CHAPTER > 21

Neural Control and Coordination

NEET KEY NOTES

- **Neural/Nervous** system provides an organised network of point to point connections for quick neural coordination and fastest means of communication between organs.
- **Coordination** is the process through which two or more organs interact and complement the functions of one another.
- The neural system is composed of highly specialised cells called **neurons**. These are the basic structural and functional unit of neural system that can detect, receive and transmit different kinds of stimuli.

Human Neural System

It is derived from embryonic ectoderm and is composed of

1. **Central Neural System** (CNS) includes brain and spinal cord and is the site of information processing and control.
2. **Peripheral Neural System** (PNS) comprises of all the nerves of the body associated with the CNS (brain and spinal cord). The nerve fibres of PNS are of two types
   - **Afferent fibres** transmit impulses from tissues to CNS.
   - **Efferent fibres** transmit impulses from CNS to tissues.
   - The two divisions of PNS are
     - **Somatic neural system** relays impulses from CNS to skeletal muscles.
     - **Autonomic neural system** transmits impulse from CNS to involuntary organs and smooth muscles. It is further classified as **sympathetic** and **parasympathetic nervous system**.
   - **Visceral nervous system** is a part of PNS that comprises whole complex of fibres, nerves, ganglia and plexuses through which impulses from CNS are transmitted to and from viscera.

Neurons and Nerves

A neuron is a microscopic structure composed of three major parts, i.e. cell body, dendrites and axons.

- **Cell body or Cyton or Soma** It possesses certain granular bodies called **Nissl's granules** in their cytoplasm along with other cell organelles.
- **Dendrites** are short, branched projections of the cell body, also containing Nissl's granules. These transmit impulse towards the cell body.
- **Axon** is a long fibre, with branched distal end. It terminates into a bulb-like structure called **synaptic knob** containing neurotransmitters. It functions to transmits impulse away from the cell body.
- On the basis of number of dendrites and axons, neurons are of following types
  - **Multipolar** One axon, two or more dendrites, found in cerebral cortex.
  - **Bipolar** One dendrite and one axon, found in retina of eye.
  - **Unipolar** Only one axon, found in embryonic stages.
- Axons are mainly of two types, i.e. **myelinated** (found in spinal and cranial nerves) and **non-myelinated** (found in autonomous and somatic neural system) nerve fibres. **Schwann cells** form the myelin sheath around the axon.
- The gap between the two adjacent myelin sheath is known as **nodes of Ranvier**.

Generation and Conduction of Nerve Impulses

Nerve impulse can be defined as a wave of depolarisation of the nerve cell membrane travelling along a neuron and throughout the nervous system.

The nerve impulse generation occurs in the following steps

1. Resting Potential

- The axonal membrane is polarised and do not conduct impulse at this stage. There is a difference in the concentration of ions across the axonal membrane.
- Axoplasm inside the axon contain more K^+ and low Na^+ ions.
- Outside the axon, fluid contain more Na^+ and low K^+ ions.
- The ionic gradient is maintained by Na-K pump which transport $3Na^+$ outward for $2K^+$ ions into the cells.
- Thus, outer surface is positively charged, while the inner surface is negatively charged. The state of resting membrane is called **polarised state**.
- The electrical potential difference across the resting plasma membrane is called as the resting potential.

2. Action Potential

- Due to the stimulation of nerve fibre, membrane become highly permeable to Na^+, leading to rapid influx of Na^+ and thus, polarity of membrane is reversed. The membrane is said to be **depolarised**.
- Action potential or nerve impulse is the electrical potential difference across plasma membrane.
- Nerve impulse is conducted along the whole length of axon.

3. Repolarisation

- Soon, permeability of K^+ ion increases and membrane again become polarised due to the diffusion of K^+ ions outside the membrane, i.e. repolarisation.

Transmission of Nerve Impulse

- A nerve impulse flows from one neuron to another through **synapses** which is formed by the membranes of a pre-synaptic neuron and post-synaptic neuron, which may or may not be separated by a gap called **synaptic cleft**.
- There are two types of synapses present, as follows
  - **Electrical synapse** In these, the gap between pre-synaptic and post-synaptic neuron is negligble and thus, the electric current flows at faster rate from one neuron to another. These are rare in human body.
  - **Chemical synapse** In these, Pre-synaptic and post-synaptic membranes are separated by chemical filled synaptic cleft. These chemicals are called neurotransmitters which are responsible for generation of action potential. Its nerve conduction is slower as compared to electrical synapse.
- At a chemical synapse, when an impulse arrives at the axon terminal, the synaptic vesicles move towards the plasma membrane, where they fuse and release their neurotransmitters in the synaptic cleft.

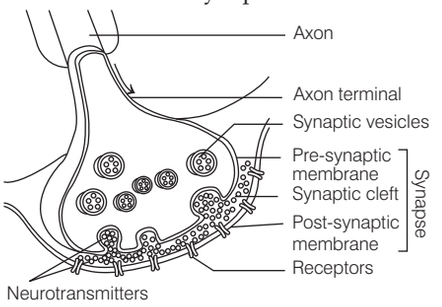


Diagram showing axon terminal and synapse

- The neurotransmitters bind to receptors an post-synaptic membrane, open ion channels and allow the entry of ions, so as to generate action potential in post-synaptic membrane. The new potential is either excitatory or inhibitory in nature.

Central Nervous System

- It controls various voluntary and involuntary movements in human body. Its parts, i.e. **brain** and the **spinal cord** are covered by three protective connective tissue sheaths, the **cranial meninges**. The inner meninge is called **piamater**, the middle **arachnoid membrane** and the outer **duramater**.
- Both brain and spinal cord are composed of two types of nervous tissue **grey matter** and **white matter**. Brain can be divided into three major parts, i.e. **forebrain** (cerebrum, thalamus and hypothalamus), **midbrain** and **hindbrain** (pons, cerebellum and medulla).

Forebrain

- It has **cerebrum** which is divided into two halves forming left and right **cerebral hemispheres**. The cerebral hemisphere are connected by a tract of nerve fibres called **corpus callosum**.

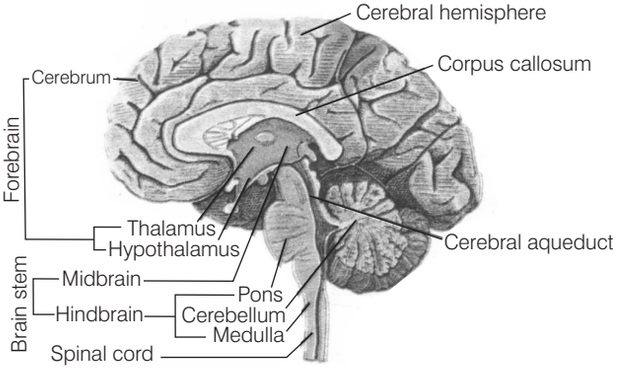


Diagram showing sagital section of the human brain

- **Cerebral cortex** is the layer of cells covering the cerebral hemispheres. It contain motor, sensory and mixed regions (**association areas**) which are neither motor nor sensory in functions.
- **Thalamus** is major coordinating centre for sensory and motor signalling.
- **Hypothalamus** is present below the thalamus and it contain neurosecretory cells which secrete hypothalamic hormones. This region control body temperature, hunger, etc.
- **Limbic system** or **limbic lobe** is a complex structure formed of inner parts of cerebral hemispheres and group of associatied deep structures like amygdala, hippocampus, etc. Limbic system along with hypothalamus regulate sexual behaviour, expression of emotional reactions (e.g. excitement, pleasure, rage and fear) and motivation.

Midbrain

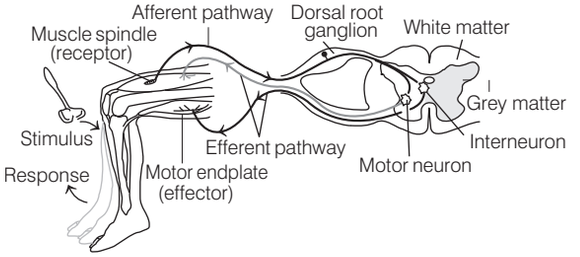
- Midbrain is located between hypothalamus of forebrain and pons of hindbrain. **Cerebral aqueduct** is a canal which passes through it. **Corpora quadrigemina** are four round swelling (lobes) at the dorsal portion of midbrain.

Hindbrain

- It comprises of the following parts
  - **Pons**, consisting of fibrous tract which interconnect different regions of brain.
  - **Cerebellum**, possessing convoluted surface, so as to accommodate maximum number of neurons.
  - **Medulla oblongata**, which is connected to spinal cord, control respiration, cardiovascular reflexes and gastric secretions.
- **Brain stem** forms the connection between brain and spinal cord. It is formed of midbrain, pons and medulla.

Reflex Action and Reflex Arc

- **Reflex action** is the involuntary functioning or movement of any organ or part of the body in response to peripheral nervous stimulation. The reflex pathway consists of at least one afferent neuron (receptor) and one efferent neuron (effector).
- The nervous pathway taken by nerve impulses in a reflex action is called **reflex arc**, e.g knee-jerk reflex given below



Diagrammatic presentation of reflex action (showing knee-jerk reflex)

Sensory Organs

Various sensory organs in human body are as follows

1. Nose

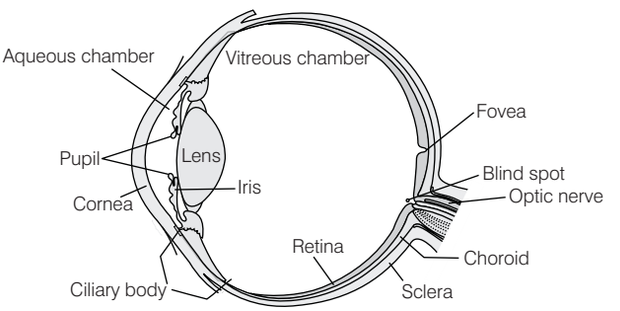
- It contain mucus coated **olfactory receptors** which are specialised for receiving the sense of smell.
- These receptors are made up of olfactory epithelium containing three types of cells, i.e. receptor cells, supporting cells and basal cells.
- Olfactory neurons extend from outside environment to **olfactory bulb** which is turn in an extension of limbic system.

2. Tongue

Like nose, it can detect dissolved chemicals **Gustatory receptors** are found in **taste buds** which can detect different taste.

3. Eyes

- These are located in the sockets of the skull called **orbits**.
- The three layers of eyeball are
  - **Sclera** external layer of dense connective tisssue.
  - **Cornea** is the anterior portion of this layer.
  - **Choroid** middle layer, containing blood.
- **Ciliary body** is the anterior thick portion of choroid and it continues forward as pigmented opaque structure, **iris** (visible coloured portion of eye).
- **Lens** is a transparent crystalline structure which is held in place by ligaments attached to ciliary body.
- **Pupil** is an aperture surrounded by iris in front of lens.



Structure of mammalian eye

- **Retina** is the inner layer of eye. It contain three layers of neural cell namely ganglion cells, bipolar cells and photoreceptor cells. It consists photoreceptor cells, i.e. rods and cones.
  - **Rods** Contain rhodopsin or visual purple protein containing a derivative of vitamin-A. It provide twilight (scotopic) vision.

- **Cones** Respond to red, green and blue light. It provide daylight (photopic) and colour vision. Sensation of white light is produced when all cones are stimulated equally.

- **Blind spot** Optic nerves leave and retinal blood vessel enter the eyeball through this region. It do not contain photoreceptor cells.
- **Macula lutea** Found at the posterior pole of eyes lateral to the blind spot. This yellowish pigmented spot contain a central pit, **fovea**. The latter contains densely packed cones only and is the point of greatest visual acuity (resolution).
- **Aqueous chamber** is the fluid-filled space between lens and cornea, while **vitreous chamber** is present between lens and retina .

Mechanism of Vision

Light rays from outside → Focus on retina → Light induces dissociation of retinal pigment, opsin → Structure of opsin changes → Potential difference is generated in photoreceptor cells. → Action potential is generated in ganglionic cells through bipolar neurons. → Action potential is transmitted to visual cortex in occipital lobe by optic nerve. → Neural impulses are analysed → Image is recognised

4. Ear

It performs very important function of hearing and maintenance of the body. Ear is divided into three major sections, which are as follows

I. External Ear

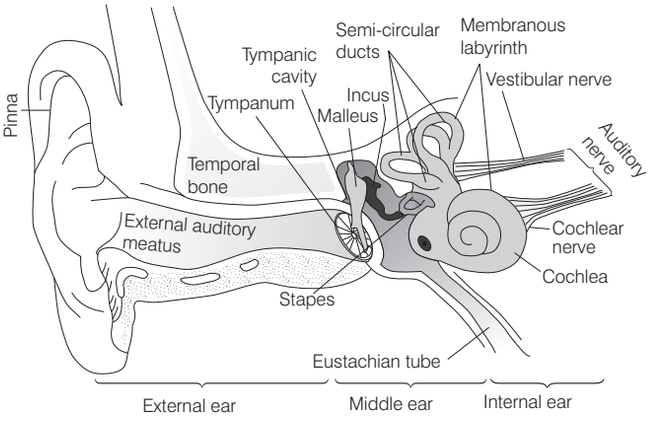
It consists of the **pinna** and **external auditory meatus** (canal). The pinna collects the sound waves and channel them inwards through the external auditory meatus leading up to the **tympanic membrane** (the eardrum).

II. Middle Ear

- It contains tympanic cavity, which communicates with the pharynx by a passage called **eustachian tube**.
- It contains three ossicles called **malleus**, **incus** and **stapes**, which are attached like a chain and increase the efficiency of transmission of sound waves to the inner ear.

III. Inner Ear

- It also called **labyrinth** which consists of two parts the bony and membranous labyrinths.
- The space between the membranous and bony labyrinth is filled by a watery fluid, perilymph and membranous labyrinth is filled with endolymph.
- The membranous labyrinth is divided into **cochlea** (main hearing organ) and **vestibular apparatus**.



Diagrammatic view of ear

- The membranes constitute cochlea, the Reissner's and basilar membrane. The **organ of Corti** is a sensory ridge located on the basilar membrane, which contains hair cells, which act as auditory receptors. Above the rows of the hair cells is a thin elastic membrane called **tectorial membrane**.
- Vestibular apparatus, composed of three **semicircular canals** and the **otolith organ**, consists of the saccule and utricle.
- Vestibular apparatus has no role in hearing, but is influenced by gravity and movements.
- The base of canals is swollen and is called **ampulla** with a projecting ridge called **crista ampularis**.
- The saccule and utricle contains a projecting ridge called **macula**.
- The **crista** and **macula** are the specific receptors of the vestibular apparatus, which are responsible for the maintenance of balance of body and posture.

Mechanism of Hearing

Sound waves → External ear → Ear drum vibrates → Vibrations transmitted to ear ossicles and then to oval window → The fluid of cochlea generate waves in the lymph. → Basilar membrane ripples → Bending of hair cells, press against tectorial membrane → Nerve impulse generated in afferent neurons → Impulse transferred to auditory cortex of brain → Sound is recognised

Mastering NCERT

MULTIPLE CHOICE QUESTIONS

TOPIC 1 ~ *Human Neural System*

1 The functions of the organs/organ systems in our body must be coordinated to maintain
(a) muscular activity (b) homeostasis
(c) respiration (d) neural coordination

2 The process through which two or more organs interact and complement the functions of one another, is called
(a) coordination (b) homeostasis
(c) chemical integration (d) transmission of impulse

3 Which pair of systems jointly coordinate and integrate all the activities of organs, so that they function in a synchronised fashion?
(a) Neural and respiratory
(b) Neural and digestive system
(c) Neural and endocrine system
(d) Neural and circulatory system

4 The system, responsible for providing an organised network of point to point connections for a quick coordination, is called
(a) endocrine system (b) circulatory system
(c) digestive system (d) neural system

5 Identify the basic functions of neural system.
(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

6 The neural system is composed of highly specialised cells called neurons that can
(a) detect stimuli (b) receive stimuli
(c) transmit stimuli (d) All of these

7 In *Hydra*, neural organisation comprises
(a) network of neurons
(b) CNS and PNS
(c) brain and neural tissue
(d) ganglia

8 The humans, neural system comprises
(a) Only PNS
(b) Only CNS
(c) Both (a) and (b)
(d) None of the above

9 Which of the following is known as the site of information processing and control?
(a) Brain and spinal cord
(b) Somatic neural system and autonomic neural system
(c) CNS and PNS
(d) Neurons

10 The two types of nerve fibres of PNS found associated with brain and spinal cord are
(a) efferent fibres; mixed fibres
(b) sensory fibres; mixed fibres
(c) afferent fibres; efferent fibres
(d) afferent fibres; mixed fibres

11 The afferent nerve fibres transmit impulses
(a) from tissues/organs to the CNS
(b) from the CNS to the concerned peripheral tissues/organs
(c) from the CNS to skeletal muscles
(d) from one tissues to another

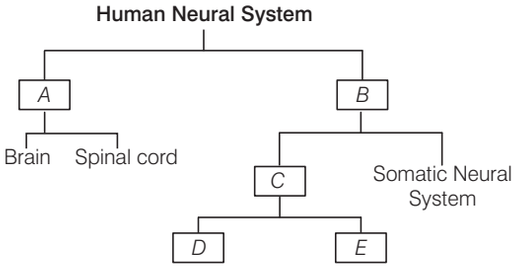
12 The efferent nerve fibres transmit impulses
(a) from tissues/organs to the CNS
(b) from the CNS to the smooth muscles
(c) from the CNS to the concerned peripheral tissues/organs
(d) from the CNS to the involuntary organs

13 The PNS includes
(a) central neural system and sympathetic neural system
(b) somatic neural system and autonomic neural system
(c) sympathetic neural system
(d) somatic neural system

14 The system that transmits impulse from the CNS to skeletal muscles is
(a) sympathetic neural system
(b) parasympathetic neural system
(c) somatic neural system
(d) autonomic neural system

15 The system that transmits impulse from the CNS to the involuntary organs and smooth muscles of the body
(a) sympathetic neural system
(b) parasympathetic neural system
(c) somatic neural system
(d) autonomic neural system

16 The diagram given below is the functional organisation of the human nervous system. Identify *A, B, C, D* and *E* in the figure.



(a) A–PNS, B–CNS, C–ANS, D–Sympathetic nervous system, E–Parasympathetic nervous system
(b) A–ANS, B–CNS, C–PNS, D–Sympathetic nervous system, E–Parasympathetic nervous system
(c) A–CNS, B–PNS, C–ANS, D–Sympathetic nervous system, E–Parasympathetic nervous system
(d) A–ANS, B–PNS, C–CNS, D–Sympathetic nervous system, E–Parasympathetic nervous system

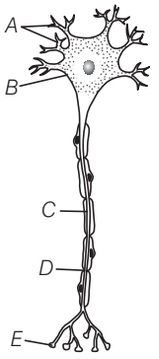
17 How do parasympathetic neural signals affect the working of the heart? ***CBSE-AIPMT 2014***
(a) Reduce both heart rate and cardiac output
(b) Heart rate is increased without affecting the cardiac output
(c) Both heart rate and cardiac output increase
(d) Heart rate decreases, but cardiac output increases

18 Visceral nervous system found in human body
(a) is a part of peripheral nervous system
(b) comprises the complex of nerves, ganglia and plexuses
(c) constitutes the connection between CNS and the viscera
(d) All of the above

TOPIC 2 ~ *Neuron as Structural and Functional Unit of Neural System*

19 A typical neuron is composed of
(a) cell body and dendrite
(b) dendrites and axon
(c) axon and nucleus
(d) cell, axon and dendrites

20 Select the correct option to represent *A-E* in the given structure of a neuron.



(a) A–Dendrites, B–Cell body, C–Axon, D–Node of Ranvier, E–Synaptic knob
(b) A–Axon, B–Myelin sheath, C–Schwann cell, D–Node of Ranvier, E–Axon terminal
(c) A–Dendrites, B–Cell body, C–Schwann cell, D–Node of Ranvier, E–Synaptic knob
(d) A–Axon, B–Cell body, C–Dendrites, D–Node of Ranvier, E–Axon terminal

21 The cytoplasm contained within the cell body of neuron is characterised by the presence of
(a) cell granules (b) neuro cells
(c) Nissl's granules (d) neurogranules

22 Nissl's bodies are mainly composed of ***NEET 2018***
(a) nucleic acid and SER (b) DNA and RNA
(c) proteins and lipids (d) free ribosomes and RER

23 Dendrites of neurons are
(a) highly branched, short fibres containing Nissl's granules
(b) unbranched, long process of cell body
(c) unbranched, short and do not contain cytoplasm
(d) branched, long process without cytoplasm

24 Dendrites transmit impulses towards the
(a) cell body (b) axon
(c) Both (a) and (b) (d) body tissues

25 Synaptic knob is bulb-like structure which is present
(a) at the end of axon terminal
(b) at the node of Ranvier
(c) in the cell body
(d) at the end of dendrites

26 Synaptic vesicles contains chemicals called
(a) synaptic fluid (b) neurotransmitters
(c) vesicular fluid (d) All of these

27 The axons transmits nerve impulse
(a) away from a cell body to a synapse
(b) towards the cell body from a neuro-muscular junction
(c) away from cell body to visceral organs
(d) towards the cell body from a synapse

28 Multipolar and bipolar neurons differ in
(a) number of axons
(b) presence or absence of Nissl's granules
(c) number of dendrites
(d) Both (a) and (c)

29 Multipolar neurons are found in the
(a) retina of eye (b) cerebral cortex
(c) embryonic stage (d) None of these

30 Bipolar neurons are found in the
(a) embryonic stage (b) cerebral cortex
(c) cerebellum (d) retina of eye

31 Unipolar neurons can be seen in the
(a) embryonic stage (b) cerebellum
(c) cerebral cortex (d) retina of eye

32 Nerve fibres enveloped with Schwann cells are
(a) myelinated fibres (b) non-myelinated fibres
(c) afferent fibres (d) efferent fibres

33 Schwann cells, form a myelin sheath around the
(a) dendrite (b) cell body
(c) axon (d) Both (a) and (b)

34 The gaps between two adjacent myelin sheaths are called
(a) synapse (b) synaptic gap
(c) nodes of Ranvier (d) sheath gap

35 Myelin sheath is produced by ***NEET 2017***
(a) Schwann cells and oligodendrocytes
(b) Astrocytes and Schwann cells
(c) Oligodendrocytes and osteoclasts
(d) Osteoclasts and astrocytes

36 Myelinated nerve fibres are found in the nerves of
(a) cranial region (b) spinal; cranial region
(c) spinal; muscular region (d) muscular region

37 Unmyelinated nerve fibres, are commonly found in
(a) central; peripheral region
(b) autonomous; cranial region
(c) somatic; peripheral region
(d) autonomous; somatic region

38 In resting stage, the axonal membrane is comparatively more permeable and nearly impermeable to
(a) sodium; potassium, respectively
(b) sodium; calcium, respectively
(c) potassium; sodium, respectively
(d) potassium; calcium, respectively

39 In resting stage, the axonal membrane for negatively charged proteins found in axoplasm is
(a) permeable (b) partially permeable
(c) impermeable (d) selectively permeable

40 In the resting stage of a neuron, concentration gradient generates due to the
(a) high concentration of K^+ and low concentration of Na^+ inside the axon
(b) high concentration of Na^+ and low concentration of K^+ inside the axon
(c) low concentration of Na^+ outside the axon
(d) high concentration of K^+ outside the axon

41 Maintenance of the ionic gradients across the resting membrane is done by
(a) active transport of ions
(b) passive transport of ions
(c) active transport of neurotransmitters
(d) passive transport of neurotransmitters

42 For the maintenance of ionic gradients across the resting membrane, the sodium-potassium pump transports
(a) $3Na^+$ outwards for $2K^+$ into the cell
(b) $2Na^+$ outwards for $2K^+$ into the cell
(c) $3Na^+$ inwards for $2K^+$ out the cell
(d) $2Na^+$ inwards for $2K^+$ out the cell

43 The electrical potential difference across the polarised plasma membrane when concentration of K^+ is high inside the axon and low outside, it is known as
(a) action potential (b) resting potential
(c) refractory potential (d) All of these

44 When a stimulus is applied at a site on the polarised membrane, the membrane at that site becomes freely permeable to
(a) Na^+ (b) K^+
(c) K^+ and Cl^- (d) Na^+ and K^+

45 During the propagation of a nerve impulse, the action potential results from the movement of
(a) K^+ ions from intracellular fluid to extracellular fluid
(b) Na^+ ions from extracellular fluid to intracellular fluid
(c) K^+ ions from extracellular fluid to intracellular fluid
(d) Na^+ ions from intracellular fluid to extracellular fluid

46 During the transmission of nerve impulse through a nerve fibre the potential on the inner side of the plasma membrane has which type of electric charge?
(a) First positive then negative and continue to be negative
(b) First negative then positive and continue to be positive
(c) First positive then negative and again back to positive
(d) First negative then positive and again back to negative

47 A wave of action potential is termed as
(a) sensory impulse (b) nerve impulse
(c) activation impulse (d) motor impulse

48 Saltatory conduction of impulse occurs in
(a) liver cells
(b) non-myelinated nerve fibres
(c) myelinated nerve fibres
(d) None of the above

49 A nerve impulse is transmitted from one neuron to another through the junctions called
(a) neuromuscular junction
(b) neuroreceptor junction
(c) synapse
(d) neuroglandular junction

50 The synaptic cleft is found between the membrane of
(a) pre-synaptic neuron and a post-synaptic neuron
(b) pre-synaptic dendrite and post-synaptic axon
(c) pre-synaptic dendrite and post-synaptic dendrite
(d) None of the above

51 The two types of synapses are
(a) neuron-neuron, chemical
(b) electrical, chemical
(c) neuron-neuron, electrical
(d) electrochemical, neuron

52 Impulse transmission across an electrical synapse is
(a) always equal to that across a chemical synapse
(b) always slower than that across a chemical synapse
(c) always faster than that across a chemical synapse
(d) either faster or slower than that across a chemical synapse

53 The fluid-filled space, synaptic cleft contain neurotransmitters
(a) released from vesicles
(b) found at chemical synapse
(c) found at chemical and electrical synapse
(d) Both (a) and (b)

54 Unidirectional transmission of a nerve impulse through nerve fibre is due to the fact that
(a) nerve fibre is insulated by a medullary sheath
(b) sodium pump starts operating only at the cyton and then continues into the nerve fibre
(c) neurotransmitters are released by dendrites and not by axon endings
(d) neurotransmitters are released by the axon endings and not by dendrites

55 A diagram showing axon terminal and synapse is given. Identify correctly at least two of *A-D*.
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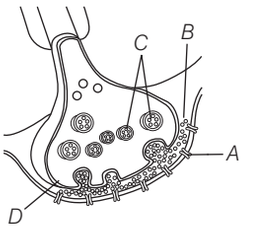


(a) A–Receptor, C–Synaptic vesicles
(b) B–Synaptic connection, D–K^+
(c) A–Neurotransmitter, B–Synaptic cleft
(d) C–Neurotransmitter, D–Ca^{2+}

56 When an impulse arrives at axon terminal, it stimulates synaptic vesicle to move towards the membrane, where they fuse with plasma membrane and release neurotransmitter in
(a) receptor (b) pre-synaptic membrane
(c) synaptic cleft (d) post-synaptic membrane

57 Receptor sites for neurotransmitters are present on
(a) membranes of synaptic vesicles ***NEET 2017***
(b) pre-synaptic membrane
(c) tips of axons
(d) post-synaptic membrane

58 On post-synaptic membrane, the new potential developed is
(a) always inhibitory
(b) always excitatory
(c) may be excitatory or inhibitory
(d) neither excitatory nor inhibitory

TOPIC 3 ~ *Central Nervous System and Reflex Arc*

59 Brain controls the
(a) voluntary movements
(b) balance of the body
(c) functioning of vital involuntary organs
(d) All of the above

60 Inside the bony structure skull, the brain is covered by
(a) arachnoid (b) cranial meninges
(c) piamater (d) duramater

61 Cranial meninges from outer layer to inner layer are called
(a) piamater, arachnoid, duramater
(b) duramater, arachnoid, piamater
(c) arachnoid, duramater, piamater
(d) arachnoid, piamater, duramater

62 The forebrain consists of
(a) cerebrum (b) thalamus
(c) hypothalamus (d) All of these

63 Which part constitutes the major part of the brain?
(a) Cerebrum (b) Hypothalamus
(c) Thalamus (d) Cerebellum

64 Corpus callosum connects two
(a) cerebral hemispheres
(b) ventricles of brain
(c) cerebellar hemispheres
(d) optic thalamus

65 The folded layer of cells that covers the cerebral hemisphere is called as
(a) association area (b) cerebral cortex
(c) amygdala (d) cerebral medulla

66 Cerebral cortex consists of
(a) motor areas (b) sensory areas
(c) association areas (d) All of these

67 Association areas of the brain are
(a) always sensory areas
(b) always motor areas
(c) neither sensory nor motor areas
(d) None of the above

68 Functions of association areas in cerebral cortex includes
(a) intersensory associations (b) memory
(c) communication (d) All of these

69 The cerebral cortex is referred to as
(a) grey matter
(b) white matter
(c) Both (a) and (b)
(d) non-myelinated nerve fibres

70 Thalamus in human brain is
(a) a major centre for motor and sensory signaling
(b) surrounded by cerebrum
(c) found above the hypothalamus
(d) All of the above

71 Which part of the brain is responsible for thermoregulation ? ***NEET 2019, JIPMER 2019***
(a) Hypothalamus (b) Corpus callosum
(c) Medulla oblongata (d) Cerebrum

72 Injury localised to the hypothalamus would most likely to disrupt ***CBSE-AIPMT 2014***
(a) short term memory
(b) coordination during locomotion
(c) executive function, such as decision making
(d) regulation of body temperature

73 The inner parts of cerebral hemispheres and a group of associated deep structures like amygdala, hippocampus, etc., form a complex structure called
(a) arbor vitae (b) limbic lobe/limbic system
(c) corpora quadrigemina (d) reticular system

74 Which of the following structure or region is incorrectly paired with its function? ***NEET 2018***

(a)	Hypothalamus	Production of releasing hormones and regulation of temperature, hunger and thirst
(b)	Limbic system	Consists of fibre tracts that interconnect different regions of brain; controls movement
(c)	Medulla oblongata	Controls respiration and cardiovascular reflexes
(d)	Corpus callosum	Band of fibres connecting left and right cerebral hemispheres

75 Which part of the human brain controls the urge for eating and drinking?
(a) Forebrain (b) Midbrain
(c) Hindbrain (d) Spinal cord

76 Four rounded lobes in midbrain are
(a) occipital condyles (b) corpora quadrigemina
(c) corpora allata (d) cerebral aqueduct

77 Hindbrain includes
(a) pons (b) cerebellum
(c) medulla oblongata (d) All of these

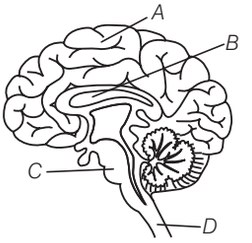
78 Which of the following regions of the brain is incorrectly paired with its function? ***CBSE-AIPMT 2015***
(a) Medulla oblongata–Homeostatic control
(b) Cerebellum–Language comprehension
(c) Corpus callosum–Communication between the left and right cerebral cortices
(d) Cerebrum–Calculation and contemplation

79 Cerebellum is concerned with the
(a) contraction of voluntary muscles
(b) coordinating and regulation muscles tone
(c) maintaining posture, orientation and equilibrium of body
(d) All of the above

80 The medulla contains centres which control
(a) respiration
(b) cardiovascular reflexes
(c) gastric secretions
(d) All of the above

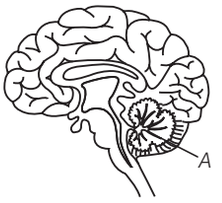
81 Brain stem is formed by
(a) cerebellum medulla and thalamus
(b) cerebrum and cerebellum
(c) midbrain, pons and medulla
(d) medulla and spinal cord

82 View the diagram of the lateral view of the human brain and choose the correct option in which *A-D* has been indicated.



	A	B	C	D
(a)	Cerebral hemisphere	Spinal cord	Corpus callosum	Cerebellum
(b)	Corpus callosum	Cerebral hemisphere	Cerebellum	Spinal cord
(c)	Cerebral hemisphere	Corpus callosum	Pons	Spinal cord
(d)	Spinal cord	Pons	Corpus callosum	Cerebral hemisphere

83 Identify the part of brain which is represented by *A* in the given diagram.

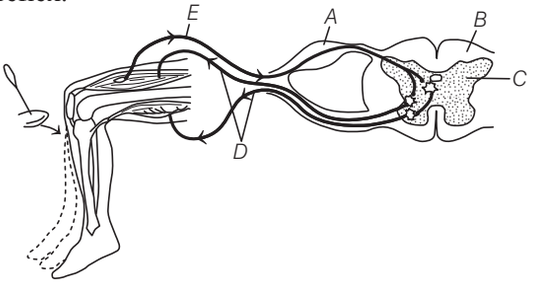


(a) Medulla oblongata
(b) Cerebellum
(c) Pons
(d) Midbrain

84 The process of response to a peripheral nervous stimulation that occurs involuntarily is called
(a) reflactory potential (b) action potential
(c) reflex action (d) activation potential

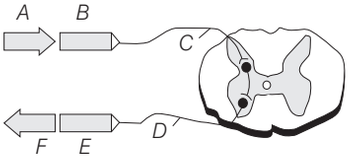
85 The reflex pathway comprises
(a) one afferent neuron
(b) one efferent neuron
(c) one afferent and one efferent neuron
(d) motor neurons

86 Identify the parts labelled as *A* to *E* and choose the correct option for the given diagrammatic representation of reflex action showing knee-jerk reflex.



(a) A–Dorsal root ganglion, B–White matter, C–Grey matter, D–Afferent pathway, E–Efferent pathway
(b) A–Dorsal root ganglion, B–White matter, C–Grey matter, D–Efferent pathway, E–Afferent pathway
(c) A–Dorsal root ganglion, B–Grey matter, C–White matter, D–Efferent pathway, E–Afferent pathway
(d) A–Ventral root ganglion, B–White matter, C–Grey matter, D–Efferent pathway E–Afferent pathway

87 The reflex arc is shown in the diagram below. Choose the correct label for the pathway of this reflex arc.



	A	B	C	D	E	F
(a)	Stimulus	Effector	Sensory nerve	Motor nerve	Receptor	Response
(b)	Stimulus	Receptor	Sensory nerve	Motor nerve	Effector	Response
(c)	Stimulus	Effector	Motor nerve	Sensory nerve	Receptor	Response
(d)	Stimulus	Receptor	Motor nerve	Sensory nerve	Effector	Response

88 Reflex action is controlled by
(a) ANS
(b) CNS
(c) Both (a) and (b)
(d) None of the above

89 Which of the following is not a reflex action?
(a) Salivation
(b) Sweating
(c) Withdrawal of hand when pinched by needle
(d) None of the above

90 Given below are different components of reflex arc.
I. Effector neuron II. Dorsal nerve root
III. CNS IV. Afferent neuron
V. Sensory receptor VI. Effector organ
Arrange these in correct order of action potential that follows a sensory receptor stimulation.
(a) V, IV, III, II, I, VI (b) V, IV, II, III, I, VI
(c) V, III, IV, I, II, VI (d) V, II, IV, III, I, VI

TOPIC 4~ *Sensory Reception and Processing*

91 The signals detected by sensory organs are processed and analysed in
(a) sensory organs (b) CNS
(c) PNS (d) ANS

92 The mucus coated olfactory receptors in nose
(a) are madeup of olfactory epithelium comprising three kinds of cells
(b) posses neurons that extend from outside environment
(c) contain olfactory bulb which is an extension of limbic system
(d) All of the above

93 The gustatory and olfactory receptors
(a) detect dissolved chemicals
(b) are functionally similar and inter-related
(c) Both (a) and (b)
(d) are highly evolved and controlled by ANS

94 The wall of the human eyeball is composed of
(a) sclera, choroid and retina
(b) sclera, cornea and choroid
(c) sclera, cornea and ciliary body
(d) sclera, choroid and iris

95 Sclera of human eye is composed of
(a) blood vessels (b) ganglion cells
(c) photoreceptor cells (d) dense connective tissue

96 Cornea transplant in humans is almost never rejected. This is beause
(a) it is composed of enucleated cells
(b) it is a non-living layer
(c) its cells are least penetrable by bacteria
(d) it has no blood supply

97 The part of human eye which contain blood vessels and appear bluish in colour is
(a) sclera (b) choroid
(c) ciliary body (d) cornea

98 The choroid layer of human eye is
(a) thin over the posterior 2/3 of eyeball
(b) thick over the posterior 4/3 of eyeball
(c) coloured over the anterior 2/3 of eyeball
(d) opaque structure over the anterior 4/3 of eyeball

99 The thick anterior part of choroid in human eye form
(a) iris (b) ciliary body
(c) pupil (d) lens

100 Which is the visible coloured portion of the eye?
(a) Pupil (b) Lens (c) Iris (d) Ciliary body

101 The transparent lens in the human eye is held in its place by ***NEET 2018***
(a) smooth muscles attached to the iris
(b) ligaments attached to the iris
(c) ligaments attached to the ciliary body
(d) smooth muscles attached to the ciliary body

102 Pupil is the aperture surrounded by the
(a) ciliary body (b) connective tissue
(c) iris (d) choroid

103 Arrange the layers of neural cells in retina of human eye from inside to outside.
(a) Photoreceptor cells → Ganglion cells → Bipolar cells
(b) Ganglion cells → Photoreceptor cells → Bipolar cells
(c) Ganglion cells → Bipolar cells → Photoreceptor cells
(d) Bipolar cells → Photoreceptor cells → Ganglion cells

104 Why is it difficult to differentiate between red and green colour objects in dark or in night?
(a) Rods work well only during daytime
(b) Cones work well only during daytime
(c) Rods work well only during night time
(d) Cones work well only during night time

105 Rhodopsin is also known as visual
(a) red (b) yellow (c) brown (d) purple

106 There are different types of cones in human eye that responds to
(a) red and green lights (b) green and blue lights
(c) red and blue lights (d) red, green and blue lights

107 When different cones of human eye are stimulated equally, a sensation of …… light is produced.
(a) red (b) white
(c) green (d) blue

108 Blind spot is called so because of
(a) the presence of photoreceptor cells
(b) the presence of optic nerves
(c) the absence of photoreceptor cells
(d) None of the above

109 At blind spot
(a) optic nerves leave the eye and retinal blood vessels enter it
(b) retinal blood vessels leave the eye and optic nerves enter it
(c) there is no involvement of optic nerves at all
(d) there is no involvement of retinal blood vessels at all

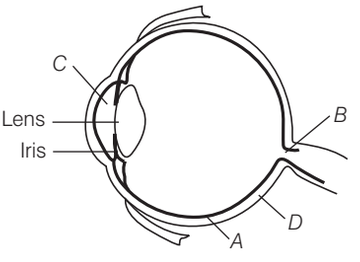
110 At the posterior pole of the eye lateral to the blind spot, there is a yellowish pigmented spot called
(a) corpus luteum
(b) fovea
(c) macula quadrigemina
(d) macula lutea

111 Choose the incorrect pair.
(a) Sclera – Dense connective tissue
(b) Choroid – Bluish in colour
(c) Iris – Opaque structure
(d) Fovea – Point where resolution is low

112 Aqueous chamber which is filled by aqueous humour is the space
(a) behind the lens (b) between sclera and retina
(c) between cornea and lens (d) between choroid and sclera

113 Vitreous chamber containing vitreous humor is found
(a) behind the blind spot (b) between lens and retina
(c) between lens and cornea (d) within retina and cornea

114 Parts *A, B, C* and *D* of the human eyes are shown in the diagram. Select the option, which gives correct identification along with its functions/characteristics. ***NEET 2013***



(a) A–Retina–contains photoreceptors–rods and cones
(b) B–Blind spot–has only a few rods and cones
(c) C–Aqueous chamber–reflects the light, which does not pass through the lens
(d) D–Choroid–its anterior part forms ciliary body

115 Arrange the given structures in the correct sequence of pathway of light from outside to inside the eyeball of human eye.

I. Pupil (through lens) II. Aqueous humour
III. Vitreous humour IV. Cornea
V. Retina

Choose the correct sequence.

(a) IV, II, I, III and V (b) I, II, III, IV and V
(c) IV, III, II, I and V (d) I, IV, II, III and V

116 Photosensitive compound in human eye is made up of ***NEET 2016***

(a) opsin and retinal (b) opsin and retinol
(c) transducin and retinene (d) guanosine and retinol

117 A potential difference is generated in the photoreceptor cells due to

(a) light rays of visible wavelength
(b) dissociation of retinal from opsin
(c) change in membrane permeability
(d) All of the above

118 Outer ear of humans consists of

(a) pinna (b) external auditory meatus
(c) Both (a) and (b) (d) labyrinth

119 The function of pinna is to

(a) collects the vibrations in the air which produce sound
(b) secrete wax
(c) increase the frequency of transmission of sound waves to the inner ear
(d) All of the above

120 In humans, tympanic membrane (eardrum) separates tympanic cavity from

(a) pinna (b) auditory meatus
(c) Eustachian tube (d) cochlea

121 Middle ear of humans contains ossicles, i.e.

(a) malleus (b) incus
(c) stapes (d) All of these

122 The ear ossicles found attached to the tympanic membrane and to the oval window of the cochlea are …… and ……, respectively.

(a) malleus, stapes (b) malleus, incus
(c) stapes, malleus (d) incus, stapes

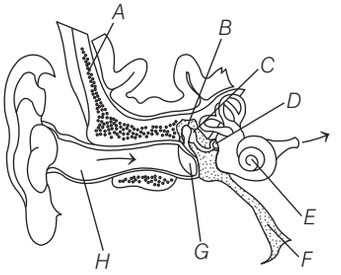
123 Function of ear ossicles in humans is

(a) to equalise the pressure on either sides of eardrum
(b) collects the vibrations in the air which produce sound
(c) to increase the efficiency of transmission of sound waves to the inner ear
(d) All of the above

124 Eustachian tube connects

(a) outer ear and pharynx (b) inner ear and pharynx
(c) pinna and pharynx (d) middle ear and pharynx

125 Given is the diagram of ear. Identify *A* to *H*.



Choose the correct option.

(a) A–Temporal bone, B–Malleus, C–Incus, D–Stapes, E–Cochlea, F–Eustachian tube, G–Tympanic membrane, H–External auditory canal
(b) A–Tympanic membrane, B–Malleus, C–Incus, D–Stapes, E–Cochlea, F–Eustachian tube, G–Temporal bone, H–External auditory canal
(c) A–Tympanic membrane, B–Incus, C–Malleus, D–Stapes, E–Cochlea, F–Eustachian tube, G–Temporal bone, H–External auditory canal
(d) A–Temporal bone, B–Malleus, C –Incus, D–Cochlea, E–Stapes, F–Eustachian tube, G–Tympanic membrane, H–External auditory canal

126 Coiled portion of the labyrinth is called

(a) cochlea (b) eardrum
(c) pinna (d) ear canal

127 Identify the incorrectly matched pair.

(a) Bony labyrinth – surrounded by perilymph, filled with endolymph
(b) Scala media – space within cochlea, filled with endolymph
(c) Scala vestibuli – Found at the pase of cochlea, ends at oval window
(d) Scala tympani – Terminate at round window which open to middle ear

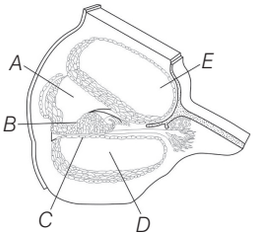
128 The structure located on the basilar membrane which contains hair cells act as auditory receptors is

(a) Eustachian tube (b) organ of Corti
(c) semi-circular canal (d) otolith

129 The gelatinous, elastic membrane covering the sensory hair cells of the human ear is known as

(a) basilar membrane (b) tectorial membrane
(c) Reissners's membrane (d) neuro-sensory membrane

130 Below is the diagram of the sectional view of cochlea of human ear. Identify *A* to *E*.



Choose the correct option.

(a) A–Scala media, B–Organ of Corti, C–Basilar membrane, D–Scala tympani, E–Scala vestibuli

(b) A–Scala vestibuli, B–Organ of Corti, C–Basilar membrane, D–Scala tympani, E–Scala media

(c) A–Scala vestibuli, B–Basilar membrane, C–Organ of Corti, D–Scala tympani, E–Scala media

(d) A–Scala vestibuli, B–Basilar membrane, C–Scala tympani, D–Organ of Corti, E–Scala media

131 In the internal ear of humans

(a) three semi-circular canals lies in different plane at right angle to each other and suspended in perilymph

(b) crista ampullaries is formed at the base of semi-circular canals as a projecting swollen ridge

(c) saccule and utricle contain projecting ridge, macula which helps in the maintenance of body balance

(d) All of the above

132 Which of the following receptors are specifically responsible for maintenance of the balance of body and posture ? ***NEET (Odisha) 2019***

(a) Basilar membrane and otoliths

(b) Hair cells and organ of Corti

(c) Tectorial membrane and macula

(d) Crista ampullaris and macula

133 Which part of the human ear plays no role in hearing as such but is otherwise very much required? ***CBSE-AIPMT 2012***

(a) Eustachian tube (b) Organ of Corti

(c) Vestibular apparatus (d) Ear ossicles

134 A gymnast is able to balance his body upside down even in the total darkness because of ***CBSE-AIPMT 2015***

(a) cochlea

(b) vestibular apparatus

(c) tectorial membrane

(d) organ of Corti

135 Identify the correct sequence of organs/regions in the organisation of human ear as an auditory mechanoreceptor organ.

(a) Pinna–Cochlea–Tympanic membrane canal–Malleus–Stapes–Incus–Auditory nerve

(b) Pinna–Tympanic membrane–Auditory canal–Incus–Malleus– Stapes–Cochlea–Auditory nerve

(c) Pinna–Malleus–Incus–Stapes–Auditory canal–Tympanic membrane–Cochlea–Auditory nerve

(d) Pinna–Auditory canal–Tympanic membrane–Malleus–Incus–Stapes–Cochlea–Auditory nerve

NEET

SPECIAL TYPES QUESTIONS

I. Assertion and Reason

■ **Direction** (Q. No. 136-144) *In each of the following questions, a statement of Assertion (A) is given followed by corresponding statement of Reason (R). Of the statements, mark the correct answer as*

(a) If both A and R are true and R is the correct explanation of A

(b) If both A and R are true, but R is not the correct explanation of A

(c) If A is true, but R is false

(d) If A is false, but R is true

136 **Assertion** (A) The pre-synaptic neuron transmits an impulse (action potential) across the synaptic cleft to the post-synaptic neuron.

Reason (R) For the transmission of impulses at synapses, chemicals called neurotransmitters are responsible.

137 **Assertion** (A) Neurons are excitable cells.

Reason (R) Membranes of the neurons are in a polarised state which is responsible for the excitability.

138 **Assertion** (A) Neuroglial cells are known as the packing cells of brain.

Reason (R) A type of neuroglial cells forms the myelin sheath around axon.

139 **Assertion** (A) Arrival of an impulse at the axon terminal, stimulates the release of neurotransmitters in the synaptic cleft.

Reason (R) These neurotransmitters are responsible for the opening of ion channels.

140 **Assertion** (A) The membrane of a neuron remains in polarised state.

Reason (R) Ion channels on the neural membrane are selectively permeable to different ions.

141 **Assertion** (A) The axoplasm inside the axon contains high concentration of K^+ and negatively charged proteins.

Reason (R) The axonal membrane is impermeable to Na^+ and negatively charged proteins.

142 **Assertion** (A) The cerebral cortex is referred to as the white matter of the brain.

Reason (R) It is due to the high concentration of neuron cell bodies in it.

143 **Assertion** (A) Iris muscles show both dilation as well as constriction of pupil.

Reason (R) It is due to sympathetic and parasympathetic nervous system which have antagonistic functions.

144 **Assertion** (A) Muscles of iris regulate the diameter of pupil.

Reason (R) Iris surround the pupil in the front side lens.

II. Statement Based Questions

145 Select the correct statement.

(a) Neurons regulate endocrine activity but not *vice-versa*
(b) Endocrine glands regulate neural activity but not *vice-versa*
(c) Endocrine glands regulate neural activity and nervous system regulates endocrine glands
(d) Neither hormones control neural activity nor the neurons control the endocrine activity

146 Consider the following statements.

I. Neural system is better organised in insects due to the presence of brain, ganglia and neural tissues.
II. Nerual organisation is very simple in lower invertebrates.

Select the correct option

(a) I is true, II is false
(b) Both I and II are true
(c) I is false, II is true
(d) Both I and II are false

147 Which of the following statements are correct regarding electrical synapses?

I. Pre and post-synaptic membrane neurons are in very close proximity at electric synapse.
II. Electric current are involved in the transmission of impulses.
III. Transmission of an impulse across electrical synapses is very similar to impulse conduction along a single axon.
IV. Impulse transmission is always faster in electric synapse than that across a chemical synapse.
V. Electrical synapses are rare in our system.

The correct option is

(a) I, II, III and IV
(b) I, III, IV and V
(c) I, II and IV
(d) I, II, III, IV and V

148 Consider the statements as True/False regarding when a neuron is at rest and no impulse is conducting.

I. The axoplasm inside the axon contains high concentration of K^+ and negatively charged proteins.
II. The axoplasm inside the axon contains low concentration of Na^+.
III. The fluid outside the axon contains a low concentration of K^+.
IV. The fluid outside the axon contains a low concentration of Na^+ and negatively charged proteins.

The correct option is

	I	II	III	IV
(a)	True	False	False	True
(b)	True	True	False	False
(c)	True	True	True	False
(d)	False	True	False	False

149 Which of the following statement(s) is/are incorrect regarding synapse?

I. Synapse is a junction between axon endings of one nerve fibre and dendrite of the other.
II. At a synapse, the membrane of axon and dendrite are not in physical contact with each other.
III. Transmission of nerve impulse through synapse is only one way.
IV. Neurotransmitter is always released from axon endings and not by dendrites.

Select the correct option.

(a) Only IV (b) Only I
(c) I, II and III (d) None of these

150 Which of the following statements is/are correct about resting state?

I. Neuron is not conducting any impulse.
II. Plasma membrane is electrically positive outside and negative inside.
III. The nerve fibre is stimulated and conduct mechanical or electrical impulse.
IV. Plasma membrane is negative outside and positive inside.

The correct option is

(a) III and IV (b) I and IV
(c) II and III (d) I and II

151 Conider the following statements.

I. Increased permeability of Na^+ ions due to the rise in stimulus is short lived.
II. The resting membrane potential of membrane at the site of excitation is restored by Na^+ and Cl^- ions.

Select the correct option.

(a) I is true, II is false (b) Both I and II are true
(c) I is false, II is true (d) Both I and II are false

152 Grey matter of the brain is

I. present outside the white matter.
II. contain medullated nerve fibres.
III. grey in colour.
IV. contains cell bodies of nerve fibres.

Which of the statement(s) mentioned above is/are correct?

(a) Only I
(b) Only II
(c) I, III and IV
(d) II, III and IV

153 Consider the following statements regarding white matter of the brain.

I. White matter of the brain is usually opaque in appearance.
II. White matter of the brain is white in colour but sometimes it is found to be grey.
III. White matter of the brain is mostly formed of medullated nerve fibres.
IV. White matter of the brain is formed of cell bodies of nerve fibres.

Which of the statement (s) above is/are correct?

(a) I and III (b) II and IV
(c) I and IV (d) II and III

154 Which of the following statement (s) is/are correct about the cortex of cerebrum? Choose the correct option from the codes given below.

I. It consists of grey matter.
II. It shows prominent folds.
III. It consists of white matter.
IV. It contains motor areas, sensory areas and association areas.

(a) Only I
(b) I and II
(c) I, II and IV
(d) I, III and IV

155 Which of the following statements are correct about the midbrain?

I. Located between the thalamus/hypothalamus.
II. Possesses a canal named cerebral aqueduct which passes through it.
III. Dorsal part consists of 4 lobes.

Choose the correct option.

(a) I and II
(b) II and III
(c) I and III
(d) All of the above

156 Consider the following statements and choose the correct option from the codes given below.

I. Nearly 50% of all brain cells are neuroglia.
II. Oligodendrocytes plays a role in the maintenance of blood brain barrier.
III. Microglia engulf microbes and cellular debris.
IV. Astrocytes, oligodendrocytes and microglia, are three different types of neuroglial cells.

(a) I and IV are correct
(b) II and IV are correct
(c) All are correct
(d) All are incorrect

157 Which of the following statements are correct about functions of hypothalamus?

I. Urge for eating and drinking.
II. Thermoregulation.
III. Hormones production that regulates the secretion of pituitary gland.
IV. Creative thinking and consciousness.

(a) I and III (b) II and III
(c) I and II (d) I, II and III

158 Which one of the following statements is not correct?

CBSE-AIPMT 2014

(a) Retinal is the light absorbing portion of visual photopigments
(b) In retina the rods have the photopigment rhodopsin, while cones have three different photopigments
(c) Retinal is a derivative of vitamin-C
(d) Rhodopsin is the purplish red protein present in rods only

159 Which of the following statement(s) is/are correct for rods?

I. Twilight vision is the function of the rods.
II. The rods contain a protein called rhodopsin.
III. Rods are photoreceptor cells.

(a) Only I (b) Only II
(c) I and III (d) I, II and III

160 Which of the following statements is not correct?

NEET (Odisha) 2019

(a) An action potential in an axon does not move backward because the segment behind is in a refractory phase
(b) Depolarisation of hair cells of cochlea results in the opening of the mechanically gated potassium-ion channels
(c) Rods are very sensitive and contribute to daylight vision
(d) In the knee-jerk reflex, stimulus is the stretching of muscle and response is its contraction

161 Which of the following statement is correct? ***NEET 2019***

(a) Cornea consists of dense connective tissue of elastin and can repair itself
(b) Cornea is convex, transparent layer which is highly vascularised
(c) Cornea consists of dense matrix of collagen and is the most sensitive portion of the eye
(d) Cornea is an external, transparent and protective proteinaceous covering of the eyeball

162 Good vision depends on adequate intake of carotene rich food. ***NEET 2017***

Select the best option from the following statements.

I. Vitamin-A derivatives are formed from carotene.
II. The photopigments are embedded in the membrane discs of the inner segment.
III. Retinal is a derivative of vitamin-A.
IV. Retinal is a light absorbing part of all the visual photopigments.

(a) I and II (b) I, III and IV
(c) I and III (d) II, III and IV

163 Following are the steps of mechanism of vision in random order.

I. Neural impulses are analysed and image formed on retina is recognised by visual cortex.
II. Membrane permeability changes.
III. Ganglion cells are excited.
IV. Bipolar cells are depolarised.
V. Action potential (impulse) is transmitted by optic nerves to visual cortex.
VI. Potential differences are generated in the photoreceptor cells.
VII. Light energy causes a change in shape of rhodopsin, leading to the dissociation of retinal (an aldehyde of vitamin-A) from opsin (a protein).
VIII. Structure of opsin is changed.

Choose the correct sequence.

(a) I, II, III, IV, V, VI, VII, VIII
(b) VIII, VII, VI, V, IV, III, II, I
(c) I, IV, III, II, VII, VIII, VI, V
(d) VII, VIII, II, VI, IV, III, V, I

164 Consider the following statements.

I. The hair cells on internal side of organ of Corti are in close contact with afferent nerve fibres and possess stereocilia.
II. Saccule and utricle are the otoliths which possess macula.

Select the correct option.

(a) Both I and II are true
(b) I is true, II is false
(c) Both I and II are false
(d) I is false, II is true

165 Arrange the following events in a correct order that lead to the formation of an auditory impulse in human ears from the steps given below.

I. Vibration is transferred from the malleus to the incus and then to stapes.
II. Basilar membrane moves up and down.
III. Nerve impulse is transmitted by cochlear nerve to auditory cortex of brain for impulse analysis and recognition.
IV. Sound waves pass through ear canal.
V. Stereocilia of hair cells of organ of Corti rub against tectorial membrane.
VI. Sound waves causes eardrum to vibrate.
VII. Nerve impulse is generated.
VIII. Vibrations move from fluid of vestibular canal to the fluid of tymapanic canal.
IX. Membrane at oval window vibrates.

Codes

(a) IV, VI, I, IX, VIII, II, V, VII, III
(b) I, II, III, IV, V, VI, VII, VIII, IX
(c) IX, VIII, VII, VI, V, IV, III, II, I
(d) IV, VI, I, VIII, IX, II, V, VII, III

166 Choose the correct statement. ***NEET 2016***

(a) Nociceptors respond to changes in pressure
(b) Meissner's corpuscles are thermoreceptors
(c) Photoreceptors in the human eye are depolarised during darkness and become hyperpolarised in response to the light stimulus
(d) Receptors do not produce graded potentials

III. Matching Type Questions

167 Match the following columns.

	Column I (Neuron type)		**Column II** (Feature)
A.	Multipolar neuron	1.	One axon, one dendrite
B.	Bipolar neuron	2.	One axon, multiple dendrites
C.	Unipolar neuron	3.	One axon and cell body

Codes

	A	B	C		A	B	C
(a)	2	3	1	(b)	1	3	2
(c)	2	1	3	(d)	3	2	1

168 Match the following columns.

	Column I		**Column II**
A.	Synaptic vesicles	1.	Resting potential
B.	Electrical potential difference across the resting plasma membrane	2.	Action potential
C.	Generation of a nerve impulse	3.	Neurotransmitter
D.	Granular bodies found in the cell body of a neuron	4.	Nissl's granules

Codes

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

169 Match the following columns.

	Column I		Column II
A.	CNS	1.	From tissue/organ to CNS
B.	PNS	2.	From CNS to tissue/organ
C.	Afferent fibres	3.	Comprises of brain and spinal cord
D.	Efferent fibres	4.	Comprises of nerves of body

Codes

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

170 Match the Column I (the parts of the human brain) with Column II (the functions) and identify the correct choice from the given option.

	Column I (Parts of brain)		Column II (Functions)
A.	Cerebrum	1.	Controls the pituitary
B.	Cerebellum	2.	Controls vision and hearing
C.	Hypothalamus	3.	Maintains body posture
D.	Midbrain	4.	Site of intelligence

Codes

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

171 Match the following columns.

	Column I (Parts of brain)		Column II (Features)
A.	Pons	1.	Neurosecretory cells
B.	Cerebellum	2.	Interconnect brain regions through fibre tracts
C.	Hypothalamus	3.	Convoluted surface to accomodate neurons
D.	Medulla	4.	Connected to spinal cord

Codes

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

172 Match the following columns.

	Column I (Features)		Column II (Parts of eye)
A.	External layer of eyeball	1.	Choroid
B.	Inner layer of eyeball	2.	Orbits
C.	Middle layer of eyeball	3.	Sclera
D.	Socket of the skull	4.	Retina

Codes

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

173 Match the following columns.

	Column I (Parts of ear)		Column II (Features)
A.	Labyrinth	1.	Coiled part, possess reissner and basilar membranes
B.	Cochlea	2.	Hair cell containing structure on basilar membrane
C.	Organ of Corti	3.	Contain semicircular canals and otolith
D.	Vestibular apparatus	4.	Fluid filled, consist of bony and membranous parts

Codes

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

NCERT Exemplar

MULTIPLE CHOICE QUESTIONS

174 Chemicals which are released at the synaptic junction are called
(a) hormones
(b) neurotransmitters
(c) cerebrospinal fluid
(d) lymph

175 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^{2+} and Cl^- ions
(c) Ca^{2+} and Mg^{2+} ions
(d) Ca^{2+} and CI^- ions

176 Resting membrane potential is maintained by
(a) hormones
(b) neurotransmitters
(c) ion pumps
(d) None of the above

177 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

178 Which of the following is not involved in knee-jerk reflex?
(a) Muscle spindle
(b) Motor neuron
(c) Brain
(d) Interneurons

179 An area in the brain which is associated with strong emotions is
(a) cerebral cortex
(b) cerebellum
(c) limbic system
(d) medulla

180 Mark the vitamin present in rhodopsin.
(a) Vitamin-A (b) Vitamin-B
(c) Vitamin-C (d) Vitamin-D

181 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

182 Wax gland present in the ear canal is called
(a) sweat gland
(b) prostate gland
(c) Cowper's gland
(d) ceruminous gland

183 The part of internal ear responsible for hearing is
(a) cochlea
(b) semicircular canal
(c) utriculus
(d) sacculus

184 The organ of Corti is a structure present in
(a) external ear
(b) middle ear
(c) semicircular canal
(d) cochlea

Answers

Mastering NCERT with MCQs

1 (b)	2 (a)	3 (c)	4 (d)	5 (d)	6 (d)	7 (a)	8 (c)	9 (a)	10 (c)
11 (a)	12 (c)	13 (b)	14 (c)	15 (d)	16 (c)	17 (a)	18 (d)	19 (d)	20 (a)
21 (c)	22 (d)	23 (a)	24 (a)	25 (a)	26 (b)	27 (a)	28 (d)	29 (b)	30 (d)
31 (a)	32 (a)	33 (c)	34 (c)	35 (a)	36 (b)	37 (d)	38 (c)	39 (c)	40 (a)
41 (a)	42 (a)	43 (b)	44 (a)	45 (b)	46 (d)	47 (b)	48 (c)	49 (c)	50 (a)
51 (b)	52 (c)	53 (d)	54 (d)	55 (a)	56 (c)	57 (d)	58 (c)	59 (d)	60 (b)
61 (b)	62 (d)	63 (a)	64 (a)	65 (b)	66 (d)	67 (c)	68 (d)	69 (a)	70 (d)
71 (a)	72 (d)	73 (b)	74 (b)	75 (a)	76 (b)	77 (d)	78 (b)	79 (d)	80 (d)
81 (c)	82 (c)	83 (b)	84 (c)	85 (c)	86 (b)	87 (b)	88 (c)	89 (b)	90 (b)
91 (b)	92 (d)	93 (c)	94 (a)	95 (d)	96 (d)	97 (b)	98 (a)	99 (b)	100 (c)
101 (c)	102 (c)	103 (c)	104 (b)	105 (d)	106 (d)	107 (b)	108 (c)	109 (a)	110 (d)
111 (d)	112 (c)	113 (b)	114 (a)	115 (a)	116 (a)	117 (d)	118 (c)	119 (a)	120 (b)
121 (d)	122 (a)	123 (c)	124 (d)	125 (a)	126 (a)	127 (a)	128 (b)	129 (b)	130 (a)
131 (d)	132 (d)	133 (c)	134 (b)	135 (d)					

NEET Special Types Questions

136 (a)	137 (a)	138 (a)	139 (a)	140 (a)	141 (b)	142 (d)	143 (a)	144 (a)	145 (a)
146 (b)	147 (d)	148 (c)	149 (d)	150 (d)	151 (a)	152 (c)	153 (a)	154 (c)	155 (d)
156 (c)	157 (d)	158 (c)	159 (d)	160 (c)	161 (c)	162 (b)	163 (d)	164 (a)	165 (a)
166 (c)	167 (c)	168 (a)	169 (c)	170 (d)	171 (d)	172 (c)	173 (c)		

NCERT Exemplar Questions

174 (b)	175 (a)	176 (c)	177 (b)	178 (c)	179 (c)	180 (a)	181 (b)	182 (d)	183 (a)
184 (d)									

Answers & Explanations

1 (*b*) Homeostasis is the ability of our body to maintain its internal environment at equilibrium. It is achieved by coordinated functions of different organs and organ systems.

3 (*c*) The neural and endocrine system together coordinate and work in synchronised fashion. The neural system sense stimulus through neurons and endocrine system provides chemical integration through hormones.

7 (*a*) In *Hydra*, neural organisation comprises of network of neurons called nerve net. Nerve nets connect sensory photoreceptors and touch sensitive nerve cells located in the body wall and tentacles.

8 (*c*) The human neural/nervous system comprises of both Peripheral Nervous System (PNS) and Central Nervous system (CNS). PNS consists of all the nerves (cranial nerves and spinal nerves) associated with CNS.

9 (*a*) Central nervous system is the main site of information processing and control. It includes brain and spinal cord.

17 (*a*) Parasympathetic neural signal reduces both heart rate and cardiac output, through the post-ganglionic fibres. Autonomic nervous system consists of sympathetic and parasympathetic nervous system. These are antagonistic to each other.

22 (*d*) Nissl's granules are found in the cell body of neurons. These granules are composed of Rough Endoplasmic Reticulum (RER) that bears free ribosomes. The latter acts as the site of protein synthesis. These granules were named after its discoverer Franz Nissl.

23 (*a*) Dendrites of neurons are highly branched, short fibres containing Nissl's granules. Short fibres which branch repeatedly and project out of the cell body also contain Nissl's granules and are called dendrites.

25 (*a*) The axon is a long fibre, the distal end of which is branched. Each branch terminates as a bulb-like structure called synaptic knob which possesses synaptic vesicles.

28 (*d*) Both options (a) and (c) are correct.

Neurons are divided on the basis of the number of axon and the number of dendrites. The neurons are multipolar (with one axon and two or more dendrites, bipolar (with one axon and one dendrite) and unipolar (cell body with one axon).

35 (*a*) Myelin sheath originated from Schwann cells in the peripheral nervous system and oligodendrocytes in the central nervous system. The myelin sheath is a greatly extended and modified plasma membrane wrapped around the nerve axon in a spiral fashion.

36 (*b*) Myelinated, nerve fibres are covered by myelin sheath and these fibres are found in cranial and spinal region. Due to the presence of myelin sheath, the transmission of nerve impulse occur faster as compared to non-myelinated fibres.

37 (*d*) Unmyelinated nerve fibre, that do not possess a myelin sheath around the axon, is commonly found in autonomous and the somatic neural systems.

38 (*c*) In resting stage, the axonal membrane is comparatively more permeable to potassium ions and nearly impermeable to sodium ions. Due to this, the inside of neuron remain negatively charged, while the other side remain positively charged.

45 (*b*) During the propagation of nerve impulse, when the stimulus of adequate strength is applied to a polarised membrane, the action potential results from the movement of Na^+ ions from extracellular fluid to intracellular fluid.

This is because the permeability of the membrane to Na^+ ions is greatly increased at the point of stimulation and since Na^+ ions are more in the extracellular fluid at resting state, there occurs influx of Na^+ ions through sodium ion channels by the diffusion. Since, there are more Na^+ ions entering than leaving, the electric potential of the membrane changes from-70mV towards + 30 mV, i.e. action potential.

46 (*d*) During the transmission of nerve impulse through a nerve fibre the potential on the inner side of the plasma membrane is first negative then positive and again back to negative.

47 (*b*) A wave of action potential is termed as a nerve impulse. When a nerve fibre receives stimulus inside the cell, plasma membrane become positively charged with respect to outside. The change in polarity across the plasma membrane is known as action potential.

The membrane with this reversed polarity is said to be depolarised.

48 (*c*) Saltatory conduction of impulse occurs in myelinated nerve fibres. The fatty myelin sheath of myelinated nerve fibres prevents the flow of ions between external fluid and fluid present within the axon. At the node of Ranvier, the insulating myelin sheath is absent and thus, the ionic flow occurs at these points only. Therefore the action potential jumps from node to node, due to which the transmission of impulse is more rapid in myelinated fibres. This is called the saltatory conduction of nerve impulse.

50 (*a*) A synapse is formed by the membrane of a pre-synaptic neuron and post-synaptic neuron. The space between these two membrane at synapse is called synaptic cleft.

51 (*b*) Synapses are of two types, i.e. electrical synapses and chemical synapses. Electrical synapse is mediated by electrical impulse. It is very fast but rare in humans. On the other hand, chemical synapse is mediated by chemicals such as neurotransmitter.

52 (*c*) Impulse transmission across an electrical synapse is always faster than that across a chemical synapse.

Transmission of an impulse across electrical synapses is very similar to impulse conduction along a single axon. Electrical synapses are rare in our system.

53 (*d*) The fluid-filled space, i.e. synaptic cleft has neurotransmitters (chemicals) released from vesicles and is found in chemical synapse. Electrical synapses do not have neurotransmitters.

55 (*a*) Option (a) is correct. The labels in the figure are

A–Post-synaptic receptor

B–Synaptic cleft

C–Synaptic vesicles containing neurotransmitters

D–Synaptic knob

57 (*d*) The post-synaptic membrane of the synapse of a neuron contains the receptors for neurotransmitters.

58 (*c*) On post-synaptic membrane, the new action potential developed can be excitatory or inhibitory, depending upon the action of neurotransmitter.

59 (*d*) Brain controls the voluntary movements, balance of the body, functioning of vital involuntary organs (e.g. lungs, heart, kidneys, etc.), thermoregulation, hunger and thirst, circadian (24-hours) rhythms of our body, activities of several endocrine glands and human behaviour.

It is the site for processing of vision, hearing, speech, memory, intelligence, emotions and thoughts.

60 (*b*) The human brain is well protected by the skull. Inside the skull, the brain is covered by cranial meninges, comprising of duramater, arachnoid and piamater.

61 (*b*) The correct sequence of meninges from outside to inside is

Duramater → Arachnoid → Piamater

64 (*a*) A deep cleft divides the cerebrum longitudinally into two halves, which are termed as the left and right cerebral hemispheres. The hemispheres are connected by a tract of nerve fibres called corpus callosum.

68 (*d*) Association areas are the regions of brain that are neither clearly sensory nor motor in function. These are responsible for complex functions like intersensory associations, memory and communication.

69 (*a*) The cerebral cortex is referred to as the grey matter. This is due to its greyish appearance. The neuron cell bodies are concentrated here giving it, its grey colour.

71 (*a*) Hypothalamus in the brain thermoregulation, water balance and control of hormone functions. It is located below the thalamus and is a part of limbic system.

72 (*d*) An injury localised to the hypothalamus will disrupt the complete regulation of body temperature. This is because thermoregulation is the ability of an organism to regulate its internal body temperature. It is under the control, of hypothalamus region of brain.

74 (*b*) Option (b) is incorrect pair and can be corrected as Limbic system consists of four major components namely hippocampus, amygdala, septal nuclei and mammilary bodies.

It controls the emotional behaviour, food habits and sex behaviour of an organism. It is not involved in controlling movements.

The rest three options are correctly paired with their functions.

75 (*a*) Forebrain consists of hypothalamus, which controls the urge for eating and drinking.

76 (*b*) The dorsal protion of the midbrain consists of four round swellings (lobes) called corpora quadrigemina. The midbrain is located between the thalamus/ hypothalamus of the forebrain and pons of the hindbrain. A canal called the cerebral aqueduct passess through the midbrain.

78 (*b*) Option (b) is incorrectly matched and can be corrected as

Wernicke's area of brain is involved in language comprehension including understanding of speech and written words. It requires input of sensory information (from hearing and vision), processing of the information in different centres of cerebral cortex and the coordination of motor output. Cerebellum is concerned with posture balance, coordination and speech.

Rest other options are correct.

81 (*c*) Three major regions make up brain stem, i.e. midbrain, pons and medulla oblongata. Brain stem forms the connections between the brain and spinal cord.

84 (*c*) The entire process of response to a peripheral nervous stimulation, that occurs involuntarily, i.e. without conscious efforts or thought and requires involvement of a part of the central nervous system is called a reflex action.

85 (*c*) The reflex pathway comprises at least one afferent neuron, i.e. receptor and one efferent (effector or excitor) neuron appropriately arranged in a series.

88 (*c*) Reflex pathway involves both ANS and CNS. In case of CNS, it may be spinal cord (spinal reflexes; more common) and brain (cerebral reflexes; less common).

89 (*b*) Sweating is not a reflex action. It is the action under the control of brain to lower down body temperature, i.e. homeostasis.

Salivation and withdrawl of hand when pinched by the needle are reflex actions not controlled by brain.

90 (*b*) The correct pathway of reflex arc is

Sensory receptor → Afferent neuron → Dorsal nerve root → CNS → Effector neuron → Effector organs.

91 (*b*) The sensory organs detect all types of changes in the environment and send appropriate signals to the CNS, where all the inputs are processed and analysed. Signals are then sent to different parts/centres of the brain. This is how you sense changes in the environment.

92 (*d*) Option (d) is correct as the nose contains mucus coated receptors which are specialised for receiving the sense of smell called as olfactory receptors. These are made up of olfactory epithelium that consists of three kinds of cells. The neurons of the olfactory epithelium extend from the outside environment directly into a pair of broad bean-sized organs called olfactory bulb, which is extensions of the brains's limbic system.

93 (*c*) The gustatory (tongue) and olfactory (nose) receptors are functionally similar and inter-related. These detect dissolved chemicals. The tongue detects tastes through taste buds, containing gustatory receptors. The nose receives sense of smell through olfactory receptors.

94 (*a*) The eyeball is enveloped by three layers, i.e. sclera layer, choroid layer and retinal layer. Outermost sclerotic layer is white portion of eye which merges with transparent round window called cornea in center. Middle choroid layer lie close to retina and contain light absorbing pigments. Infront, it form ciliary body, which is hidden by iris. Retina, the innermost thin transparent layer appear purplish due to the presence of eye pigment rhodopsin.

95 (*d*) Sclera is the external layer of eyeball is composed of dense connective tissue. It is protective in nature.

96 (*d*) Cornea transplant in humans is almost never rejected. This is because it has no blood supply. Cornea is continuous with the sclerotic, that forms the front part of the vertebrate eye, over the iris and lens.

98 (*a*) The middle layer choroid, contains many blood vessels and looks bluish in colour. The choroid layer is thin over the posterior two-third of the eyeball.

99 (*b*) Ciliary body is the thick anterior part of choroid in the human eye.

The ciliary body itself continues forward to form a pigmented and opaque structure called the iris.

101 (*c*) The eyeball contains a transparent crystalline lens which is held in place by ligaments attached to ciliary body.

102 (*c*) Iris surrounds the aperture known as pupil in the human eye. The diameter of the pupil is regulated by the muscle fibres of iris.

103 (*c*) The inner layer is the retina and it contains three layers of neural cells from inside to outside–ganglion cells, bipolar cells and photoreceptor cells. There are two types of photoreceptor cells, namely rods and cones. These cells contain the light-sensitive proteins called the photopigments.

104 (*b*) It is difficult to differentiate between red and green colour objects in dark or in night because cones which are cells of daylight (photopic) vision and colour vision work well only during daytime. Rods and cones are two types of photoreceptor cells, out of which rods are responsible of twilight (scotopic) vision.

105 (*d*) The rods contain a purplish red protein called the rhodopsin (photosensitive substance) or visual purple, which contains a derivative of vitamin-A.

106 (*d*) In the human eye, there are three types of cones which possess their own characteristic photopigments that respond to red, green and blue lights. The sensations of different colours are produced by various combinations of these cones and their photopigments.

108 (*c*) Blind spot is the region as retina where there is absence of photoreceptor cells, thus called blind spot. At this region, no image is formed.

109 (*a*) The optic nerves leave the eye and the retinal blood vessels enter it at a point medial to and slightly above the posterior pole of the eyeball known as blind spot.

111 (*d*) Option (d) is incorrect pair. It can be corrected as The fovea is the thinned out portion of retina where only the cones are densely packed. It is the point where the visual acuity (resolution) is the greatest.

112 (*c*) Aqueous chamber is the space between the lens and the cornea. This space is filled with aqueous humour which is a transparent, gelatinous fluid similar to plasma, but it contain low-protein concentration. It is secreted from the ciliary epithelium, a structure supporting the lens.

114 (*a*) Option (a) is correct as

A–**Retina**—contains photoreceptors, i.e. rods and cones. The day light vision is function of cones and twilight vision is related to rods.

Other options can be corrected as follows

B–**Blind spot**—photoreceptor cells are not present in this part.

C–**Aqueous chamber**–contains a thin watery fluid called aqueous humour. It reflect light, so that it can pass through the lens.

D–**Sclera** is the external layer of eye having dense connective tissue.

116 (*a*) The photosensitive compounds (photopigments) in the human eyes is composed of opsin (a protein) and retinal (an aldehyde of vitamin-A).

117 (*d*) Option (d) is correct which can be explained as when the light rays of visible wavelength focussed on the retina through the cornea and lens, the photopigment (rhodopsin) dissociates into opsin and retinal. This causes membrane permeability change. As a result potential difference are generated in the photoreceptor cells.

119 (*a*) The pinna collects the vibrations in the air, which produce sound. There are present very fine hairs and wax secreting glands in the skin of pinna.

120 (*b*) The tympanic membrane (eardrum) separates the tympanic cavity from the external auditory meatus. The tympanic membrane is composed of connective tissues covered with skin outside and with mucous membrane inside.

121 (*d*) The middle ear contains three ossicles namely malleus, incus and stapes. These are attached to one another in a chain-like fashion.

124 (*d*) A Eustachian tube connects the middle ear cavity with the pharynx. The Eustachian tube helps in equalising the pressures on either sides of the eardrum.

127 (*a*) Option (a) is incorrect pair. It can be corrected as The fluid-filled inner ear called labyrinth consists of two parts, the bony and the membranous labyrinths. The bony labyrinth is a series of channels. Inside these channels lie the membranous labyrinth, which is surrounded by a fluid called perilymph. The membranous labyrinth is filled with a fluid called endolymph.

128 (*b*) The organ of Corti is a structure located on the basilar membrane which contains hair cells that act as auditory receptors. The hair cells are present in rows on the internal side of the organ of Corti.

131 (*d*) Option (d) is correct, which can be explained as the inner ear contains vestibular apparatus composed of three semi-circular canals and the otolith. Each semi-circular canal lies in a different plane at right angles to each other. The membranous canals are suspended in the perilymph of the bony canals. The base of canals is swollen and is called ampulla, which contains a projecting ridge called crista ampullaris which has hair cells. The saccula and utricle contain a projecting ridge called macula. The crista and macula helps in maintaining balance of body and posture.

132 (*d*) Crista ampullaris and macula present in the inner ear are the specific receptors of the vestibular apparatus. Which are responsible for maintening balance of the body and posture.

133 (*c*) The vestibular apparatus (located above the cochlea) has no role in hearing, but it is influenced by gravity and movements. Its specific receptors called Crista and macula are responsible for the maintenance of balance of the body and posture, thus are very much required.

134 (*b*) A gymnast is able to balance his body upside down even in total darkness because of vestibular apparatus. It is an intricate series of interconnected and fluid-filled canals which regulates balance and spatial orientation. In the absence of vision, the movement of body is regulated by vestibular apparatus.

136 (*a*) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

The pre-synaptic neuron transmits an impulse (action potential) acrosses the synaptic cleft to the post-synaptic neuron. This occurs *via* a sequence of events occurring at the synapsis and due to the presence of neurotransmitters. As the impulse comes at the pre-synaptic membrane, the neurotransmitters get attached to neuroreceptors on the pre-synaptic membrane and thereby changing its potential and opening the ion channels.

This allows Ca^+ ions to get into the pre-synaptic lobe which causes the release of neurotransmitters into the synaptic cleft. These then moves towards the post-synaptic neuronal membrane. Here, again the neurotransmitters bind to the complementary receptors on the post-synaptic membrane. The increase in the concentration causes the ion channels of post-synaptic neuron to open allowing Na^+ ions to diffuse into the post-synaptic neuron thereby creating potential difference and generation of action potential in post-synaptic neuron.

137 (*a*) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

Neurons are excitable cells because their membranes are in a polarised state. This means that there is an electrical difference across the cell membrane, i.e. the electrical charge on the outside of the membrane is positive, while the electrical charge on the inside of the membrane is negative.

138 (*a*) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

The neuroglial cells are of three types, i.e. astrocytes, oligodendrocytes and microglia. Out of these, oligodendrocytes are the cells which form the myelin sheath around axon, thus are also called the packing cells of the brain. The other cells like astrocytes are responsible for the separation of two neurons by providing insulation and microglia are phagocytic cells. Nearly 50% of all brain cells are neuroglia.

139 (*a*) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

Arrival of an impulse at the axon terminal, stimulates the release of neurotransmitters in the synaptic cleft because neurotransmitters bind to specific receptors on the membrane and change the membrane potential of the neuron which opens the ion channels.

140 (*a*) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

The plasma membrane of the neuron is polarised, i.e. there is positive charge outside of the membrane and negative charge on the inside of the membrane. This difference in charge in due to the selective permeability of the membrane, i.e. the Na-K pump transfer $3Na^+$ outside for $2k^+$ ions inside the neural membrane. The difference in the positive potential created due to this makes the membrane less positive inside which is normally termed negative inside with respect to outside.

141 (*b*) Both Assertion and Reason are true, but reason is not the correct explanation of Assertion.

The axoplasm inside the axon contains high concentration of K^+ and negatively charged proteins because the voltage gated Na-K channels are closed at resting state and axonal membrane is impermeable to Na^+ ions and negatively charged proteins.

142 (*d*) Assertion is false, but Reason is true and Assertion can be corrected as

The layer of cells which covers the cerebral hemispheres is called cerebral cortex and is thrown into prominent folds. It is referred to as the grey matter. It is called grey matter due to its greyish appearance. Neuron cell bodies are concentrated here which give it the greyish appearance.

143 (*a*) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

Autonomic nervous system includes sympathetic nervous system and parasympathetic nervous system. These two systems have antagonistic functions. Iris muscles, under sympathetic nervous system dilates pupil, while under parasympathetic nervous system constricts pupil.

144 (*a*) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

Iris is the muscular covering in the front of the eye between the cornea and the lens that is perforated by an opening called the pupil. Iris is made up of two groups of smooth muscle that regulates the diameter of pupil, i.e. decrease or constrict the size of the pupil in order to control the light entering the eye.

145 (*a*) Statement in option (a) is correct.
Neurons regulate the endocrine activity, but endocrine activity do not regulates the neural activity.

Rest statements are incorrectly written.

148 (*c*) Statements I, II and III are true for a neuron not conducting any impulse, i.e. resting.

Statement IV is false and can be corrected as

The fluid outside the axon contains a low concentration of K^+, a high concentration of Na^+ and thus, form a concentration gradient.

150 (*d*) Statements I and II are correct because
A neuron is said to be in resting state when it do not conduct an impulse and possess positive charge outside with respect to the inside of the plasma membrane. The statements III and IV are incorrect for neuron at resting state.

151 (*a*) Statement I is true and II is false and it can be corrected as

The resting membrane potential at the site of excitation is restored by K^+ ions and not by Na^+ and Cl ions.

These ions diffuses rapidly outside the membrane and thus, the outer surface become positively charged, while the inner surface become negatively charged.

152 (*c*) Statements I, III and IV are correct. Statement II is incorrect and can be corrected as
For grey matter of brain as it does not contain medullated portion of nerve fibre, rather have cell bodies of nerve fibres. Grey matter is grey in colour and is present outside the white matter in brain.

154 (*c*) Statements I, II and IV are correct.
Statement III is incorrect for the cortex or outer part of cerebrum. It can be corrected as
This is because white matter refers to the inner part of cerebral hemisphere or cerebrum and grey matter refers to the outerpart or cortex of cerebrum.

155 (*d*) All statements are correct. Midbrain is located between the thalamus/ hypothalamus of the forebrain and pons of the hindbrain. A canal, called the cerebral aqueduct passes through the midbrain. The dorsal portion of the midbrain consists of four round swellings (lobes) called corpora quadrigemina.

158 (*c*) Statetment in option (c) is incorrect and can be corrected as
Retinal is a derivative of vitamin-A. Retinal pigment of epithelium shields the retina from excess incoming light. It supplies omega-3 fatty acid and glucose to the retina.

160 (*c*) Statements in option (c) is incorrect and can be corrected as
Rods and cones are photoreceptor cells in our eyes. The rod cells contain a purple pigment rhodopsin that is useful in night vision or scotopic vision. Daylight (photopic) vision and colour vision are the functions of cones.

161 (*c*) Statement in option (c) is correct.
Cornea consists of dense matrix of collagen and is the most sensitive portion of the eye.
Rest statements are incorrect and can be corrected as
- The outer layer of the wall of eyeball, sclera, consists of a dense connective tissue containing mainly collagen and some elastic fibre.
- Cornea is convex, transparent layer which is non-vascularised.
- The cornea is the clear part of eye's protective covering.

162 (*b*) Statements I, III and IV are correct. Statement II is incorrect and can be corrected as
The photopigments (e.g. rhodopsin) are embedded in the membrane discs of the outer segment in the retina.

166 (*c*) Statement in option (c) is correct. Other statements are incorrect and can be corrected as
Nociceptors are pain receptors and meissner's corpuscles are light sensitive. Receptors produces graded potentials.

174 (*b*) Neurotransmitters, e.g. acetylcholine are the chemical which are present in the synaptic vesicles at axon terminals. These are involved in the transmission of impulses at the chemical synapses.

176 (*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^+ outward for every $2K^+$ into the cell.

177 (*b*) Sympathetic and parasympathetic neural system control all the functions of visceral organs of the body. These two systems are the part of autonomic nervous system.

178 (*c*) Brain is not involved in knee-jerk reflex as it is an example of spinal reflex. While the muscle spindle, inter neuron and motor neuron are the part of reflex arc.

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

180 (*a*) Option (a) is correct.
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).

181 (*b*) Human eyeball consists of three layers, i.e. sclera, choroid and retina. These layers enclose lens, aqueous humor and vitreous humor.

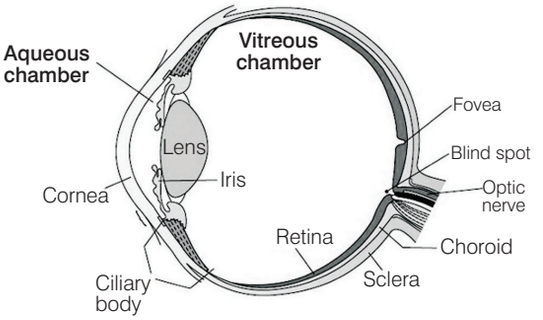


Diagram showing parts of an eye

183 (*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.

184 (*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 called basilar membrane. Organ of Corti are present on the sensory ridge of basilar membrane.