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## Neural Control and Co-ordination

### Multiple Choice Questions (MCQs)

**Q. 1** Chemicals which are released at the synaptic junction are called

- (a) hormones (b) neurotransmitters  
(c) cerebrospinal fluid (d) lymph

**Ans. (b)** Neurotransmitters are involved in the transmission of impulses at the chemical synapses. They are present in the synaptic vesicles at axon terminals.

Whereas, hormones are non-nutrient chemicals which act as intercellular messengers and are produced in trace amounts.

Cerebrospinal fluid is present in subarachnoid space. It provides shock resistance to brain

Lymph is a colourless fluid containing specialised lymphocytes which are responsible for the immune responses of the body. It is important carrier for nutrients, hormones, etc. Fats are absorbed through lacteals (lymph vessels) present in microvilli of intestine.

**Q. 2** Potential difference across resting membrane is negatively charged. This is due to differential distribution of the following ions.

- (a)  $\text{Na}^+$  and  $\text{K}^+$  ions (b)  $\text{CO}_3^{2-}$  and  $\text{Cl}^-$  ions  
(c)  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions (d)  $\text{Ca}^{+4}$  and  $\text{Cl}^-$  ions

#### 💡 Thinking Process

*Neurons are called excitable cells because their membranes are in a polarised state, Different types of ion channels are present on the neural membrane. These ion channels are selectively permeable to different ions.*

**Ans. (a)** The ion gated channels on the neurolemma control the movement of  $\text{Na}^+$  and  $\text{K}^+$  ions on both inner and outer side of nerve cell.

$\text{Ca}^{2+}$ ,  $\text{CO}_3^{2-}$ ,  $\text{Mg}^{2+}$  and  $\text{Ca}^{4+}$  ions are not related with nerve excitation rather are involved in other biological functions.  $\text{Ca}^{+2}$  ions are related to muscle metabolism where  $\text{Mg}^{2+}$  ions act as a cofactor in some reactions.

$\text{Cl}^-$  ion channels are important for setting cell resting membrane potential, transepithelial salt transport, and the acidification of internal and extracellular compartments.

**Q. 3** Resting membrane potential is maintained by

- (a) hormones
- (b) neurotransmitters
- (c) ion pumps
- (d) None of these

**💡 Thinking Process**

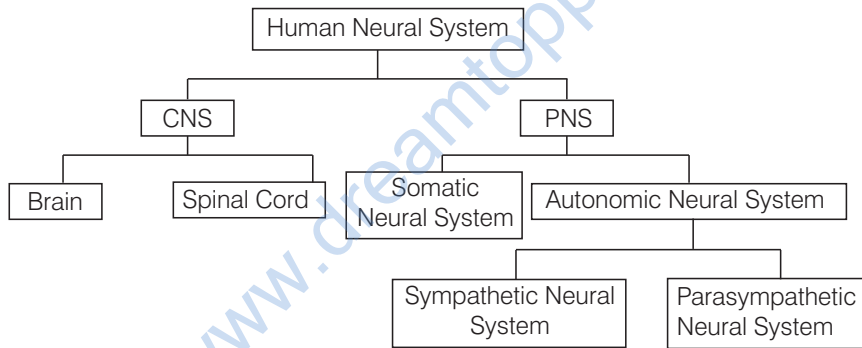
The electrical potential difference across the resting plasma membrane is called as the **resting potential**.

**Ans. (c)** The ionic gradients across the resting membrane are maintained by the active transport of ions by the sodium-potassium pumps (or ion pumps) which transport 3 Na<sup>+</sup> outward for every 2K<sup>+</sup> into the cell.

**Q. 4** The function of our visceral organs is controlled by

- (a) sympathetic and somatic neural system
- (b) sympathetic and parasympathetic neural system
- (c) central and somatic nervous system
- (d) None of the above

**Ans. (b)** Sympathetic and parasympathetic neural system control all the visceral organs of the body. Whereas, somatic neural system is a part of peripheral nervous system and is not related to regulation of visceral organs. Similarly CNS is not concerned with it.



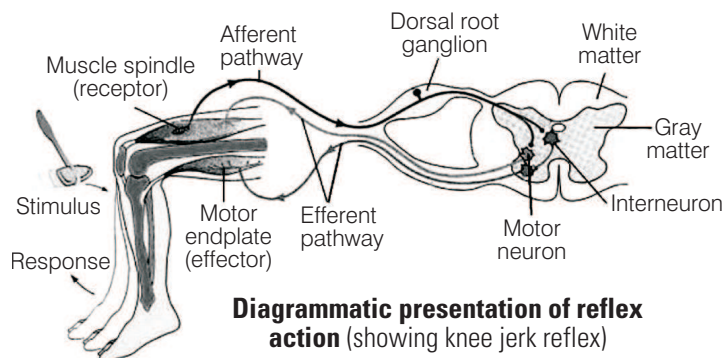
**Q. 5** Which of the following is not involved in knee-jerk reflex?

- (a) Muscle spindle
- (b) Motor neuron
- (c) Brain
- (d) Inter neurons

**💡 Thinking Process**

Reflex action is a form of animal behaviour in which the stimulation of a sensory organ results in the activity of some organs without the intervention of will.

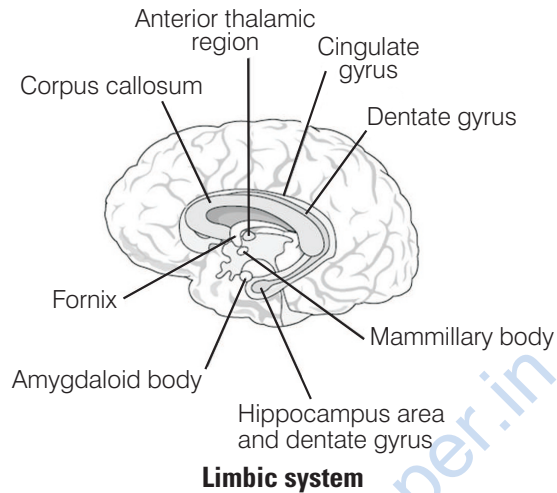
**Ans. (c)** Brain is not involved in any reflex action (e.g., knee-jerk reflex) while the muscle spindle, inter neuron and motor neuron are the part of reflex arch.



**Q. 6** An area in the brain which is associated with strong emotions is

- (a) cerebral cortex (b) cerebellum  
(c) limbic system (d) medulla

**Ans. (c)** The **limbic lobe or limbic system**, along with the hypothalamus, is involved in the regulation of emotions (e.g., excitement, pleasure rage and fear) and motivation.



**Q. 7** Mark the vitamin present in rhodopsin

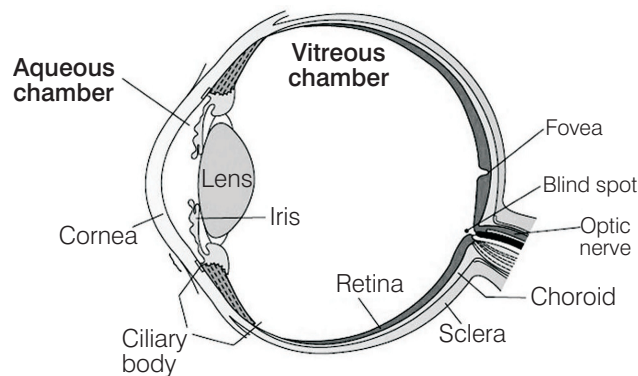
- (a) vit-A (b) vit-B (c) vit-C (d) vit-D

**Ans. (a)** The rods contain a purplish red protein called the rhodopsin. It is a photosensitive compound in eye that is composed of opsin (a protein) and retinal (an aldehyde of vitamin-A), whereas vitamin-B, C and D not directly related with vision.

**Q. 8** Human eyeball consists of three layers and it encloses

- (a) lens, iris, optic nerve  
(b) lens, aqueous humor and vitreous humor  
(c) cornea, lens, iris  
(d) cornea, lens, optic nerve

**Ans. (b)** Human eye ball consist of three, i.e., layers sclera, choroid and retina and these layer enclose **lens, aqueous humor** and **vitreous humor**.



**Diagram showing parts of an eye**

**Q. 9** Wax gland present in the ear canal is called

- (a) sweat gland (b) prostate gland  
(c) Cowper's gland (d) sebaceous gland/ceruminous gland

**Ans. (d)** **Sebaceous gland/Ceruminous gland** are the wax secreting glands present in the ear canal.

Whereas, **sweat gland** also known as sudoriferous glands are tubular structures of the skin that **produces sweat**.

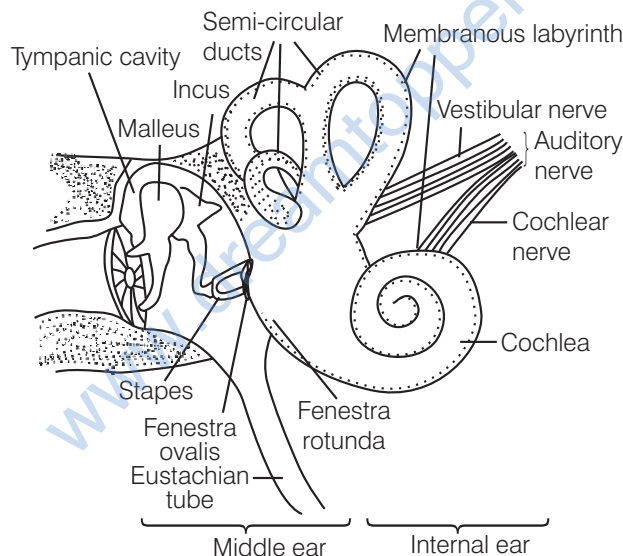
**Prostate gland** is walnut sized gland located between the bladder and the penis and secretes fluid that nourishes and protects sperms.

**Cowper's gland/bulbourethral gland** is one of the two small exocrine glands present in the reproductive system of many male mammals. It helps in lubricating urethra for spermatozoa to pass through by the secretion of viscous fluid known as **pre-ejaculate**.

**Q. 10** The part of internal ear responsible for hearing is

- (a) cochlea (b) semicircular canal (c) utriculus (d) sacculus

**Ans. (a)** **Cochlea** is the part of internal ear responsible for hearing. It is connected with saccule and is a spirally coiled structure that resembles a snail shell in appearance.



**Diagram human middle and internal ear**

**Semicircular canal** are membranous canal suspended in the perilymph of the bony canals and are the structures of equilibrium (balancing). Whereas, **utricle** and **sacculus** are the parts of the balancing apparatus located within the vestibule of the bony labyrinth.

These have small stones and a viscous fluid to stimulate **hair cells** to detect **motion** and **orientation**.

**Q. 11** The organ of corti is a structure present in

- (a) external ear (b) middle ear  
(c) semi circular canal (d) cochlea

**Ans. (d)** The organ of Corti is a structure present in cochlea. Cochlea bears the most important channel/canal called scala media, which has an upper membrane, the Reissner's membrane and a lower membrane basilar membrane. Organ of corti are present on the sensory ridge of **basilar membrane**.

## Very Short Answer Type Questions

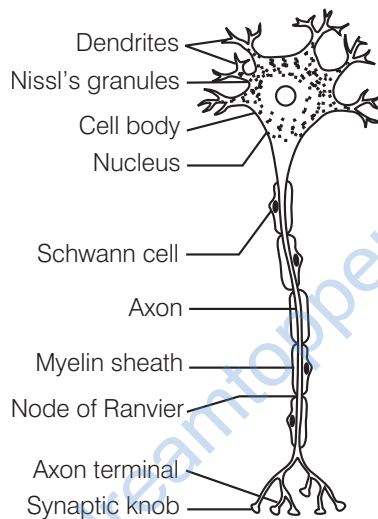
**Q. 1** Rearrange the following in the correct order of involvement in electrical impulse movement.

**Thinking Process**

*Neurons are excitable cells because their membranes are in a polarised state.*

**Ans.** The correct order of involvement in electrical impulse movement.

- |                   |                    |
|-------------------|--------------------|
| (i) Dendrites     | (ii) Cell body     |
| (iii) Axon        | (iv) Axon terminal |
| (v) Synaptic knob |                    |



**Structure of neuron**

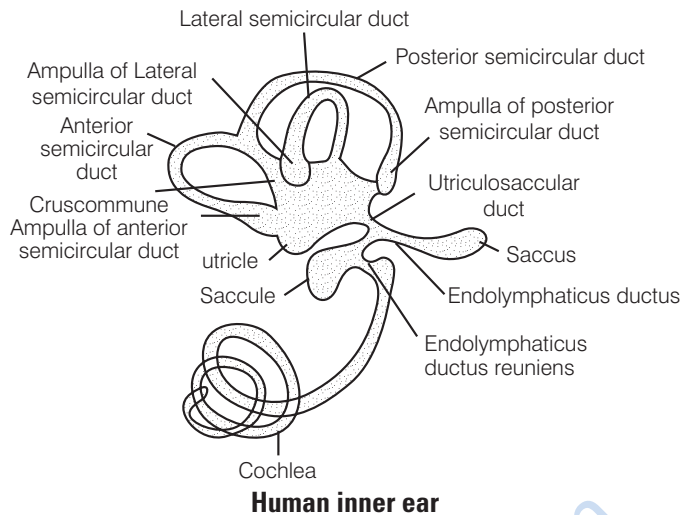
**Q. 2** Comment upon the role of ear in maintaining the balance of the body and posture.

**Ans.** The vestibular system is the sensory apparatus of the inner ear that helps the body maintain its postural equilibrium.

There are two sets of organs in inner ear, or labyrinth—The semicircular canals which respond to rotational movements; and the utricle and saccule within the vestibule, which respond to changes in the position of the head with respect to gravity.

Each semicircular canal contains hair cells. Rotation of the head causes a flow of fluid, which in turn causes displacement of the top portion of hair cells embedded in jelly-like capula. Utricle and saccule called otolithic organs contain hair cells blanketed with tiny stones called otoconia.

When the head is tilted or body position is changed the displacement of stones causes the hair cells to bend.



**Q. 3** Which cells of the retina enable us to see coloured objects around us?

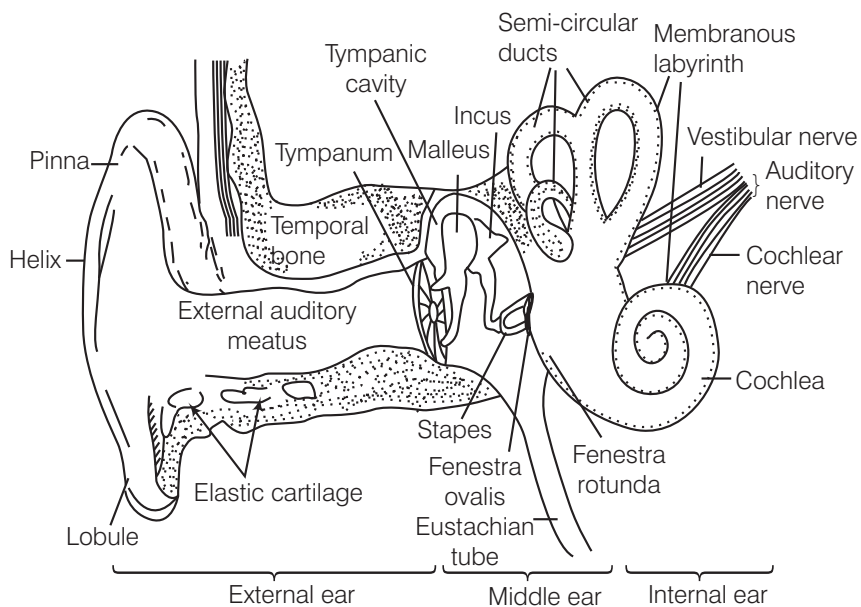
**Thinking Process**

*There are two types of photoreceptor cells, namely rods and cone. These cells contain the light sensitive proteins called the photopigments.*

**Ans.** Cone cells of retina enable us to see the colours. There are three types of cones which possess their own characteristic photopigments that respond to red, green and blue light.

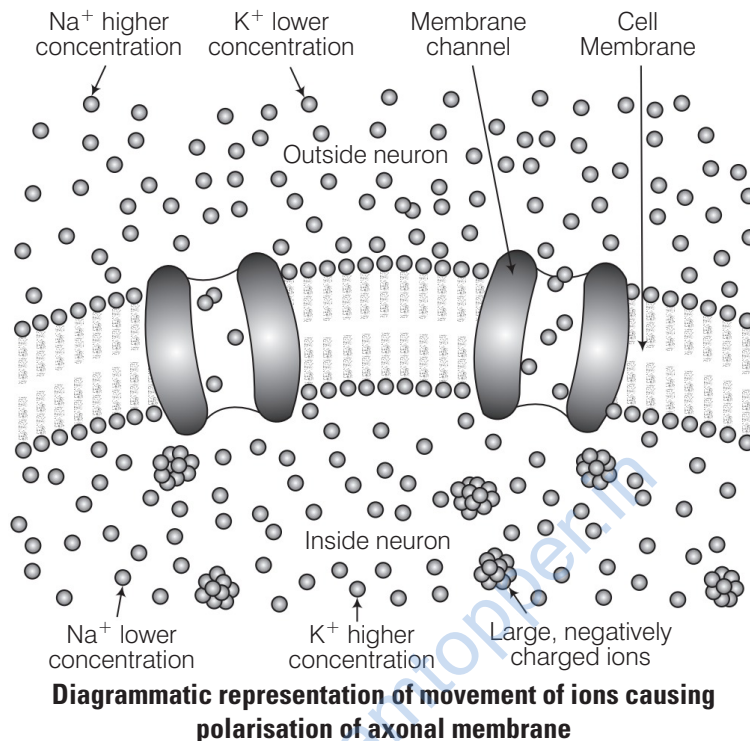
**Q. 4** Arrange the following in the order of reception and transmission of sound wave from the ear drum. Cochlear nerve, external auditory canal, ear drum, stapes, incus, malleus, cochlea.

**Ans.** External Auditory canal → Eardrum → Malleus → Incus → Stapes → Cochlea → Cochlear nerve



**Q. 5** During resting potential, the axonal membrane is polarised, indicate the movement of +ve and –ve ions leading to polarisation diagrammatically.

**Ans.**



**Q. 6** Name the structures involved in the protection of the brain.

**Ans.** The following structures are involved in the protection of brain in animals

- (i) **Cranium** There are 8 cranial bones which form the hard protective outer covering cranium for the brain.
- (ii) **Meninges** The brain is covered with three membranes called meninges.
  - (a) **Piamater** Inner most membrane very thin, delicate and vascular and invests the brain closely.
  - (b) **Arachnoid membrane** It is like spider web in structure from which its gets its name.
  - (c) **Duramater** It is outer most, thick, tough fibrous membrane adhering closely to the inside of the skull.
- (iii) **Cerebrospinal fluid** The cerebrospinal is present in the spaces between the meninges, *i.e.*, arachnoid and duramater, which functions as a pad, absorbing shocks.

**Q. 7** Our reaction like aggressive behaviour, use of abusive words, restlessness etc. are regulated by brain, name the parts involved.

**Ans.** The inner part of cerebral hemispheres and a group of associated deep structures called limbic lobe or limbic system along with hypothalamus are involved in the above said functions, *i.e.*, aggressive behaviour, use of abusive words, restlessness, etc.

**Q. 8** What do grey and white matter in the brain represent?

**Ans.** Grey matter is a major component of CNS consisting of neuronal cell bodies, dendrite, unmyelinated axons, glial cells and capillaries.

White matter is also a component of CNS and consists mostly of glial cell and myelinated axons.

**Q. 9** Where is the hunger centre located in human brain?

**Ans.** Hypothalamus contains many centres which control urge for eating and drinking.

**Q. 11** While travelling at a higher altitude, a person complains of dizziness and vomiting sensation. Which part of the inner ear is disturbed during the journey?

**Ans.** The symptoms of dizziness and vomiting, faced by a person travelling at higher altitude is because of the following reasons

- (i) The function of Eustachian tube is to equalise the pressure on either sides of the ear drum; sudden elevation in height causes disturbance in maintaining pressure by this area of ear.
- (ii) The semicircular ducts, **the anterior, posterior and lateral semicircular** ducts, are enlarged at one end to give rise to ampulla. Each ampulla contains sensory path of hairs, the cristae, which is concerned with the balancing of the body, Change in altitude brings changes in the reorientation and adjustments in these structures of internal ear causing the above said symptoms.

**Q. 12** Complete the statement by choosing appropriate match among the following.

Column I	Column II
A. Resting potential	1. Chemicals involved in the transmission of impulses at synapses.
B. Nerve impulse	2. Gap between the pre synaptic and post synaptic neurons.
C. Synaptic cleft	3. Electrical potential difference across the resting neural membrane.
D. Neurotransmitters	4. An electrical wave like response of a neuron to a stimulation.

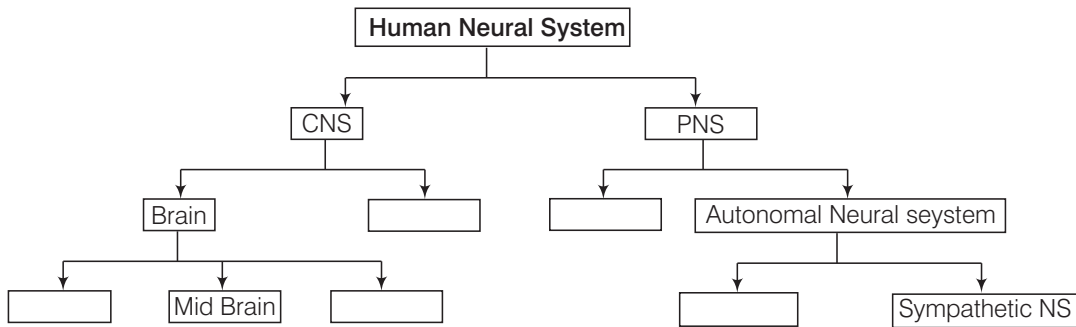
**Ans.** A. → (3) B. → (4) C. → (2) D. → (1)

Column I	Column II
A. Resting potential	Electrical potential difference across the resting neural membrane.
B. Nerve impulse	An electrical wave like response of a neuron to a stimulation.
C. Synaptic cleft	Gap between the pre-synaptic and post-synaptic neurons.
D. Neurotransmitters	Chemicals involved in the transmission of impulses at synapses.

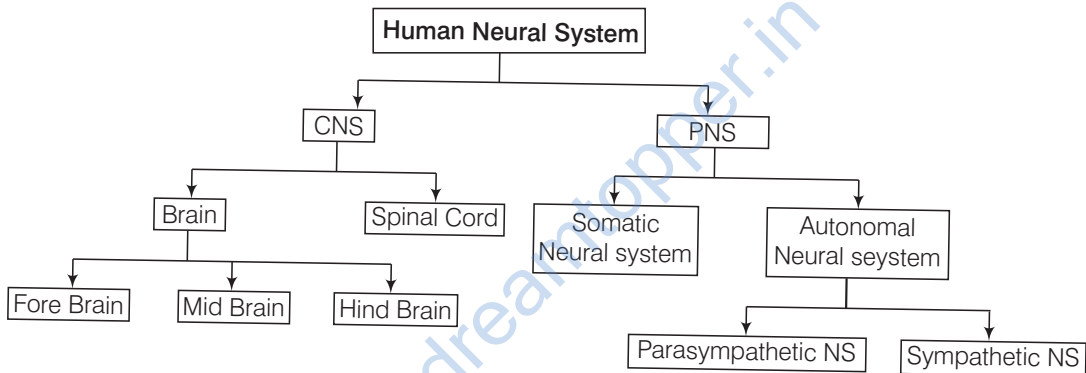


## Short Answer Type Questions

**Q. 1** The major parts of the human neural system is depicted below. Fill in the empty boxes with appropriate words.



**Ans.** The major parts of the human neural system is filled in the boxes with appropriate words



**Q. 2** What is the difference between electrical transmission and chemical transmission?

**Ans.** Differences between electrical transmission and chemical transmission are as given below

Electrical Transmission	Chemical Transmission
It occurs at electric synapse.	It occurs at chemical synapse.
Synaptic cleft may or may not be present.	Synaptic cleft is present.
At electrical synapses, electrical current can flow directly from one neuron into the other across these synapses.	At chemical synapse, neurotransmitter from pre-synaptic neurons transfer to post-synaptic neurons leading to transmission of impulse.
Impulse transmission across an electrical transmission is always faster.	Chemical transmission is slower.

**Q. 3** Neuron system and computers share certain common features. Comment in five lines.

**Ans.** The **sensory neurons** present in various organs sense the environment and extend the message to the brain. So, it is equivalent to input device of computers.

**Brain** acts as CPU, *i.e.*, Central Processing Unit. The information gathered by sensory neurons is processed by brain and it gives command to the concerned organ to act accordingly. This message is taken or conveyed by **motor neurons** which act as output devices.

**Q. 4** If someone receives a blow on the back of neck, what would be the effect on the person's CNS?

**💡 Thinking Process**

*The central nervous system, that includes brain and spinal cord, is the actual command centre for entire body and any damage, or abnormality in these can lead to non-functioning of body parts and organs.*

**Ans.** If a person receives a blow on the back, then it will lead in an impairment of cognitive abilities or physical functioning. It can also result in the disturbance of behavioural or emotional functioning. Cervical injuries often lead to quadriplegia (tetraplegia).

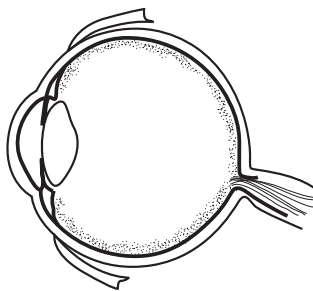
**Q. 5** What is the function described to Eustachian tube?

**Ans.** The **eustachian tube** connects the middle ear cavity with the pharynx. It helps in equalising the pressures on either sides of the ear drum. At the pharyngeal opening of the Eustachian tube, is a valve which normally remains closed.

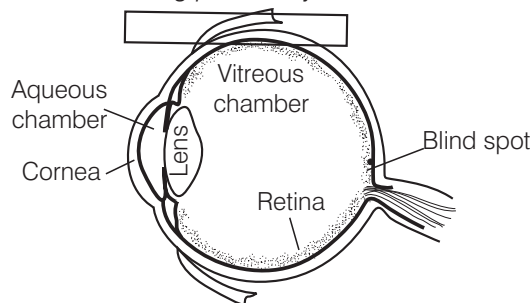
The valve opens during yawning, swallowing and during an abrupt change in altitude, when air enters or leaves the tympanic cavity to equalise the pressure of air on the two sides of the tympanic membrane.

**Q. 6** Label the following parts in the given diagram using arrow.

- (a) Aqueous chamber
- (b) Cornea
- (c) Lens
- (d) Retina
- (e) Vitreous chamber
- (f) Blind spot



**Ans.** Representation of the following parts of eye



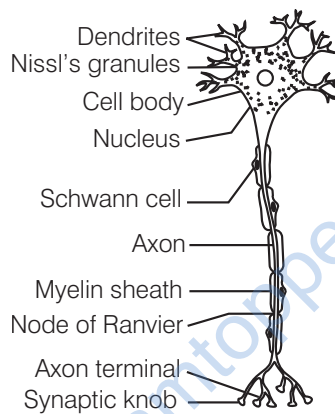
## Long Answer Type Questions

**Q. 1** Explain the process of the transport and release of a neurotransmitter with the help of a labelled diagram showing a complete neuron, axon terminal and synapse.

**Ans.** A neuron has three main parts

- (i) Cell body
- (ii) Axon
- (iii) Dendrites

Any stimulus/nerve impulse passes from one neuron to another *via* axon. This nerve impulse is wave of bioelectric/electrochemical disturbance that passes along neuron during conduction of an excitation.

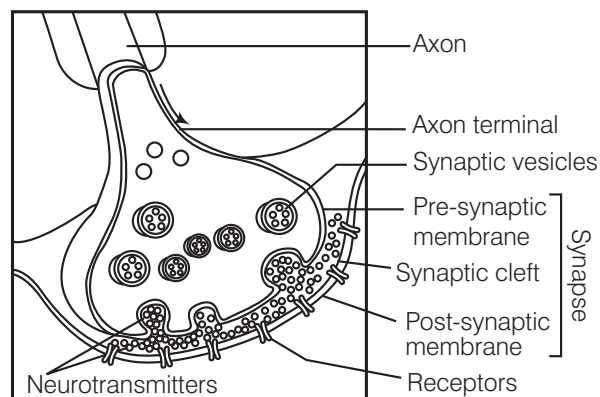


**Structure of a neuron**

Transport and release of a neurotransmitter occurs within a synapse. At a chemical synapse, the membranes of the pre- and post-synaptic neurons are separated by a fluid-filled space called synaptic cleft. Chemicals called neurotransmitters are involved in the transmission of impulses at these synapses. The axon terminals contain vesicles filled with these neurotransmitters.

When an impulse (action potential) arrives at the axon terminal, it stimulates the movement of the synaptic vesicles towards the membrane, where they fuse with the plasma membrane and release their neurotransmitters in the synaptic cleft.

The released neurotransmitters bind to their specific receptors, present on the post-synaptic membrane. This binding opens ion channels allowing the entry of ions which can generate a new action potential in the post-synaptic neuron.



**Transmission of a nerve impulse at chemical synapse**

**Q. 2** Name the parts of human forebrain indicating their respective functions.

**💡 Thinking Process**

*The brain is the central information processing organ of our body and act as the 'command and control system'.*

**Ans.** The forebrain is the largest part of the brain most of which is **cerebrum**. Other important structures include the **thalamus**, **hypothalamus** and the **limbic system**.

The cerebrum is divided into two cerebral hemisphere connected here by a mass of white matter known is **corpus callosum**. Each hemisphere is split into four lobes. The surface of each hemisphere is made up of grey matter known as the cerebral cortex that is folded to increase the surface area. *Various structures of forebrain are given below*

Brain Region	Structure	Function
Diencephalon	Thalamus	Organising sensory information
Diencephalon	Hypothalamus	Endocrine system, thermoregulation
Diencephalon	Pituitary	Endocrine system
Telencephalon	Cerebral cortex	Consciousness, language, etc
Telencephalon	Limbic system	Memory, motivation, emotions
Telencephalon	Olfactory bulb /lobes	Smell

**Thalamus**

The thalamus has many functions including processing and relaying sensory information selectively to various parts of the cerebral cortex, translating signals to the cerebral cortex and also regulating states of sleep and wakefulness. The thalamus plays a major role in regulating arousal levels of consciousness and levels of activity.

**Hypothalamus**

The function of the hypothalamus is mainly related to the overall regulation of the endocrine system and closely related to the pituitary gland.

**Pituitary**

The function of the pituitary is mainly related to the production of hormones as part of the endocrine system.

**Cerebral Cortex**

The cerebral cortex is essential for memory, attention, awareness, thought, language and consciousness. The cerebral cortex is connected to structures such as the thalamus and the basal ganglia, sending information to them along efferent connections and receiving information from them via afferent connections.

**Motor Cortex**

The motor cortex areas of the brain are located in both hemispheres of the cortex are related to controlling voluntary movements, especially fine movements.

**Sensory Areas**

The sensory areas are the areas that receive and process information from the senses. inputs from the thalamus are called primary sensory areas, where vision, hearing and touch are processed. The two hemispheres of the cerebral cortex receive information from the opposite (contra lateral) side of the body.

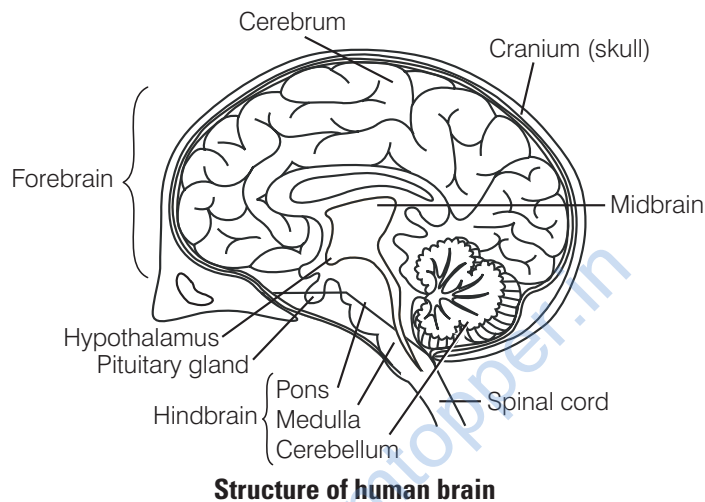
The association areas of the brain function to produce a perception of the world enabling an animal to interact with their environment effectively. The frontal lobe or prefrontal association complex is involved in planning actions and movement.

### Limbic System

The limbic system is principally responsible for emotions and the various types of emotion can affect the activity of the Autonomic Nervous System (ANS) facilitated by the hypothalamus.

### Olfactory Bulb

The olfactory bulb is responsible for olfaction concerned with sense of smell.



**Q. 3** Explain the structure of middle and internal ear with the help of diagram.

**Ans.** Ears are a pair of **statoacoustic organ** meant for both balancing and hearing. In most mammals, the external ear is a flap of tissue also called pinna. It is a part of auditory system. The human ear consists of three main parts external ear, middle ear and internal ear.

### Structure of Middle Ear

The middle ear contains three bones or ossicles—the **malleus** (hammer), **incus** (anvil) and **stapes** (stirrup). These bones are attached to one another in a chain-like fashion. The malleus is attached to the tympanic membrane and the stapes is attached to the oval window (a membrane beneath the stapes) of cochlea. These three ossicles increase the efficiency of transmission of sound waves to the inner ear.

The middle ear also opens into the **Eustachian tube**, which connects with the pharynx and maintains the pressure between the middle ear and the outside atmosphere,

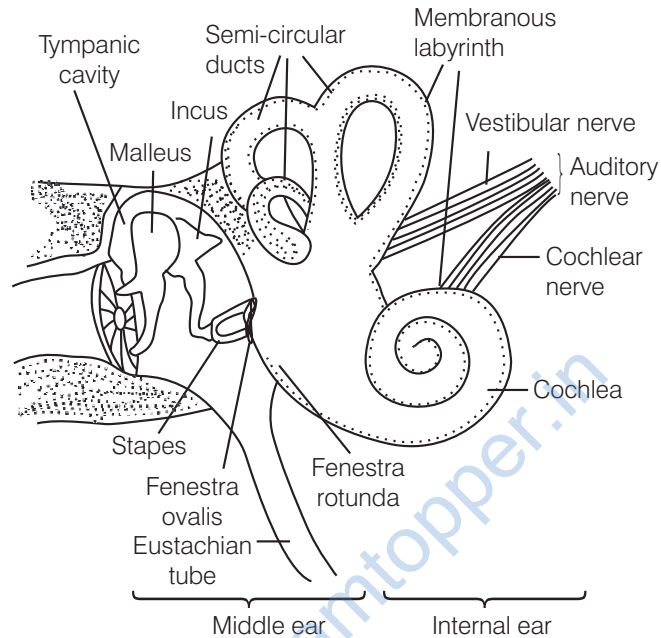
### Structure of Internal Ear

The inner ear consists of a **labyrinth** of fluid-filled chambers within temporal bone of the skull. The labyrinth consists of two parts, *i.e.*, the **bony** and **membranous labyrinth**. The bony labyrinth is a series of channels.

Inside these channels, membranous labyrinth lies, which is surrounded by a fluid called **perilymph**. The membranous labyrinth is filled with a fluid called **endolymph**. The coiled portion of the labyrinth is called **cochlea**.

The cochlea has two large canals-an upper vestibular canal (scala vestibuli) and a lower tympanic canal (scala tympani)-separated by a small **cochlear duct** (scala media). The vestibular and tympanic canals contain **perilymph** and the cochlear duct is filled with **endolymph**.

At the base of scala vestibuli, the wall of membranous labyrinth comes in contact with the fenestra ovalis, while at the lower end of scala tympani lies the fenestra rotunda.



**Diagram representing middle ear and internal ear**

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