Lesson - 06

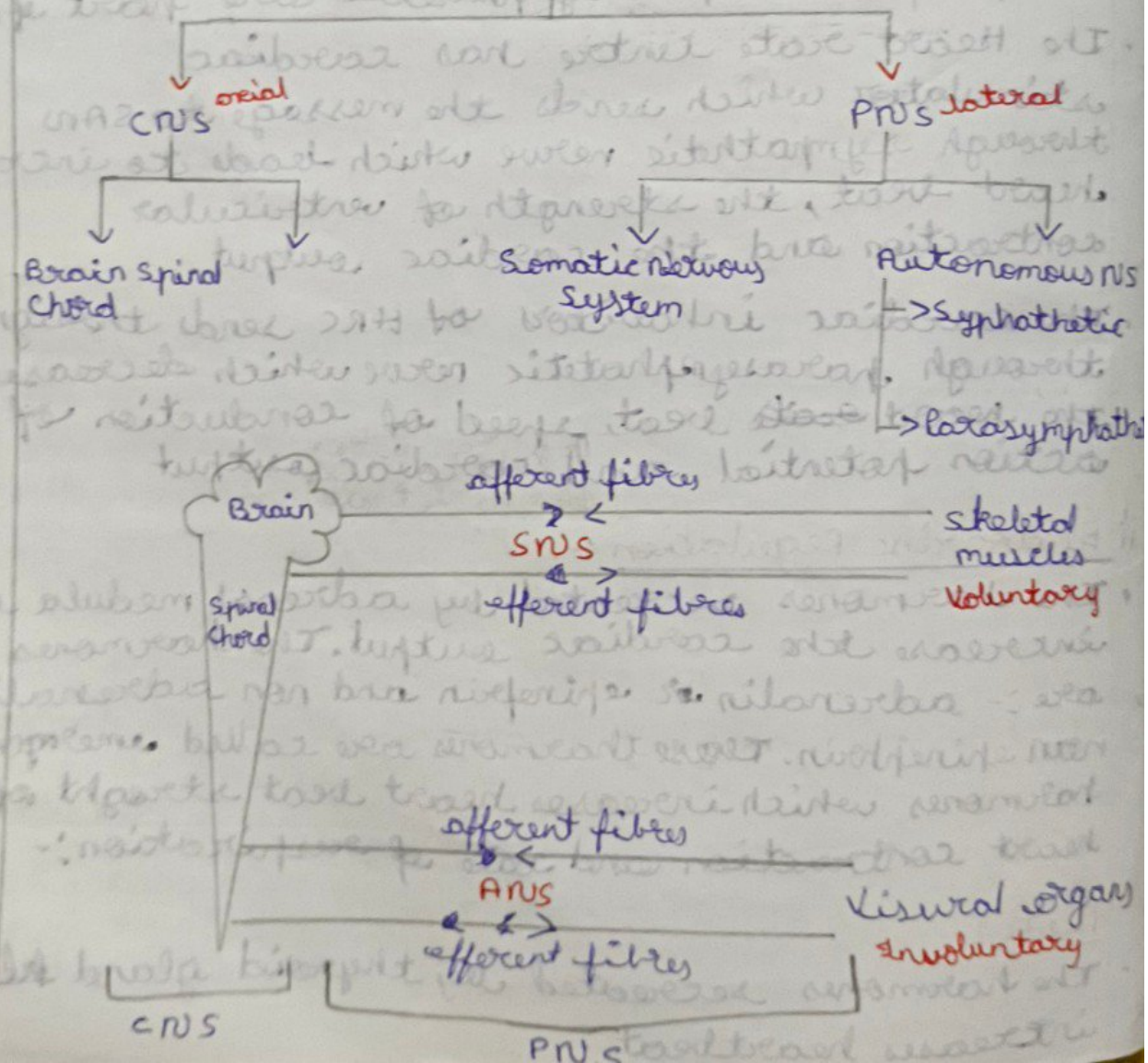
Neural Control and Co-ordination

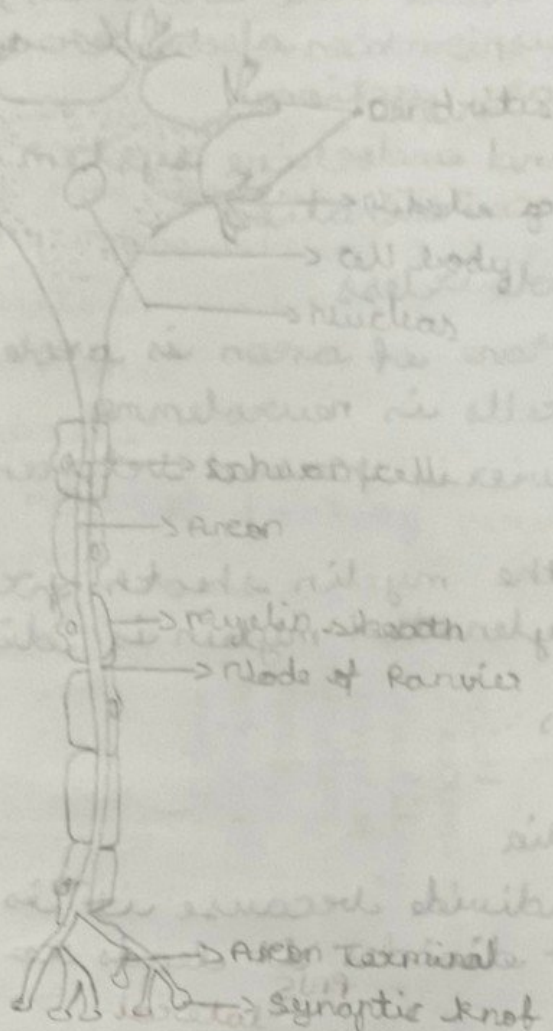
- Co-ordination → two organs → homeostasis
  - Integration → Implintation
  - Neural system, Endocrine system

Parameter	Neural System	Endocrine System
Integration	neurotransmitter	Hormones
Co-ordination	Quick	Slow

- Hydra → network of neurons
- Insect → Brain, no. of ganglia and neural tissue
- Vertebrates → well developed nervous system, i.e. brain and spinal chord.

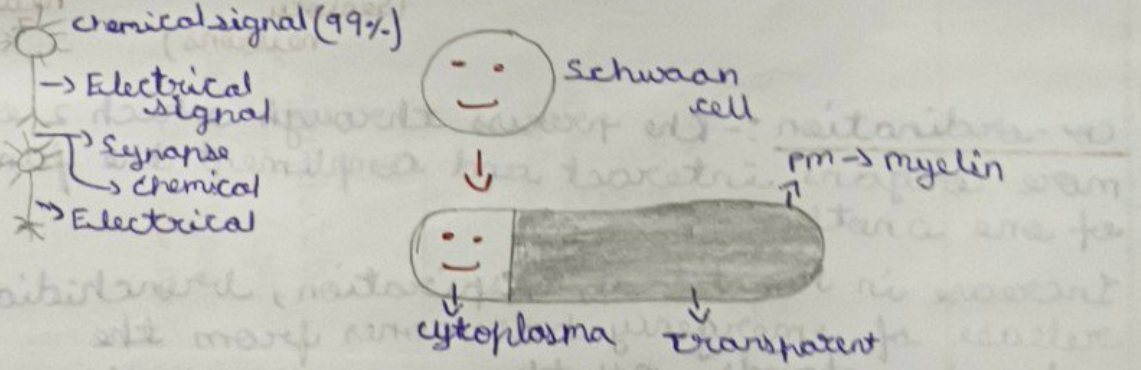
Human Nervous System

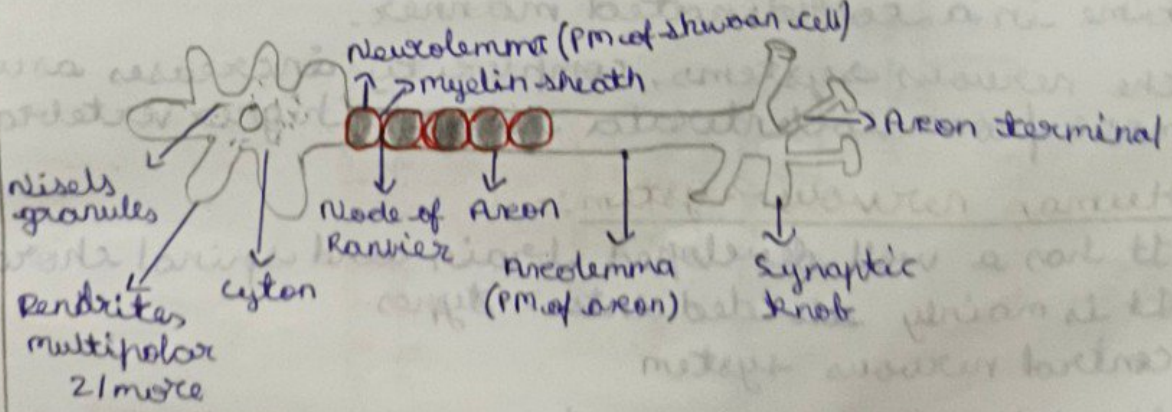




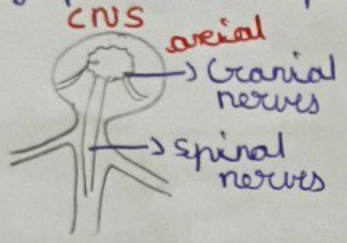
Structure of a Neuron

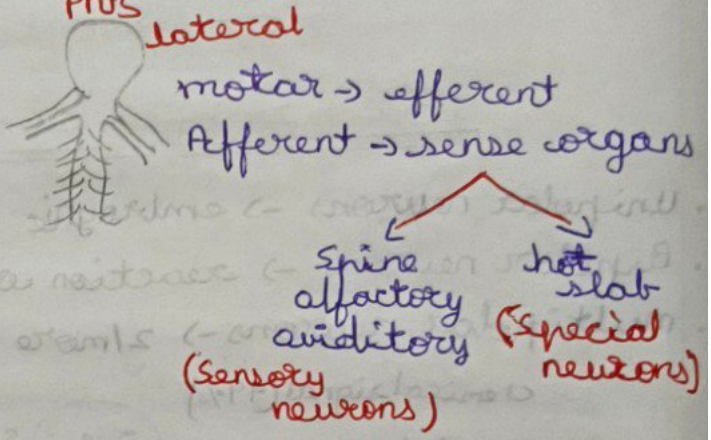
- Unipolar neurons -> embryonic
- Bipolar neurons -> reaction of the -> sensory receptor
- multipolar neurons -> 2/more dendrites





- During running heart beat increases and respiration also increases which are all involuntary actions.
- Neural system and endocrine system are important in maintaining coordination.
- The myelin is colourless.
- The plasma membrane of axon is axolemma and PM of schwann cells is neurolemma
- The node of ranvier is present between myelin sheath.
- myelenated has the myelin sheath present and in case of non - myelenated mylein is discrete.
- Types of Tissues
  - Neuron
  - Neuroglia
- Neuron will not divide because it is present in Go phase and if it divides it leads to cancer.





- Co-ordination :- The process through which 2 or more organs interact and compliment the function of one another.

Eg Increase in heart beat, respiration, bronchidialatio release of emergency hormones from the endocrine glands - All these occur at the same time in a coordinated manner.

- The nervous systems, complexity increases as we move from coelenterata towards higher vertebrate

Human nervous system :-

- It has a well developed brain cand spinal chord,
- It is mainly divided into 2 types

i Central nervous system

ii Cheripheral nervous system

i. Central nervous system:-

- It consists of brain and spinal chord.

ii. Pheriphoral nervous system:-

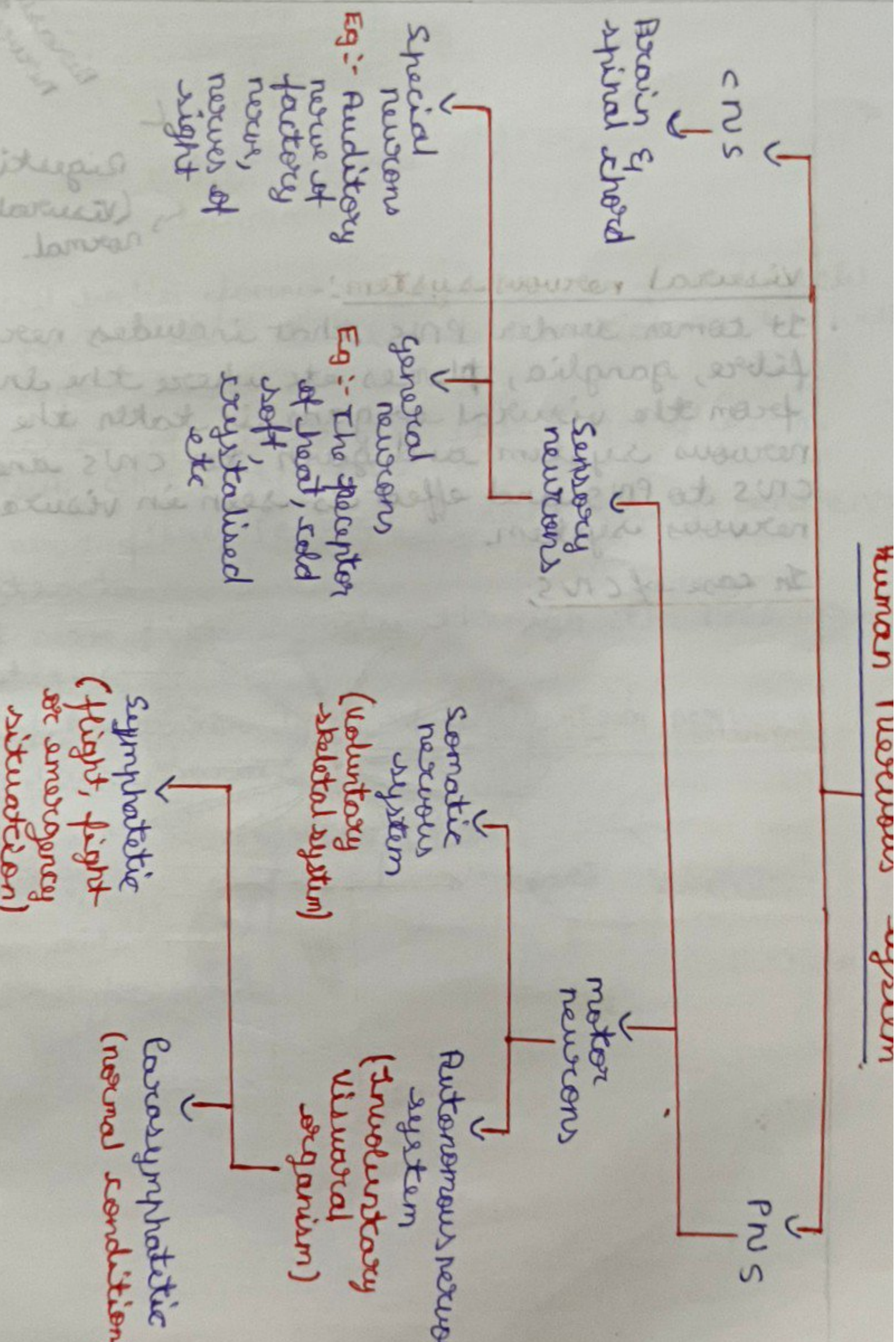
- It consists of sensory neurons and motor neurons
- sensory neurons are of 2 types:-

a. special neurons

b. General neurons

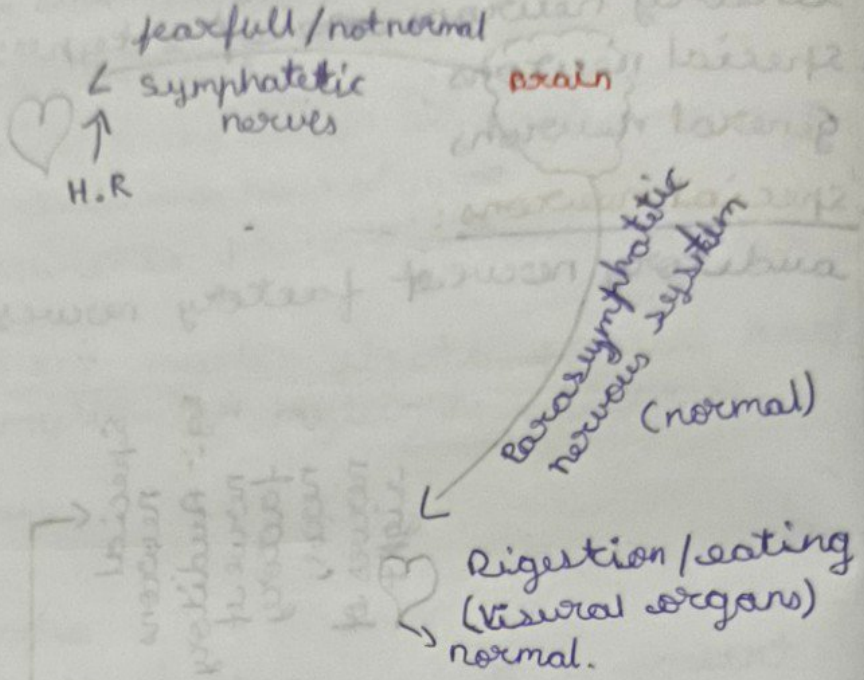
a. Special neurons:-

Eg: auditory nerve of factory nerves, nerves of sight



1 Does neuron has centrioles?

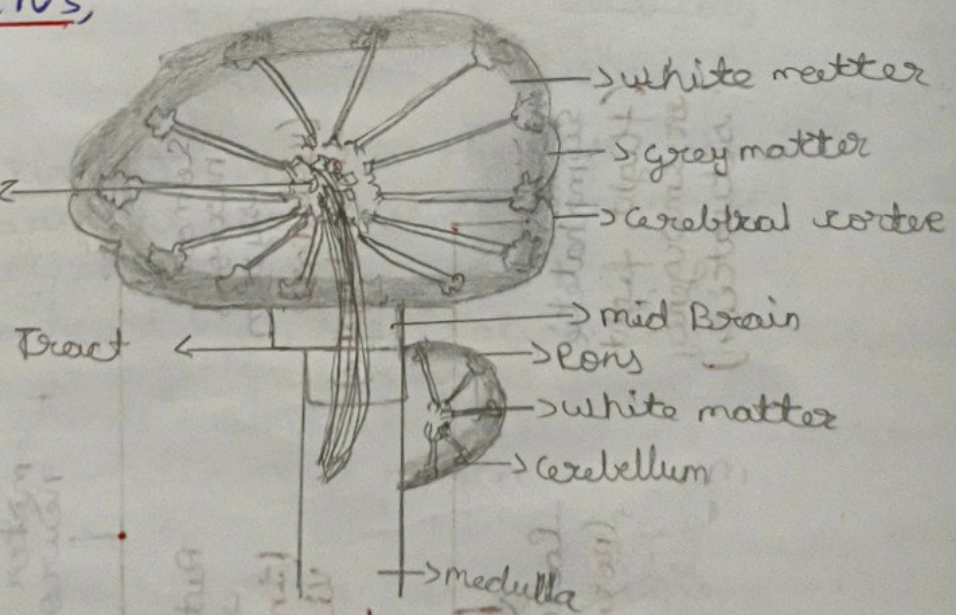
→ centrioles are absent as we know neuron cells will not divide

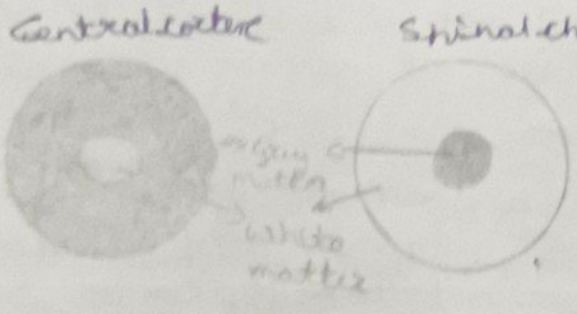


Visural nervous system:-

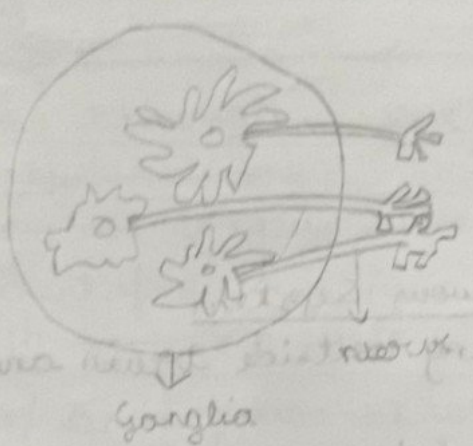
- It comes under PNS that includes nerves, nerve fibre, ganglia, plexes etc where the information from the visural organs is taken the peripheral nervous system and given to CNS and back from CNS to PNS and effect is seen in visural ~~organs~~. nervous system.

In case of CNS,

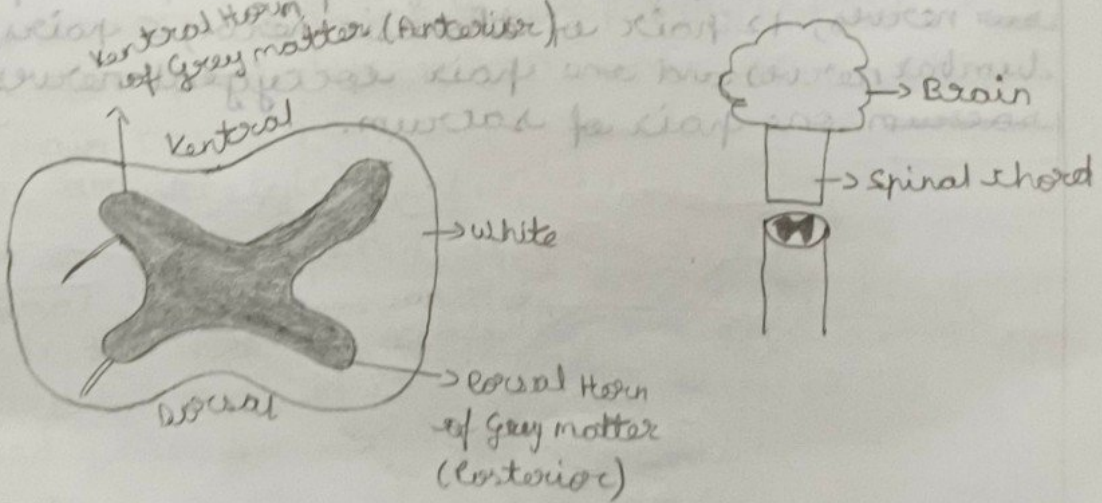


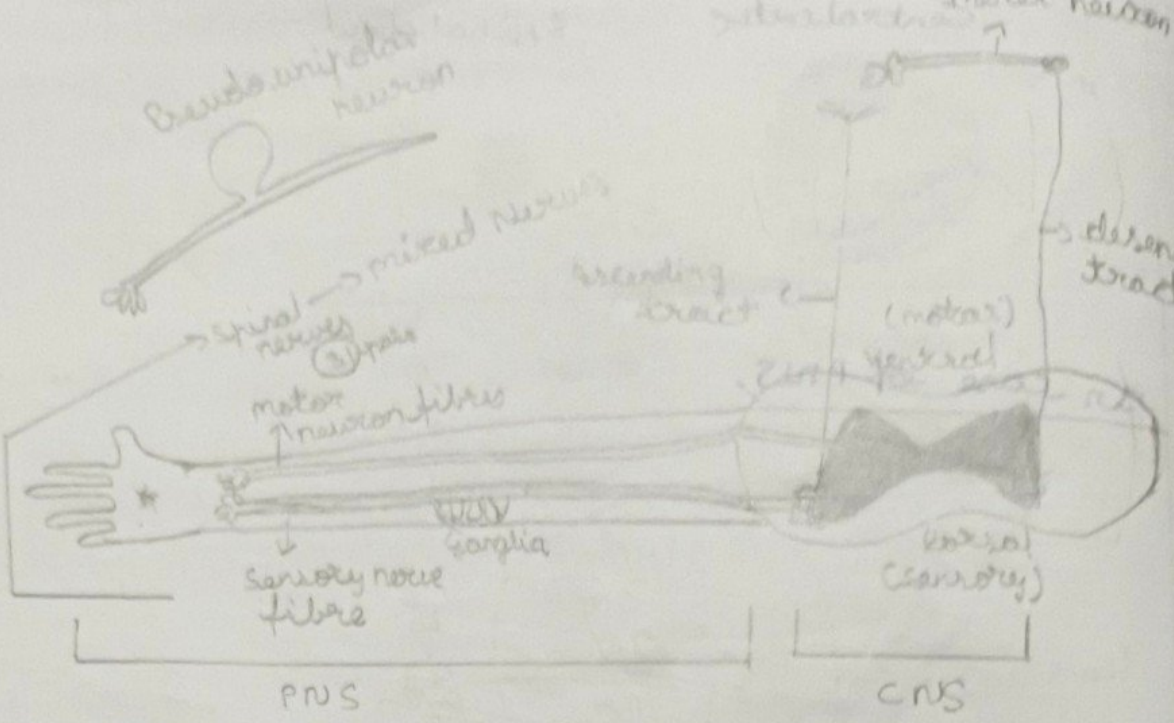


In case of PNS,



- In CNS, cell bodies found in clusters is called nuclei
- This well protected location is essential to the well being of nervous tissue.
- Small collection of cell bodies called ganglia are found outside CNS in the PNS.
- Bundle of nerve fibres ie, axon running through the CNS is called tracts
- Bundle of nerve fibres running through the PNS are called nerves.
- Cell body of the neuron lying on central nervous system is called nuclei.





Cheripharal Nervous System

- The nerves running outside brain and spinal chord constitute PNS.
- There nerves are of 2 types :-

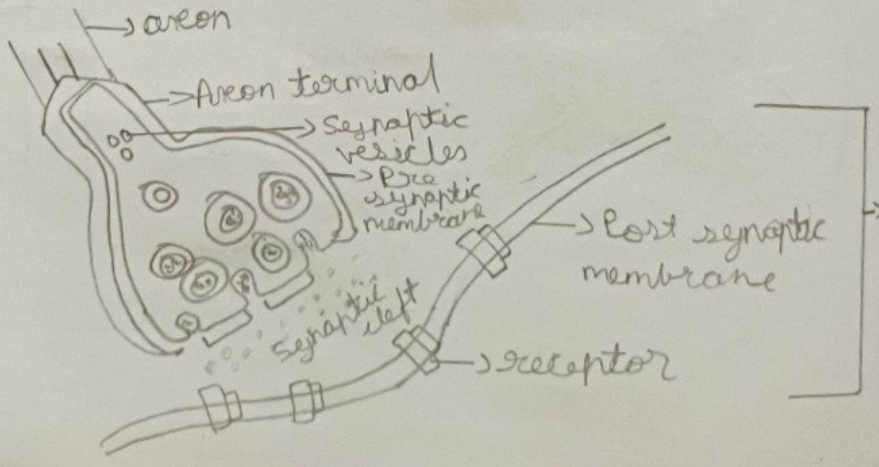
i Cranial nerves (12 pairs of nerves originating from brain)

ii Spinal nerves (31 pairs nerves originating from the spinal chord)

- Spinal and cranial nerves are mylinated nerves.
- The cranial nerves are olfactory (sensory), optic (sensory), oculomotor (motor), trochlia (motor), trigeminal (mixed), abducens (motor), facial (mixed), auditory (sensory), glossopharyngeal (mixed), Vagus (mixed), spinal accessory (motor) and hypoglossal (motor)

Spinal Nerves

- They are classified into 5 groups :- 8 pairs of cervical nerves, 12 pair of thoracic nerve, 5 pairs of lumbar nerves and one pair coccygeal nerves and one pair of sacrum.



- signal is transmitted in the form of electrochemical wave from one neuron to another neuron through junctions called synapse.
- synapse formed by the membranes of a pre synaptic neuron and a post synaptic neuron which is seperated by a gap called a synaptic cleft.
- there are 2 types of synapse:-

i Electrical synapse
ii chemical synapse

Nerve impulse through a electrical synapse

- In electrical synapsis the membranes of pre and post synaptic neuron are in very close proximity.
- Electrical current from one neuron into another is passed through synaptic cleft.
- transmission of an impulse across electrical synapse to another neuron is by impulse conduction along signal axon.
- Electrical synapse are rear in our system.

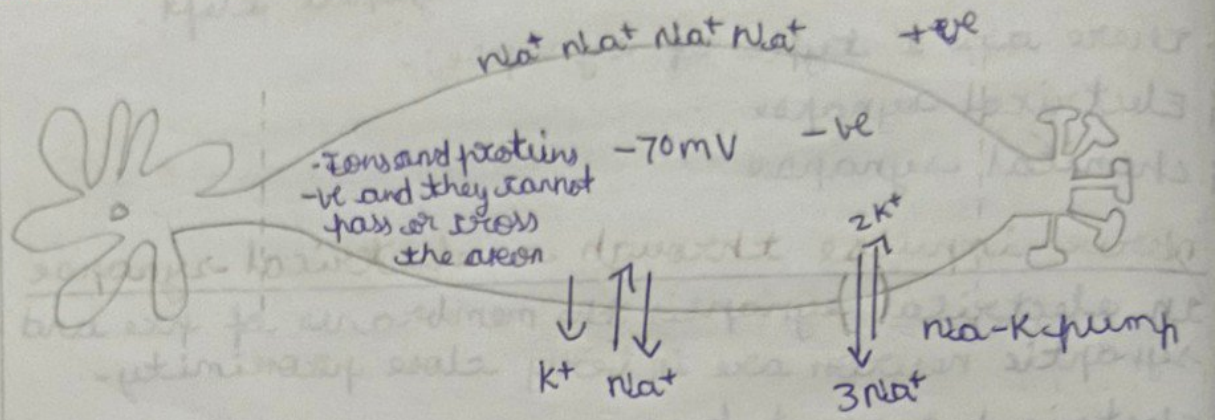
Nerve impulse through chemical synapse

- In case of chemical synapse the membranes of the pre and post synaptic neurons are seperated by a fluid filled space called synaptic clift.
- Chemicals called neuro transmitters are involved in the transmission of impulses and synapsis.
- Axon terminal contains vesicles filled with neuro transmitters.
- Neuro transmitter may be excitatory (acetylcholine) which can pass by GABA channels
- The 2 main neurotransmitter in vertebrates nervous system are acetylcholine and non adrenaline
- Signal or action potential arrives at the axon terminal by the movement of the synaptic vesicles towards the pre synaptic membrane where they fuse with the PM and the neuro transmitters are released into the synaptic clift
- Neuro transmitter bind to the specific receptors on the post synaptic membrane. This binding opens allowing the entry of ion which can generate

signal in post synaptic neurons.

- signal developed may be either excitatory or non excitatory and they get transmitted across an chemical synapse.

generation and conduction of nerve impulse



Polarised / resting potential

- the charge inside the axon is -70mV during resting potential
- Na^+ ions will be more in number outside the PM whereas K^+ ions are comparitively less in number inside the axon with respect to Na^+ and hence, we say it is +vely charged outside the membrane and -vely charged inside the membrane
- 4 Reasons why axon is -vely charged from in

i Based on amount of Na^+ & K^+ ions

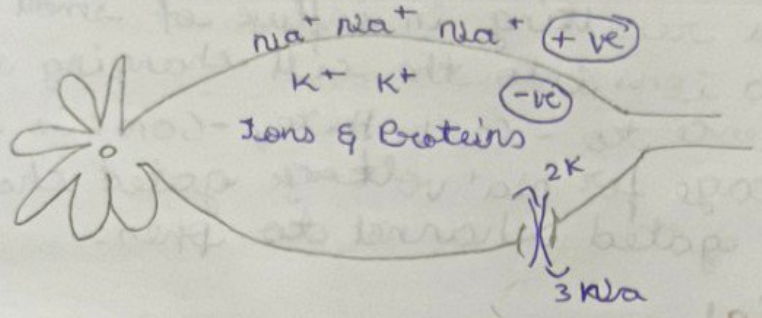
ii Ions and proteins inside the axon are -vely charged and they cannot pass across the axon.

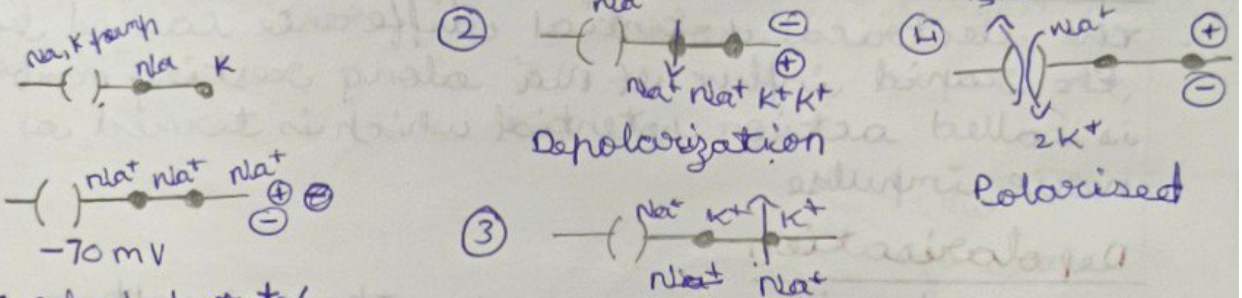
iii The axolemma is permeable to K^+ but not Na^+. Th allowing the K^+ ions to come out of the axon making it negative region.

iv There is Na-K pump across the PM which allows $3Na^+$ to come out and first $2K^+$ to g in, again favoring -ve charge inside the axo

membrane channels

1. leaky channels Na^+, K^+
2. mechanical gated channels
   closed $\xrightarrow{\text{pressure}}$ open
3. voltage gated channels
   ↓
   close $\xrightarrow{\text{pressure}}$ open
4. ligament gated channel
   close $\xrightarrow{\text{ligament}}$ open

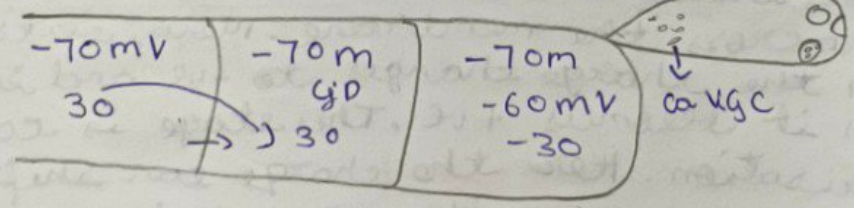


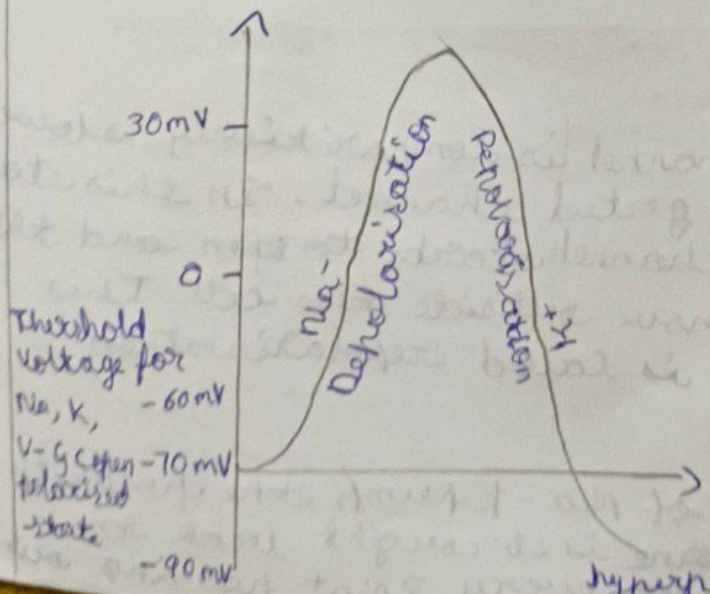


① Polarised state/ Resting potential

② Depolarisation

③ Repolarisation [transmition]





Polarised

- Ionic gradient across the resting membrane is maintained by the active transport of ions by the Na - K pump which transports 3 Na^+ outwards for 2 K^+ into the cell. As a result, the outer surface of the axon membrane posses a +ve charge while its inner surface becomes negatively charged resulting in -70mV potential difference across the resting plasma membrane. This phase is also called as resting potential.

- Due to the external stimulus mechanical gated channel opens a resulting in influx of small amount of Na ions into the cell changing the potential difference to -60mV. Here, -60mV is the threshold voltage for Na^+ voltage gated channel and K^+ voltage gated channel to open.

Action Potential

- The electrical potential difference caused by the rapid influx of Na^+ along resting membrane is called action potential which is termed as nerve impulse

Depolarisation

- Threshold voltage now makes the Na^+ voltage gated channel to open up, resulting in the influx of Na^+ ions inside the axon. This changes the polarity across the membrane. Now, outside the axon the charge changes to -ve and inside the axon it becomes +ve. This stage is called as depolarisation. Here the charge can shift upto 30 - 45 mV. This voltage is called as action potential

Repolarisation

- K^+ voltage gated channel is comparitively slower than Na^+ voltage gated channel. In this stage K^+ voltage gated channel starts to open and the K^+ ions starts to move outside the cell. This transition phase is called repolarisation

Polarised state

- With the help of Na - K pump the polarity across the membrane is brought back to resting Potential for every 3 Na^+ passing out

-70 mV. Some times there are chances of hyperpolarisation where it can reach upto -90 mV inside the axonal membrane

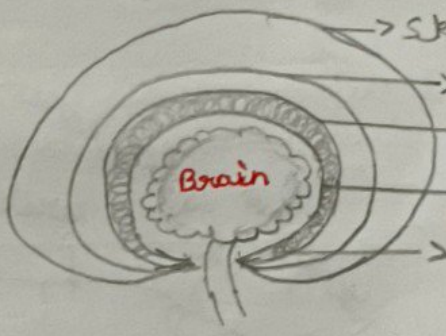
- Series of impulses is transferred across the axon because of potential difference created causing Ca^+ voltage gated channel to open up on the synaptic knob. Ca^+ influxed helps to push the synaptic vesicles to the pre synaptic membrane causing the release of neuro transmitter inside it.

Brain => central nervous system
-> main control and command centre

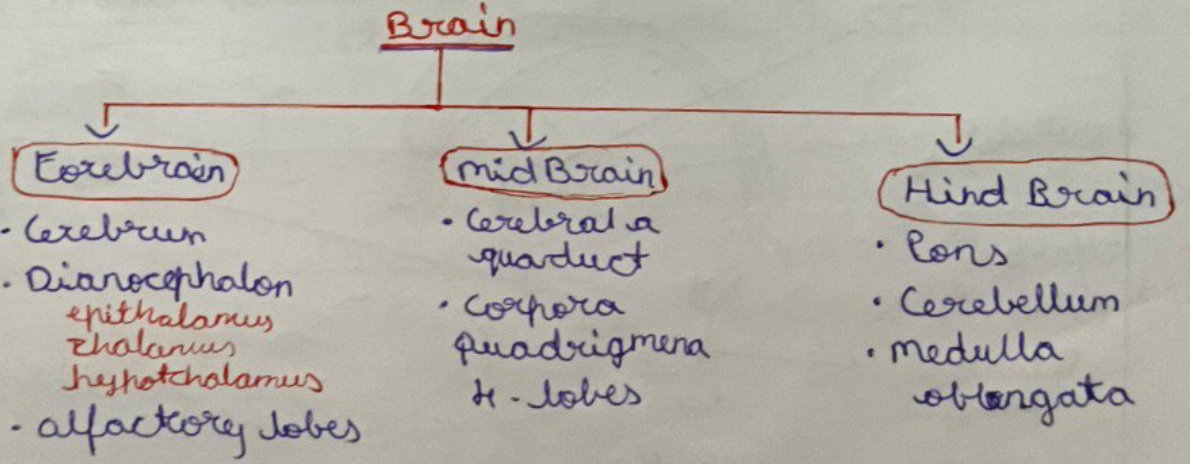
- sense
- Endocrine glands
- Exocrine glands
- organs (Visural)
- Voluntary organs
- skeletal
- circation cycle
- Emotion
- Homeostasis

hypothalamus
↓
nuclei
↓
hormones
(neurosecretory hormones)

S Frontal ①
K Parietal ②
V Temporal ②
L Occipital ①
L



meaning



Brain :-

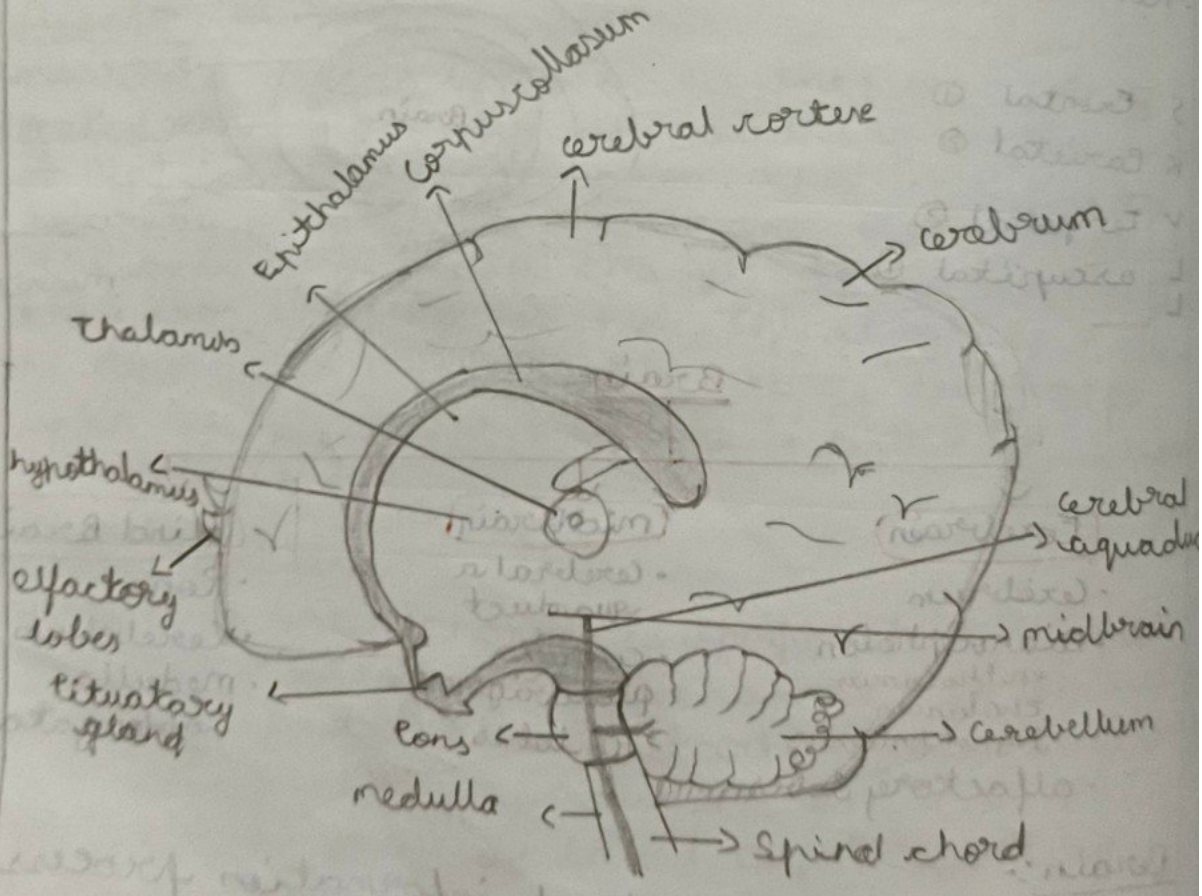
- The brain is the central information processing organ of our body and acts as the command and control system. It controls the voluntary movements, balance of the body, functioning of vital involuntary organs. (Eg :- lungs, heart, kidney etc

Thermoregeulation, circadian
(24-hour) rythms of our body, activities of
several endocrine glands and human behaviour
. It is also the site for processing of vision, hear
speech, memory, intelligence, emotions and
thoughts. The human brain is well protected by
the skull.

. Inside the skull the brain is covered by
cranial meninges consisting of an outer layer
called dura mater, a very thin middle layer
called arcnaroid and an inner layer called
pia-mater. *

. The brain can be divided into 3 major part
i Forebrain
ii midbrain
iii Hindbrain

. Cerebral spinal fluid is the clear fluid present in
the ventricals of brain, sub arcnaroid space
brain and spinal chord. It acts as shock
absorbing medium for brain.



Brain:-

Forebrain

Olfactory lobes
↓
2 lobes
↓
Anterior olfactory bulb
Posterior olfactory bulb

Gyri (upward ridge)
↓
Sulci (downward ridge)

Cerebrum (downward)
- largest region
- 2 hemisphere → left side & Right side
- outer → Cerebral cortex
↓
Gray matter
↓
Cyton body of neuron

- Inner region
↓
White matter (axon)
- neither sensory nor clearly motor

Association areas
communication, memory intersensory

Diencephalon

epithalamus (roof)
→ stalk - pineal
→ stalk - melatonin
skin tone, Circulation cycle

Thalamus
- Sensory & motor region
- most of the senses except with smell

hypothalamus (ground) Infundibulum Pituatory
↓
Seautions of hormones
GnRH (releasing)
Somatostatin (Antibities)
↓
Allow the pituatory gland to regulate homeostasis thermoregulation of the body

Limbic lobe limbic system

Associated deep structure
→ amygdala & hippocampus
etc.

Fore brain (Prosencephalon)
- Fore brain consists of cerebrum, olfatory lobes and diencephalon

Olfactory lobes
- Paired, club shape structure forming anterior part of brain concerned with sense of smell.
- Each lobe consist of 2 parts :- Aterior olfactory bulb and posterior olfactory bulb.

Cerebrum :-
- Largest and most complex part of human brain, consists of left and right cerebral hemisphere connected by corpus callosum (tract of nerve fibres)