Chapter
18

Neural Control and Coordination

- INTRODUCTION
- NEURAL SYSTEM
- HUMAN NEURAL SYSTEM
- NEURON AS STRUCTURAL AND FUNCTIONAL UNIT OF NEURAL SYSTEM
- CENTRAL NEURAL SYSTEM

INTRODUCTION

- **Coordination** is the process through which two or more organs interact and complement the functions of one another.
- In our body, **neural system and endocrine system** jointly coordinate and integrate all the activities of the organs so that they function in a **synchronised fashion**.
- The neural system provides an organised network of **point-to-point** connections for a quick coordination.
- The endocrine system provides chemical integration through **hormones**
- Nervous system and endocrine system are called **Integrative system** of the body.

18.1 NEURAL SYSTEM

- The neural system of all animals is composed of highly specialised cells called **neurons** which can detect, receive and transmit different kinds of stimuli.
- Nervous tissue is ectodermal in origin.
- The neural organisation is **very simple** in lower invertebrates. For example, in *Hydra,* it is composed of a network of neurons.
- The neural system is better organised in insects where a brain is present along with a **number of ganglia and neural tissues**.
- The **vertebrates** have a more developed neural system

18.2 HUMAN NEURAL SYSTEM

The human neural system is divided into two parts :

- **Central neural system (CNS)**
- **Peripheral neural system (PNS)**

The CNS includes the brain and the spinal cord and is the site of **information processing and control.**
The PNS comprises of all the nerves of the body associated with the CNS (brain and spinal cord).
The nerve fibres of the PNS are of two types :

- **Afferent fibres**
- **Efferent fibres**

The afferent nerve fibres transmit impulses from tissues/organs to the CNS and the efferent fibres transmit regulatory impulses from the CNS to the concerned peripheral tissues/organs.
The PNS is divided into two divisions :-

- **Somatic neural system (SNS)**
- **Autonomic neural system (ANS)**

The somatic neural system relays impulses from the CNS to skeletal muscles while the autonomic neural system transmits impulses from the CNS to the involuntary organs and smooth muscles of the body.
The autonomic neural system is further classified into **sympathetic** neural system and **parasympathetic** neural system.

- **Visceral nervous system** is the part of the peripheral nervous system that comprises the whole complex of nerves, fibres, ganglia, and plexuses by which impulses travel from the central nervous system to the viscera and from the viscera to the central nervous system.

TOPIC CENTRIC EXERCISE 01

Q1. Nerve fibres of PNS are of

(a) Two types (b) Three types
(c) Single type (d) Four types

Q2. Afferent nerve fibre carries signals from

(a) CNS to CNS (b) Organ to CNS
(c) Organ to organ (d) CNS to organ

Q3.	**ANS is divide into**	
	(a) SNS and CNS	(b) Sympathetic nervous system
	(c) Parasympathetic nerves system	(d) Both b and c
Q4.	**Nervous system is divided into**	
	(a) PNS and SNS	(b) SNS and CNS
	(c) CNS and PNS	(d) ANS And PNS
Q5.	**CNS is composed of**	
	(a) All neurons of body	(b) Brain and spinal cord
	(c) Nerves associated with CNS	(d) Nerves associated with PNS

18.3 NEURON AS STRUCTURAL AND FUNCTIONAL UNIT OF NEURAL SYSTEM

- **Neuron, a microscopic structure,** is the structural and functional unit of neural system.
- It generates and transmits nerve impulses. It is the longest cell of the body.
- It is composed of **three** major parts, namely, **cell body, dendrites and axon**.

(A) Cell Body or Cyton

- It contains uninucleated cytoplasm.
- Except centriole, all cell organelles are found in cytoplasm.
- Centriole is absent in the nerve cell thus cell division is absent.
- Some granular bodies Nissl's granules are also found in cell body and dendrites.
- Nissl's granules are mainly composed of free ribosomes & RER
- These are the centre of protein synthesis.

(B) Dendrites

- Short fibres which branch repeatedly and project out of the cell body also contain **Nissl's granules**.
- Some receptor's are found on the dendrites, so dendron receive the stimuli & produce centripetal (towards the cell body) conduction.

(C) Axon

- Axon is a long fibre, the **distal end** of which is branched.
- It is the **functional part of nerve cell**.
- Each branch terminates as a bulb-like structure called **synaptic knob** which possess **synaptic vesicles** containing chemicals called **neurotransmitters**.
- Axons transmit nerve impulses **away** from the cell body to a synapse or to a neuro-muscular junction.
- Axon is covered by **Axolemma**. Part of cyton where axon arises called **Axon hillock**.
- Cytoplasm contained in axon is **axoplasm**.
- Axoplasm of axon contains neurofibrils and mitochondria and lacks Nissl`s granules.
- The axon hillock is the neuron's trigger zone, because it is the site where action potential are triggered. There are two types of axons, namely, **myelinated and non myelinated**

➢ Myelinated (Medullated) nerve fibres

- Myelinated nerve fibres are enveloped with **Schwann cells,** which form a **myelin sheath** around the axon.
- Gaps between two adjacent myelin sheaths are called **nodes of Ranvier**.
- Myelinated nerve fibres are found in **spinal and cranial nerves**.
- Schwann cell takes part in the formation of myelin sheath (myelinogenesis).
- Myelin sheath acts as insulator and prevents leakage of ions.
- Neurilemma or schwann cells are not present in CNS, therefore myelinogenesis process occurs with the help of **oligodendrocytes (Neuroglia).**

➢ Non-myelinated (non-medullated) nerve fibres

- Unmyelinated nerve fibre is enclosed by a Schwann cell that does not form a myelin sheath around the axon.
- It is commonly found in **autonomous and somatic neural systems**.
  - **Gray matter :-** It is composed of nerve cells. It consists of cytons & nonmyelinated nerve fibres (Gray fibers).
  - **White matter :-** It contains myelinated nerve fibres (White fibres).

Table: Differences between Axon & Dendron

Axon		Dendron	
1.	It is always single in a neuron	1.	May be one or more in number
2.	It is long	2.	Short
3.	It has no Nissl's granules	3.	Nissl's granules present
4.	Nerve impulse travels away from the cell body. (centrifugal)	4.	Nerve impulse travels towards the cell body. (centripetal)

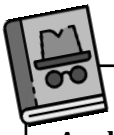
➢ **Types of Neurons**

Based on the number of axon and dendrites, the neurons are divided into three types.

(i) Unipolar: Single process arises from cyton. (1 Axon) e.g. Nervous system of embryo

(ii) Bipolar: Two process arises from cyton (1 Axon & 1 dendron) e.g. Retina of eye

(iii) Multipolar: Neuron which have one axon but many dendrons. e.g. Most neurons of vertebrates, Cerebral cortex.



Clue Finder

Apolar/Nonpolar Neuron :– Cell process are either absent or if present are not differentiated in axon and dendrons. Nerve impulse radiates in all directions. e.g. **Hydra**.

Pseudounipolar :– In this type, nerve cell has only axon but a small process develop from axon which act as dendron. eg. **Dorsal root ganglia of spinal cord**.

18.3.1 Generation and Conduction of Nerve Impulse

- Neurons are excitable cells because their membranes are in a polarized state.
- Polarized state is due to differential concentration gradient of ions across membrane.
- Different types of ion channels are present on the neural membrane. These ion channels are selectively permeable to different ions.

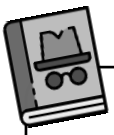
➢ **Resting Phase**

- In a **resting** nerve fibre, i.e., when a nerve fibre that is not conducting any impulse, the axonal membrane is comparatively **more permeable** to **potassium ions (K^+)** and nearly **impermeable** to **sodium ions (Na^+)**.
- Similarly, the membrane is **impermeable to negatively charged proteins** present in the axoplasm.
- Consequently, the axoplasm inside the axon contains **high concentration of K^+** and **negatively charged proteins** and **low** concentration of **Na^+**.
- In contrast, the fluid **outside the axon** contains a **low** concentration of **K^+**, a **high** concentration of **Na^+** and thus form a concentration **gradient**.
- These **ionic gradients** across the **resting membrane** are maintained by the active transport of ions by the **sodium-potassium pump** which transports **$3Na^+$** outwards for **$2K^+$** into the cell.
- The potential difference (a charge) which exists across the cell surface membrane of nerve cells, negative inside the cell with respect to the outside. The membrane is said to be **polarised**.

- The potential difference across the membrane at rest is called the **resting membrane potential** and this is about –70 mV (the negative sign indicates that inside the cell is negative with respect to the outside).
- Resting membrane potential is maintained by the active transport of ions against their electrochemical gradient by **sodium potassium pump**.

➢ **Exciting Stage**

- Once the event of depolarization occurs, a nerve impulse is initiated. **Action potential** is another name of **nerve impulse.** This is generated by a change in the sodium ion channels. These channels, and some of the potassium ion channels, are known as **voltage gated channel,** meaning they can be opened or closed with change in voltage. In resting state these channels are closed due to binding of Ca^{++}.
- A potential is generated and it cause sudden opening of the sodium gates. Opening of gates increases the permeability of the axon membrane to sodium ions which enter by diffusion. This increases the number of positive ions inside the axon.



Clue Finder

- A change of +10mV in potential difference from RMP through influx is sufficiently significant to trigger a rapid influx of Na^+ ions leading to generation of action potential.
- This change of +10 mV is called as threshold stimulus.

- This potential is called as **action potential**. In this state, the inner surface of axolemma becomes positively charged and outer surface becomes negatively charged. The rise in the stimulus-induced permeability to Na^+ is extremely short lived. It is quickly followed by a rise in permeability to K^+.

➢ **Repolarisation**

- The rise in the stimulus-induced permeability to Na^+ is extremely shortlived i.e., Na^+ channels close.
- It is quickly followed by a rise in permeability to K^+. Within a fraction of a second, K^+ diffuses outside the membrane and restores the resting potential of the membrane at the site of excitation
- This makes the membrane negative on inside and positive on outside. This process is called repolarisation.

➢ **Hyperpolarisation**

- K^+ ion channels remain open for a longer time period so that the membrane potential becomes more negative than –70mv.

Process	$Na^+ - K^+$ Pump	Na^+ VGC	K^+ VGC	Inside charge after the event
Polarisation	✓	×	×	Negative
Depolarisation	×	✓	×	Positive
Repolarisation	✓	×	✓	Negative
Hyperpolarisation	✓	×	✓	Negative

➢ **Saltatory Conduction of Nerve Impulse**

- This type of conduction occurs in **myelinated fibre**.
- This means, in effect that the action potential jumps from node of Ranvier to another. This type of conduction is called **saltatory conduction**. Leakage of ions takes place only in nodes of Ranvier and less energy is required for saltatory conduction.

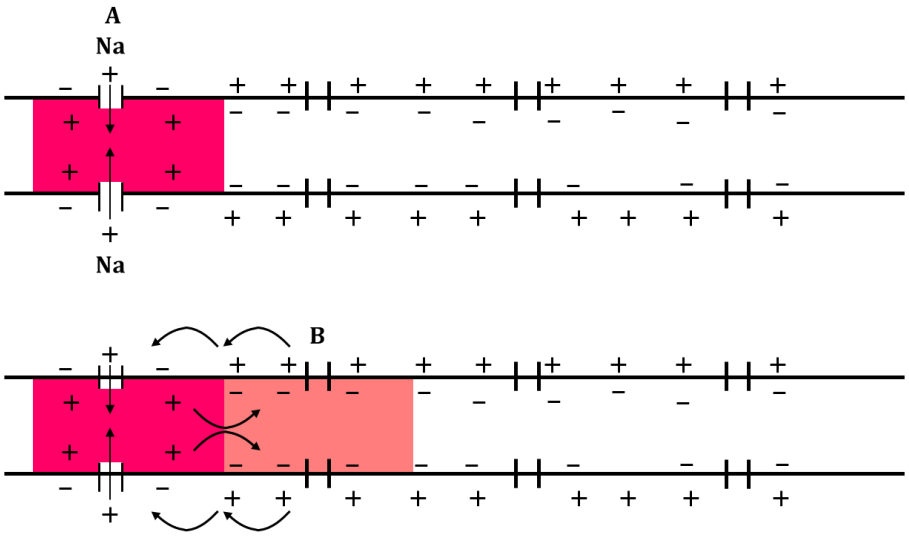


Fig.: Diagrammatic representation of impulse conduction through an axon (at points A and B)

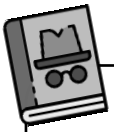
Clue Finder

- The entire process of repolarisation requires some time during which the nerve cannot be stimulated again. This period is called **refractory period.**
- Threshold stimulus: A stimulus that is just strong enough to depolarise the membrane or excite a given tissue.

18.3.2 Transmission of Impulses

- A nerve impulse is transmitted from one neuron to another through junctions called **synapses.**
- A synapse is formed by the membranes of a pre-synaptic neuron and a post-synaptic neuron, which may or may not be separated by a gap called **synaptic cleft.**
  Synapse = Presynaptic knob + synaptic cleft + postsynaptic membrane
- There are two types of synapses, namely, **electrical synapses** and **chemical synapses**.
- At electrical synapses, the membranes of pre- and postsynaptic neurons are in very close proximity.
- Electrical current can flow directly from one neuron into the other across these synapses.
- **Transmission of an impulse across electrical synapses is very similar to impulse conduction along a single axon**.
- Impulse transmission across an electrical synapse is always faster than that across a chemical synapse. Electrical synapses are rare in our system.
  On the other hand, chemical synapses are characterised by a synaptic cleft. At these synapse, impulse transmission occurs with the help of a chemical, called neurotransmitter.
- **Mechanism :-** When the Action potential develops in presynaptic membrane, it becomes permeable for Ca^{++}.
- Ca^{++} enter presynaptic membrane & neurotransmitter vesicles burst due to the stimulation by Ca^{++} and they release neurotransmitters in synaptic cleft.
- The released neurotransmitters bind to their specific receptors, present on the post-synaptic membrane. This binding opens up ion channels, allowing the entry of ions which can generate a new potential on post synaptic membrane. The potential may be **excitatory (EPSP)** or **inhibitory (IPSP).**
- In **Excitatory postsynaptic potential (EPSP)** Acetylcholine is main neuro transmitter, which develop due to opening of Na^{+} gated channels.
- On the rest of the Ach. **cholinestrase** enzyme functions, which is found in synaptic cleft. This enzyme decomposes the Ach. into choline & Acetate.

- The products of the hydrolysis are acetate and choline which are reabsorbed into the synaptic knob where they are resynthesised into acetylcholine, using energy from ATP.
- If neuro inhibitory transmitter (GABA) binds with post synaptic membrane to open the Cl^- gated channels and hyperpolarization of neuron occurs. Now the potential is called **inhibitory postsynaptic potential (IPSP)**.



Clue Finder

Transmission of an impulse across a synapse is slower than its conduction along a neuron. This is because of the time needed for the release of a neurotransmitter, its diffusion through the synaptic cleft and its action on the postsynaptic membrane. The difference in the rate is called synaptic delay.

TOPIC CENTRIC EXERCISE 02

Q1. Saltatory conduction occurs in
(a) Myelinated neurons (b) Unmyelinated neurons
(c) Both of them (d) Muscle cell

Q2. Bipolar neuron is found in
(a) Retina of eye (b) Cerebral cortex
(c) Embryonic stage (d) None of these

Q3. Inner membrane of axon is positively charged in case of
(a) Polarised phase (b) Depolarised phase
(c) Hyperpolarisation (d) Both a and c

Q4. Impulse transmission in electrical synapse is
(a) Slower than chemical synapse (b) Faster than chemical synapse
(c) Same as chemical synapse (d) Transmission do no occurs

Q5. In polarised state axolemma is more permeable for
(a) Na^+ (b) Cl^-
(c) K^+ (d) Negatively charged proteins

18.4 CENTRAL NEURAL SYSTEM

- In all the vertebrates including man, CNS is dorsal, hollow and single.
- In invertebrates when present, it is ventral, solid, and double.
- CNS is formed of two parts: Brain and Spinal cord
- These are formed from the neural-tube which develops from the ectoderm after the gastrula stage of embryo
- Anterior part of neural tube develops into brain while caudal part of neural tube develops into spinal cord

➢ **Human 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 (e.g. lungs, heart, kidney etc.), thermoregulation, hunger and thirst, circadian (24 hours) rhythms of our body, activities of several endocrine glands and human behaviour.
- It is also site for processing of vision, hearing, speech, memory, intelligence, emotions and thoughts.
- The weight of brain of an adult male is 1400 gm and of female is 1250 gm.
- It is situated in cranial box which is made up of 1 frontal bone, 2 parietal bone, 2 temporal bone, 1 sphenoid, 1 ethmoid and 1 occipital bone.

Critical Thinking

Brain Meninges :

The human brain is well protected by the skull. Inside the skull, the brain is covered by cranial meninges consisting of:

(i) Duramater :

This is the first and the outermost membrane which is thick, strong and elastic layer.

At several places it forms cranial venous sinuses containing blood.

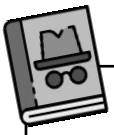
(ii) Arachnoid :

It is middle and delicate layer and found only in mammals. (Mammalian character)

At several places it forms villi like foldings to absorb CSF called arachnoid villi.

(iii) Piamater :

Inner most, thin and transparent membrane, which is firmly attached to the brain.



Clue Finder

Subdural space: A very narrow space exists below duramater or between the duramater and the arachnoid membrane.

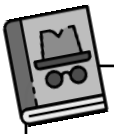
Subarachnoid space: contains cerebrospinal fluid (CSF): A narrow space that exists below arachnoid membrane or between arachnoid membrane and piamater

- **Cerebrospinal-Fluid (CSF) :**
  - This fluid is clear and alkaline in nature just like lymph.
  - C.S.F. is formed in ***choroid plexus*** found in the ventricles of the brain.
- **Functions of C.S.F. :**
  - Protection of Brain :- It acts as shock absorbing medium and works as cushion.
  - It provides buoyancy to the brain. The brain can be divided into three major parts: **forebrain, midbrain, and hindbrain**

18.4.1 Fore Brain :

- The fore brain consists of **cerebrum, thalamus and hypothalamus**

- **Cerebrum :**
  - Cerebrum forms the major part of the brain which is most developed in human.
  - The cerebrum is made up of two cerebral hemispheres, with a longitudinal groove present on the dorsal surface, known as the **median fissure,** which separates the two hemispheres. These hemispheres are partially connected by a thick, curved white nerve fiber called the **corpus callosum,** a characteristic feature of mammals.



Clue Finder

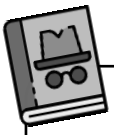
The outer part of cerebral hemisphere is called Cerebral cortex and thrown into prominent folds. These folds are found as ridges and grooves on dorsal surface of cerebral hemisphere. Ridges are known as Gyri while grooves are called sulci. Gyri and sulci increase the surface area of cerebrum.

- The layer of cells which covers the cerebral hemisphere is called cerebral cortex. The cerebral cortex is referred to as the grey matter due to its **greyish appearance,** The neuron cell bodies are concentrated here giving the colour.
- The cerebral cortex contains three types of functional areas :-

(a) **Sensory area** – Analysis of sensory impulses
(b) **Motor area** – Generation of motor impulses
(c) **Association area** – These are large regions that are neither clearly sensory nor motor in function. They are responsible for certain complex functions like :-**Intersensory associations, memory, communication.**

- Fibres of the tracts are covered with the myelin sheath, which constitute the inner part of cerebral hemisphere. They give an opaque white appearance to the layer and, hence, is called the **white matter**.
- The cerebrum wraps around a structure called thalamus, which is a major coordinating centre for sensory and motor signaling.

Function of cerebrum : It is the most important part of brain because it controls and regulates different part of brain. This is the centre of conscious senses, will power, voluntary movements, knowledge, etc.



Clue Finder

Diencephalon :
It consists of 3 parts : Epithalamus, Thalamus and Hypothalamus
(a) **Epithalamus :** It form the roof of diencephalon.

- **Thalamus :** It forms upper lateral wall of Diencephalon. It acts as a **relay centre.** It receives all sensory inputs from all part of body & these impulses are send to the cerebral cortex. It is a major coordinating centre for sensory and motor signaling.
- **Hypothalamus :** It lies at the base part thalamus and forms the lower or ventral part of diencephalon.
  - The hypothalamus contains a number of centre which control body temperature, urge for eating and drinking (Hunger and thirst).
  - It also contains several group of neurosecretory cells, which secrete hormone called hypothalamic hormone.
- **Hypothalamus controls :-** Thermoregulation, behaviour and emotion, endocrine control, biological clock system, Osmoregulation, urge for eating and drinking.

Critical Thinking

Limbic system :
The inner part of cerebral hemispheres and a group of associated deep structures like **amygdala, hippocampus** etc. form a complex structure called **Limbic system**. Along with the hypothalmus, it is involved in the regulation of sexual behaviour, expression of emotional reactions (e.g. excitement, pleasure, rage, fear) and motivation

18.4.2 Mid Brain :

- It is a small part of brain. The midbrain is located between **the thalamus/hypothalamus of the forebrain and pons of the hindbrain**.
- A canal called **Cerebral aqueduct** passes through the midbrain.
- Anterior part of midbrain contains two longitudinal myelinated nerve fibre called **cerebral** or **crura cerebri.**
- The dorsal portion of the midbrain consists mainly of four round swellings (lobes) called **corpora quadrigemina.** (2 upper & 2 lower)
- Mid brain and hind brain (except cerebellum) form the brain stem.

Function :

- The mid brain receives and integrates **visual, tactile** and **auditory inputs.**

18.4.3 Hind Brain :

- The hind brain comprises **pons, cerebellum** and **medulla** (also called the medulla oblongata).

(i) Pons :

- Pons consists of fibre tracts that interconnect different regions of the brain. e.g. Transverse and longitudinal nerve fibre.
- **Transverse nerve fibre** connect with cerebellum while **longitudinal nerve fibre** connect cerebrum to medulla oblongata.
  Function :- It regulates the breathing reaction through **pneumotaxic centre.**

(ii) Cerebellum :

- Cerebellum has very convoluted surface in order to provide the additional space for many more neurons.
- Outer part of cerebellum is made up of gray matter while inner part is of white matter. White matter projects outside & forms a branched tree like structure known as **Arbor Vitae**.
  Functions : Controls voluntary movements and body balance
- The cerebellum integrates information received from the semicircular canals of the ear and the auditory system
- The person who take alcohol in excess their cerebellum gets affected as a result that person can not maintain his balance and walking is disturbed.

(iii) Medulla Oblongata :

- The medulla contains centres which control respiration, cardiovascular reflexes and gastric secretions.
- It is also concerned with cranial reflex action like sneezing reflex, salivation reflex, coughing reflex, swallowing reflex, vomiting reflex, yawning reflex.
- Mid brain, pons and medulla are situated in one axis and it is called as ***Brain stem***.
- Brain stem forms the connections between the brain and spinal cord.

TOPIC CENTRIC EXERCISE 03

Q1. Diencephalon do not includes
(a) Thalamus (b) Epithalamus
(c) Hypothalamus (d) Cerebrum

Q2. Brain is formed by
(a) Mid brain (b) Pons
(c) Medulla (d) All of these

Q3. Cerebral aqueduct passes through
(a) Pons (b) Medulla
(c) Cerebrum (d) Mid brain

Q4. Corpora quadrigemina is a part of
(a) Pons (b) Fore brain
(c) Hind brain (d) Mid brain

Q5. Brain is divided into
(a) Fore brain, mid brain and hind brain (b) Pons mid brain and medulla
(c) Medulla, pons and hind brain (d) Cerebrum, pons and thalamus

Solved Examples

Ex: 1- Function of axon is to
(a) Bring impulse into cyton (b) Take impulse away from cyton
(c) Support neuroglial cell (d) None of these

Sol. (b): The function of an axon is to carry impulses away from the cell body toward the axon terminal.

Ex: 2- Neurons are excitable cells because their membranes are in a
(a) Depolarised state (b) Repolarized state

(c) Polarized state (d)Hyperpolarized state

Sol. **(c):** Neurons are excitable cells because their membranes are in a polarized condition, meaning there is an electrical charge difference between the inside and outside of the cell.

Ex: 3- The new potential developed on post-synaptic membrane is

(a) Always inhibitory (b) Always excitatory

(c) May be excitatory or inhibitory (d) Neither excitatory nor inhibitory

Sol. **(c):** The new potential developed on the post-synaptic membrane may be excitatory or inhibitory"

Ex: 4- Hypothalamus does not control

(a) Urge for eating and drinking (b) Thermoregulation

(c) Osmoregulation (d) Creative thinking and consciousness

Sol. **(d):** Creative thinking and consciousness is under the control of cerebrum .

Ex: 5- Saltatory conduction is found in

(a) Myelinated neurons (b) Non myelinated neuron

(c) Both of them (d) None of them

Sol. **(a):** Saltatory conduction means transmission of nerve impulse from a node of Ranvier to another, node of Ranviers are found in myelinated neurons.

Ex: 6- Brain stem includes

(a) Mid brain only

(b) Hind brain only

(c) Mid brain and hind brain (except cerebellum)

(d) Fore brain and hind brain only

Sol. **(c):** Mid brain, pons and medulla are situated in one axis and it is called as ***Brain stem***.

Ex: 7- Corpora quadrigemina is found at

(a) Ventral side of mid brain (b) Lateral side of mid brain

(c) Anterior side of mid brain (d) Dorsal side of mid brain

Sol. **(d):** The dorsal portion of the midbrain consists mainly of four round swellings (lobes) called corpora quadrigemina

Ex: 8- Neurons have the property of

(a) Conductivity (b) Excitability

(c) Both of them (d) None of them

Sol. **(c):** Neurons are specialized cells in the nervous system that have the unique properties of **conductivity** (the ability of neurons to transmit electrical impulses along their length and across synapses to other neurons or muscle cells) and **excitability** (the ability of a neuron to respond to stimuli and generate an electrical impulse).

Ex: 9- PNS includes

(a) Brain (b) Spinal cord

(c) Motor nerves of SNS (d) All of these

Sol. **(c):** Brain and spinal cord are the part of Central nervous system.

Ex: 10- Which part of brain consists of fibre tracts that interconnect different regions of the brain

(a) Medulla (b) Pons

(c) Cerebellum (d) Cerebrum

Sol. **(b):** Pons consists of fibre tracts that interconnect different regions of the brain. e.g. Transverse and longitudinal nerve fibre.

Exercise-01 Level -01

1. The process by which two or more organs interact and complement each other's functions is called
(a) Combination (b) Adaptation
(c) Coordination (d) None of these

2. All the nerves of the body associated with the CNS (brain and spinal cord) are comprised in
(a) ANS (b) CNS
(c) SNS (d) PNS

3. Voluntary movement of the body is controlled by
(a) Sympathetic nerves system
(b) Parasympathetic nerves system
(c) Somatic nerves system
(d) Autonomic nerves system

4. Node of Ranvier is
(a) Gape between adjacent myelin sheath
(b) Gape between axolemma and neurilemma
(c) Place where neurilemma and myelin sheath are discontinuous
(d) Place where myelin sheath is continuous

5. Nissl's granules are found in
(a) Cell body (b) Axon
(c) Dendrites (d) Both (a) and (c)

6. Bulb like terminated part of axon is called as
(a) Axon hillock
(b) Node of Ranvier
(c) Synaptic vesicle
(d) Synaptic knob

7. During impulse conduction leakage of ions occurs at
(a) Along the entire length of the axons
(b) Only at cyton
(c) Only at axon hillock
(d) Only at the nodes of ranvier

8. How many types of synapse are found in body
(a) One type (b) Two types
(c) Three types (d) Four types

9. Axon membrane is negatively charged from inside in
(a) Depolarised state
(b) Action potential
(c) Resting potential
(d) None of these

10. Neurotransmitters are released from synaptic vesicles with the help of
(a) HCO_3^- (b) K^+
(c) Cl^- (d) Ca^{2+}

11. An extremely rapid change in membrane potential from negative to positive, then back to negative again, is best termed as
(a) A resting potential
(b) A repolarisation
(c) A voltage
(d) An action potential

12. The medulla of the brain is connected to the _____
(a) Spinal cord
(b) Cerebrum
(c) Cerebellum
(d) Hypothalamus

13. Non functioning of Na^+-K^+ pump will result in
(a) Increase of Na^+ out side the axon
(b) Increase of K^+ inside the axon
(c) Increase of Na^+ inside the axon
(d) Decrease K^+ outside the axon

14. Sequence of meninges from outside to inside is
(a) Dura mater – Arachnoid – Pia mater
(b) Dura mater – Pia mater –Arachnoid
(c) Arachnoid– Dura mater – Pia mater
(d) Pia mater – Arachnoid –Dura mater

15. Controlling centre of thermoregulation is
(a) Hypothalamus
(b) Cerebrum
(c) Pons
(d) Medulla oblongata

16. _____ is a major coordinating centre for sensory and motor signaling.
(a) Limbic system
(b) Thalamus
(c) Brain stem
(d) Hypothalamus

17. Cerebral cortex is greyish in appearance due to
(a) Oligodendrocytes
(b) Nissl`s granules
(c) Myelin sheath
(d) Schwann cell

18. Gastric secretions, respiration, heart beat are controlled by
(a) Medulla oblongata and hypothalamus
(b) Pons and cerebrum
(c) Pons and cerebellum
(d) Medulla oblongata

19. The part of the brain responsible for a loss of control when a person is unable to walk properly is
(a) Thalamus

(b) Cerebellum
(c) Hypothalamus
(d) Cerebrum

20. Value of resting membrane potential is correctly given as
(a) +70 mV (b) –90 mV
(c) +35 mV (d) –70 mV

21. Which part of the brain works along with hypothalamus
(a) Cerebral cortex (b) Cerebellum
(c) Limbic system (d) Medulla

22. Nissl's bodies can be defined as
(a) Fragments of DNA
(b) Fragments of RER
(c) Fragments of RNA
(d) Fragments of mitochondria

23. Which of the following is not a feature of the chemical synapse?
(a) Slow
(b) Multidirectional
(c) Neurotransmitters
(d) Common

24. Nucleus of neuron is found in
(a) Axons
(b) Axon hillock
(c) Synaptic knobs
(d) Soma

25. Afferent nerves carry impulse towards
(a) PNS (b) CNS
(c) ANS (d) SNS

26. Point to point connection in body is provided by
(a) Hormones
(b) Endocrine system
(c) Nervous system
(d) All of them

27. Neuron do not have
(a) Mitochondria (b) Cytoplasm
(c) Nucleus (d) Centriole

28. Oligodendrocytes are responsible for
(a) Myelin sheath formation in CNS
(b) Myelin sheath formation in SNS
(c) Myelin sheath formation in ANS
(d) Myelin sheath formation in PNS

29. Myelin sheath is found at ?
(a) Cyton and axon
(b) Axon
(c) Axlemma and sarcolemma
(d) Tendons

30. As compared to white matter grey matter do not have
(a) Nissl`s granules
(b) Myelin sheath
(c) Axon
(d) Neurotransmitters

31. Function of nervous tissue is
(a) Excitability
(b) Sensitivity
(c) Conductivity
(d) All of these

32. Neurons are the
(a) Longest cell
(b) Heaviest cell
(c) Smallest cell
(d) Rapid dividing cell

33. Chemical transmission of nerve impulses from one neuron to another at a synapse is by :-
(a) Cholesterol
(b) Neurotransmitters
(c) Enzymes only
(d) ATP

34. During transmission of nerve impulse the membrane is more permeable to
(a) Potassium ions (b) Phosphorus
(c) Sodium ions (d) Chlorine ion

35. The functional connection between two neurons is called :-
(a) Synapse (b) Neuro junction
(c) Fissure (d) Tetrad

36. Repolarisation of Neuron is occured due to:-
(a) Efflux of K+ (b) Influx of K+
(c) Efflux of Na+ (d) Influx of Na+

37. The one way or unidirectional transmission of nerve cells is due to :
(a) Synapses
(b) Axon
(c) Nodes of Ranvier
(d) Interneurons

38. Corpus callosum connects :-
(a) Right and left cerebral hemisphere
(b) Upper and lower cerebral hemisphere
(c) Right and left olfactory lobes
(d) Mid brain and hind brain

39. Find out the odd one with respect to cranial meninges
(a) Choroid (b) Duramater
(c) Piamater (d) Arachnoid

40. Crura cerebri is located in :-
(a) Fore brain (b) Hind brain
(c) Mid brain (d) None

41. The box like bony structure which encloses the brain is called :-
(a) Cranium (b) Epicardium

(c) Meninges (d) Periosteum

42. Epithalamus is situated on the
(a) Roof of diencephalon
(b) Lateral wall of hypothalamus
(c) Dorsal side of Thalamus
(d) Floor of diencephalon

43. Which of the following is not a part of hind brain:
(a) Medulla oblongata
(b) Thalamus
(c) Cerebellum
(d) Pons

44. If the corpus callosum is removed in mammalian brain then what will be affected :-
(a) Coordination of Cerebrum
(b) Osmoregulation
(c) Body balance
(d) Behaviour and emotional disturbances

45. Arbor vitae is a part of -
(a) Cerebrum (b) Cerebellum
(c) Midbrain (d) Forebrain

46. In man the osmotic centres are situated in -
(a) Cerebrum
(b) Hypothalamus
(c) Pituitary gland
(d) Medulla oblongata

47. Hypothalamus does not control -
(a) Thirst
(b) Osmoregulation
(c) Creative thinking and consciousness
(d) Thermoregulation

48. Voluntary activites of body are controlled by :-
(a) Diencephalon (b) Cerebrum
(c) Crura cerebri (d) Cerebellum

49. Drinking of alcohol affects mostly:-
(a) Cerebrum
(b) Cerebellum
(c) Medulla oblongata
(d) Diencephalon

50. Which of the following is only a mammalian character
(a) Olfactory lobe
(b) Hypothalamus
(c) Cerebellum
(d) Corpus callosum

Exercise-02 Level -02

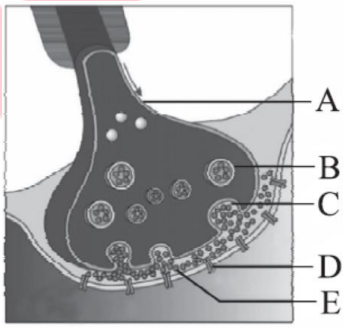
1. Which of the following is likely to occur during transmission of nerve impulse by a neuron
(a) More Efflux Na^+ ions than influx of K^+ ions
(b) Efflux of all positive charge
(c) More influx Na^+ ions than efflux of K^+ ions
(d) Efflux of all negative charged proteins

2. Which part of the brain is more likely to be affected if a person is not able control breathing properly
(a) Cerebellum (b) Cerebrum
(c) Pons (d) Thalamus

3. Working of visceral organs is regulated by
(a) Somatic nervous system
(b) Somatic and peripheral nervous system
(c) Central and somatic nervous system
(d) Sympathetic and parasympathetic nervous system

4. Which of the following statement depict correct concentration of ions, when neuron is in polarized state
(a) Na+ and K+ are same at outside and inside of the membrane
(b) Na+ is lower at outer side and K+ is lower at inner side
(c) Na+ is higher at outer side and K+ is higher at inner side
(d) Na+ is lower at outer side and higher at inner side

5. Find out the correct labelling with respect to the diagram



(a) C- Axon
(b) B- Neurotransmitter
(c) D- Synaptic cleft
(d) D- Receptors

6. Which one of the following statement is incorrect for mid brain?
(a) Cerebral duct passes through it
(b) Involved in the formation of brain stem
(c) It is located between the thalamus/hypothalamus of the forebrain and pons of the hind brain

(d) Involved in thermoregulation along with hypothalamus

7. Read the given statements and select the correct options

A. Synaptic cleft has more role in electric synapse than chemical synapse

B. Shwann cells are found only at myelinated neurons

C. Non-myelinated nerve fibres are enclosed by a Schwann cell that does not form a myelin sheath

D. Cerebrum is the main control center for thinking and intelligence

(a) A and B (b) A, B and C

(c) C and D (d) B and C

8. Hyperpolarisation occurs

(a) During depolarization

(b) Before depolarization

(c) While attaining repolarization

(d) None of these

9. Which of the following statements is True

I. At electrical synapses, the membranes of pre and post synaptic neurons are in very close proximity.

II. Electrical current can flow directly from one neuron into the other across the chemical synapses.

(a) Both (b) Only II

(c) Only I (d) None

10. The cerebrum wraps around a structure, which is-

(a) A major coordinating centre for sensory signal only

(b) A major centre for motor signaling

(c) A major coordinating centre for sensory and motor signaling

(d) Not a nervous part of a brain

11. The inner parts of cerebral hemispheres and a group of associated deep structures like amygdala, hippocampus, etc; form a complex structure called-

(a) Brain stem (b) Cerebral duct

(c) Limbic system (d) Life tree

12. Select the mismatched pair.

(a) Arachnoid – Middle layer

(b) Piamater – Inner layer

(c) Cerebrum - Hindbrain

(d) Brain – Central information processing organ

13. Read the following statements and choose the correct option –

I. Pons interconnect different regions of brain.

II. Medulla contains controlling centres for respiration, cardiovascular reflexes and gastric secretion.

(a) Both are correct

(b) Only I is correct

(c) Only I and III are correct

(d) Only II is correct.

14. Read the following statements :-

(A) Medulla is connected to spinal cord

(b) Hormones provides point to point connection

(c) The neural organisation is very complex in higher vertebrates

(d) Neuron can detect & receive stimuli but can't transmit.

How many of above statements are false.

(a) 1 (b) 3

(c) 2 (d) 4

15. The axon is a long fibre, the distal end of which is branched. Each branch terminates as a bulb-like structure called ___A___ which possess ___B___ containing chemicals called ___C___. The axons transmit nerve impulses ___D___ the cell body.

(a) A = Synaptic knob, B = synaptic vesicle, C = neurotransmitter, D = away from

(b) A = Synaptic vesicle, B = synaptic knob, C = neurotransmitter, D = away from

(c) A = Synaptic vesicle, B = synaptic knob, C = neurotransmitter, D = towards

(d) A = Synaptic knob, B = synaptic vesicle, C = neurotransmitter, D = towards

16. Movement in smooth muscles is controlled by

(a) Sympathetic nervous system

(b) Parasympathetic nervous system

(c) Autonomic nervous system

(d) All of these

17. Read the following statement :-

(a) ANS is a part of CNS

(b) CNS includes brain and spinal cord

Which of above statements is false

(a) A & B

(b) Only A

(c) Only B

(d) Both are incorrect

18. Which of the following statement is correct.

(a) -70 mv is the value of action potential during impulse transmission in neuron

(b) Action potential transmit in both direction in a neuron

(c) Axon terminal has receptors for neurotransmitter
(d) None of these

19. Na^+ – K^+ pump –
(I) Transports 3Na+ outwards & 2K+ inwards.
(II) Works along with concentration gradient.
Which of above statements are false ?
(a) Only I (b) Only II
(c) Both (d) None

20. In the following statements, find the correct one.
A. Impulses towards CNS is carried by afferent fibres.
B. Afferent fibres are motor neurons.
C. Efferent fibres transmit regulatory impulses from the CNS to the concerned peripheral tissues/organ.
(a) Only A is correct.
(b) B, C are correct.
(c) Only B is correct.
(d) A and C are correct.

21. Which of the following regions of the brain is incorrectly paired with its function?
(a) Corpus callosum - Communication between the left and right cerebral hemisphere.
(b) Cerebrum – Body balance
(c) Medulla oblongata - Control gastric secretions
(d) None of these

22. Which of the following indicates correct distribution of charge at inner side of axon while moving from polariaed to depolarise state and returning back polarised state
(a) Positive → Negative → Negative
(b) Negative →Positive → Positive
(c) Negative → Positive → Negative
(d) Negative → Negative → Positive

23. These ionic gradients across the resting membrane are maintained by the ___A___ transport of ions by the sodium-potassium pump which transports ___B___ Na+ outwards for ___C___ K+ into the cell. As a result, the outer surface of the axonal membrane possesses a ___D___ charge while its inner surface becomes ___E___ charged and therefore is polarized.
(a) A = Active, B = 2, C = 3, D = negatively, E = positively
(b) A = passive, B = 2, C = 3, D = negatively, E = positively
(c) A = Active, B = 3, C = 2, D = negatively, E = positively
(d) A = Active, B = 3, C = 2, D = positively, E = negatively

24. Read the given statements and select the option that correctly identifies true and false ones.
(I) Leak channels open at the time of depolarisation only
(II) The axoplasm inside the axon contains high concentration of K^+
(III) The fluid outside the axon contains a high concentration of Na^+ and negatively charged proteins.
(a) (I)-True, (II)-True, (III)-True
(b) (I)-False, (II)- False, (III)-False
(c) (I)-True, (II)- True, (III)- True
(d) (I)- False, (II)- True, (III)-False

25. Hypothalamus do not controls-
(I) Thermoregulation
(II) Urge for eating and drinking
(III) Coordination of smooth muscle
(IV) Creative thinking and consciousness
(a) (II) and (III)
(b) (III) and (IV)
(c) (I) and (III)
(d) (II) and (IV)

26. Five events in the transmission of nerve impulse across the synapse are given below.
(a) Synaptic vesicle fuses with pre-synaptic membrane, neurotransmitter releases into synaptic cleft.
(b) Depolarization of pre-synaptic membrane.
(C) Arrival of action potential at axon terminal.
(D) Opening of specific ion channels allows the entry of ions, a new action potential is generated in the post-synaptic neuron.
(E) Neurotransmitter binds to the receptor on post synaptic membrane.
In which sequence to the events occur?
(a) D → E → A → B → C
(b) A → B → C → D → E
(c) C → B → A → E → D
(d) A → C → B → E → D

27. Potential difference across resting membrane is negatively charged. This is due to differential distribution of the following ions:
(a) Na^+ and K^+ ions
(b) CO^{3+} and Cl^- ions
(c) Ca^{2+} and Mg^{2+} ions
(d) Ca^{4+} and Cl^- ions

28. Read the following statements and select the correct options

(i) ANS - Divided into sympathetic and parasympathetic nervous system.
(ii) ANS - Conduct impulses from CNS to Skeletal muscles.
(iii) SNS - involuntary control of body movements via Smooth
(a) Only (ii) is correct
(b) Only (i) is incorrect
(c) (ii) and (iii) are incorrect
(d) All are correct

29. Amygdala and hippocampus are components of:
(a) Fore brain
(b) Midbrain
(c) Medulla oblongata
(d) Limbic system

30. Pre synaptic membrane is a part of
(a) Dendrites
(b) Synaptic knob
(c) Axon hillock
(d) Cyton

31. Non-myelinated nerve fibres are enveloped by
(a) Ranvier cells
(b) Muscle cells
(c) Schwann cells
(d) None of these

32. Cerebral cortex is referred to as gray matter due to -
(a) Fibres of tract covered by myelin sheath
(b) Presence of Nissl's bodies collection
(c) Due to presence of association area
(d) Due to (a) and (b) both

33. Select the incorrect statement for synapse
(a) Synapse are of two types electric and chemical
(b) Synapse is formed by two membranes first presynaptic membrane of synaptic knob and second post synaptic membrane of dendrites.
(c) Synaptic membranes are always separated by a gap called synaptic cleft.
(d) Transmission of impulse in electric synapse is similar to transmission of impulse in a axon

34. Cerebral medulla is consist of
(a) Cell bodies
(b) Unmyelinated neurons
(c) Myelinated neurons
(d) None of these

35. Basic functions of neural system is/are
(a) Receiving sensory input from internal and external environment by nerves
(b) Processing the input information
(c) Responding to stimuli
(d) All of the above

36. Along with hypothalamus, limbic system regulates (find out the most appropriate one):
A – Regulation of sexual behaviour
B – Expression of emotions
C – Olfaction and autonomic responses
D – Integration of visual, tactile and auditory inputs
E – Regulation of motivation
(a) C only (b) D only
(c) A and D (d) A, B and E

37. Sub arachnoid space is present between
(a) Arachnoid and Duramater
(b) Duramater and pia mater
(c) Arachnoid and pia mater
(d) None of these

38. Which of the following are parts of the hindbrain?
(1) Cerebral aqueduct
(2) Medulla oblongata
(3) Cerebellum
(4) Pons
(5) Corpora quadrigemina
Choose the correct answer from the options given below:
(a) (1), (2) and (4) only
(b) (2), (3) and (4) only
(c) (2), (4) and (5) only
(d) (3), (4) and (5) only

39. Which of the following is not a part of our brain?
(a) Cerebral aqueduct
(b) Isthmus
(c) Olfactory lobe
(d) Corpora quadrigemina

40. Multipolar neurons are present in
(a) Cerebral cortex
(b) Retina of eye
(c) Embryonic stage
(d) Both (a) and (b)

Exercise-03 Level -03

Assertion & Reason Based Questions

1. **Assertion:** In our body the neural system and the endocrine system jointly coordinate and integrate all the activities of the organs so that they function in a synchronised fashion
Reason: The neural system provides an organised network of point-to-point connections for slow coordination.
(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

2. **Assertion:** Neurons are excitable cells.
Reason: Their membranes are in a Depolarized state
(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

3. **Assertion:** The neural system of all animals is composed of highly specialised cells called neurons which can detect, receive and transmit different kinds of stimuli.
Reason: The neural organisation is very simple in lower invertebrates. For example, in Hydra it is composed of a network of neurons.
(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

4. **Assertion:** Nervous system of Human is divided into CNS and PNS
Reason: The CNS includes the brain and the spinal cord and is the site of information processing and control.
(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

5. **Assertion:** The hypothalamus contains a number of centre which control body temperature, urge for eating and drinking (Hunger and thirst).
Reason: It also contains several group of neurosecretory cells, which secrete hormone called hypothalamic hormone
(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

6. **Assertion:** A neuron is a microscopic structure composed of two major parts
Reason: The Axon contains cytoplasm with typical cell organelles and certain granular bodies called Nissl's granules
(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

7. **Assertion:** The gaps between two adjacent myelin sheaths are called nodes of Ranvier
Reason: Myelinated nerve fibres are found in spinal and cranial nerves.
(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

8. **Assertion:** The dendrites transmit nerve impulses away from the cell body to a synapse or to a neuro-muscular junction.
Reason: Based on the number of axon and dendrites, the neurons are divided into two types.

(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

9. **Assertion:** Multipolar neurons have two more dendrites
Reason: They are found in cerebral cortex
(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

10. **Assertion:** The ion channels in axon membrane are non-selectively permeable to different ions.
Reason: Resting stage is a phase of neuron when it carry only unidirectional stimulus.
(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

11. **Assertion:** The axonal membrane is comparatively more permeable to potassium ions when it does not carry impulse.
Reason: Number of potassium leak channels are more than sodium leak channels.
(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

12. **Assertion:** The axoplasm inside the axon contains high concentration of K+ and negatively charged proteins and low concentration of Na^+.
Reason: Potassium is considered as principle cation of ECF
(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

13. **Assertion:** Transport of ions through sodium potassium pump is considered as a active process
Reason: Transport of ions through sodium potassium pump requires energy.
(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

14. **Assertion:** The brain is the central information processing organ of our body, and acts as the 'command and control system'.
Reason: The human brain is well protected by the skull
(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

15. **Assertion:** The forebrain consists of cerebrum, thalamus and hypothalamus
Reason: Cerebrum forms the major part of the human brain
(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

16. **Assertion:** the association areas are responsible for complex functions like intersensory associations, memory and communication
Reason: . Fibres of the tracts are covered with the myelin sheath, which constitute the uter part of cerebral hemisphere

(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

17. **Assertion:** The midbrain is located between the thalamus/hypothalamus of the forebrain and pons of the hindbrain.
Reason: A canal called the cerebral aqueduct passess through the midbrain
(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

18. **Assertion:** The neural system coordinates and integrates functions as well as metabolic and homeostatic activities of all the organs
Reason: A synapse is formed by the membranes of a pre-synaptic neuron and a post-synaptic neuron which may or may not be separated by a gap called synaptic cleft
(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

19. **Assertion:** Human neural system consists of three parts
Reason: The brain can be divided into two major parts
(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

20. **Assertion:** The hindbrain comprises pons, cerebellum and medulla
Reason: The cerebellum integrates information received from the semicircular canals of the ear and the auditory system
(a) If both Assertion & Reason are true & the Reason is a correct explanation of the Assertion.
(b) If both Assertion & Reason are true but Reason is not correct explanation of the Assertion
(c) If Assertion is true but the Reason is False
(d) If both Assertion & Reason are False

Statement Based Questions

21. **Statement I:** The forebrain consists of cerebrum, thalamus and hypothalamus.
Statement II: The cerebrum is longitudinally divided into two halves that are connected by the corpus callosum
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

22. **Statement I:** The human brain is well protected by the skull. Inside the skull, the brain is covered by cranial meninges
Statement II: Arachnoid is in contact with brain tissue.
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

23. **Statement I:** The new potential developed on pre-synaptic membrane may be either excitatory or inhibitory
Statement II: The released neurotransmitters bind to their specific receptors, present on the post-synaptic membrane
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

24. **Statement I:** At a chemical synapse, the membranes of the pre- and post-synaptic neurons are separated by a fluid-filled space called Synapse.
Statement II: Electrical synapses are very common in our system
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

25. **Statement I:** The electrical potential difference across the plasma membrane at the site of depolarization is called the action potential.
Statement II: When a stimulus is applied at any site on the polarised membrane, the membrane at that site becomes freely permeable to Na^+
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

26. **Statement I:** The axonal membrane is
Selectively permeable to negatively charged proteins present in the axoplasm.
Statement II: Electrical current can flow directly from one neuron into the other across some synapses.
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

27. **Statement I:** Visceral nervous system is the part of the peripheral nervous system that comprises the whole complex of nerves, fibres, ganglia, and plexuses.
Statement II: The autonomic neural system is further classified into sympathetic neural system and parasympathetic neural system
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

28. **Statement I:** The cerebrum wraps around a structure called thalamus.
Statement II: Thalamus lies at the base of the hypothalamus
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

29. **Statement I:** The ventral portion of the midbrain consists mainly of four round swellings
Statement II: Two major regions make up the brain stem
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

30. **Statement I:** A very important part of the forebrain called hypothalamus controls the body temperature, eating and drinking
Statement II: The midbrain receives and integrates visual, tactile and auditory inputs
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

31. **Statement I:** Brain stem forms the connections between the brain and spinal cord
Statement II: Neurons, the functional units of neural system are excitable cells due to a differential concentration gradient of ions across the membrane.
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

32. **Statement I:** Cerebellum has very convoluted surface in order to provide the additional space for many more neurons
Statement II: The inner parts of cerebral hemispheres and a group of associated deep structures like amygdala, hippocampus, etc., form a complex structure
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

33. **Statement I:** The cerebral cortex contains large regions that are neither clearly sensory nor motor in function
Statement II: These regions are responsible for complex functions like intersensory associations, memory and communication.
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

34. **Statement I:** Dura mater is an inner layer of cranial meninges
Statement II: Brain also controls circadian rhythms of our body.
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

35. **Statement I:** Synapse consist of pre synaptic membranae, post synaptic membrane and synaptic cleft.
Statement II: Synaptic cleft have significant role in synapse, where impulse transmission occurs

by chemicals known as neurotransmitters and these synapses are very rare in our body
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

36. **Statement I:** Schwann cells are responsible for synthesis of myelin sheath
Statement II: The cerebral hemispheres are connected by a tract of nerve fibres called corpus callosum
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

37. **Statement I:** The nerve fibres of the PNS are of two types.
Statement II: Sodium potassium pump maintains resting membrane potential.
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

38. **Statement I:** Impulse transmission in chemical synapse is slow as compared to electrical synapse
Statement II: Chemical synapses has a gape called as synaptic cleft
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

39. **Statement I:** Cerebellum is not included in brain stem
Statement II: Cerebellum is not a part of hind brain
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

40. **Statement I:** The brain is the central information processing organ of our body and acts as the 'Command and control system'.
Statement II: The midbrain receives and integrates visual, tactile and auditory inputs
(a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

Match up Based Questions

41. Match the following column – I with Column – II

Column - I		Column - II	
A.	Soma	(i)	Carry impulse towards synapse
B.	Axon	(ii)	Carry impulse towards cell body
C.	Dendrites	(iii)	Neurotransmitters
D.	Synaptic Vesicles	(iv)	Nissl's granules

(a) A – (ii), B – (i), C – (iii), D – (iv)
(b) A – (iv), B – (i), C – (ii), D – (iii)
(c) A – (ii), B – (i), C – (iv), D – (iii)
(d) A – (iii), B – (i), C – (iv), D – (ii)

42. Match the following column – I with Column – II

Column - I		Column - II	
A.	Outer layer	(i)	Arachnoid
B.	Inner layer	(ii)	Dura mater
C.	Middle layer	(iii)	Pia Mater

(a) A – (i), B – (ii), C – (iii)
(b) A – (ii), B – (i), C – (iii)
(c) A – (ii), B – (iii), C – (i)
(d) A – (iii), B – (ii), C – (i)

43. Match the following column – I with Column – II

Column - I		Column - II	
A.	Synapse	(i)	Gap between Pre & post synaptic membrane
B.	Neuromuscular Junction	(ii)	Bulb-like structure
C.	Synaptic cleft	(iii)	Formed by Pre & post synaptic membrane.
D.	Synaptic knob	(iv)	Junction between neuron & muscle

(a) A – (i), B – (ii), C – (iii), D – (iv)
(b) A – (ii), B – (i), C – (iii), D – (iv)
(c) A – (iii), B – (iv), C – (i), D – (ii)
(d) A – (iii), B – (iv), C – (ii), D – (i)

44. Match the following column – I with Column – II

Column - I		Column - II	
A.	Cerebrum	(i)	Inter connect brain regions
B.	Hypothalamus	(ii)	Major part of fore brain
C.	Pons	(iii)	Thermoregulation

(a) A – (i), B – (ii), C – (iii)

(b) A – (ii), B – (iii), C – (i)
(c) A – (ii), B – (i), C – (iii)
(d) A – (i), B – (iii), C – (ii)

45. Match the following column – I with Column – II

Column - I		Column - II	
A.	CNS	(i)	Efferent neuron
B.	PNS	(ii)	Relay impulse CNS to skeletal
C.	SNS	(iii)	Relay impulse CNS to smooth muscle
D.	ANS	(iv)	Spinal cord

(a) A – (iv), B – (i), C – (ii), D – (iii)
(b) A – (iv), B – (i), C – (iii), D – (ii)
(c) A – (iv), B – (iii), C – (i), D – (ii)
(d) A – (iv), B – (ii), C – (i), D – (iii)

46. Match the following column – I with Column – II

Column - I		Column - II	
A.	Corpus Callosum	(i)	White matter
B.	Cerebrum	(ii)	Gray matter
C.	Cerebral cortex	(iii)	Cerebral hemisphere
D.	Inner part of cerebral hemisphere	(iv)	Tract of Nerve fibre

(a) A – (iv), B – (iii), C – (i), D – (ii)
(b) A – (iv), B – (i), C – (iii), D – (ii)
(c) A – (iv), B – (iii), C – (ii), D – (i)
(d) A – (iv), B – (ii), C – (iii), D – (i)

47. Match the following column – I with Column – II

Column - I		Column - II	
A.	Multipolar	(i)	Retina of eye
B.	Unipolar	(ii)	Embryonic stage
C.	Bipolar	(iii)	Cerebral cortex

(a) A – (iii), B – (ii), C – (i)
(b) A – (i), B – (ii), C – (iii)
(c) A – (ii), B – (i), C – (iii)
(d) A – (ii), B – (iii), C – (i)

48. Match the following column – I with Column – II

Column - I		Column - II	
A.	Fore brain	(i)	Corpora quadrigemina
B.	Brain stem	(ii)	Mid Brain, and Hind brain except cerebellum
C.	Mid brain	(iii)	Balance body
D.	Cerebellum	(iv)	Cerebrum

(a) A – (iii), B – (ii), C – (i), D – (iv)
(b) A – (iii), B – (ii), C – (iv), D – (i)
(c) A – (ii), B – (iii), C – (iv), D – (i)
(d) A – (iv), B – (ii), C – (i), D – (iii)

49. Match the following column – I with Column – II

Column - I		Column - II	
A.	Hippocampus	(i)	Hypothalamus
B.	Corpora quadrigemina	(ii)	Mid brain
C.	Olfactory bulb	(iii)	Olfaction
D.	Urge for eating	(iv)	Limbic system

(a) A – (i), B – (iii), C – (iv), D – (ii)
(b) A – (iv), B – (ii), C – (iii), D – (i)
(c) A – (iv), B – (iii), C – (ii), D – (i)
(d) A – (iii), B – (ii), C – (i), D – (iv)

50. Match the column I with column II and choose the correct option.

Column - I		Column - II	
A.	Afferent fibres	1.	Relays impulses from the CNS to skeletal muscles
B.	Efferent fibres	2.	Transmits impulses from the CNS to smooth muscles
C.	Somatic neural system	3.	Transmit impulses from tissues/organs to the CNS
D.	Autonomic neural system	4.	Transmit regulatory impulses from the CNS to tissues/organs

(a) A-2, B-1, C-4, D-3
(b) A-1, B-2, C-3, D-4
(c) A-4, B-3, C-2, D-1
(d) A-3, B-4, C-1, D-2

Exercise-04 Previous Year Questions

1. Match List I with List II : **(2024)**

List - I		List -II	
A.	Pons	I.	Provides additional space for Neurons, regulates posture and balance.
B.	Hypothalamus	II.	Controls respiration and gastric secretions.
C.	Medulla	III.	Connect different regions of the brain
D.	Cerebellum	IV.	Neuro secretory cells

(a) A-III, B-IV, C-II, D-I
(b) A-I, B-III, C-II, D-IV
(c) A-II, B-I, C-III, D-IV
(d) A-II, B-III, C-I, D-IV

2. Given below are two statements :-

Statement I : The cerebral hemisphere are connected by nerve tract known as corpus callosum

Statement II : The brain stem consists of the medulla oblongata, pons and cerebrum. In the light of the above statements, choose the most appropriate answer from the options given below :-

(a) Both statement I and statement II are incorrect
(b) Statement I is correct but statement II is incorrect
(c) Statement I is incorrect but statement II is correct
(d) Both statement I and statement II are correct

3. Match List-I with List-II with respect to human eye. **(2022)**

List-I		List-II	
A.	Multipolar neuron	(i)	Somatic neural system
B.	Bipolar neuron	(ii)	Cerebral cortex
C.	Myelinated nerve fibre	(iii)	Retina of Eye
D.	Unmyelinated nerve fibre	(iv)	Spinal nerves

Choose the correct answer from the options given below:

(a) A-(ii), B-(iii), C-(iv), D-(i)
(b) A-(iii), B-(i), C-(iv), D-(ii)
(c) A-(ii), B-(iv), C-(iii), D-(i)
(d) A-(ii), B-(iii), C-(i), D-(iv)

4. Select the incorrect statement regarding synapses : **(2022)**

(a) The membranes of presynaptic and postsynaptic neurons are in close proximity in an electrical synapse
(b) Electrical current can flow directly from one neuron into the other across the electrical synapse
(c) Chemical synapse use neurotransmitters
(d) Impulse transmission across a chemical synapse is always faster than that across an electrical synapse

Answer keys

TOPIC CENTRIC EXERCISE-1 : Answer Key

1. (a)	**2.** (b)	**3.** (d)	**4.** (c)	**5.** (b)

TOPIC CENTRIC EXERCISE-2 : Answer Key

1. (a)	**2.** (a)	**3.** (b)	**4.** (b)	**5.** (c)

TOPIC CENTRIC EXERCISE-3 : Answer Key

1. (d)	**2.** (d)	**3.** (d)	**4.** (d)	**5.** (a)

Exercise-01 Level -01 Answer Key

1. (c)	**6.** (d)	**11.** (d)	**16.** (b)	**21.** (c)	**26.** (c)	**31.** (d)	**36.** (a)	**41.** (a)	**46.** (b)
2. (d)	**7.** (d)	**12.** (a)	**17.** (b)	**22.** (b)	**27.** (d)	**32.** (a)	**37.** (a)	**42.** (a)	**47.** (c)
3. (c)	**8.** (b)	**13.** (c)	**18.** (d)	**23.** (b)	**28.** (a)	**33.** (b)	**38.** (a)	**43.** (b)	**48.** (b)
4. (a)	**9.** (c)	**14.** (a)	**19.** (b)	**24.** (d)	**29.** (b)	**34.** (c)	**39.** (a)	**44.** (a)	**49.** (b)
5. (d)	**10.**(d)	**15.** (a)	**20.** (d)	**25.** (b)	**30.** (b)	**35.** (a)	**40.** (c)	**45.** (b)	**50.** (d)

Exercise-02 Level -02 Answer Key

1. (c)	**6.** (d)	**11.** (c)	**16.** (d)	**21.** (b)	**26.** (c)	**31.** (c)	**36.** (d)
2. (c)	**7.** (c)	**12.** (c)	**17.** (b)	**22.** (c)	**27.** (a)	**32.** (b)	**37.** (c)
3. (d)	**8.** (c)	**13.** (a)	**18.** (d)	**23.** (d)	**28.** (c)	**33.** (c)	**38.** (b)
4. (c)	**9.** (c)	**14.** (c)	**19.** (b)	**24.** (d)	**29.** (d)	**34.** (c)	**39.** (b)
5. (d)	**10.**(c)	**15.** (a)	**20.** (d)	**25.** (b)	**30.** (b)	**35.** (d)	**40.** (a)

Exercise-03 Level -03 Answer Key

1. (c)	**6.** (d)	**11.** (a)	**16.** (c)	**21.** (a)	**26.** (c)	**31.** (a)	**36.** (a)	**41.** (b)	**46.** (c)
2. (c)	**7.** (b)	**12.** (c)	**17.** (b)	**22.** (b)	**27.** (a)	**32.** (a)	**37.** (a)	**42.** (c)	**47.** (a)
3. (b)	**8.** (d)	**13.** (a)	**18.** (b)	**23.** (c)	**28.** (b)	**33.** (a)	**38.** (a)	**43.** (c)	**48.** (d)
4. (b)	**9.** (b)	**14.** (b)	**19.** (d)	**24.** (d)	**29.** (d)	**34.** (c)	**39.** (d)	**44.** (b)	**49.** (b)
5. (b)	**10.**(d)	**15.** (b)	**20.** (b)	**25.** (a)	**30.** (a)	**35.** (b)	**40.** (a)	**45.** (a)	**50.** (d)

Exercise-04 Previous Year Questions

1. (a)	**2.** (b)	**3.** (a)	**4.** (d)