JRG College of Pharmacy

JRG COLLEGE OF PHARMACY

UNIVERSITY SOLVED QUESTION

WITH ANSWER

Year : 2019-2020

Subject : HAP

Subject Code : BP-101T

Subject In-Charge : Arun Aniket Das & Kabita panda

Registration No: | | | | | | | | | | |

Total Number of Pages : 01

B.Pharma
BP101T

1st Semester Regular/Back Examination 2019-20
HUMAN ANATOMY AND PHYSIOLOGY I
BRANCH : B.Pharma
Max Marks: 75
Time : 3 Hours
Q.CODE : HRB559

Answer Question No.1 (Part-A) and 02 (Part-B) which are compulsory and any TWO from Part-C.
The figures in the right hand margin indicate marks.

Part-A

Q1 **Only Short Answer Type Questions (Answer All-10)** **(2 x 10)**

a) Define homeostasis with an example.
b) Write the structure and functions of plasma membrane.
c) Write different types of WBC and their functions.
d) What is cardiac output?
e) What are the antigens and antibodies present in A^+ blood group?
f) What is Electrocardiogram?
g) What is hypertension?
h) Definepronation and supination?
i) What is erythropoiesis?
j) Name the neurotransmitters released from preganglionic and postganglionic sympathetic nerve endings.

Part-B

Q2 **Only Focused-Short Answer Type Questions- (Answer Any FIVE out of SEVEN)** **(5 x 7)**

a) Define and classify tissue. Write detail notes on epithelial tissue.
b) Write the principles of cell communication.
c) Write the structure and functions of skin.
d) Discuss in details about the neuromuscular junction.
e) Classify different types of bone joint. Explain briefly on synovial joints.
f) Write notes on cardiac cycle?
g) Write the origin and functions of cranial nerves.
h) Write the detail mechanisms of blood coagulation.
i) Write the structure and functions of human eye.

Part-C

Only Long Answer Type Questions (Answer Any TWO out of FOUR)

Q3 Discuss the human cell with neat and labeled diagram. Explain briefly the structure and functions of different cell organelles. **(10)**

Q4 With neat and labeled diagram describe the anatomy and physiology of human heart. Write notes on cardiac output. **(10)**

Q5 Define lymph. Write detail about lymphatic system. Add a note on the functions of spleen. **(10)**

Q6 Write the classification and functions of peripheral nervous system. Discuss about sympathetic and parasympathetic nervous system. **(10)**

Q1. Only Short Answer Type Questions

(a) Define homeostasis with an example.

Ans:- Homeostasis is the ability to maintain internal stability in an organism in response to the environmental changes.

Ex:- The regulation of body temperature, & the balance between acidity & alkalinity.

(b) Write the structure & functions of plasma membrane.

Ans:- The cell membrane, also called the plasma membrane, is found in all cells & separates the interior of the cell from the outside environment. The cell membrane consists of a lipid bilayer that is semipermeable. The cell membrane regulates the transport of materials entering & exiting the cell.

(c) Write the different types of WBC & their functions.

Ans:- There are five types of white blood cells:

(i) Neutrophils :- Help protect your body from infections by killing bacteria, fungi & foreign debris.

(ii) Lymphocytes :- Consist of T cells, natural killer cells & B cells to protect against viral infections & produce proteins to help you fight infection (antibodies).

(iii) Eosinophils :- Identify & destroy parasites, cancer cells & assists basophils with your allergic response.

(iv) Basophils :- Produce an allergic response like coughing, sneezing or a runny nose.

(v) Monocytes :- Defend against infection by cleaning up damaged cells.

(d) What is cardiac output?

Ans:- The volume of blood being pumped by the heart, in particular by the left or right ventricle, per unit time.

(e) What are the antigens & antibodies present in A^+ blood group?

Ans:- Type A^+ blood contains the A antigen. When exposed to type B or type AB blood it will coagulate, meaning that it will reject these 2 blood types because each contain the B antigen which is an enemy to type A blood. This setup an antibody reaction to protect Type A blood from foreign invaders. Type AB blood will accept both A antigen & B antigen. Type O -blood is the Universal Donor because it does not contain any antigens.

(f) What is Electrocardiogram?

Ans:- Electrocardiogram (ECG) is defined as a recording of the heart's electrical activity.

(g) What is hypertension?

Ans:- Hypertension, also known as high or raised blood pressure, is a condition in which the blood vessels have persistently raised pressure.

(h) Define pronation & supination?

Ans:- Supination & pronation refer to the movements of the forearm & hand. Supination is the movement that occurs when the palm of the hand faces upward or forward, while pronation is the movement that occurs when the palms faces downward or backward.

(i) What is erythropoiesis?

Ans:- Erythropoiesis, the development of red blood cells, is a tightly regulated process for maintaining sufficient oxygen delivery to tissue.

(ii) Name the neurotransmitters released from preganglionic & postganglionic sympathetic nerve endings.

Ans:- The neurotransmitters involved in the autonomic nervous systems are acetylcholine, norepinephrine & epinephrine.

Q2. Only Focused - Short Answer Type Questions.

(a) Define & classify tissue. Write detail notes on epithelial tissue.

Ans :- Tissue can be defined as a group of cells with similar shape & function are termed as tissues. They form a cellular organizational level, intermediate between the cells & organ system. Organs are then created by combining the functional groups of tissues.

There are four basic tissue types :

~~Defined by~~

(i) Epithelial tissue
(ii) Connective tissue
(iii) Muscle tissue
(iv) Neurons tissue

Epithelial tissue or epithelium forms the outer covering of the skin & also lines the body cavity. It forms the lining of respiratory, digestive, reproductive & excretory tracts.

Structure:- Epithelial tissue is formed from a tightly fitted continuous layer of cells. One surface of the epithelial tissue is exposed to either the external environment or the body fluid. The other surface is attached to tissue by a membrane, which consists of fibres & polysaccharides secreted by epithelial cells.

There is little intercellular material present bet^{n} cells. There are specialised junctions present bet^{n} the cells of the epithelium that link individual cells.

Tight junctions - prevent leakage across tissues.

Adhering junctions :- keep the neighbouring tissues well cemented together.

Gap junctions :- facilitate the movement of ions & molecules across the tissue.

Epithelial cells form membranes. The epithelial membranes consists of a layer of epithelial tissue & has underlying connective tissue. There are two types of epithelial membranes, mucous membrane & serous membrane.

Mucous membrane :- It is also known as mucosa. There are goblet cells present, which secrete mucus. The mucus helps in lubrication, protection & easy movement of materials. It prevents tissues from drying. It lines the body cavities such as respiratory & digestive tracts, which open outside the body.

Serous membrane :- The serous membrane lines the body cavities, which do not open outside the body, such as the

lining of the pleural cavity, pericardial membranes. These membranes secrete the fluid inside the cavity & are made up of simple squamous epithelium.

Glands :- These glands are made up of epithelial cells. There are two types of glands, exocrine & endocrine.

Exocrine glands secrete their product into a duct, e.g., goblet cells, sebaceous glands. Endocrine glands are called ductless glands & they release their product directly into the blood or interstitial fluid, e.g., hormones.

Epithelial tissue performs following functions:

- They protects the underlying cells from injury, drying & chemical effects.
- They form the lining of various internal organs to protect them.

- Some cells have secretory functions.
- They help in the removal of waste products.

(b) Write the principles of cell communication.

Ans :- • Cellular systems in the body communicate with each other to coordinate integrate their functions.

- This occurs through a variety of processes known collectively as cell signaling, in which a signaling molecule produced by one cell is decided by another, almost always by means of a specific receptor protein molecule.
- The recipient cell transduces the signal, which it most often detects at the plasma membrane, into intracellular chemical messages that change cell behavior.

Forms of intracellular signaling:

The signaling by cell are following types:

1. Endocrine signaling (neurocrine or neuroendocrine signaling)
2. Paracrine Signaling
3. Contact-depending or Juxtacrine Signaling
4. Synaptic Signaling

1. Endocrine Signaling:-

- Most endocrine hormones are circulating hormones - they pass from the secretory cells that make them into interstitial fluid & then into the blood.
- The endocrine cells are located in endocrine glands like thyroid gland, hypothalamus.
- These types of signals usually produce a slower response, but have a longer lasting effect.
- The ligands released in endocrine

signaling are called hormones.

- Hormones travel the large distance both endocrine cells & their target cells via bloodstream which is relatively slow away to move throughout the body.

2. Paracrine Signaling :-

- In this form, the products of the cells diffuse in the extracellular fluid to affect neighboring cells that may be some distance away.
- Local hormones that act on neighboring cells are called paracrine & those that act on the same cell that secreted them are called autocrine.

3. Contact-Dependent or Juxtacrine Signaling :-

- In this there is the actual contact both the cells. It is particularly important for normal development & immunity. Some bacteria & other infectious agents use contact signa-

ling to identify "preferred" target tissues or organs.

- Gap junctions in animals & plasmodesmata in plants are connections betⁿ the plasma membranes of neighbouring cells, this water filled channels allow small signaling molecules called intracellular mediators, to diffuse betⁿ the two cells.
- The transfer of signaling molecules communicates the ~~coorrent~~ state of the cell that is directly next to the target cell, this allows a group of cells to coordinate their response to a signal that only one of them may have received.

4. Synaptic Signaling :-

- The point at which the nerve impulse passes from one to another is the Synapse. There is no physical contact betⁿ these neurons.

- In this form, neurotransmitters are released at synaptic junctions from nerve cells & act across a narrow synaptic cleft on a postsynaptic cell.

(c) Write the structure & functions of skin.

Ans :- The skin is the largest organ of the body. It has three main layers, the epidermis, the dermis & the subcutaneous layer.

The epidermis is an elastic layer on the outside that is continually being regenerated. It includes the following:

- Keratinocytes :- The main cells of the epidermis formed by cell division at its base. New cells continually move towards the surface. As they move they gradually die & become flattened.

- Corneocytes :- The flattened dead keratinocytes that together make up the very outer layer of the epidermis is called the Stratum corneum or horny layer. This protective layer is continually worn away or shed.
- Melanocytes :- Produce the pigment melanin that protects against UV radiation & gives skin its colour.

The dermis is the inner layer that includes the following:

- Sweat glands :- Produce sweat that travels via sweat ducts to openings in the epidermis called pores. They play a role in temperature regulation.
- Hair follicles :- These are pits in which hairs grow. Hairs also play a role in temperature regulation.
- Sebaceous glands :- It produce sebum (an oil) to keep hairs free from

dust & bacteria. Sebum & sweat make up the 'surface film'.

The subcutaneous layer under the dermis is made up of connective tissue & fat (a good insulator).

Functions of the skin :-

- Provides a protective barrier against mechanical, thermal & physical injury & hazardous substances.
- Prevents loss of moisture.
- Reduces harmful effects of UV radiation.
- Acts as a sensory organ (touch, detects temperature).
- Helps regulate temperature.
- An immune organ to detect infections etc.
- Production of vitamin D.

(c) Classify different types of bone joint. Explain briefly on synovial joints.

Ans:- Bone joints can be classified based on their structure & function. The main types are fibrous joints, cartilaginous joints, & synovial joints.

Types of Bone Joints:-

1. Fibrous Joints:
   - Structure: These joints are connected by dense connective tissue consisting mainly of collagen. They do not have a joint cavity.
   - Function: These joints are typically immovable (synarthroses) or only allow slight movement.
   - Examples:- Sutures: Found bet^n the bone of the skull.
     - Syndesmoses: Joints where bones are connected by a ligament, such as the distal tibiofibular joint.

- Gomphoses: Peg-in-socket joints, such as the connection betⁿ teeth & their sockets.

2. Cartilaginous Joints:

- Structures: These joints are connected entirely by cartilage (hyaline cartilage or fibrocartilage). They do not have a joint cavity.
- Function: They allow more movement than fibrous joints but less than synovial joints.
- Examples: - Synchondroses: Joints where bones are connected by hyaline cartilage, such as the epiphyseal plates in growing bones.

- Symphyses: Joints where bones are connected by fibrocartilage, such as the public symphysis & intervertebral discs.

3. Synovial Joints:

- Structure: These joints have a joint cavity filled with synovial fluid, surrounded by a fibrous capsule & supported by ligaments.
- Function: They are freely movable (diarthroses) & are the most common type of joint in the body.
- Examples: knee, elbow, shoulder, hip, etc.

Synovial Joints: Synovial joints are the most complex & versatile type of joint in the human body. Here are the characteristics & types of synovial joints:

Characteristics:

- Articular Cartilage: Covers the ends of the bones, providing a smooth, low-friction surface for movement.
- Joint (Synovial) Cavity: A space betⁿ the articulating bones that contains synovial fluid.

- Synovial fluid: A viscous fluid that lubricates the joint, reducing friction & nourishing the articular cartilage.
- Articular Capsule: A double-layered structure enclosing the joint cavity.
  - Fibrous layer: The outer layer, composed of dense connective tissue, providing strength to the joint.
  - Synovial Membrane: The inner layer, which secretes synovial fluid.
- Ligaments: Strong bands of connective tissue that reinforce the joint & limit its movement to prevent dislocation.
- Bursae & Tendon Sheaths: Fluid-filled sacs & tubes that reduce friction between tissues around the joint.

Types of Synovial Joints:

1. Plane joints (Gliding Joints)
   - Movement: Allow sliding or gliding movements.

Examples: Intercarpal joints in the wrist intertarsal joints in the ankle.

2. Hinge Joints:

- Movement: Permit flexion & extension.

Examples: Elbow joints, knee joint, interphalangeal joints.

3. Pivot Joints:

- Movement: Allow rotational movement around a single axis.

Examples: Proximal radioulnar joint (enabling pronation & supination of the forearm), atlantoaxial joint in the neck.

4. Condyloid Joints (Ellipsoidal Joints):

- Movement: Permit flexion, extension, abduction, adduction, & circumduction

Examples: Wrist joint (radiocarpal joint), metacarpophalangeal joints (knuckle joints)

5. Saddle Joints:

- Movement: Allow movements similar to condyloid joints but with a greater

range of motion.

Examples:- Carpometa carpal joint of the thumb.

6. Ball-&-Socket Joints:

- Movement: Provide the most extensive range of movements, including flexion, extension, abduction, adduction, rotation & circumduction.

Examples: Shoulder joint (glenohumeral joint), hip joint.

Importance of Synovial Joints:

Synovial joints are essential for a wide range of bodily movements, allowing for complex & varied motion necessary for daily activities, sports, & other physical ~~tasks~~ tasks. They play a crucial role in maintaining mobility & flexibility, which are vital for overall health & quality of life. Proper functioning of synovial joints depends on the integrity of their structures, & issues such as

arthritis, injuries, or wear & tear can significantly impact their performance.

(f) Write notes on Cardiac cycle?

Ans:- The cardiac cycle describes all the activities of the heart through one complete heartbeat - that is, through one contraction & relaxation of both the atria & ventricles. A contraction event (of either the atria or ventricles) is referred to as systole, & a relaxation event is referred to as diastole.

The cardiac cycle includes a description of the systolic & diastolic activities of the atria & ventricles, the blood volume & pressure changes within the heart, and the action of the heart valves. A description of each period of the cardiac cycle follows:

- The isovolumetric ventricular relaxation is the period during which the ventricles are relaxed both AV & semilunar valves are still closed.

The volume of the ventricles remain unchanged (isovolumetric) during this period.

- Ventricular filling begins as the AV valves open & blood fills the ventricles. The ventricles remain in diastole during this period. The filling of the ventricles can be described as three successive events:

-Rapid ventricular filling occurs as blood flows into the empty & relaxed ventricles. Volume of the ventricles increases rapidly

-Diastasis is a slower filling event than that of the preceding because most of the volume of the ventricle is already occupied by blood.

-Atrial systole (and the P wave of the ECG) occurs & forces the remaining blood from the atria into the ventricles. The blood volume at the end of this interval is called the end-diastolic volume (EDV).

- Ventricular contraction (ventricular systole) begins as the action potential from the AV node enters the ventricles, the ventricles depolarize, & the QRS complex is observed on the ECG. The following intervals during this phase are observed:

- Isovolumetric contraction occurs when the AV valves are forced shut. During this brief period, while the semilunar valves are still closed, the volume of the ventricles remains unchanged.

- Ventricular ejection occurs as the continuing contraction of the ventricles increases the pressure in the ventricles & forces the semilunar valves open. At this point, blood is forced out of the ventricles. This interval ends when the ventricles begin to relax, & the semilunar valves close. The closing of the

Semilunar valves causes a small increase in blood pressure visible as the dicrotic notch on a plot of blood pressure ~~visible as the~~ against time. The amount of blood remaining in the ventricles at this time is called the end-systolic volume (ESV).

(g) Write the origin & functions of cranial nerves.

Ans: Cranial nerves are a set of twelve nerves that originate directly from the brain & brainstem, rather than from the spinal cord. They are primarily responsible for transmitting information betⁿ the brain & various regions of the head, neck, & thoracic area. Here is an overview of their organs & functions:

1. Olfactory Nerve (CN I)
   - Origin - Olfactory bulb, located in the forebrain.
   - Function - Responsible for the sense of smell.

2. Optic Nerve (CN II)

- Origin: Retinal ganglion cells in the eye, with fibers converging at the optic chiasm.
- Function: Transmits visual information from the retina to the brain.

3. Oculomotor Nerve (CN III)

- Origin: Midbrain, specifically the oculomotor nucleus.
- Functions:
  - Motor: Controls most of the eye's movements, including the constriction of the pupil & maintaining an open eyelid.
  - Parasympathetic: Adjusts lens shape for focusing & pupil constriction.

4. Trochlear Nerve (CN IV)

- Origin: Midbrain, from the trochlear nucleus.
- Function: Motor nerve that innervates

the superior oblique muscle of the eye, responsible for downward, inward, & lateral eye movement.

5. Trigeminal Nerve (CN V)
   - Origin: Pons.
   - Functions:
     - Sensory: Conveys sensations from the face, sinuses, & teeth.
     - Motor: Controls muscles used for chewing.

6. Abducens Nerve (CN VI)
   - Origin: Pons, from the abducens nucleus
   - Function: Motor nerve that controls the lateral rectus muscle of the eye, responsible for outward eye movement.

7. Facial Nerve (CN VII)
   - Origin: Pons.
   - Functions:
     - Motor: Controls the muscles of the facial expression.

- Sensory :- Conveys taste sensations from the anterior two-thirds of the tongue.
- Parasympathetic :- Stimulates salivary & lacrimal glands.

8- Vestibulocochlear Nerve (CN VIII)
- Origin : Pons & medulla.
- Functions :
  - Cochlear branch :- Responsible for hearing.
  - Vestibular branch :- Responsible for balance & spatial orientation.

9- Glossopharyngeal Nerve (CN IX)
- Origin : Medulla oblongata
- Functions :
  - Motor :- Innervates part of the tongue ~~decreases~~ & pharynx for swallowing.
  - Sensory :- Conveys taste from the posterior one-third of the tongue, & general sensory information from the pharynx & tonsils.

- Parasympathetic :- Stimulates the parotid salivary gland.

10. Vagus Nerve (CN X)

- Origin : Medulla oblongata.
- Functions:
  - Motor :- Controls muscles for voice & resonance & the soft palate.
  - Sensory :- Provides sensory information from the larynx, pharynx, thoracic & abdominal viscera.
  - Parasympathetic :- Controls autonomic functions of the heart, lungs & digestive tract.

11. Accessory Nerve (CN XI)

- Origin :- Medulla oblongata & the upper spinal cord.
- Function :- Motor nerve that controls the sternocleidomastoid & trapezius muscles to coordinate head movements.

12. Hypoglossal Nerve (CN XII)

- Origin : Medulla oblongata.
- Function : Motor nerve that controls the muscles of the tongue, important for speech & swallowing.

Each cranial nerve has distinct pathways & functions, contributing to the complex control of sensory & motor activities in head & neck regions.

(h) Write the detail mechanism of blood coagulation.

Ans :- Blood coagulation is a complex process that prevents excessive bleeding when a blood vessel is injured. It involves a series of steps & interactions bet^n cellular components (primarily platelets) & plasma proteins (clotting factors). Here is a detailed overview of the mechanisms involved in blood coagulation:

1. Vascular Spasm :- When a blood vessel is injured, it constricts (vascular

spasm) to reduce blood flow to the affected area. This initial response is immediate & helps to minimize blood loss.

2. Platelet Plug Formation: Platelet plug formation occures in three stages:

(a) Platelet Adhesion:- Platelets adheree to the exposed collagen fibrees in the damaged vessel wall. This adhesion is mediated by von Willebrand factor (vWF), a plasma protein that binds to both collagen & platelet surface receptores (glycoprotein Ib).

(b) Platelet Activation:- Once adhered, platelets become activated & change shape, releasing granules containing various substances, including ADP, thromboxane A2, & serotonin. These substances amplify the response by attracting more platelets to the site of injury.

(c) Platelet Aggregation:- ADP & thromboxane A2 stimulate nearby platelets

plug. This aggregation is facilitated by fibrinogen, which bridges both platelets via glycoprotein IIb/IIIa receptors.

3. Coagulation Cascade:- The coagulation cascade is a series of enzymatic reactions that lead to the formation of a fibrin clot. It consists of three pathways: intrinsic, extrinsic, & common pathways.

(a) Intrinsic Pathway -

- Initiation: Triggered by damage to the blood vessel, exposing collagen & other subendothelial substances.
- Sequence: Involves clotting factors XII, XI, IX, & VIII.
  - Factor XII (Hageman factor) is activated upon contact with the damaged surface.
  - Activated Factor XII (XIIa) converts factor XI to XIa.
  - Factor XIa activates Factor IX.
  - Factor IXa, in the presence of

Factor VIIIa, calcium ions, & phospholipids activates Factor X.

(b) Extrinsic Pathway:-

- Initiation: Triggered by external trauma that causes blood to escape from the vascular system.
- Sequence: Involves tissue factor (TF) & Factor VII.
  - Tissue factor (TF) is released from damaged tissues.
  - TF forms a complex with Factor VII, activating it to VIIa.
  - The TF-VIIa complex, along with calcium ions, directly activates Factor X.

(c) Common Pathway:-

- Initiation: Convergence of intrinsic & extrinsic pathways at Factor X.
- Sequence: Involves Factors X, V, II (prothrombin), I (fibrinogen), & XIII.

- Activated Factor X (Xa) forms a complex with Factor V (Va), calcium ions, & phospholipids, known as the prothrombinase complex.
- The prothrombinase complex converts prothrombin (Factor II) into thrombin (Factor IIa).
- Thrombin then converts fibrinogen (Factor I) into Fibrin (Factor Ia).
- Fibrin strands form a mesh that is stabilised by Factor XIII (activated by thrombin), creating a stable fibrin clot.

4. Clot Retraction & Repair:

After the fibrin clot forms, platelets contract, pulling the edges of the wound together (clot retraction). This process reduces the size of the damaged area & facilitates tissue repair. Platelets also release growth factors that promote healing.

5. Fibrinolysis :- Fibrinolysis is the process of breaking down the clot once the tissue is repaired. Plasminogen, incorporated into the clot, is activated to plasmin by tissue plasminogen activator (tPA) & urokinase. Plasmin digests fibrin, dissolving the clot.

Key Components of Coagulation :

- Platelets :- Cell fragments that form the initial plug & provide a surface for coagulation reactions.
- Clotting Factors :- Proteins in the plasma that interact in a cascade to form fibrin.
- Calcium Ions :- Essential cofactor for many steps in the coagulation cascade.
- Phospholipids :- Provided by activated platelets, they form a surface for the assembly of enzyme complexes

Regulation of Coagulation :-

Coagulation must be tightly regulated to prevent excessive clotting (thrombosis) or insufficient clotting (bleeding). Regulatory mechanisms include:

- Antithrombin : Inhibits thrombin & other proteases in the coagulation cascade.
- Protein C & Protein S : Inactivate factors Va & VIIIa.
- Tissue Factor Pathway Inhibitor (TFPI): Inhibits the TF-VIIa complex & Factor Xa.

These mechanisms ensure that coagulation occurs only where & when it is needed, maintaining the balance betn clot formation & dissolution.

(i) Write the structures & functions of human eye.

Ans:-

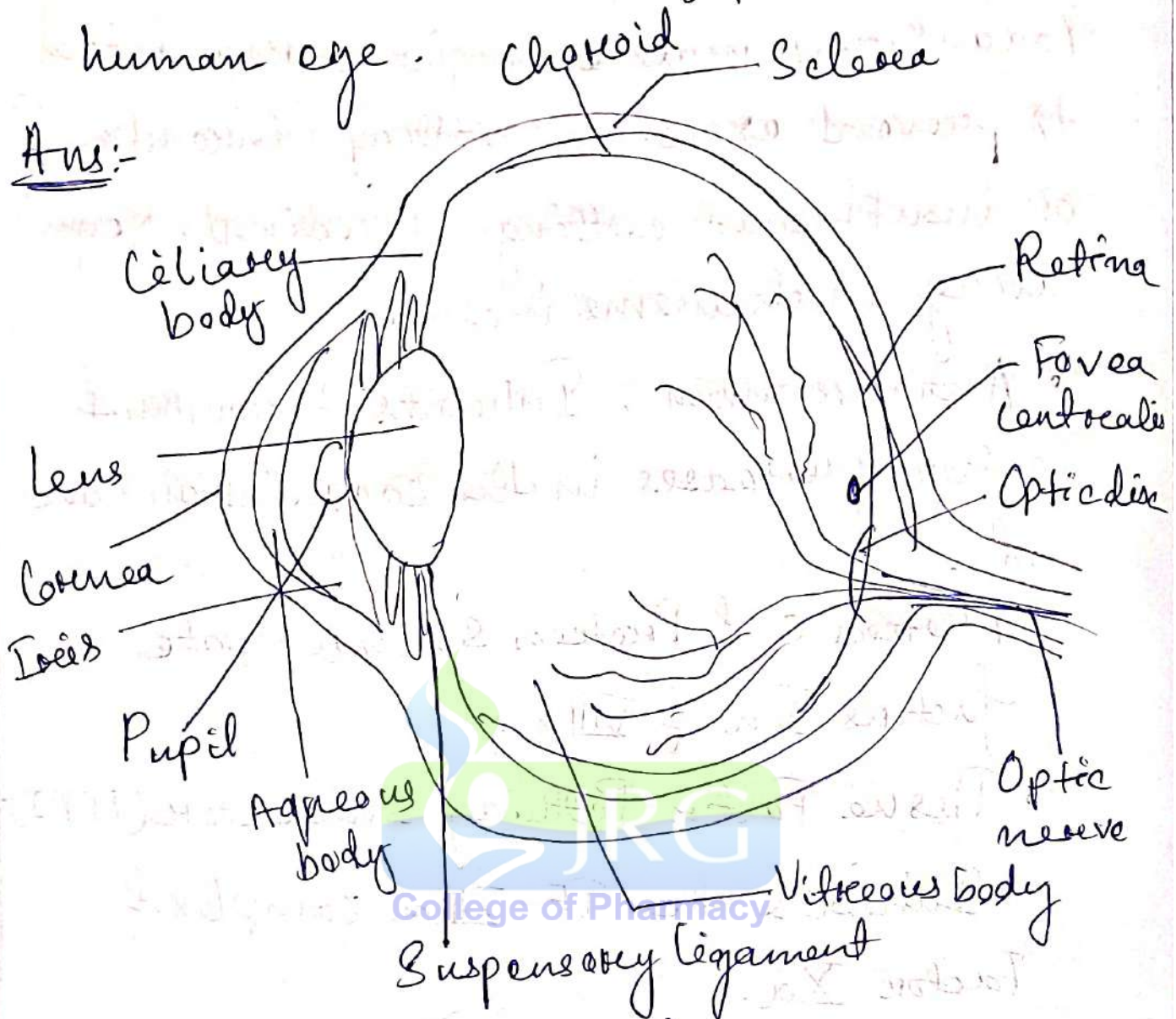


Fig:- Structure of human eye.

The human eyes are the most complicated sense organs in the human body. From the muscles & tissues to nerves & blood vessels, every part of the human eye is responsible for a certain action. Furthermore, contrary to popular belief,

the eye is not perfectly spherical; instead, it is two separate segments fused together. It is made up of several muscles & tissues that come together to form a roughly spherical structure. From an anatomical perspective, the human eye can be broadly classified into external structures & internal structures.

The External Structures of an Eye :-

The parts of the eye that are visible externally include the following :

Sclera :- It is a white visible portion. It is made up of dense connective tissue & protects the inner parts.

Conjunctiva :- It lines the sclera & is made up of stratified squamous epithelium. It keeps our eyes moist & clear & provides lubrication by secreting mucus & tears.

Iris :- It is the pigmented, coloured portion of the eye, visible externally. The main function of the iris is to control the diameter of the pupil according to the light source.

Cornea :- It is the transparent, anterior one front part of our eye, which covers the pupil & the iris. The main function is to refract the light along with the lens.

Pupil :- It is the small aperture located in the centre of the iris. It allows light to enter & focus on the retina.

The Internal Structures of an Eye :-

The internal components of an eye are;

Lens :- It is a transparent, biconvex, lens of an eye. The lens is attached to the ciliary body by ligaments. The lens along with the cornea refracts light so that it focuses on the retina.

Retina :- It is the innermost layer of the eye, it is light sensitive & acts as a film of a camera. Three layers of neural cells are present in them. They are ganglion, bipolar & photoreceptor cells. It converts the image into electrical nerve impulses for the visual perception by the brain.

Optic Nerve :- It is located at the posterior portion of the eyes. The optic nerves carry all the nerve impulses from the retina to the human brain for perception.

Aqueous Humour :- It is a watery fluid present both the cornea & the lens. It nourishes the eye & keeps it inflated.

Vitreous Humour :- It is a transparent, jelly-like substances present both the lens & the retina. It contains water (99%), collage,

proteins, etc. The main function of vitreous humour is to protect the eyes & maintain its spherical shape.

Part-C

Q3. Discuss the human cell with neat & labeled diagram. Explain briefly the structures & functions of different cell organelles.

Ans:- The cellular components are called cell organelles. These cell organelles include both membrane & non-membrane bound organelles, present within the cells & are distinct in their structures & functions. They coordinate & function efficiently for the normal functioning of the cell. A few of them function by providing shape & support, whereas some are involved in the locomotion & reproduction of a cell. There are various organelles present within the cell & are classified

into three categories based on the presence or absence of membrane.

Organelles without membrane :- The cell wall, ribosomes & cytoskeleton are non-membrane-bound cell organelles. They are present both in the prokaryotic cell & the eukaryotic cell.

Single membrane-bound organelles :- Vacuole, Lysosome, Golgi Apparatus, endoplasmic reticulum are single membrane-bound organelles present only in a eukaryotic cell.

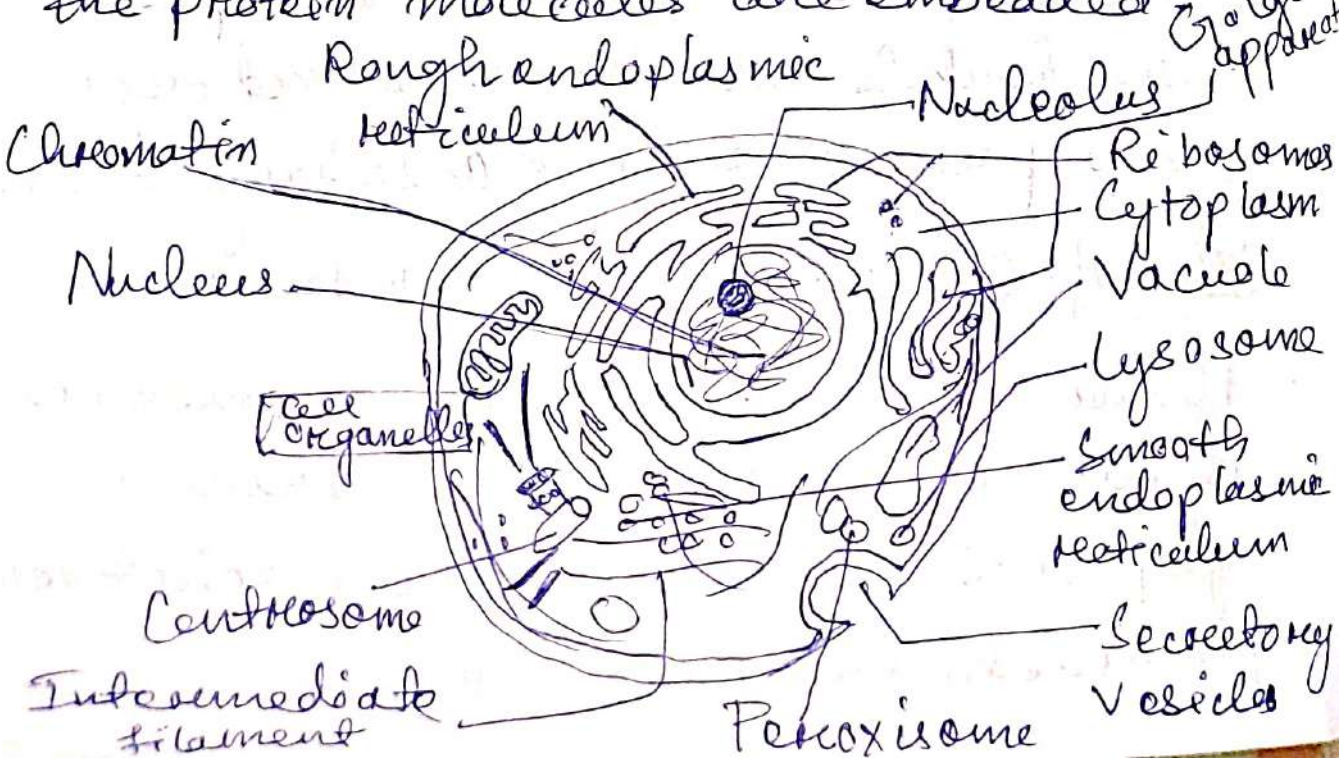
Double membrane-bound organelles :- Nucleus, mitochondria & chloroplast are double membrane-bound organelles present only in a eukaryotic cell.

List of Cell organelles & their Functions :-

Plasma membrane :- The plasma membrane is also termed as a cell membrane or cytoplasmic Membrane. It is a selectively permeable membrane of the cells, which

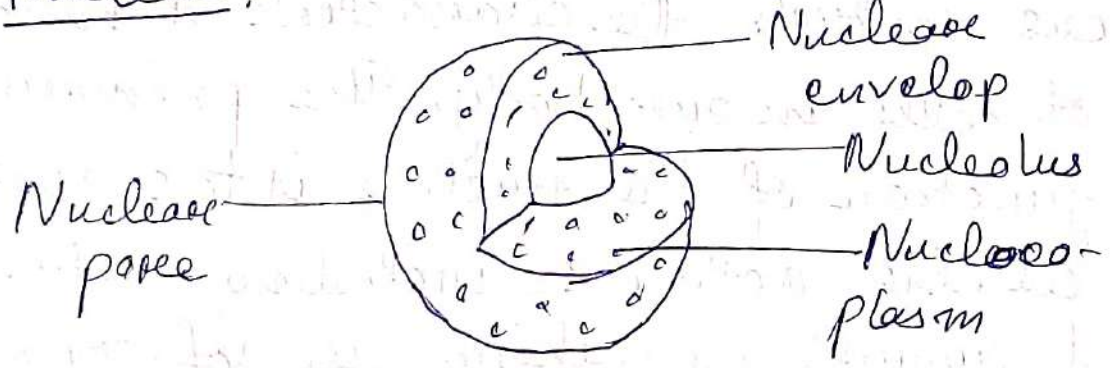
is composed of a lipid bilayer & proteins.

The plasma membrane is present both in plant & animal cells. It functions as the selectively permeable membrane, by permitting the entry of selective materials in & out of the cell according to the requirement. In an animal cell, the cell membrane functions by providing shape & protects the inner contents of the cell. Based on the structure of the plasma membrane, it is regarded as the fluid mosaic model. According to the fluid mosaic model, the plasma membranes are subcellular structures, made of a lipid bilayer in which the protein molecules are embedded



Cytoplasm :- The cytoplasm is present both in plant & animal cells. They are jelly-like substances, found betn the cell membrane & nucleus. They are mainly composed of water, organic & inorganic compounds. The cytoplasm is one of the essential components of the cell, where all the cell organelles are embedded. These cell organelles contain enzymes, mainly responsible for controlling all metabolic activity taking place within the cell & are the site for most of the chemical reactions within a cell.

Nucleus :-



The nucleus is a double-membraned organelle found in all eukaryotic cells. It is the largest organelle, which functions as the control centre of the cellular activities & is the storehouse of

the cell's DNA. By structure, the nucleus is dark, round, surrounded by a nuclear membrane. It is a porous membrane (like cell membrane) & forms a wall between cytoplasm & nucleus. Within the nucleus, there are tiny spherical bodies called nucleoli. It also carries an essential structure called chromosomes.

Chromosomes are thin & thread-like structures which carry another important structure called a gene. Genes are a hereditary unit in organisms i.e., it helps in the inheritance of traits from one generation (parents) to another (offspring). Hence, the nucleus controls the characters & functions of cells in our body. The primary function of the nucleus is to monitor cellular activities including metabolism & growth by making use of DNA's genetic information. Nucleoli in the nucleus are responsible for the synthesis of protein & RNA.

Endoplasmic Reticulum :- The endoplasmic

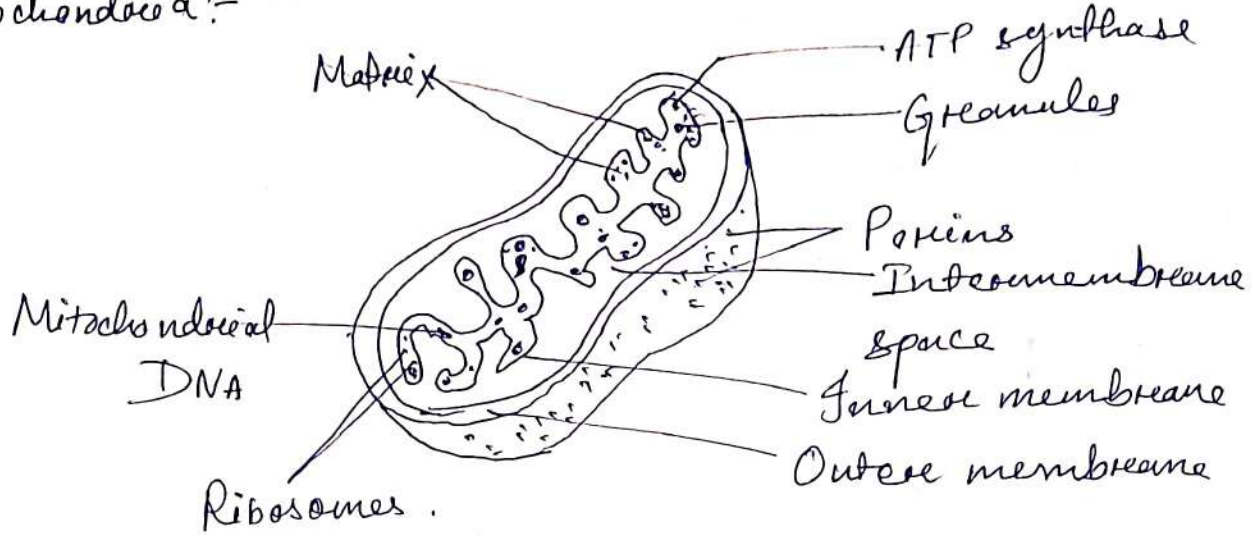
Reticulum is a network of membranous canals filled with fluid. They are the transport system of the cell, involved in transporting materials throughout the cell.

There are two different types of ER :-

1. Rough ER :- They are composed of cisternae, tubules & vesicles, which are found throughout the cell & are involved in protein manufacture.

2. Smooth ER :- They are the storage organelle, associated with the production of lipids, steroids & also responsible for detoxifying the cell.

Mitochondria :-



Mitochondria are called the powerhouse of the cell as they produce energy-rich molecules for the cell. The mitochondrial genome is inherited maternally in several organisms. It is a double membrane-bound, sausage-shaped organelle, found in almost all eukaryotic cells.

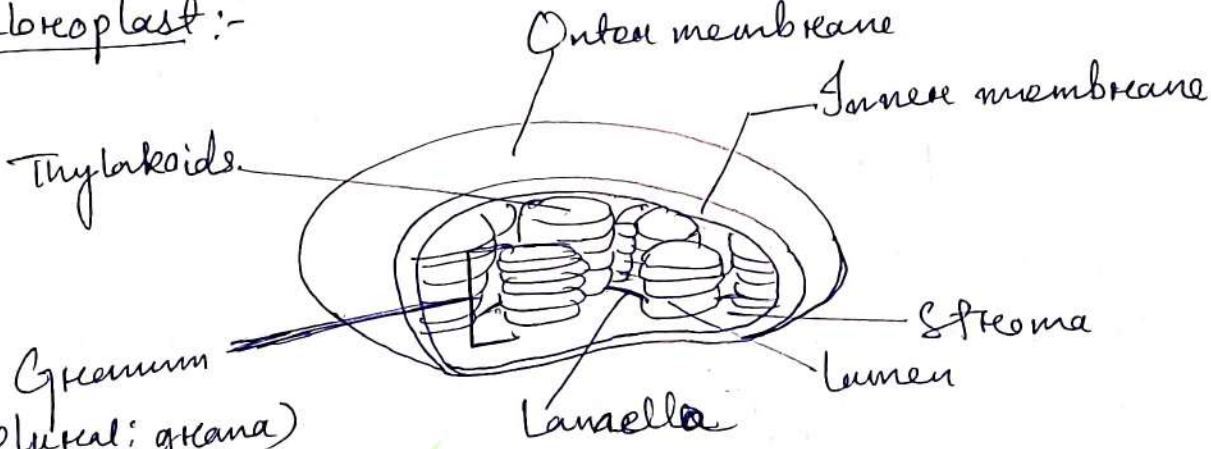
The double membranes divide its lumen into two distinct aqueous compartments. The inner compartment is called a "matrix" which is folded into cristae whereas the outer membrane forms a continuous boundary with the cytoplasm. They usually vary in their size & are found either round or oval in shape. Mitochondria are the sites of aerobic respiration in the cell, produces energy in the form of ATP & helps in the transformation of the molecules.

For instance, glucose is converted into adenosine triphosphate - ATP. Mitochondria have their own circular DNA, RNA molecules, ribosomes (the 70s), & a few other

molecules that help in protein synthesis.

Plastids :- Plastids are large membrane-bound organelles which contain pigments. Based on the type of pigments, plastids are of three types:

Chloroplast :-



- Chloroplasts :- Chloroplasts are double membrane-bound organelles, which usually vary in their shape from a disc shape to spherical, discoid, oval & ribbon. They are present in mesophyll cells of leaves, which store chloroplasts & other carotenoid pigments. These pigments are responsible for trapping light energy for photosynthesis. The inner membrane encloses a space called the stroma. Flattened disc, like chlorophyll containing structures known as thylakoids are arranged in a stacked manner like a pile of coins. Each pile is called a granum & the thylakoids of different grana are connected by flat membranous tubules known as stromal

lamella. Just like the mitochondrial matrix, the stroma of chloroplast also contains a double-stranded circular DNA, 70S ribosomes, & enzymes which are required for the synthesis of carbohydrates & proteins.

- Chromoplasts :- The chromoplasts include fat soluble, carotenoid pigments like xanthophylls, carotene, etc. which provide the plants & with their characteristic color - yellow, orange, red, etc.
- Leucoplasts :- Leucoplasts are colorless plastids which store nutrients. Amyloplasts store carbohydrates (like starch in potatoes), aleuroplasts store proteins, & elaioplasts store oils & fats.

Ribosome :- Ribosomes are non membrane-bound & important cytoplasmic organelles found in close association with the endoplasmic reticulum. Ribosomes are found in the form of tiny particles in a large no. of cells & are mainly composed of 2/3rd of RNA & 1/3rd of protein. They are named as the 70S (found in prokaryotes) or 80S (found in eukaryotes). The letter S refers to the density & the size, known as Svedberg's unit. Both 70S & 80S ribosomes are composed of two subunits.

Ribosomes are either encompassed within the

endoplasmic reticulum are freely traced in the cell's cytoplasm. Ribosomal RNA & Ribosomal proteins are the two components that together constitute ribosomes. The primary function of the ribosomes includes protein synthesis in all living cells that ensure the survival of the cell.

Golgi Apparatus :- Golgi apparatus is also termed as Golgi complex. It is a membrane-bound organelle, which is mainly composed of a series of flattened, stacked pouches called cisternae. This cell organelle is primarily responsible for transporting, modifying & packaging proteins & lipids to targeted destinations. Golgi apparatus is found within the cytoplasm of a cell & is present in both plant & animal cells.

Microbodies :- Microbodies are membrane-bound, minute, vesicular organelles, found in both plant & animal cells. They contain various enzymes & proteins & can be visualized only under the electron microscope.

Cytoskeleton :- It is a continuous network of ~~fibers~~ filamentous proteinaceous structures that run

throughout the cytoplasm, from the nucleus to the plasma membrane. It is found in all living cells, notably in the eukaryotes. The cytoskeleton matrix is composed of different types of proteins that can devide rapidly or disassemble depending on the requirement of the cells. The primary functions include providing the shape & mechanical resistance to the cell against deformation, the contractile nature of the filaments helps in motility during cytokinesis.

Cilia & Flagella:- Cilia are hair-like projections, small structures, present outside the cell wall & work like oars to either move the cell or the extracellular fluid. Flagella are slightly bigger & are responsible for the cell movements. The eukaryotic flagellum structurally differs from its prokaryotic counterpart. The core of the cilium & flagellum is called an axoneme, which contains nine pairs of gradually arranged peripheral microtubules & a set of central microtubules running parallel to the axis. The central tubules are interconnected by a bridge & are embedded by a central sheath. One of the peripheral micro-

tubulare paires is also interconnected to the centreal sheath by a radial spoke. Hence there are a total of 9 radial spokes. The cilia & flagella emerge from centriole-like structures called basal bodies.

Centrosome & Centrioles :- The centrosome organelle is made up of two mutually perpendicular structures known as centrioles. Each centriole is composed of 9 equally spaced peripheral fibrils of tubulin protein, & the fibril is a set of interlinked triplets. The core part of the centriole is known as a hub & is proteinaceous. The hub connects the peripheral fibrils via radial spoke, which is made up of proteins. The centrioles from the basal bodies of the cilia & flagella give rise to spindle fibres during cell division.

Vacuoles :- Vacuoles are mostly defined as storage bubbles of irregular shapes which are found in cells. They are fluid-filled organelles enclosed by a membrane. The vacuole stores the food or a variety of nutrients that a cell might need to survive. In addition to this, it also stores waste products. The waste products are

eventually thrown out by vacuoles. Thus, the rest of the cell is protected from contamination. The animal & plant cells, have different size & no. of vacuoles. Compared to the animals, plant cells have largeee vacuoles.

Q4. With neat & labeled diagram describe the anatomy & physiology of human heart. Write notes on cardiac output.

Ans:- The human heart is a muscular organ responsible for pumping blood throughout the body. It has four chambers: two atria (upper chambers) & two ventricles (lower chambers). Here is a neat & labeled diagram of the human heart followed by descriptions of its ~~main~~ major components:

(Heart diagram)

1. Right Atrium :- Receives deoxygenated blood from the body via the superior & inferior vena cava.

2. Right Ventricle :- Pumps deoxygenated blood to the lungs through the pulmonary artery for oxygenation.

3. Left atrium :- Receives oxygenated blood from the lungs via the pulmonary veins.

4. Left Ventricle :- Pumps oxygenated blood to the body through the aorta.

5. Tricuspid Valve :- Located betn the right atrium & right ventricle ; prevents backflow of blood.

6. Pulmonary Valve :- Located betn the right ventricle & pulmonary artery ; prevents backflow into the ventricle.

7. Mitral (Bicuspid) Valve :- Located betn the left atrium & left ventricle ; prevents backflow of blood.

8. Aortic Valve :- Located betn the left ventricle & aorta ; prevents backflow into the ventricle.

9. Superior Vena Cava :- Brings deoxygenated blood from the upper body to the right atrium.

. Inferior Vena Cava :- Brings deoxygenated blood from the lower body to the right atrium.

1. Pulmonary Veins :- Transport oxygenated blood from the lungs to the left atrium.

2. Pulmonary Arteries :- Transport deoxygenated blood from the right ventricle to the lungs.

3. Aorta :- The largest artery; distributes oxygenated blood from the left ventricle to the rest of the body.

4. Septum :- Divides the right & left sides of the heart to prevent mixing of oxygenated & deoxygenated blood.

Physiology of the Heart :- The heart functions as a pump in the circulatory system, working through a rhythmic cycle of contraction (systole) & relaxation (diastole).

1. Diastole (Relaxation Phase) :-

- Blood returns to the heart from the body & lungs.
- Deoxygenated blood fills the right atrium via the vena cavae.
- Oxygenated blood fills the left atrium via the pulmonary veins.

- The atrioventricular valves (tricuspid & mitral) open, allowing blood to flow from the atria to the ventricles.

2. Systole (Contraction Phase):-
   - The atria contract first (atrial systole), pushing additional blood into the ventricles.
   - The ventricles then contract (ventricular systole), propelling blood into the pulmonary artery & aorta.
   - The semilunar valves (pulmonary & aortic) open, allowing blood to exit the ventricles.
   - The cycle repeats, maintaining continuous blood flow.

Cardiac Output:- Cardiac output (CO) is the volume of blood the heart pumps per minute. It is a crucial measure of the heart's efficiency & overall cardiovascular health.

Formula:-

$$\text{Cardiac Output} = \underset{(HR)}{\text{Heart Rate}} \times \underset{(SV)}{\text{Stroke Volume}}$$

⇒ Heart Rate (HR): The no. of heartbeats per minute.

⇒ Stroke Volume (SV): The vol. of blood pumped by the left ventricle per beat.

Factors affecting Cardiac Output:-

1. Heart Rate:- Increases with exercise, stress & certain medical conditions. Decrease during rest & sleep.

2. Stroke Volume: Influenced by;

- Preload: The degree of stretch of cardiac muscle fibres at the end of diastole.
- Afterload: The resistance the left ventricle must overcome to circulate blood.
- Contractility: The strength of the heart's contractions.

Regulation of Cardiac Output:-

- Neural Control: Autonomic nervous system adjusts heart rate & stroke volume. Sympathetic stimulation increases CO, while parasympathetic stimulation decreases it.
- Hormonal Control: Hormones like adrenaline & noradrenaline increase heart rate & contractility
- Intrinsic Control:- The heart's own mechanism (e.g., Frank-Starling Law) adjust stroke volume based on venous return.

Cardiac output is vital for ensuring that tissues receive adequate oxygen & nutrients. Abnormal CO can indicate heart failure, shock or other cardiovascular conditions.

Q5. Define Lymph. Write detail about lymphatic system. Add a note on the functions of spleen.

Ans:- Lymph is a clear to slightly yellowish fluid that circulates through the lymphatic system. It is similar to blood plasma but contains a lower concentration of proteins. Lymph originates from interstitial fluid, which is the fluid that surrounds the body's cells. It is collected through the lymphatic vessels & eventually returned to the bloodstream.

Lymphatic System:- The lymphatic system is a crucial part of the immune system & the circulatory system. It consists of a network of lymphatic vessels, lymph nodes, & lymphoid organs. Here's a detailed overview:

1. Lymphatic Vessels:

- Lymph Capillaries: These tiny vessels are

located in the spaces betn cells & are responsible for collecting lymph from the interstitial fluid.

- Lymph Vessels: These larger vessels transport lymph to lymph nodes. They have valves to ensure the one-way flow of lymph.
- Lymphatic Ducts: The two main ducts, the thoracic duct and the right lymphatic duct, drain lymph into the subclavian veins, returning it to the bloodstream.

2- Lymph Nodes:- Lymph nodes are small, bean-shaped structures scattered throughout the lymphatic system. They filter lymph & trap foreign particles like bacteria & viruses. Lymphocytes (a type of white blood cells) within the nodes respond to these pathogens.

3. Lymphoid Organs:-

- Thymus: Located in the upper chest, the thymus is where T lymphocytes mature.
- Spleen: Situated in the upper left abdomen, the spleen filters blood, removes old red blood cells, & helps fight infections.

- Tonsils & Adenoids :- These are located in the throat & help protect against pathogens that enter through the mouth & nose.
- Peyer's Patches :- Found in the small intestine, they monitor intestinal bacteria populations & prevent the growth of pathogenic bacteria.

Functions of the Lymphatic System :-

1. Fluid Balance :- The lymphatic system helps maintain fluid balance by returning excess interstitial fluid to the bloodstream.
2. Fat Absorption :- It absorbs fats & fat-soluble vitamins from the digestive system & transports them to the bloodstream.
3. Immune Response :- The lymphatic system is essential for immune function. It transports lymphocytes & facilitates the detection & response to pathogens.
4. Waste Removal :- It helps remove waste products & cellular debris from tissues.

Spleen :- The spleen is a highly vascular organ located in the upper left quadrant of the abdomen, just beneath the rib cage. It is about the size of a

fest & plays multiple roles in the body:

1. Immune Function :-
   - The spleen contains white blood cells that respond to pathogens. It filters the blood & helps detect & fight infections.
   - It produces antibodies & helps initiate an immune response.

2. Filtration of Blood :-
   - The spleen removes old & damaged red blood cell from the circulation. Macrophages in the spleen break down these cells & recycle their components, such as iron.
   - It also removes abnormal cells & pathogens from blood.

3. Storage of Blood Cells :-
   - The spleen acts as a reservoir for various blood components, including platelets & white blood cells. This can be crucial in case of hemorrhage, as it can release these stored cells to help with clotting & immune response.

4. Hematopoiesis :-
   - In fetal life, the spleen plays a role in producing red blood cells. In adults, this function

is taken over by the bone marrow, but the spleen can resume this role under certain pathological conditions.

Q6:- Write the classification & functions of peripheral nervous system. Discuss about sympathetic & parasympathetic nervous system.

Ans:- The peripheral nervous system (PNS) connects the central nervous system (CNS) to the limbs & organs. It is ~~res~~responsible for transmitting sensory & motor signals to & from the CNS. The PNS is broadly divided into two major subdivisions:

1. Somatic Nervous System (SNS):
   - Function: The SNS is responsible for voluntary movements & the relay of sensory information to the CNS.
   - Components:
     - Sensory (Afferent) Neurons: Transmit sensory information from receptors (e.g., skin, muscles) to the CNS.
     - Motor (Efferent) Neurons: Conduct impulses from the CNS to skeletal muscles, enabling voluntary movements.

2. Autonomic Nervous System (ANS):

- Function; The ANS controls involuntary bodily functions, such as heart rate, digestion & respiratory rate.
- Components:
  - Sympathetic Nervous System (SNS): Prepares the body for 'fight to flight' responses during stressful situations.
  - Parasympathetic Nervous System (PNS): Promotes 'rest & digest' responses that conserve energy & maintain homeostasis.

Sympathetic & Parasympathetic Nervous System

The autonomic nervous system (ANS) is further divided into the sympathetic & parasympathetic nervous system, each with distinct functions & effects on the body.

Sympathetic Nervous System (SNS):

Function:- The SNS prepares the body for rapid, intense physical activity & is often referred to as the 'fight or flight' system. It helps the body cope with stress & emergencies.

Characteristics;

- Increases Heart Rate; Accelerates heartrate to pump more blood to muscles.
- Dilates Pupils: Enhances vision by dilating pupils
- Bronchodilation: Expands air passages in the lungs to improve oxygen intake.
- Inhibits Digestion: Slows down digestive processes to divert energy to more critical functions.
- Stimulates Adrenal Medulla: Promotes the release of adrenaline (epinephrine) & noradrenaline (norepinephrine) into the bloodstream, enhancing alertness & energy levels.
- Vasoconstriction: Constricts blood vessels in non-essential areas, such as the skin & GI tract, to redirect blood flow to muscles & vital organs.

Neurotransmitters:-

- Primary: Norepinephrine
- Secondary: Epinephrine

Parasympathetic Nervous System (PNS):

Function:- The PNS is responsible for conserving energy & restoring the body to state of calm. It is often referred to as the 'rest & digest' System.

Characteristics:

- Decreases Heart Rate: Slows down the heart rate to conserve energy.
- Constricts Pupils: Reduces pupil size to ↓ses light intake & protect the eyes.
- Bronchoconstriction: Narrows air passages in the lungs as the demand for oxygen decreases.
- Stimulates Digestion: Enhances digestive processes by increasing the secretion of saliva, digestive enzymes & bile.
- Promotes Urination & Defecation: Facilitates the excretion of waste products.
- Vasodilation: Dilates blood vessels in the digestive tract & other non-muscular areas, improving nutrient absorption & circulation.

Neurotransmitters:-

- Primary: Acetylcholine

Comparision of Sympathetic & Parasympathetic Nervous Systems :-

Function	SNS	PNS
Heartrate	Increases	Decreases
Pupil Size	Dilates	Constricts
Bronchi	Dilates	Constricts
Digestion	Inhibits	Stimulates
Bloodvessels	Constricts	Dilates
Saliva Production	Decreases	Increases
Adrenal Gland	Stimulates adrenaline release	No direct effect

Overall Function of the PNS :-

The PNS is essential for :

- Sensory Input : Gathering information from the environment & the body's internal cond^{n}. & relaying it to the CNS.
- Motor Output : Conducting signals from the CNS to muscles & glands to produce movement & control bodily functions.

- Regulation of Autonomic Functions: Maintaining homeostasis is through the balanced activity of the SNS & PNS.