TIRUPATI COLLEGE OF POLYTECHNIC AND PHARMACY, RATIA

D. PHARMACY FIRST YEAR

HUMAN ANATOMY AND PHYSIOLOGY (2115)

Section-A

Fill in the blanks with answers. Each question carries one mark. 1x10=10

1. Night blindness is caused by the deficiency of **vitamin A.**
2. **Sarcolemma** is the covering of muscles.
3. Out of yellow and white fibrous tissue, the elastic cartilage contains **yellow** fibers.
4. Those leucocytes which can stain with both the acidic and basic dyes are called **neutrophiles.**
5. Lacteals are concerned with the absorption of **fat.**
6. Deficiency of vitamin A causes **night blindness.**
7. Deficiency of vitamin D causes **rickets** and **osteomalacia.**
8. Pleura is the membrane around the **lungs.**
9. The kidney works under the control of **vasopressin (antidiuretic)** harmone from the posterior lobe of the pituitary gland.
10. **Ganglia** are formed by the crossing over of the sympathetic nervous system.
11. Blind spot is located on the **retina.**
12. Lacteals are branches of **blood vessels.**
13. Ovarian cycle is of **28** days.
14. Intestine consists of **3** parts.
15. Bowman's capsule is a part of **nephrons**.
16. Cell membrane is made up of **3** layers.
17. A long bone contains two epiphysis and one **diaphysis (shaft).**
18. The covering of lungs is called as **pleura.**
19. Pituitary gland contains **two** numbers of lobes.
20. Pancreas is an **endocrine** gland.
21. Cell membrane is a part of animal **cell.**
22. Bone is hard because of **calcium** and **phosphorus.**
23. Normal pH of blood is **7.4.**
24. Junction between axon and dendrite is called **synapse.**
25. Arthritis is a joint **disorder.**
26. Liver has **four** numbers of surfaces.
27. Alveoli are part of **respiratory system.**
28. **Ribosomes** are called as protein factory of cell.
29. Function of adipose tissue is **food reservation and to retain body heat.**
30. Ovaries secrete **oestrogen** and **progesterone** hormones.

31. The other name of pacemaker is **sino-aterial node.**
32. A ligament joins bone with bone, while a tendon joins **bones** with **muscles.**
33. Muscle fiber contains **myosin** and **actin** proteins.
34. Thyroid gland secretes **tri-iodothyronin** and **thyroxin** hormones.
35. **Pulmonary** veins carry oxygenated blood.
36. Cerebrum is a part of **brain.**
37. The function of villi of intestine is **to increases the surface area for food absorption.**
38. Muscles get fatigued due to accumulation of **lactic acid** in them.
39. Blood group O negative is called as **universal** donor.
40. Blood Pressure is measured with help of **sphygmomanometer.**
41. Anatomy is defined as **study of internal structure of an organism.**
42. The function of Golgi apparatus is **protein storage.**
43. Skeletal muscles are covered by a membrane called as **sarcolemma.**
44. Liver is made up of **two** numbers of lobes.
45. Pulmonary veins carry **oxygenated** blood.
46. Joint is a union between **two bones.**
47. Heart is covered by a membrane are called **pericardium, myocardium, endocardium.**
48. SA node is also called as **pace maker** of heart.
49. Oedema is accumulation of **tissue fluid.**
50. An autonomic response of the body to a stimulus is called **reflex action.**
51. Physiology is the study of **body functions.**
52. The primary function of lymph glands is the production of **lymph.**
53. Power houses of the cells are the **mitochondria.**
54. FSH stands for **follicle stimulating hormone.**
55. There are **46** no. of chromosomes in human cells.
56. Oestrogen and progesterone are secreted by **ovary.**
57. Smooth muscles have **one** no of nuclei.
58. **Endocrine glands** are called as ductless glands.
59. Fertilisation is union of sperm and **ovum.**
60. Exchange of gases in the lungs is called **breathing.**
61. Functional unit of kidney is known as **nephrons.**
62. Skin is made of **two** layers.
63. MTP stands for **medical termination of pregnancy.**
64. IUCD stands for **intra uterine contraceptive device.**
65. Lecithin is present in **cell membrane.**
66. In human, fertilization takes place in **fallopian tube in female.**

67. Lysosomes act as scavengers and also called as **suicidal beg.**

68. Normal systolic blood pressure is **100-140 mm of Hg**

Define the following terms:

1. **Oedema:** It is water logging of the tissues. It occurs as swelling of the body or any part of the body due to retention of fluid.
2. **Cartilage:** It has a tough, gelatinous and elastic matrix formed of chondrin. The cells are more or less round and lie in group of four embedded in matrix.
3. **Micturation:** It is an act of passing urine. When urine accumulates in the bladder, it produces stretching of its wall and relaxation of the sphincter.
4. **Anatomy:** Anatomy is the science of body structures and the relationship among them.
5. **Zygote**: Zygote is a diploid cell formed by the union of the two haploid gametes, especially a fertilized ovum before cleavage.
6. **Rh factor:** It is an agglutinogen called as Rhesus factor (Rh factor) since it was first seen in Rhesus monkey.
7. **Anaemia:** It is the disease which occurs due to deficiency in the number of red blood cells or deficiency of hemoglobin. Because of any one of these deficiencies, there is decrease in oxygen carrying capacity of blood. The symptoms of anemia are in the form of breathlessness, tiredness, loss of appetite and pallor of skin.
8. **Coagulation:** It is a life saving process which prevents loss of blood from the site of injury if a leak develops in blood vessels then after some time a clot is formed called coagulation.
9. **Joint:** Joint is the site at which two or more bones articulate with each other. Joints allow flexibility and movement of the skeleton.
10. **Suture:** Sutures are immovable joints which unite the bones of the skull.
11. **Polycythemia:** In this condition, there is an abnormal increase in the number of red blood cells. This increases the viscosity of blood.
12. **Reflex action:** It is an involuntary and immediate motor response to a sensory stimulus. Reflex action occur independent of will. It is a defense mechanism for a quick and automatic motor response for a sensory stimulus.
13. **Nephron:** Kidney contains number of structural and functional units called nephrons. There are about 1 million nephrons in each kidney. Nephron consists of malphigian bodies, renal tubules and collecting duct.
14. **Neuromuscular junction:** It is the junction between a nerve ending and skeletal muscle. At this site, the nerve loses its myelin sheeth and gets expanded.
15. **Histology and cytology:** Histology is the science that deals with the study of tissues & cytology deals with study of cells.

16. **Balanced diet:** A diet which contains adequate amount of all the essential nutrients like carbohydrates, proteins, fats, minerals, water, roughage material and vitamins sufficient for normal growth and development of the body, is called as balanced diet.
17. **BMR:** BMR is a basal metabolic rate defined as the minimum amount of energy required by the body during a period of complete rest.
18. **Glaucoma:** It is increase in intraocular tension produced due to excessive collection of aqueous humor (due to impaired drainage of aqueous fluid through canal of schlemm) in the anterior chamber.
19. **Meningitis:** The brain and spinal cord are protected by three coverings called meninges. Inflamation of these meninges is known as meningitis.
20. **Physiology:** Physiology is the science of body functions i.e. how the body parts work.
21. **Blood:** Blood is a specialized connective tissue, which is fluid in nature. It has alkaline pH i.e., 7.4 and specific gravity 1.055; it is reddish in colour due to presence of pigment hemoglobin.
22. **Lymph:** Lymph is a tissue fluid which is formed by the passage of substances from blood capillaries into tissue spaces.
23. **Respiration:** It is defined as the exchange of gases between body tissue and the external environment, supply of oxygen to tissue and excretion of CO_2 occur only through respiration.

Section – B

Each question carries three marks. **3x5=15**

Question No. 01 What is sexually transmitted diseases?

Question No. 02 Give two examples of immovable joint.

Question No. 03 List six functions of skin.

Question No. 04. Give functions of spleen.

Question No. 05. Give structure and function of Mitochondria.

Question No. 06. Define blood pressure and pulse and give its normal range.

Question No. 07. Give the composition of lymph.

Question No. 08. Give the clinical significance of Rh factor.

Question No. 09. What is the balanced diet?

Question No. 10 What is reflex action? Give two examples.

Question No. 11. Define respiration and metabolism.

Question No. 12. Define and classify vitamins.

Question No. 13. Explain term ovulation.

Question No. 14. Differentiate hyaline cartilages and elastic cartilages.

Question No. 15. What are functions of cerebrum?

Question No. 16. Draw a well labeled diagram of animal cell.

Question No. 17. Name the various parts of respiratory system.

Question No. 18. Write a short note on disorders of joints

Question No. 19. Explain the functions of skeleton system:

Answers

.**Question No. 01 What are sexually transmitted diseases?**

Answer: Sexually transmitted diseases: - These are a group of communicable diseases which are transmitted by sexual intercourse and are caused by a wide range of bacterial, viral, protozoal and fungal agents and ectoparasites.

Sexually transmitted disease includes the following diseases.

1. Syphilis: It is caused by *Treponema pallidum*. Initially syphilis occurs as a hard sore in the penis or vulva. Gradually, it affects heart, blood vessels and nerves within a period of 4 or 5 years.

2. Gonorrhea: Gonorrhea is caused by Gonococci. It affects the mucous membranes of urethra, ano-rectal mucosa and conjunctiva. It also affects the mucous membranes of vagina, cervix and distant organs like joints, valves of the heart and ocular apparatus.

3. Lymphogranuloma venerum: A viral disease characterised by urethral and cervical discharge, inguinal lymphedenitis and elephentiasis of external genitalia.

Question No. 02 Give two examples of immovable joint.

Answer: Immovable/ Fibrous joints: - It is a type of joint where bones are not movable. Here, the connecting medium between the joints is fibrous tissue.

1. Sutures of skull: The articulation of skull bones are typical examples of the fibrous joints e.g. coronal suture (joint the frontal and parietal bone), lambdoid suture (joints both parietal with occipital) and sagittial suture (joints two parietal bones).

2. Teeth in socket:- Teeth in the socket is an example of peg and socket joint.

Question No. 03 List six functions of skin.

Answer: 1. It protects the underlying organs from injury.

2. It excretes salts like sodium chloride and metabolites like urea.
3. It secretes sweat and sebum.
4. Skin helps to regulate body temperature.
5. Synthesis of vitamin D from ergosterol of skin by action of ultraviolet rays of sun takes place.
6. It acts as a sense organ to the body.

Question No. 04. Give functions of spleen.

Answer: Functions of spleen are: 1. Spleen produces all types of blood cells during foetal life.

2. Red blood cells are destroyed in spleen.
3. Histocytes of spleen ingest and destroy foreign particles including bacteria.
4. Spleen serves as a reservoir of blood.
5. It also produces antibodies.

Question No. 05. Give structure and function of Mitochondria.

Answer: Structure and functions of mitochondria: They occur in the cytoplasm at variable numbers e.g. few hundreds to few thousands. The mitochondrion is composed of two layers of membranes. They are an outer layer which is smooth and an inner folded layer which is folded into sheets of tubules called cristae. Both these layers enclose a central cavity called matrix.

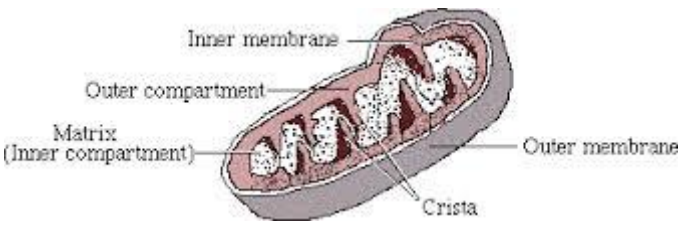


Fig. of Mitochondria

Functions: 1. It produces ATPs so rightly called "power house of cell"

2. Mono-amine-oxidase (MAO) enzymes are found in inner membrane of mitochondria which activates various reaction of the cell respiration.

3. Mitochondria contain RNA and DNA thus carries blue prints for their own replication and growth.

Question No. 06. Define blood pressure and pulse and give its normal range.

Answer: Blood pressure: It is defined as the lateral pressure exerted by blood on the walls of the blood vessels. The blood pressure which is normally expressed is arterial blood pressure. It has two phases:

1) Systolic blood pressure: It is the maximum blood pressure. This occurs during the systole of the heart. Normal range is 100 to 120 mm Hg.

2) Diastolic blood pressure: It is the minimum blood pressure. This occurs during the diastole of the heart. Normal range is 60 to 80 mm Hg.

Pulse: It is the throbbing sensation felt over the walls of arteries. It is defined as the pressure difference transmitted in the form of a wave over the arterial walls. Pulse rate is almost the same as heart rate (60-80 per minute). The wrist is the common site where pulse is usually felt. At this site, radial artery is very superficial. In case of fever, the rate pulse increases at the rate of 10 per every rise of 1^0F.

Question No. 07. Give the composition of lymph.

Answer: Composition of lymph: Lymph consists of large number of leucocytes, mainly lymphocytes ranging from 1000 to 20,000 per mm^3. Platelets and red blood corpuscles are absent in lymph. The non-cellular part consists of 94% water and 6% solids in a soluble form. The composition of solids varies from time to time and site. The main solids are proteins (2.0-4.5%), fats (5-15%), carbohydrates (130 mg/100 ml), urea (23.5mg/100 ml), non-protein nitrogenous substances (34.8 mg %), creatinine (1.4 mg %) and other inorganic substances.

Question No. 08. Give the clinical significance of Rh factor.

Answer: Clinical significance of Rh factor: It is an agglutinogen called as Rhesus factor (Rh factor) since it was first seen in Rhesus monkey. Rh +ve individuals have this factor but Rh –ve individual do not have this. The foetus of a Rh –ve mother and Rh +ve father is Rh +ve, serious complications may occur. Then the Rh antigen will travel from the foetus to mother's blood. As a result Rh antibodies will develop in the mother's blood. When these antibodies reach the foetus, they produce severe hemolytic reactions. This condition is called as erythroblastosis foetalis.

Question No. 09. What is the balanced diet?

Answer: Balanced diet: A diet which contains adequate amount of all the essential nutrients like carbohydrates, proteins, fats, minerals, water, roughage material and vitamins sufficient for normal growth and development of the body, is called as balanced diet. The composition of a balance diet for an average adult human being is:

Cereals = 400 gm	Pulses = 50-80 gm
Oil or ghee = 57gm	Leafy vegetables =114gm
Other vegetables = 85gm	Fruits = 85gm
Milk or milk products = 284gm	Sugar and Jaggary = 57gm

Fish/Meat = 85gm Eggs = 1-2 eggs

Water = According to need Salt = According to need

Question No. 10 What is reflex action? Give two examples.

Answer: Reflex action: It is an involuntary and immediate motor response to a sensory stimulus. Reflex action occur independent of will. It is a defense mechanism for a quick and automatic motor response for a sensory stimulus.

Reflexs arc: It consists of some body organs, which are involved in the production of a reflex action. These organs are:

1) A sensory organ like skin, which receives the sensory stimulus.

2) A sensory nerve, which arises from the sensory organ.

3) The spinal cord.

4) A motor nerve which transmits the impulses to the motor organ such as muscle.

Importance of reflex action: The impulses of reflex action are carried only to the spinal cord and not to the brain. The impulses (signals) from the spinal cord are then carried to the motor organ. So that the response is quick and immediate, for example removal of finger immediately when it touches a hot plate.

Question No. 11. Define respiration and metabolism.

Answer: Respiration: It is defined as the exchange of gases between body tissues and the external environment, supply of oxygen to tissues and excretion of co_2 occur only through respiration.

Metabolism: It is defined as biochemical changes which occur in the body in order to maintain its vital functions. Metabolism is classified into: 1) anabolism 2) catabolism

1) Anabolism: - It is a constructive process. It leads to building up of fresh tissues from nutritive materials of food.

2) Catabolism: It is a destructive process. It leads to break down of worn out tissues and their removal.

Question No. 12. Define and classify vitamins.

Answer: Vitamins: Vitamins are complex organic compounds required for vital metabolic functions in the body and are needed by the body in small amount. They are grouped as:

1) Fat soluble vitamins - Vitamin A, D, E, K.

2) Water soluble vitamins – Vitamin B complex and vitamin C.

Role of Vitamins:

1. Vitamin A helps in proper functioning of retina and vision.
2. Vitamin A helps to maintain functioning and integrity of glandular and epithelial tissues.
3. It helps in skeletal growth and has an anti-infective action.

4. Vitamin D facilitates the absorption and utilization of calcium and phosphorus for healthy bones and teeth.

5. Vitamin E maintains healthy muscular system and act as antioxidant.

6. Involved in the metabolism of carbohydrates, fats and proteins.

Question No. 13. Explain term ovulation.

Answer: Ovulation: Maturation of the graffian follicles and generation of ovum are termed as ovulation. The ovary contains graffian follicles. These follicles are about 40,000 in number. They are formed even in foetal life. The rest get degenerated. But all the follicles are lost in menopause. Ovulation occurs due to the rupturing of graffian follicles. This is stimulated by luteinising hormones of anterior pituitary. After that follicles form the corpus luteum which produce estrogen. Ovulation occurs at about 14^{th} day of menstrual cycle. The ovum is discharged in peritoneal cavity.

Question No. 14. Differentiate hyaline cartilages and elastic cartilages.

Answer:

S. No.	Hyaline Cartilages	Elastic Cartilages
01.	Hyaline cartilage is bluish green in appearance	Elastic cartilage is yellowish in appearance.
02.	Have fewer, very fine white fibres in the matrix.	Have abundant yellow fibres in the matrix.
03.	No fibres are visible in the matrix under light microscope.	Fibres are visible under light microscope.
04.	Present in sternal ribs, nasal septum, tracheal and bronchial rings.	Present in pinna, nose tip and epiglottis.

Question No. 15. What are functions of cerebrum?

Answer: Cerebrum: It is the largest part of the brain. It consists of two hemispheres namely right and left hemisphere. Each cerebral hemisphere has four lobes. They are:

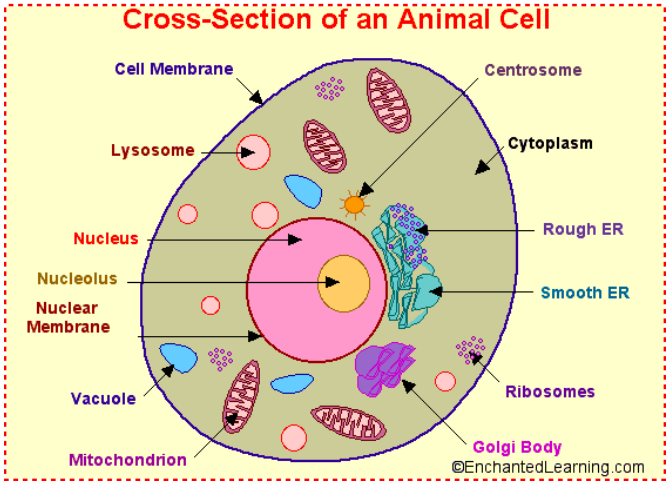
1) Frontal lobe 2) Temporal lobe 3) Parietal Lobe 4) Occipital Lobe

Functions of cerebrum:

1. Cerebrum performs motor functions like control of voluntary movements.
2. It also performs sensory functions which include:
    a) Analysis of touch, temperature, pain, pressure, shapes etc.
    b) Governing of conditional reflexes.
    c) Control of intelligence, speech, memory etc. through higher centers of cerebrum.

Question No. 16. Draw a well labeled diagram of animal cell.

Answer: Cell: The cell is the smallest unit of living tissues. Cells of different tissues perform different functions. A cell consists of the following parts: 1) Cell wall 2) Nucleus 3) Cytoplasm 4**)** Microsomes 5) Endoplasmic reticulum 6) Golgi apparatus 7) Mitochondria 8) Lysosomes 9) Centrosome 10) Microtubules.



Question No. 17. Name the various parts of respiratory system.

Answer: Respiratory system: It consists of following parts: (i) Nasal cavity (ii) Pharynx (iii) Larynx (iv) Trachea (v) Bronchi (vi) Bronchioles (vii) Alveloi (viii) Lungs

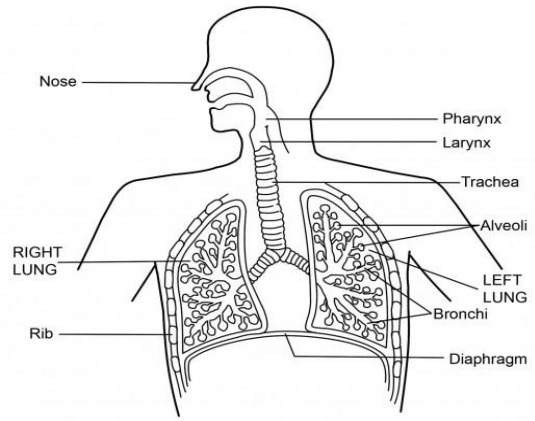


Fig. Human respiratory system

Question No.18 Write a short note on disorder of joints.

Answer: Disorders of joints:

1) Arthritis: It is a type of inflammatory disorder characterized by changes in joint. Two types of arthritis are-

(i) Rheumatoid Arthritis: It is inflammatory autoimmune disease mainly affecting peripheral joints. In this inflammatory changes also affect heart, blood vessels and skin. It is more common in females than males and can affect all ages. Symptoms are joint pain, stiffness etc.

(ii) Osteoarthritis: This is degenerative non-inflammatory disease. In this disorder articulating cartilage become thinner and bone begin to degenerate. Some time there are abnormal outgrowths of cartilage at the edges of bone, which is painful. It is generally occurs in middle age and affects mostly lower joints.

2) Gout: It is caused by deposition of sodium urate crystals in joints. It occurs in people with high uric acid levels.

Question No 19 Explain the functions of skeleton system:

Answer- Bones and joints form the skeleton system of the body. Functions of skeleton system are:

1) Support and protection of soft tissues and vital organs.

2) To give attachment to the muscles.

3) Formation of RBCs in the red bone marrow of long bones.

4) Storage of mineral salts like phosphorus and calcium

SECTION-C

Each question carries five marks. **5x5=15**

Question No. 01 What is immunity and how it is classified?

Question No. 02 Write a detailed note on blood groups and blood coagulation.

Question No. 03. Write down the mechanism of blood coagulation.

Question No. 04. Define cardiac cycle.

Question No. 05. Give the Physiology of pain.

Question No. 06. What is anemia and Thrombocytopenia?

Question No. 07. Differentiate tendons and ligaments.

Question No. 08. Differentiate sympathetic and parasympathetic nervous system.

Question No. 09. Differentiate skeletal and smooth muscles.

Question No. 10. Draw a well labeled diagram of digestive system.

Question No. 11. Name endocrine glands and explain any three.

Question No. 12. Write a short note on double circulation.

Question No. 13. Write a short note on menstrual cycle.

Question No. 14. Write a short note on pancreas gland.

Question No. 15. Explain the functions of liver.

ANSWERS

Question No. 01 what is immunity and how it is classified?

Answer: Immunity: The power of the body to resist the effects of invasion of pathogenic micro-organism is known as immunity. Phagocytosis and antibody formation are the most important factors responsible for immunity.

Types of immunity: 1) Natural immunity 2) Acquired immunity

1) Natural immunity: It is god gifted immunity which exerts resistance to disease. It differs between species, races, individuals and ages.

2) Acquired immunity: This is an additional immunity which is acquired either by the stimulation of the antibodies producing cells of the body or by introducing antibodies formed from another person or animals. It is of two types: - a) Active immunity b) Passive immunity

a) Active immunity: Active immunity developed in an individual due to formation of antibodies on the introduction of antigenic substances in the body. Further it is of two types i) Naturally acquired active immunity ii) Artificially acquired active immunity

Naturally acquired active immunity: It is acquired as a result of natural infection produced by pathogenic micro-organism.

Artificially acquired active immunity: This type of immunity acquired by the administration of specific vaccine or toxoids.

b) Passive immunity: This type of immunity is produced by the introduction of already formed antibodies into the body of an individual. Passive immunity is rapidly formed but it is not long lasting. It is also of two types:

Naturally acquired passive immunity: In this type of immunity the antibodies are transmitted from the mother to the foetus through the placental blood. This provides immunity to the infants for several months.

Artificially acquired passive immunity: This type of immunity is produced by injecting antibodies containing preparations known as antisera, sera and immune serum

Question No. 02 Write a short note on blood groups.

Answer: Blood groups: Plasma of some individuals contains some factors. These factors produce agglutination or hemolysis of the erythrocytes of other persons. These reactions occur due to presence of agglutinins and agglutinogens in blood. Agglutinogens are present in erythrocytes. They are of two types A and B. Agglutinins are present in plasma. They are of two type: a and b. Depending on the presence of these two substances, there can be four blood group- A, B, AB, and O.

Group A - contains A agglutinogen and b agglutinin.

Group B - contains B agglutinogen and a agglutinin.

Group AB - contains AB agglutinogen and no agglutinin.

Group O - contains no agglutinogen and a and b agglutinin.

Question No. 03. Write down the mechanism of blood coagulation.

Blood clotting/Coagulation: It prevents the loss of blood from the site of injury. If a leak develops in blood vessels then after sometime a clot is formed which prevents the loss of blood.

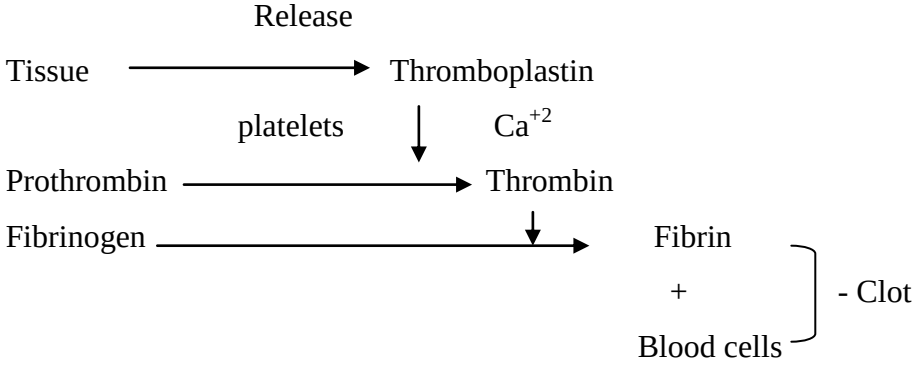
Mechanism of blood clotting: The various steps in blood clotting are:

1) Thromboplastin is liberated from disintegrated tissues.

2) Thromboplastin converts prothrombin into thrombin in presence of Ca^{+2} ions.

3) Thrombin converts fibrinogen to fibrin.

4) This insoluble fibrin forms threads. The formed elements of blood get entangled in this and form the clot.



This mechanism of blood clotting is not so simple but very complex. There are 13 factors involved in this mechanism, which are as follows:

Factor I - Fibrinogen

Factor II - Prothrombin

Factor III - Thromboplastin

Factor IV - Calcium

Factor V - Proaccelerin or Labile factor or Accelerator globulin factor

Factor VI - Not present

Factor VII - Stable factor or Proconvertin

Factor VIII - Antihaemophilic factor (AHF) or Antihaemophilic globulin (AHG)

Factor IX - Platelet co-factor-II or Plasma thromboplastin component (PTC) or Christmas factor

Factor X - Stuart factor

Factor XI - Plasma thromboplastin antecedent (PTA)

Factor XII - Surface factor or Hageman factor

Factor XIII - Fibrin stabilizing factor.

Question No. 04. Define cardiac cycle.

Answer: Cardiac cycle: Cardiac cycle is the sequence of events which occur in the heart during a single beat. The rate of heart is 72 beats/min. So the time taken for one beat is 0.8 sec. Cardiac cycle occur in two phases :-

1) Systolic phase - a period of contraction

2) Diastolic phase- a period of relaxation

The events of cycle occur as follow:

1. To start with, blood from the veins fills the two atria, i.e. superior and inferior vena cava fill the right atrium, the pulmonary veins fill the left atrium.

2. This is followed by a wave of contraction in the atria. This leads to empting of atrial blood into the respective ventricles.

3. When the ventricles are full, they contract. The blood present in ventricles is forced into systemic and pulmonary circulation. At this stage, the semilunar valves guarding the aorta and pulmonary arteries are opened.

4. At the same time, the atrio-ventricular valves are closed. This period of muscular contraction of heart is called systole.

5. This is followed by a period of rest called diastole.

Question No. 05. Give the Physiology of pain.

Answer: Physiology of pain: Pain is a protective mechanism which warns the body against disorders and defects in its parts. Pain can be classified into: i) cutaneous pain ii) visceral pain iii) deep pain iv) head-ache

1) Cutaneous pain: it may be produced by pathological states of skin, injury to skin and by release of chemical substances such as those which produce itching. In some cases, the painful area may extend beyond the damaged or diseased area.

2) Visceral pain: It may occur due to an altered physiology of an internal organ like kidney, liver etc. sometimes sensation of pain is displaced from the affected area and felt at adjacent areas and it is called as referred pain e.g. pain arising from liver is felt in the skin of right shoulder.

3) Deep pain: It arises from the receptors of muscles, tendons and joints e.g. powerful contraction of a muscle may occlude blood supply to the muscle and this may cause pain. Like visceral pain, deep muscle pain can also be referred on the surface of body.

4) Head-ache: It may occur due to a variety of conditions like anxiety, tension and pathological changes in intracranial blood vessels or visual defects.

Pathway of pain: The sensation of pain is carried by non myelinated afferent nerves to dorsal horn of grey matter of spinal cord. From here, the sensation is carried to thalamus through spinothalamic tract. From the thalamus, the impulses are carried to subcortical area for crude sensation and then to cerebral cortex.

Question No. 06. What is anaemia and thermbocytopenia?

Answer: Anemia: It is the disease which occurs due to deficiency in the number of red blood cells or deficiency of hemoglobin. Because of any one of these deficiencies, there is decrease in oxygen carrying capacity of blood. The symptoms of anemia are in the form of breathlessness, tiredness, loss of appetite and pallor of skin. The important types of anemia are:

1) Iron deficiency anemia
2) Megaloblastic anemia
3) Hemolytic anemia
4) Aplastic anemia

1) Iron deficiency anemia: This type of anemia occurs due to deficiency of iron in dietary intake or decreased absorption. Due to lack of iron sufficient hemoglobin is not formed.

2) Megaloblastic anemia: This type of anemia occurs due to the deficiency of either vitamin B_{12} **(**also known as **pernicious anemia)** or folic acid. Both are required for the maturation of red blood cells so due to deficiency immature, large sized red blood cells called magaloblasts are released in circulation.

3) Hemolytic anemia: It occurs due to increased destruction of red blood cells. It occurs due to hereditary disorders, mechanical injury to red blood cells and infections like malaria.

4) Aplastic anemia: It occurs due to suppression of bone marrow function. It can be caused by drugs, chemicals, irradiation or malignant diseases.

Thermbocytopenia: It is a condition where there is decrease in number of platelets. It results in hemorrhages, increase in bleeding time and defect in retraction of clot.

Question No. 07. Differentiate tendons and ligaments.

Answer:

S. No.	Tendons	Ligaments
01.	Type of connective tissue which joins muscles with bone.	Type of connective tissue which joins bone with bone.
02.	Tendons are inflexible and cannot be stretched.	Ligaments are flexible and can be stretched.
03.	Large amount of collagen fibres are present which are thick.	Large amount of elastic fibres are present which are thin.
04.	Made up of protein collagen.	Made up of protein elastin.
05.	Fibroblasts lie in almost continuous rows	Fibroblasts lie scattered.

Question No. 08. Differentiate sympathetic and parasympathetic nervous system.

Answer:

S. No.	Sympathetic Nervous System	Parasympathetic Nervous System
01.	Sympathetic ganglia are the sites of synapses between sympathetic preganglionic and post ganglionic neuron.	Parasympathetic ganglionic is axon of parasympathetic division synapse with postganglionic neuron in the terminal ganglia.
02.	It causes dilation of the pupil of eye.	It causes constriction of pupil.
03.	It causes dilation of bronchi.	It causes constriction of bronchi.
04.	It causes constriction of blood vessels.	It causes dilation of blood vessels.
05.	It causes increase in the rate and force of heart.	It causes decrease in the rate and force of heart.

Question No. 09. Differentiate skeletal and smooth muscles.

Answer:

S. No.	Skeletal Muscles	Smooth Muscles
01.	It is under the control of will so called voluntary muscle.	It is not under the control of will so called involuntary muscle.
02.	These are consisting of distinct striations, strippes.	These are non striated smooth muscles.

03.	These fibres are cylindrical in shape, consist of numerous nuclei.	These are long spindle shaped fibres, consist of single nuclei.
04.	Muscles are covered by sarcolemma.	There is no distinct sarcolemma.
05.	These muscles are found in limbs and trunk work under the control of CNS.	These muscles are found in internal organ like stomach, intestine and uterus work under the control of ANS.

Question No. 10. Draw a well labeled diagram of digestive system.

Answer: Digestive system: The digestive system consists of gastrointestinal tract and its gland. The functions of gastrointestinal tract are ingestion, digestion and absorption of food and excretion of waste products.

Parts of digestive system: It consists of following parts: 1) Mouth 2) Pharynx 3) Oesophagus 4) Stomach 5) Small intestine 6) Large intestine 7) Rectum 8) Anus 9) Liver 10) Pancreas

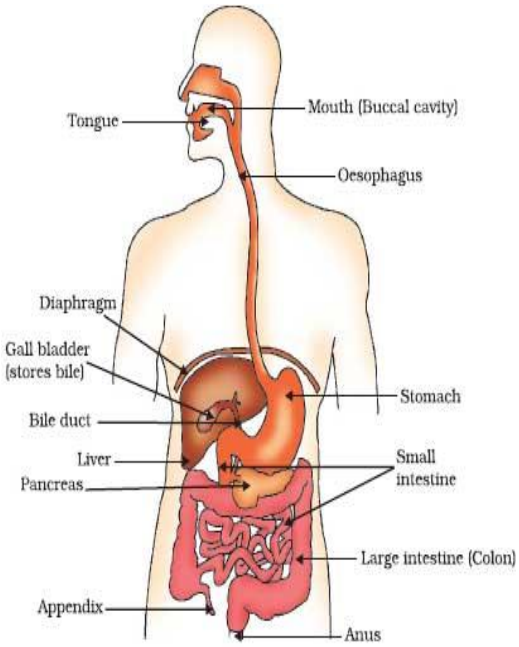


Figure 6.6 Human alimentary canal

Question No. 11. Name endocrine glands and explain any three.

Answer: Endocrine glands: These are ductless glands which secrete hormones. The hormones are directly poured into circulation without the help of a duct. The following are the endocrine glands present in the body:

1) Pituitary gland 2) Thyroid gland 3) Pancreas
4) Adrenal (suprarenal) gland 5) Parathyroid gland 6) Sex gland
7) Thymus 8) Pineal gland

1) Pituitary gland: The Pituitary gland is situated at the base of brain in a hollow called Sellaturnica of Sphenoid bone. It consists of two main lobe:

Anterior lobe of Pituitary gland: Anterior lobe of Pituitary gland secrete following hormones: (a) Growth Hormone (b) ACTH (c) TSH (d) Prolactin (e) Gonadotrophins

Posterior lobe of Pituitary gland: Posterior lobe of Pituitary gland secretes two hormones: (a) Oxytocin (b) Vassopressin.

2) Thyroid gland: Thyroid gland is situated in the lower part of neck on the thyroid cartilage and contains two lobes, one on each side of trachea. These two lobes are connected by isthmus.

3) Pancreas gland: It consists of an exocrine and endocrine part. The islets of langerhans are the endocrine parts that consist of about two % of glandular tissue.

Two polypeptides hormones are secreted by pancreas: a) Insulin: secreted by beta cells b) Glucagon: secreted by alpha cells.

Question No 12. Write a short note on double circulation.

Answer: Double circulation is a process during which blood passes twice through the heart during one complete cycle. This type of circulation is found in birds, and mammals as in them the heart is completely divided into four chambers – the right atrium, the right ventricle, the left atrium, and the left ventricle. The movement of blood in an organism is divided into two parts:

(i) Systemic circulation

(ii) Pulmonary circulation

Systemic circulation involves the movement of oxygenated blood from the left ventricle of the heart to the aorta. It is then carried by blood through a network of arteries, arterioles, and capillaries to the tissues. From the tissues, the deoxygenated blood is collected by the venules, veins, and vena cava, and is emptied into the right auricle.

Pulmonary circulation involves the movement of deoxygenated blood from the right ventricle to the pulmonary artery, which then carries blood to the lungs for oxygenation. From the lungs, the oxygenated blood is carried by the pulmonary veins into the left atrium.

Hence, in double circulation, blood has to pass alternately through the lungs and the tissues.

Significance of double circulation:

The separation of oxygenated and deoxygenated blood allows a more efficient supply of oxygen to the body cells. Blood is circulated to the body tissues through systemic circulation and to the lungs through pulmonary circulation.

Question No. 13 Write a short note on menstrual cycle.

Answer: The menstrual cycle is the regular natural change that occurs in the female reproductive system (specifically the uterus and ovaries) that makes pregnancy possible. The cycle is required for the production of ovocytes, and for the preparation of the uterus for pregnancy. Up to 80% of women report having some symptoms during the one to two weeks prior to menstruation.

Symptoms: Acne, tender breasts, Bloating, Feeling tired, Irritability and mood changes

These symptoms interfere with normal life and therefore qualify as premenstrual syndrome in 20 to 30% of women. In 3 to 8%, they are severe. 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 average age of the first period is generally later in the developing world and earlier in developed world. 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.

The menstrual cycle is governed by hormonal changes. These changes can be altered by using hormonal birth control to prevent pregnancy. Each cycle can be divided into three phases based on events in the ovary (ovarian cycle) or in the uterus (uterine cycle).The ovarian cycle consists of the follicular phase, ovulation, and luteal phase whereas the uterine cycle is divided into menstruation, proliferative phase, and secretary phase.

Question No- 14 Write a short note on pancreas gland.

Answer- Pancreas gland: It consists of an exocrine and endocrine part. The islets of langerhans are the endocrine parts that consist of about 2 % of glandular tissue.

Two polypeptides hormones are secreted by pancreas:

1) Insulin: secreted by beta cells.

2) Glucagon: secreted by alpha cells.

Functions of insulin:

1) It increases the permeability of cell membrane.

2) Insulin also promotes the entry of amino-acids & fatty acid in to the cell.

3) Insulin promotes synthesis of glycogen from glucose.

4) Insulin inhibits the synthesis of glucose from sources other than carbohydrate.

5) Insulin inhabits glycogenolysis.

6) It inhabits the formation of ketone bodies.

Functions of glucagons:

1) It raises the blood sugar level. This is done by enhancing liver glycogenolysis and gluconeogenesis.

2) It increases adipose tissue lipolysis.

Question No- 15 Explain the functions of liver.

Answer- Functions of liver: Liver performs following functions:

1) Secretion of bile.

2) It synthesizes and store glycogen.

3) All monosaccharide are converted into glucose in the liver, thus help in glucose metabolism.

4) Liver regulates blood glucose level.

5) Synthesis of fat from carbohydrates takes place in the liver.

6) Formation of urea from amino acid occurs in liver.

7) Plasma proteins are synthesized in liver.

8) Conversion of unsaturated fats into saturated fats.

9) Liver store iron and vitamin B_{12}, which are required for RBC's synthesis.

10) Synthesis of prothrombin and fibrinogen, which are necessary for blood coagulation.

11) Synthesize heparin.

12) Inactivates drugs and toxic substances.

13) Store vitamin A, D, E, and K

14) Production of heat as a result of various metabolic reactions thus regulates heat of the body.

SECTION-D

Each question carries ten marks. **10x3=30**

Question No. 01 Classify joints. Explain Synovial joint in detail.

Question No. 02 Classify tissue. Give detail of epithelial tissue.

Question No. 03 Describe the structure and functions of kidney.

Question No. 04 Describe the structure of nephron. Discuss in detail the physiology of urine formation.

Question No. 05 Describe structure of heart with the help of neat and clean diagram. Explain various types of cardiovascular disorders.

Question No. 06 Describe eye with the help of neat and clean diagram with functions of different parts.

Question No .07 Define blood and give its component. Describe the various functions of blood.

Question No. 08 Write a note on physiology of muscle contraction.

ANSWERS

Question No. 01. Classify joints. Explain Synovial joint in detail.

Answer: Joint: Joint is the site at which two or more bones articulate with each other. Joints allow flexibility and movement of the skeleton. Joints are of three types:

1) Fibrous joints

2) Cartilagenous joints

3) Synovial joints

1) Fibrous joint: In these joints bones are not movable. Bones are joined together by fibrous tissue for example – Sutures of skull and teeth in their socket.

2) Cartilagenous joint: In these joints bones are slightly movable. In this type of joints articular ends of bones are covered by hyaline cartilage and a pod of fibrocartilage is present between joints e.g. intervertebral joints.

3) Synovial joints: These are freely movable joints. Characteristics of these joints are as follows:

(a) The surface of articulating bones are covered with cartilage. These cartilages are not attached to each other.

(b) There is a cavity around the joint called synovial cavity.

(c) Synovial cavity is surrounded by ligament or capsule.

(d) Synovial membrane covers all around the cavity.

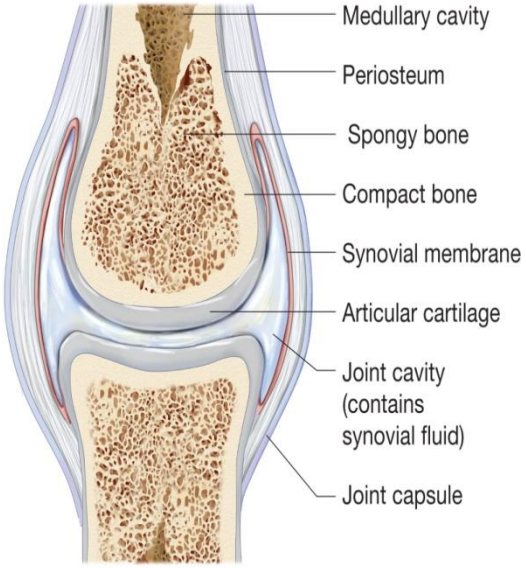
(e) The cavity is filled with a fluid known as synovial fluid secreted by synovial membrane.

Functions of Synovial fluid:

1. It provides nutrients for the structure within the joint.
2. It contains phagocytes, which kills microbes.
3. It acts as lubricant.

Various types of synovial joints are:

a) Ball and socket joint: In this type, rounded part of one bone (ball) fits into cavity (socket) of another bone and thus help in movement in all direction. Here a ball is moving in a cup shaped socket examples are shoulder joint, hip joint.



b) Hinge joint: In this movement is possible in only one direction, examples are elbow joint, knee joint etc.

c) Condyloid joint: It resembles with hinge joint but helps in movement in two planes, examples are wrist joint, ankle joint etc.

d) Gliding joint: In this joint two bones are flat which glide on each other; examples are carpal and tarsal joint etc.

e) Saddle joint: In this the articulating bones fit together like a man sitting on a saddle, example is joint at base of thumb.

f) Pivot joint: This joint help in rotation, example is movement of head.

Question No. 02 Classify tissue. Give detail of epithelial tissue.

Answer: A group of cells having the same origin, similar shape and common function is known as tissue. Tissues are classified into following four groups:

(1) Epithelial tissue or epithelium (2) Connective tissue (3) Muscular tissue (4) Nervous tissue

1) Epithelial tissue: This tissue consists of cells, which are held together by intercellular substances. They form external surface of body for example skin or covering of internal surface of hollow organs like mucous membrane of stomach or get specialized for secretory functions forming various glands of body. Epithelium is attached to basement membrane, which is composed of amorphous substances. Epithelial tissue is of two types: (i) Simple epithelial tissue (ii) Stratified epithelial tissue

i) Simple epithelial tissue: It is composed of a single layer cell. It is further classified as-

Squamous epithelium: It is composed of a single layer of thin, scale-like flat cells arranged edge to edge like as in mosaic with flat nucleus e.g. alveoli of lungs, lining of heart chambers, lining of blood vessel and lymphatic tissue.

Cuboidal epithelium: It consists of single layer of cells which are cubical in side view. They are arranged over a basement membrane. It is found in follicles of thyroid gland, ducts and alveoli of many glands.

Columnar epithelium: In this cells are columnar that is their length is more than breadth. They are arranged over a basement membrane e.g stomach and large intestine, convoluted and distal tubules of nephron.

Ciliated epithelium: In this the cell are cuboidal or columnar in shape and bear cilia, a hair like structure on their surfaces e g. lining of trachea, lining of uterus.

Glandular epithelium: It consists of cylindrical or columnar cells. It is present in secretory glands like salivary glands and breast.

ii) Stratified epithelialium: It is composed of multilayer of cell attached to the basement membrane. It is further classified as -

Squamous keratinised epithelium: The cells of this layer contains derivative of keratohyalin. The outer most layers of cells of this epithelium are dead, example, epidermis of skin.

Squamous non-keratinised epithelium: Here the stratum corneum and the keratin are absent. Cell of the superficial layer of this epithelium are living and remain moist e.g. lines buccal cavity, oesophagus.

Transitional epithelium: There is a basal layer of columnar cells attached to the basement membrane. This epithelium allows stretching by flattening of its constituent cells e.g. urinary bladder and uterus.

Question No. 03. Describe the structure and functions of kidney.

Ans. 03. Urinary system is the main excretory system of body. It contains two kidneys, two ureters, a urinary bladder and a urethra.

Kidney: These are two beans shaped organ lying on the each side of vertebral column.

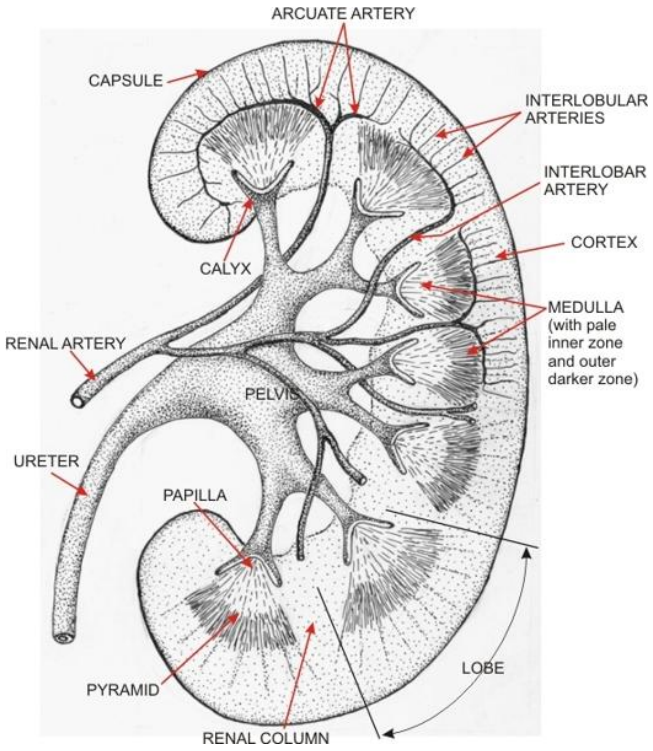
Structure of Kidney: Kidney is surrounded by outer fibrous capsule and below this capsule lies:

1) An outer cortex, which is reddish brown in colour.

2) Inner medulla, which contains pyramids of kidney.

3) An upper expanded end of ureters called pelvis.

4) Contains number of structural and functional units called nephrons. There are about 1 million nephrons in each kidney.



Structure of human kidney

Functions: Kidney performs following functions:

1) Excretion of water and waste products.

2) Excretion of excess salt.

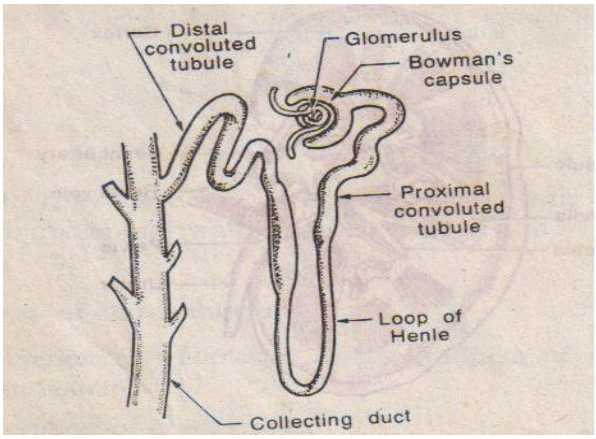
3) Excretion of harmful substances, drugs and toxins.

4) Regulation of pH of blood.

5) Maintains acid base equilibrium.

Question No. 04 Describe the structure of nephron. Discuss in detail the physiology of urine formation.

Answer: Structure of nephrons: Nephron consists of malphigian bodies, renal tubules and collecting duct. Malphigian bodies are made up of Bowman's capsule and glomerulus. Renal tubules consist of proximal convoluted tubule (PCT), loop of Henle and distal convoluted tubule (DCT). Collecting tubules passes through the medulla and opens into pelvis.



Structure of Nephron

Physiology of urine formation: Urine is formed by kidney by 3 processes, which are as follows:

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

1) Glomerular filtration: Filtration of water, salts and other substances occurs in the glomerulus and fluid formed after filtration is called as glomerular filtrate. Glomerular filtration rate (GFR) is the volume of glomerular filtrate produced by both kidneys in one minute. It is about 125 ml.

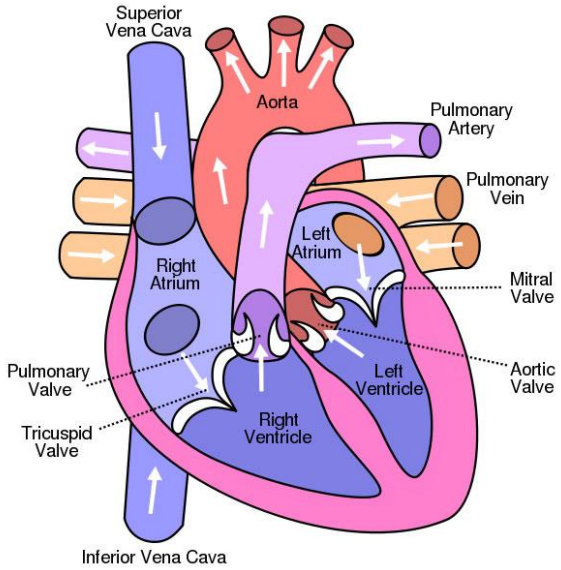
2) Tubular secretion: It is active process, which occurs in convoluted tubule and drugs like penicillin are excreted by tubular secretion.

3) Tubular reabsorption: GFR is about 125 ml so that about 180 liters of Glomerular filtrate is formed in a day. But the volume of urine eliminated per day is only 1.5 liter. It is so, because nearly 99% of glomerular filtrate is reabsorbed. Reabsorption of water occurs in the convoluted tubules and collecting tubule.

Question No. 05. Describe structure of heart with the help of neat and clean diagram. Explain various types of cardiovascular disorders.

Answer: Cardiovascular system consists of heart and blood vessels. It transports gases, nutrients and excretory products to various parts of body through blood. Heart is present between the lungs and behind the sternum. It is 10cm long and weight about 300gm.

Structure/Anatomy: Heart is surrounded by an outer covering called pericardium. Pericardium contains two inner layers, which touch the heart, is called as visceral pericardium and outer is called as parietal pericardium. Between these two layers pericardial fluid is present. The function of these layers is to protect the heart. Human heart is made up of four chambers. Upper chambers are called as atrium and lower are called as ventricles. These are again divided into right atrium and left atrium and right ventricle and left ventricle.



Structure of Human Heart

Blood supply to the heart: Heart receives blood supply through right and left coronary artery, which are branches of aorta. Venous blood is collected by coronary vein, which opens into coronary sinus.

Conducting system of heart: The impulses for cardiac contraction are transported through this system. This is made up of following parts:

1) Sino-atrial node/S.A. node: It is present at the opening of superior vena cava into the right atrium. It is also called as pace-maker of heart. The impulses for cardiac contraction start at S.A. node.

2) Atrioventricular node/A.V. node: Present in upper part of atrio-ventricular septum. Impulses from S.A. node pass to A.V. node.

3) Bundle of his: Presents in the inter-ventricular septum. It receives impulses from A.V. node.

4) Purkinje Fibres: These are branches of bundle of his and present in the walls of left and right ventricles.

Cardiovascular disorders:

1) Cardiac failure: It is a condition in which the myocardium of ventricle is unable to maintain sufficient circulation of blood to meet the needs of the body. Depending on onset it may be classified as: Acute cardiac failure when the onset is sudden and chronic cardiac failure when the onset is gradual.

2) Ischaemic heart disease: It occurs due to narrowing or occlusion of one or more branches of coronary arteries. It may lead to angina pectoris.

3) Angina pectoris (angina of effort): It is pain occurring due to myocardial ischaemia. It occurs due to narrowing of coronary arteries. Because of this, physical effort causes severe ischaemic pain.

4) Myocardial infarction: It is the death of an area of cardiac tissue due to lack of coronary blood supply to that segment of the myocardium. It occurs due to occlusion of coronary artery.

5) Cardiac arrhythmia: It is a disorder in cardiac rate and rhythm. It occurs due to defective impulse formation and defective impulse conduction in the heart.

Question No. 06. Describe eye with the help of neat and clean diagram with functions of different parts.

Ans. Eye: It is the sensory organ of vision present in the orbital cavity. It is spherical in shape. Space between eye and orbital cavity is occupied by adipose tissue.

Structure: There are three layers of tissues in each eye ball. These are:

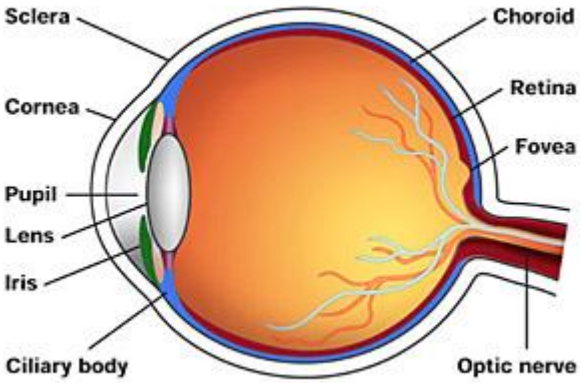
1) Outer fibrous layer - Sclera and cornea

2) Middle vascular layer - Choroid, ciliary body and iris

3) Inner nervous tissue layer -Retina

Structures inside the eye ball are lens, aqueous fluid and vitreous body.

1) Sclera and cornea: Sclera or white portion of the eye forms outermost layer of the eyeball and form transparent membrane in front known as cornea. Cornea is not supplied by blood vessels. Light rays pass through cornea to reach retina.



Structure of Human Eye

2) Choroid: It is the middle layer and very rich in blood vessels. Choroid contains melanocytes, which synthesize the melanin, which absorbs extra light.

Ciliary body: It is anterior part of choroid consists of ciliary muscles and ciliary process. Ciliary process secretes aqueous humor.

Iris: It is the visible colored part of the eye and present above ciliary body. Pigments are present in iris, which determine the color of the eye.

Lens: Lens is highly elastic, biconvex, lying behind the pupil and made up of protein. Lens is hold in position by Zonular fibres.

3) Retina: It is the innermost layer. It consists of photoreceptors known as rods and cones. Rods contain pigment rhodopsin and cones contain iodopsin. Rods and cones generate nerve impulses which are taken to the visual centre of brain. In the centre of retina space known as macula-lautea or yellow spot is present. In this a depression fovea centralis is present which consist of only cones. It has no light sensitive cells. Space between lens and retina is called as vitreous chamber, which is filled with vitreous body fluid. This fluid is formed during embryonic life and is not replaced thereafter. This fluid contains phagocytic cells also.

Question No .07 Define blood and give its component. Describe the various functions of blood.

Answer: Blood is a specialized connective tissue, which is fluid in nature. It has alkaline pH i.e., 7.4 and specific gravity 1.055. It is reddish in colour due to presence of pigment hemoglobin.

Components of Blood: Blood consist of two Components. They are plasma (55%) and cells (cellular elements) which are suspended in plasma (45%).

(a) Plasma: It is pale colored fluid, which consist of water up to 91%, Proteins like albumin, globulin, fibrinogen up to 7 to 8%, other substances which are present in plasma, are glucose, sodium chloride, iron, urea, uric acid, fats, enzymes, hormones, vitamins etc.

(b) Cells or cellular components of blood: (i) Red blood cells or Erythrocytes (RBC's) (ii) white blood cells or leucocytes (WBC's) and (iii) platelets or thrombocytes

(i) RBC's: These are circular, biconvex, disc shaped and non-nucleated cells contain hemoglobin. These are synthesized in the bone marrow. Average life span is about 120 days and normal count is 4.5-5 million/ cu mm.

(ii) WBC's: WBC's are of two types: ***Granulocytes and Agranulocytes***.

***Granulocytes*:** Granulocytes contains granules in their cytoplasm and nucleus is multilobed. These are of three types.

Neutrophils (Polymorphs**):** They stain with neutral dyes. Nucleus may contain 2-5 lobes and forms 65-70% of total WBC's.

Eosinophils or Acidophils**:** These cells are longer than neutrophils and takes acidic stain. Nucleus is 2 lobed. Their amount is 2-4% of total WBC's.

Basophils or mast cells**:** They stains blue with basic dyes. Nucleus is Kidney shaped. They contains histamine, heparin etc. Their count is 0.5% of total WBC's.

Agranulocytes: They do not contain granules in their cytoplasm and nucleus is not lobed. These are of two types i.e., Lymphocytes and Monocytes

Lymphocytes: These are of two types i.e. small and large. Small are 25% of total WBC's and large are 3- 5% only. In small lymphocytes nucleus almost occupies the whole cell, leaving a thin rim of cytoplasm. Large lymphocytes contain more amount of cytoplasm.

Monocytes: They are the largest of WBC's and about 2-4% of total WBC's.

Functions of WBC's:

1) They protect the body against infection.
2) They repair injured tissues.
3) They secrete anticoagulant heparin.

iii) Platelets or Thrombocytes: Round and biconvex. Normal platelets count is 2-5 lakh per cu mm of blood. Platelets do not contain nucleus and formed by red bone marrow.

Functions of Platelets:

1) Help in blood clotting.
2) Protect body from bacteria, viruses.
3) Contain histamine and serotonin.

Functions of Blood: Blood performs following functions:

1) It transports oxygen and nutrients (Food) to various tissues.
2) It excretes the waste products.
3) It carries hormone to various tissues.
4) It contains antibodies and WBC's, which protect the body from diseases.
5) Clotting of blood protects against blood loss.

6) It maintains the water balance in the body

7) It regulates the body temperature.

Question No-08 Write a note on physiology of muscle contraction.

Answer- Physiology of muscle contractions:

1) During normal resting state of a muscle, the muscle membrane is in a polarized state. This occurs because:

a) The interior of the muscle cell is negatively charged. It contains a large concentration of K^+ ions.

b) The exterior of the muscle cell is positively charged. It contains a large concentration of Na^+ ions.

2) When a nerve is stimulated, acetylcholine is liberated at the neuromuscular junction.

3) Acetylcholine increases the permeability of the muscle membrane. So Na^+ ions come inside of the cell. This produces a change in electrical charge. Both the interior and exterior of the muscle cell become positively charged. Now the membrane becomes depolarized. This depolarization produces a muscle contraction.

4) When the muscle contraction is over, acetylcholine is destroyed by the enzyme acetylcholinesterase.

5) Now, K^+ ions move into the cell and Na^+ ions out of the cell. This produces repolarisation of the muscle membrane. Now the muscle is ready for a second contraction.

Energy for muscle contraction: Actin and myosin are the two important muscle proteins. They form the contractile elements of a muscle. Muscle contraction is produced by the contraction of actin filaments over the stationary myosin filaments. The energy for muscle contraction is provided as follows:

1) Adenosine triphosphate (ATP) is broken down by the enzyme ATPase. This liberates Adenosine diphosphate (ADP) and also phosphate bond energy which is utilized for muscle contraction.

2) ATP is regenerated again by the reaction between phosphocreatinine and ADP.

3) Regeneration of phosphocreatinine occurs by the combination of creatinine and phosphate energy which is formed in the conversion of glycogen to lactic acid.

4) About one fifth of the lactic acid produced from glycogen is oxidized to carbon dioxide and water. The remaining is converted to glycogen and stored in liver, muscles and other tissues.