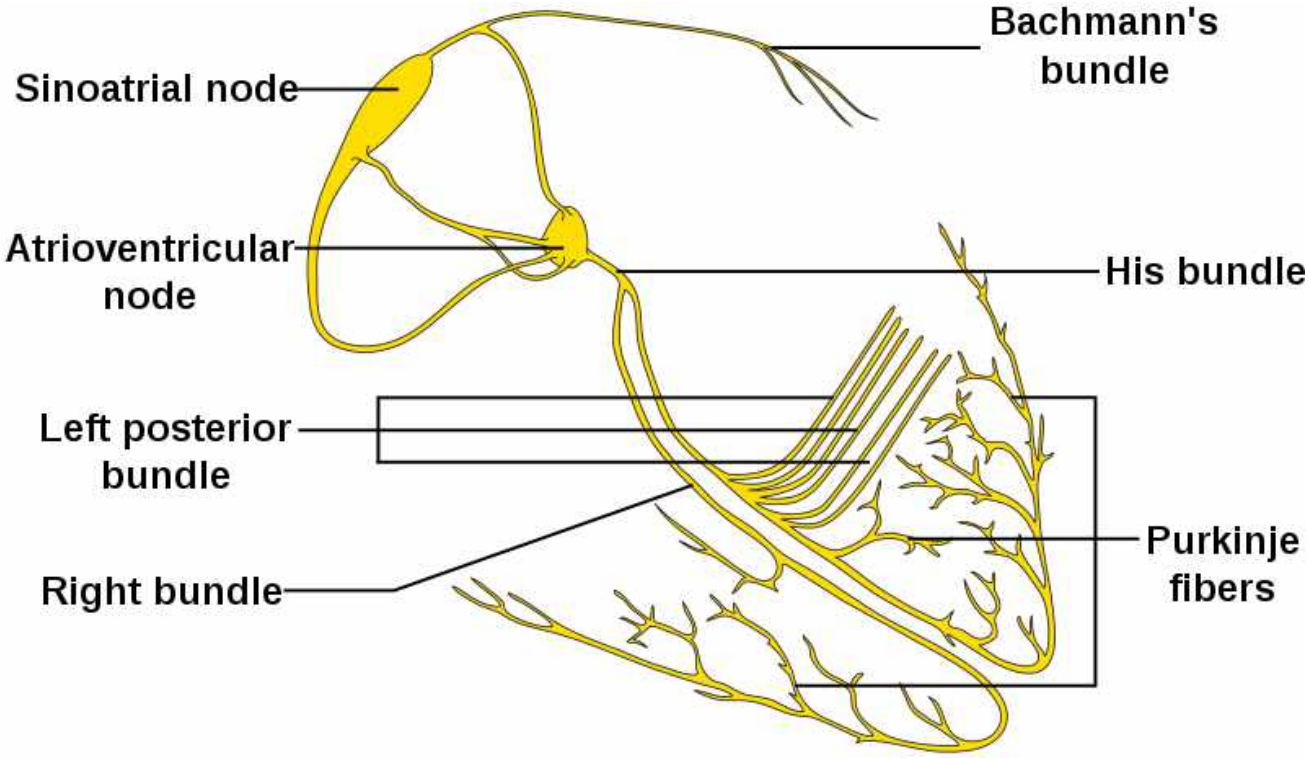
The functions of the large intestine is :

1. Absorbing water: Completing the process of digestion that largely takes place in the small intestine
2. Absorbing Vitamins: large intestine helps in absorption of vitamins made by bacteria that normally live in the large intestine.
3. Reducing acidity:
4. Defending from infections
5. Producing antibodies: The large intestine, particularly the appendix, is a confluence of several lymphoid tissues. These play an important role in immunity
6. Incubate bacteria: bacteria grow and undigested material and convert some of it to vitamins.

Answer (C): Conducting system of heart

The electrical conduction system of the heart transmits signals generated usually by the sinoatrial node to cause contraction of the heart muscle. The pacemaking signal generated in the sinoatrial node travels through the right atrium to the atrioventricular node, along the Bundle of His and through bundle branches to cause contraction of the heart muscle. This signal stimulates contraction first of the right and left atrium, and then the right and left ventricles.

The conduction system consists of specialised heart muscle cells, and is situated within the myocardium. There is a skeleton of fibrous tissue that surrounds the conduction system which can be seen on an ECG.

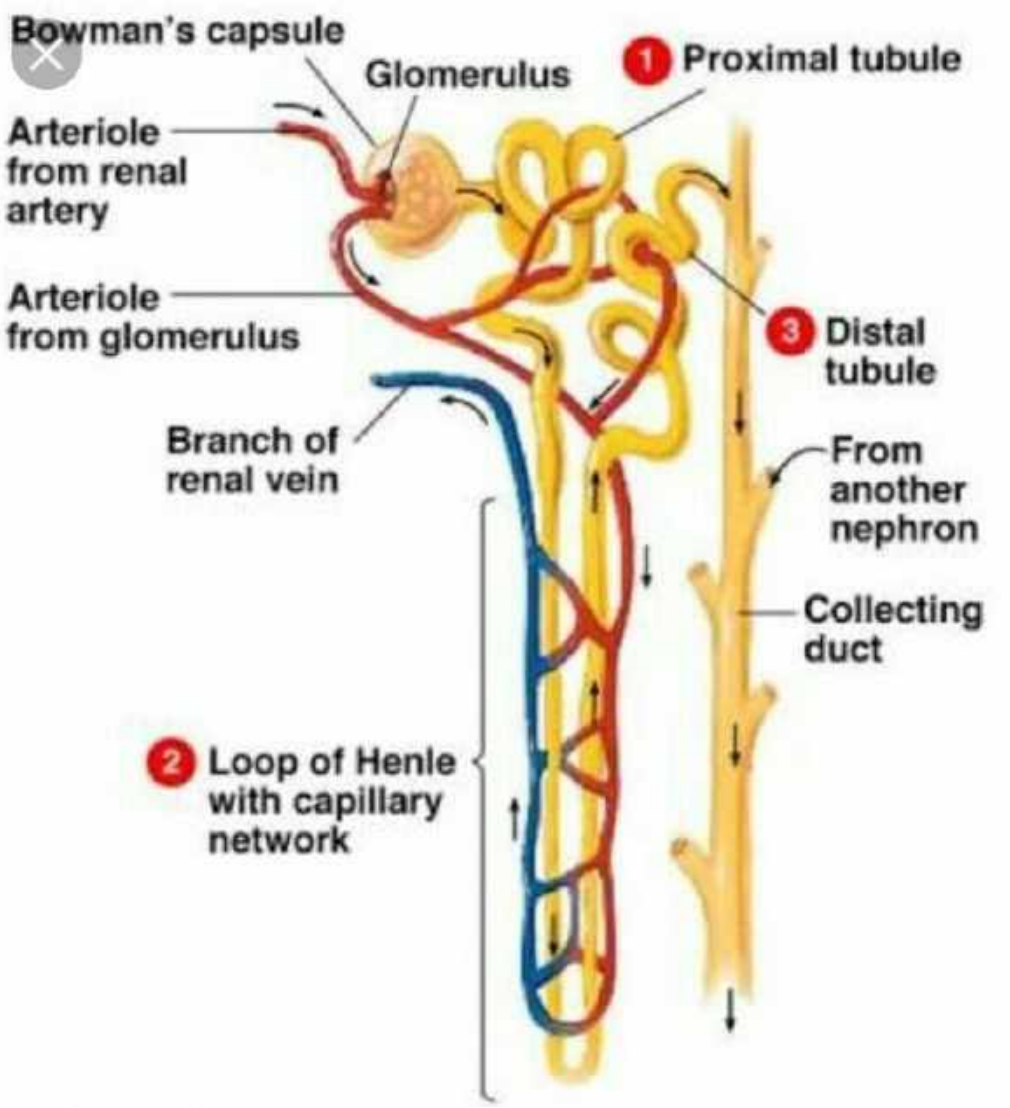


Electrical signals arising in the SA node (located in the right atrium) stimulate the atria to contract. Then the signals travel to the atrioventricular node (AV node), which is located in the inter atrial septum. After a delay, the electrical signal diverges and is conducted through the left and right bundle of His to the respective Purkinje fibers for each side of the heart, as well as to the endocardium at the apex of the heart, then finally to the ventricular epicardium; causing its contraction. These signals are generated rhythmically, which in turn results in the coordinated rhythmic contraction and relaxation of the heart.

Q3.

a. Draw a well labeled diagram of Nephron
b. Explain the mechanism of formation of urine

Answer (A): Labeled diagram of Nephron



Answer (B): Mechanism of formation of urine

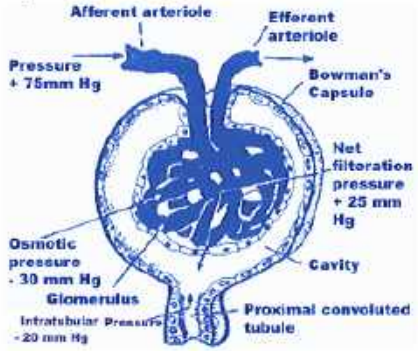
Formation of urine is a process important for the whole organism. Not only acid-base balance is modulated by it, but also blood osmolarity, plasma composition and fluid volume, and thus it influences all cells in our body.

A healthy adult person produces 1.5-2 liters of urine per day and this process involves three basic mechanisms:

1) Glomerular filtration
2) Tubular reabsorption
3) Tubular secretion

Step 1:Glomerular filtration

The first step in the formation of urine is the filtration of blood. The blood in the glomerulus is separated from the cavity within the Bowman's capsule only by (i) a thin layer of tissue composed of the single-celled endothelial lining, (ii) a layer of material called the basement membrane, and (iii) the single-celled lining of the Bowman's capsule. This barrier permits the filtration of the fluid from the capillaries into the Bowman's capsule. The energy for filtration is derived from the hydrostatic pressure of the blood. The glomerular afferent arteriole has a pressure of +75 mmHg. The osmotic pressure of the plasma proteins (about 30 mmHg) opposes the pressure exerted by the arteriole. The renal and tubular pressure is about 25 mmHg. The normal glomerular filtration rate is 120 ml/minute. The average volume of fluid filtered from the plasma into Bowman's capsule is about 170 litres per day. The composition of the ultrafiltrate in the Bowman's capsule is the same as the composition of blood, except that it does not contain blood cells and proteins. The appearance of red blood cells and protein in the urine indicates a defect in the process of glomerular filtration.



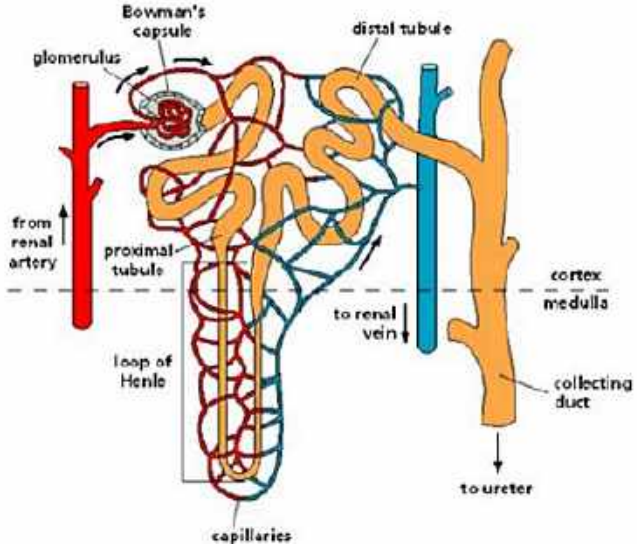
A Magnified View of the Glomerulus and Bowman's Capsule of the Nephron

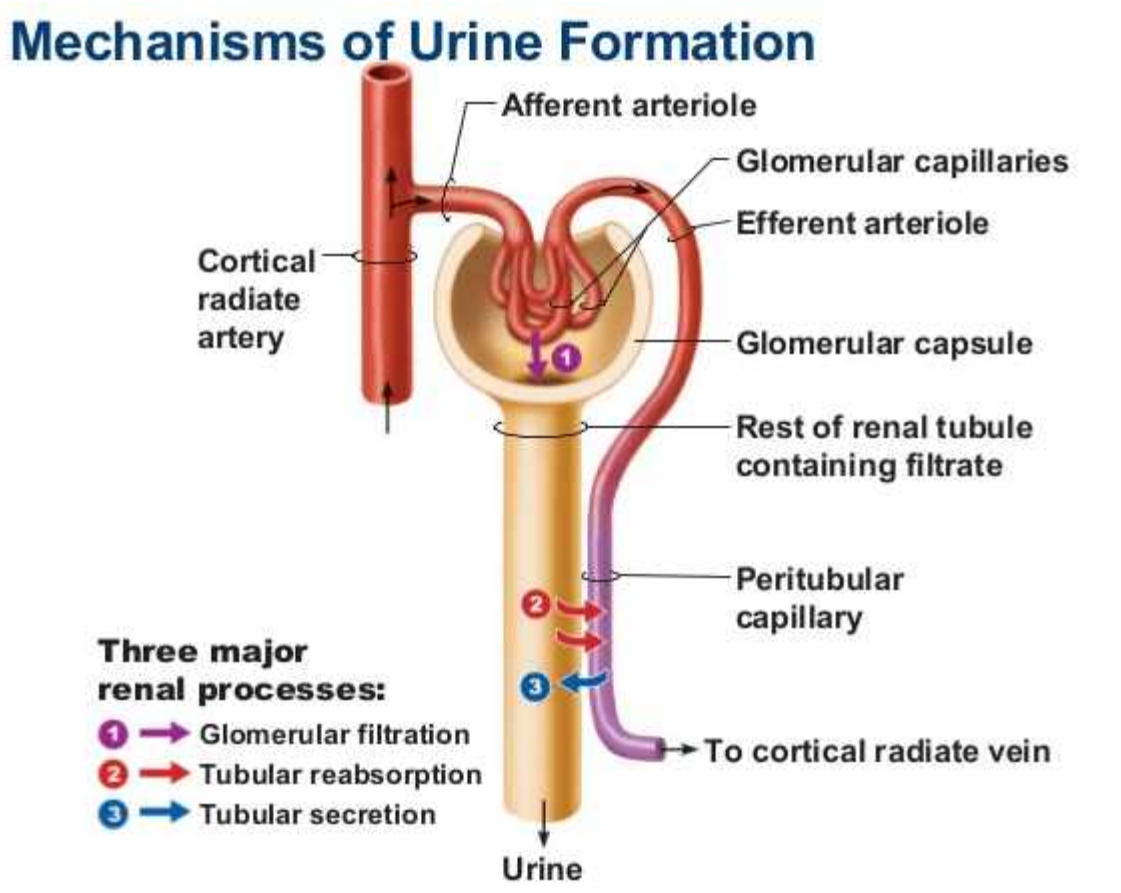
The ultra filtrate in the Bowman's capsule contains many substances besides waste products like urea. Most of the useful substances are reabsorbed from the ultrafiltrate as it is being carried to the renal tubule.

In the first part of the nephron, that is, in the proximal convoluted tubule, glucose and sodium ions are actively reabsorbed from the filtrate into the surrounding blood vessels. Reabsorption is an active transport process requiring energy form ATP. Chloride ions (Cl^-) are also passively reabsorbed along with sodium ions. However, the reabsorption of these solutes does not change the total solute concentration and the osmotic potential of the glomerular filtrate as its flows through the proximal convoluted tubule. This is because of the absorption of water. The water movement is passive. Movement of glucose and sodium and chloride ions from the glomerular filtrate to the blood tends to make the blood slightly hypertonic to the filtrate, therefore osmosis of water occurs to restore osmotic balance.

Certain substances are transported from the surrounding blood vessels into the nephron, in the region of the proximal convoluted tubule. This process is called secretion. The process of secretion allows these

From the loop of Henle, the urine which is now rather dilute, moves to the distal convoluted tubule, and then to a common collecting duct. Each collecting duct serves several nephrons, draining the urine into the pelvis of the kidney. The final changes in the composition of urine occur in the distal convoluted tubule and the collecting duct. Potassium ions, hydrogen ions and ammonia are secreted into the distal convoluted tubule and much water is reabsorbed in the distal convoluted tubule and the collecting tubule. Thus, the process of reabsorption and secretion of specific materials occurring at various places along the nephron, change the composition of the glomerular filtrate resulting in the formation of urine.





Q4.

a. Name the organs of respiratory system and explain the physiology of respiration

Answer:

The organs of respiratory system are:

1. Nose
2. Pharynx
3. Larynx
4. Trachea
5. Bronchi
6. Bronchioles
7. Lungs

Physiology of Respiration

Respiration: Inflation and deflation of the lungs occurring with each breath ensures that regular exchange of gases takes place between the alveoli and the external air.

Muscle of Respiration: The main muscles of respiration in normal quiet breathing are the intercostal muscles and the diaphragm.

Cycle of Respiration : This occurs 12 to 15 times per minute and consists of three phases:

- Inspiration
- Expiration
- Pause

Inspiration : When the capacity of the thoracic cavity is increased by contraction of the intercostal muscles and the diaphragm, the parietal pleura moves with the walls of the thorax and the diaphragm.

It reduces the pressure in the pleural cavity to a level considerably lower than atmospheric pressure.

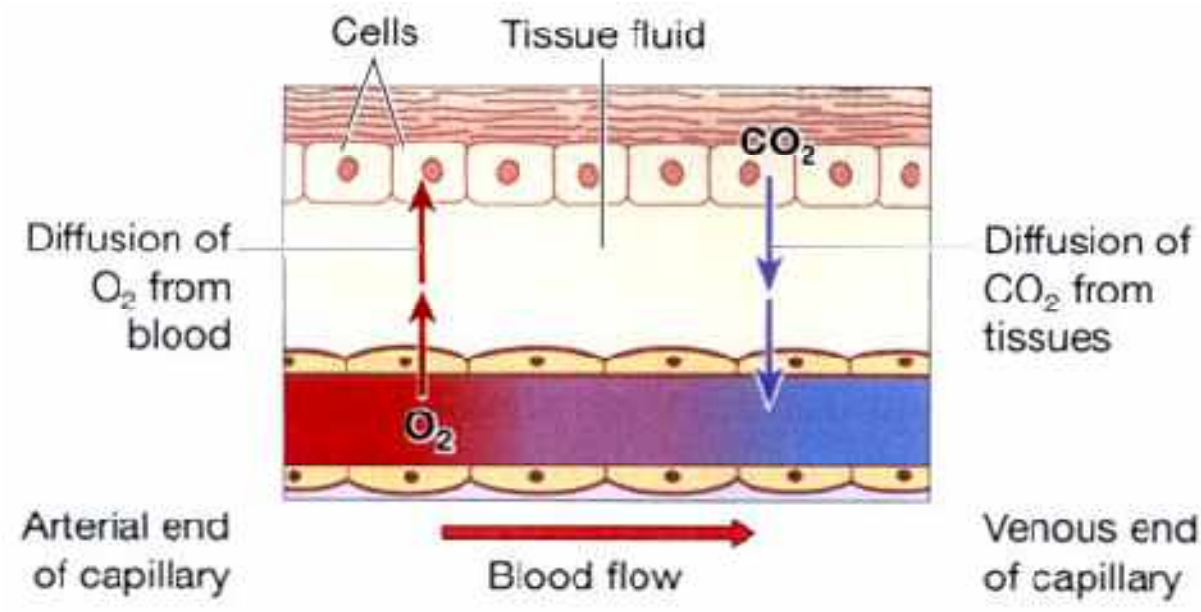
The visceral pleura follow the parietal pleura pulling the lung with it.

It stretches the lungs and the pressure within the alveoli and in the air passages falls, drawing air into the lungs in an attempt to equalize the atmospheric and alveolar air pressures.

The process of inspiration is active, as it requires expenditure of energy for muscle contraction. The negative pressure created in the thoracic cavity aids venous return to the heart and is known as the respiratory pump.

Expiration: Relaxation of the intercostal muscles and the diaphragm results in downward and inward movement of the rib cage and elastic recoil of the lungs. As this occurs, pressure inside the lungs exceeds that in the atmosphere and therefore air is expelled from the respiratory tract. The lungs still contain some air and are prevented from complete collapse by the intact pleura. This process is passive as it does not require the expenditure of energy.

Pause: After expiration, there is a pause before the next cycle begins.


Cells
Tissue fluid
CO_2
Diffusion of O_2 from blood
Diffusion of CO_2 from tissues
O_2
Arterial end of capillary
Blood flow
Venous end of capillary