

**EXAM
DRILL**

Neural Control and Coordination

ANSWERS

1. (c) : The dorsal root ganglion contains cell bodies of sensory neurons. These are the pseudounipolar neurons. A pseudounipolar neuron has one extension from its cell body (soma) which divides into an axon and dendrite.

2. (b) : Human brain and spinal cord are surrounded by three protective coats of connective tissue called meninges (singular meninx). The thin, highly vascular innermost membrane is called pia mater. It is directly adherent to the surface of brain and spinal cord. The next is arachnoid mater (spider-webby structure) and third and outermost, membrane, the dura mater is tough fibrous membrane adhering closely to the inside of skull.

OR

(c)

3. (d) : Thalamus is a large ovoid mass of grey matter, situated bilaterally in diencephalon. It is the central translator of the brain which acts as major coordinating centre for sensory and motor signalling. It has been thought of as a 'relay' that simply forwards signals to the cerebral cortex, hence, also called relay centre or 'gatekeeper of brain'.

4. (a) : The preganglionic fibres of parasympathetic neural system run along with four cranial nerves : The oculomotor (III cranial nerve), facial (VII cranial nerve), glossopharyngeal (IX cranial nerve) and vagus (X cranial nerves).

5. (d) : During depolarisation phase, the gated sodium ion channels on the neuron's membrane suddenly open and allow sodium ions present outside the membrane to rush into the cell.

6. Axon hillock is the part of cyton from where the axon arises. It is the most sensitive part of the neuron.

7. Cerebellum, Pons varolii and Medulla oblongata.

8. Trochlear and Abducens cranial nerves.

9. (b)

10. (c) : Nissl's granules are irregular masses of rough endoplasmic reticulum with numerous attached and free ribosomes and polysomes.

11. (d) : Inner butterfly shaped area of spinal cord is the grey matter.

12. (i) A is the corpus callosum, a large bundle of myelinated fibres connecting left and right cerebral hemispheres. Anteriorly it is folded back to form genu and posteriorly curves ventrally to form splenium.

(ii) B is pons varolii. It relays impulses between medulla oblongata and superior part of brain. The pneumotaxic centres present in pons limit inspiration.

(iii) C is cerebellum. It is the second largest part of human brain. It has two cerebellar hemispheres and central worm shaped part vermis. It contains flask shaped Purkinje cells. Cerebellum controls muscular activities such as running, typing, talking, etc.

(iv) (c) : Cerebellum controls rapid muscular activities, such as running, typing and even talking.

(v) (d) : E is medulla oblongata. It extends from pons varolii above and is continuous with spinal cord below. It receives and integrates signals from spinal cord and sends resulting signals to cerebellum and thalamus.

13. Certain components of the cerebrum and diencephalon constitute the limbic system. It deals with emotions and memory, by activating the fight, fear and flight response. It controls emotional behaviours such as fear, sorrow, joy, liking and disliking.

14. Forebrain consists of three regions:

(i) Olfactory lobes : These are a pair of very small, solid, club-shaped bodies which are widely separated from each other. They are fully covered by cerebral hemisphere.

(ii) Cerebrum : It is the largest and most complex of all the parts of human brain. It consists of left and right hemispheres, connected by corpus callosum, a large bundle of myelinated fibres.

(iii) Diencephalon : It encloses a slit-like cavity, the third ventricle, the thin roof of this cavity is called epithalamus that forms anterior choroid plexus. The thick right and left sides of this cavity are called the thalami and floor as the hypothalamus. The latter is called thermostat of the body as it keeps body temperature at roughly 37°C by means of a complex thermostat system.

OR

Differences between axon and dendron are as follows :

S.No.	Characteristics	Axon	Dendron
(i)	Structure	Formed of neuroplasm with only neurofibrils but no Nissl's granules.	Formed of neuroplasm with both neurofibrils and Nissl's granules.
(ii)	Direction of nerve impulse conduction	Always away from the cell body (soma).	Always towards the cell body.

15. Afferent nerve fibres are sensory in nature and conduct impulses from receptors to central neural system, while the efferent nerve fibres are motor in nature and conduct impulses from CNS to effectors.

- 16.** (i) Glossopharyngeal nerve
(ii) Corpus callosum
(iii) Purkinje cells
(iv) Arbor vitae

17. Visceral neural system is the part of peripheral neural system that comprises the whole complex of nerve fibres, ganglia and plexus by which impulses travel from central neural system to the viscera and from viscera to the CNS.

18. Two sub-divisions of peripheral nervous system are :

(i) Somatic neural system : This includes nerves supplying the skeletal muscles. Thus, it controls the movements of body by acting on the skeletal muscles.

(ii) Autonomic neural system : It controls and coordinates such organs which are under involuntary control. It is further classified into sympathetic and parasympathetic neural system.

19. (i) Superior colliculi are concerned with sense of sight and inferior colliculi are concerned with hearing.

(ii) Crura cerebri relay impulses back and forth between the cerebrum, cerebellum, pons and medulla.

20. (i) Lateral ventricles (paracoel) inside each hemisphere of the cerebrum.

(ii) Third ventricle (diocoel) lies in diencephalon.

(iii) Fourth ventricle (metacoel) lies in medulla oblongata.

21. Coordination is the process through which two or more organs interact and complement the functions of one another. The neural system gives an organised network of point-to-point connections for a quick coordination. It is necessary to maintain homeostasis. For example; when we do physical exercises, the energy demand is increased for maintaining an increased muscular activity. The supply of oxygen is also increased. The increased supply of oxygen necessitates an increase in the rate of respiration, heart beat and increased blood flow *via* blood vessels. When physical exercise is

stopped, the activities of nerves, lungs, heart and kidney gradually return to their normal conditions.

22. (i) Trigeminal nerve is the 5th cranial nerve. It is the largest cranial nerve which arises from the ventral surface of the pons varolii. It has three branches :

(a) Ophthalmic nerve is a sensory nerve and innervates lacrimal glands, conjunctiva and eyelids.

(b) Maxillary nerve is a sensory nerve that innervates cheeks, upper gums, upper teeth.

(c) Mandibular nerve is a mixed branch that supplies impulses to lower jaw, pinna, lower lip and tongue.

(ii) Certain components of cerebrum and diencephalon constitute the limbic system. It is sometimes called 'emotional brain'. Its main components are hippocampus, amygdala, septal nuclei, basal ganglia and mamillary bodies. Alongwith hypothalamus, it controls sexual behaviour, normal emotions expressed in the form of joy, fear, fight, liking and disliking.

23. Differences between cranial nerve and spinal nerves are as follows :

S.No.	Cranial nerves	Spinal nerves
(i)	There are 12 pairs of cranial nerve in human beings.	31 pairs of spinal nerves are present.
(ii)	They come out of brain.	They come out of spinal cord.
(iii)	Cranial nerves are sensory, motor or mixed in nature.	Spinal nerves are mixed in nature.

OR

The name, function and distribution of cranial nerves are given below :

Cranial nerve	Name	Function	Distribution
III	Oculomotor	Movement of eyeball	Eyeball muscles, ciliary muscles, tear glands
VI	Abducens	Eyeball movement	Eyeball muscle
VIII	Auditory	Hearing and body equilibrium	Internal ear
XI	Spinal accessory	Muscle movements, visceral reflexes	Neck and shoulder muscles, thoracic and abdominal viscera
XII	Hypoglossal	Tongue movements	Tongue muscles and hyoid apparatus

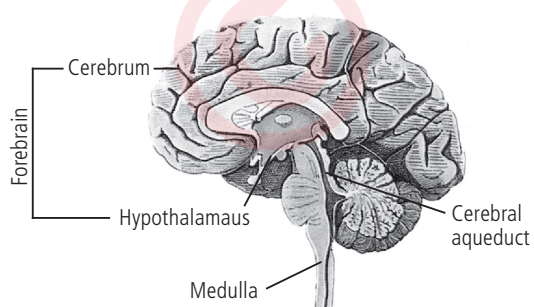
24. A resting nerve fibre (*i.e.*, nerve fibre not conducting an impulse) shows a potential difference between the inside and outside of the axonal membrane. Outside the axonal membrane is the extracellular fluid which is positively charged with respect to the cell contents inside the axonal membrane. This difference in electrical charge across the axonal membrane is known as resting potential. A membrane with the resting potential is said to be electrically polarised and is about -70 millivolt. This means that the inside of the neuron is 70 mV less than the outside.

25. The human neural system mainly consists of two sub-systems : The central neural system (CNS) and the peripheral neural system (PNS). The CNS consists of brain and spinal cord while the PNS comprises of the nerves arising from the brain and spinal cord.

The PNS is further divided into two parts namely; somatic neural system (SNS) that is under voluntary control of brain and consists of the nerves supplying the skeletal muscles, whereas the autonomic neural system (ANS) controls and operates those body organs which are under involuntary control. The ANS again consists of two neural systems; sympathetic and parasympathetic. Both of these systems act antagonistic (opposing) to the somatic neural system and has mainly calming influences. The sympathetic neural system prepares the body for the "fight or flight" response during any potential danger. On the other hand, the parasympathetic neural system inhibits the body from overworking and restores the body to a calm state.

OR

Sagittal section of human brain is shown as follows :



Functions :

- (i) **Cerebrum** : It perceives the sensory impulses coming from the sense organs and also issues motor impulses to striated muscles for voluntary movements. It is a seat of intelligence, will, memory, learning, thinking and emotions.
- (ii) **Hypothalamus** : It maintains homeostasis, controls urge for eating and drinking. It also provides anatomical connections between neural and endocrine systems.

(iii) **Cerebral aqueduct** : It is also called iter. It is a very narrow cavity that extends through the midbrain. It connects the third and fourth ventricles of brain.

(iv) **Medulla** : It receives and integrates signals from spinal cord and sends signal to the cerebellum and thalamus. It contains centres that regulate blood pressure, heart rate, breathing, swallowing, sneezing, etc.

26. (i) Differences between cerebrum and cerebellum are as follows:

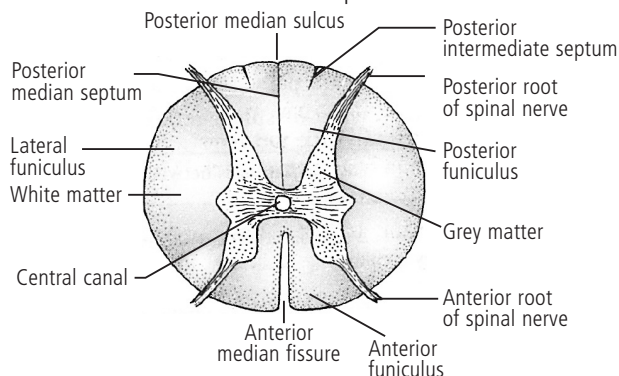
S.No.	Cerebrum	Cerebellum
(i)	It is a part of the forebrain.	It is a part of the hindbrain.
(ii)	It is the largest part of the brain, forming four-fifth of its weight.	It is the second largest part of the brain, forming one-eighth of its mass.
(iii)	Arbor vitae is absent.	White matter forms arbor vitae.
(iv)	It consists of two cerebral hemispheres each comprising four lobes <i>i.e.</i> , frontal, parietal, temporal and occipital.	It consists of two cerebellar hemispheres and a median vermis.
(v)	It initiates voluntary movements and is a seat of will, intelligence, memory, etc.	It maintains posture and equilibrium.

(ii) Differences between grey matter and white matter are as follows:

S.No.	Grey matter	White matter
(i)	Greyish in colour	White in colour due to presence of fatty myelin sheath.
(ii)	Comprises of cell bodies, dendrites and synapses of neurons.	Consists of nerve fibres (axons) arising from or to the nerve cells in grey matter.
(iii)	Grey matter is situated on the surface, while white matter is located deeper.	In the spinal cord, white matter forms the outer layer and grey matter is located deep into the core.

OR

The transverse section of human spinal cord is shown below :



27. (i) Midbrain : (a) Corpora quadrigemina : The upper or superior surface of the midbrain has two pairs of protrusions collectively called the corpora quadrigemina; one pair is called superior colliculi and the other pair is called inferior colliculi. The superior and inferior colliculi of each side are termed the corpora bigemina.

Functions : The superior colliculi are concerned with the sense of sight. However, the inferior colliculi are concerned with hearing.

(b) Cerebral peduncles (Crura cerebri) : These are two bundles of fibres which lie on the lower or inferior surface of the midbrain.

Function : They relay impulses back and forth between the cerebrum, cerebellum, pons and medulla.

(ii) The cerebrospinal fluid is secreted by anterior choroid plexus and posterior choroid plexus and is found inside the ventricles of the brain, the central canal of the spinal cord and in the subarachnoid space around the brain and spinal cord.

The cerebrospinal fluid performs the following functions :

(a) Protection of the brain and spinal cord : CSF protects the delicate brain and spinal cord by providing shock-absorbing medium. It acts as cushion jolts to the central nervous system.

(b) Buoyancy to the brain : Since the brain is immersed in the CSF, the net weight of the brain is reduced from about 1.4 kg to about 0.18 kg. Thus, the pressure at the base is reduced.

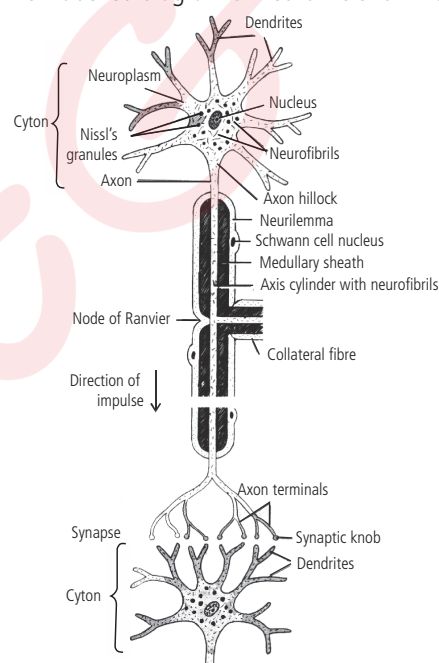
(c) Excretion : CSF carries harmful metabolic wastes, drugs and other substances from the brain to the blood.

(d) Endocrine medium for the brain : Certain hormones are released into CSF. These hormones are carried to different parts of the brain by CSF where they may act.

(iii) Nissl's bodies (also called Nissl's granules) are small basophilic granules and are named after its discoverer. These are the irregular masses of rough endoplasmic reticulum with numerous attached and free ribosomes and polysomes, so, these bodies are concerned with synthesis of proteins in the neurons.

OR

(a) The well labelled diagram of neuron is shown below:



(b) There are two types of axon namely myelinated and non-myelinated. In myelinated nerve fibres, Schwann cells form myelin sheath around the axon. The gaps between two adjacent myelin sheaths are called nodes of Ranvier. Myelinated nerve fibres are found in cranial and spinal nerves. In non-myelinated nerve fibres, Schwann cells do not form myelin sheath and are without nodes of Ranvier. They are commonly found in autonomous and somatic neural systems.

