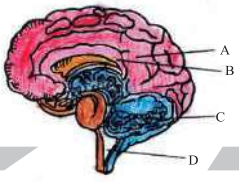


Chapter - 21 Neural Control and Coordination

Points To Remember

Coordination : Process through which two or more organs interact and complement the functions of one another surrounding the brain.

Action potential : A sudden change in the electrical charges in the plasma membrane of a nerve fibre.

Aqueous humour : The thin watery fluid that occupy space between lens and cornea in eye.

Blind spot : A spot on retina which is free from rods and cones and lack the ability for vision.

Cerebrospinal fluid : An alkaline fluid present in between inner two layers of meninges, surrounding the brain and spinal cord.

Cerebellum : A part of hind brain that controls the balance and posture of the body.

Cochlea : A spirally coiled part of internal ear which is responsible for hearing.

Corpus callosum : A curved thick bundle of nerve fibres that joins two cerebral hemisphere.

Depolarisation : A condition when polarity of the plasma membrane of nerve fibre is reversed.

Endolymph : The fluid filled within membranous labyrinth.

Eustachian Tube : A tube which connect ear cavity with the pharynx.

Fovea : An area of highest vision on the retina which contain only cones.

Meninges : Three sheets of covering of connective tissue wrapping the brain.

Gray Matter : This is the area of processing : Contains cell bodies and their dendrites (of neurons)

White matter : It provides communication between the grey matter and the rest of the body. Consists of bundles of axons.

Medula oblongata : Posterior most part of the brain which is continuous with spinal cord and control respiration, heart rate,swallowing,vomiting.

Pons : Thick bundles of fibres on the ventral side of brain below cerebellum.

Foramen magnum : A big aperture in the skull posteriorly through which spinal cord emerges out.

Spinal cord : A tubular structure connected with medulla oblongata of brain and situated in the neural canal of the vertebral column, covered by meninges.

Synaptic cleft : A narrow fluid filled space which separates two membranes of the two neurons at the synapse.

Synaptic vesicles : These are membrane bound vesicles in the axoplasm of the axon terminal and they store neurotransmitter.

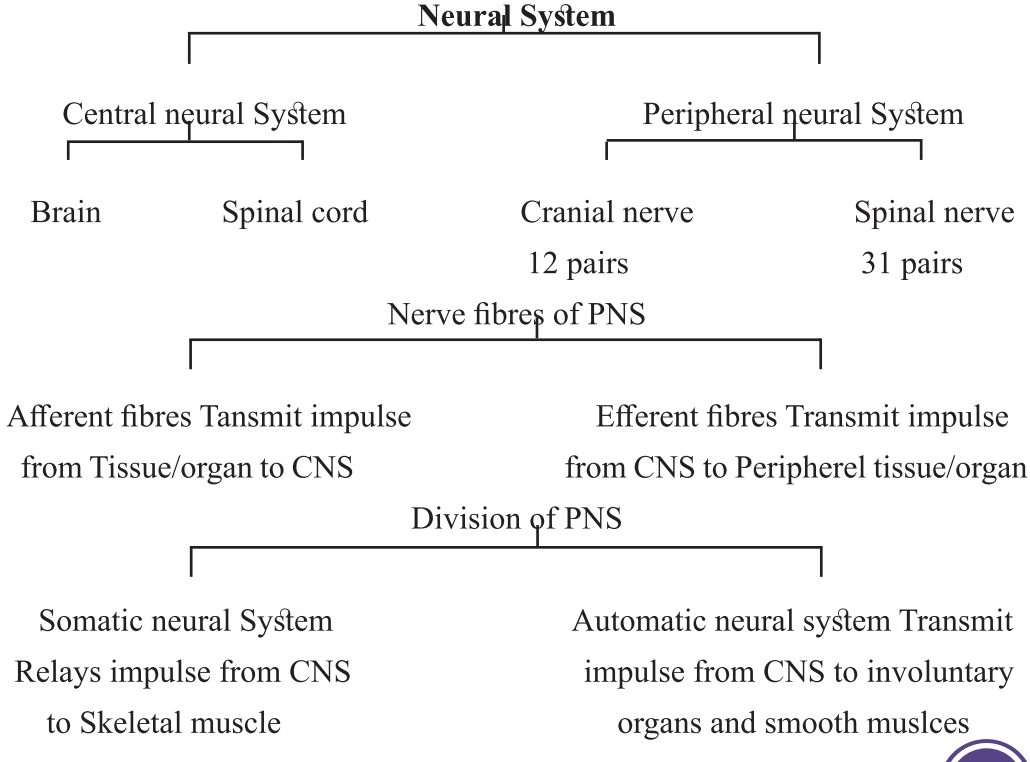
Neurotransmitter : These are chemicals stored in synaptic vesicles, diffuse to reach the membrane of next neuron for its stimulation.

Synapse : A physiological junction between axon of one neuron and dendrite of next neuron.

CNS—Central neural system

PNS—Peripheral neural system

ANS—Autonomic neural system



Visceral Nervous System : whole complex of nerves, fibres, ganglia and plexuses by which impulses travel from CNS to the viscera and from viscera to CNS

Parts of Neuron
- Cell body = Cytoplasm with nucleus, cell organelles and Nissl's granules
- Dendrites = Short fibres which branch rapidly and project out of cell
- Axon = Single, long fibre, branched at distal end

(Refer fig. 21.1, page 317, NCERT - Biology, Class-XI)

Neuron
- Multipolar = : One axon and two or more dentrites
  : Found in cerebral Cortex
- Bipolar = : One axon and one dendrite
  : Found in retina of eye
- Unipolar = : Cell body with axon only
  : Found usually in the embryonic stage

Conduction of Nerve Impulse

Polarization : Resting potential

- Before stimulation axoplasm contain –vely high concentration of K+ and low concentration of Na+ Inner surface is –vely charged.
- Fluid outside axon – low concentration of K+ and high concentration of Na+. Outside the membrane is + vely charged.
- Most membrane channels are closed.

Depolarization: Action potential

- Stimulation of nerve.
- Permeability of membrane to Na+ increases.
- Na+ channels opens allowing Na+ to diffuse into the cell quickly.
- As a result inside become +ve and outside -ve.

Repolarization : Normalising

- K+ gates open in order to allow K+ to diffuse out of the axon. This restores the membrane. (+ve outside -ve inside)

Transmission of Impulses at Synapse

(i) At electrical synapses : Here the membrane of pre and post-synaptic neuron are in very close proximity. Electric current can flow directly from one neuron into other across these synapses, like impule conduction along a single axon.

(ii) At chemical synapses : Here the membrane of pre and post-syneptic neuron are separated by fluid filled space called synaptic cleft. Neurotransmitter are involved here.

When an impulse arrives at the axon terminal, it stimulates the movement of the synaptic vesicles towards membrane and they fuse with the plsama membrane and release their neurotransmitter in the synaptic cleft. These chemicals bind to specific receptors, present on the post-syneptic membrane. Their binding opens ion channels and allow the entry of ion which generate new potential in post synaptic neuron.

Human brain : Human brain is the major portion of central neural system. Which is well protected by the skull.

The brain is surrounded by three cranial meninges—

(i) Duramater—outer layer

(ii) Arachnoid—middle layer

(iii) Piamater—Inner layer-remain incontact with brain

Parts of Brain

Fore brain	Mid brain	Hind brain
(a) Cerebrum		(a) Cerebellum
(b) Thalamus		(b) Pons
(c) Hypothalamus		(c) Medulla oblongata

Functions of pars of brain :

Cerebrum : Centre of intelligence, memory and imagination, reasoning, judgement, expression of will power.

Thalamus : Acts as relay centre to receive and transmit general sensation of pain, touch and temperature.

Hypothalamus : Centre for regulation of body temperature, urge for eating and drinking.

Midbrain : Responsible to coordinate visual reflexes and auditory reflexes.

Cerebellum : Maintains posture and equilibrium of the body as well as coordinates and regulates voluntary movement.

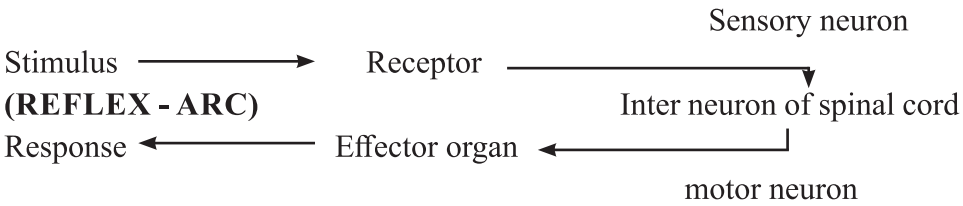
Pons : Relays impulses between medulla oblongata and cerebral hemisphere and between the hemisphere of cerebrum and cerebellum. It also heps to regulate breathing.

Medulla oblongata : Centre that control heart beat, breathing, swallowing, salivation, sneezing, vomitting and coughing.

Reflex action : It is spontaneous, autonomic and mechanical response to a stimulus that occurs at the level of spinal cord, without involvement of brain.

Reflex arc : The flow of nerve impulse along the specific, path during reflex action. It consist of—

(a) A receptor
(b) An Afferent neuron (sensory neuron)
(c) An inter neuron
(d) An efferent neuron (motor neuron)
(e) An effector organ



Organ of Sight-Eye

Layer	Component	Function
1. External layer	Sclera	Protects and maintain shape of the eye ball
	Cornea	Outermost transparent portion of eye which allows light to enter
2. Middle layer	Choroid	Absorb light and prevent light from being reflected within the eye ball.
	Ciliary body	Holds lens, regulate shape of the lens.
	Iris	Control amount of light entering.
3. Inner layer	Retina	Vision in dim light, colour vision, vision in bright light. Sends the image to brain through optical nerves.

(Refer-Fig. 21.6, Page 323 NCERT-Biology, Class XI)

Organ of Hearing–Ear

Portion of the ear	Component	Function
1. External ear	Pinna	Collect sound waves
	External auditory canal	Direct sound waves towards ear drum, ear wax prevents the entry of foreign bodies.
2. Middle ear	Tympanic membrane	Acts as resonator that reproduces the vibration of sound.
	Ear ossicles	Transmit sound waves to internal ear.
	Eustachian tube	Helps in equalising the pressure on either side of ear drum.
3. Internal ear	Cochlea	Hearing organ.
	Vestibular apparatus	Balancing of body.

(Refer Fig. 21.7, page 325-NCERT-Biology, Class XI)

Organ to smell – Nose (Factor Organ)

NOSE

Olfactory Epithelium

Olfactory Receptors – Receives sense of smell (air/chemicals)

(mucus coated)

↓

Olfactory Neurons

↓

Olfactor bulbs (limbic system of brain)

Organ to Taste – Tongue (Gustatory Organ)

TONGUE

Papillae

↓

Taste buds

↓

Gustatory Nerves

↓

Brain (integrates the differential inputs from taste buds).

Questions

(SRT) Select Response Type Question (1 mark each)

1. Name the fluid present in the membranous Labyrinth
   (a) hemolymph (b) endolymph
   (c) myolymph (d) peri lymph
2. Name the area of retina where only cones are densely packed
   (a) Sclera (b) choroid
   (c) fovea (d) iris
3. Name the innermost meninges of the brain?
   (a) duramater (b) arachnoid
   (c) piamater (d) pieuron

CONSTRUCTED RESPONSE TYPE (CRT)

Very Short Answer Questions (1 mark each)

4. To which part of the brain communication and memory are associated ?
5. Name the bundle of fibres that connect two cerebral hemisphere in human being.
6. Name the photo pigment present in the rod cells.
7. Why do impulses flow only in one direction ?
8. Where is hypothalamus located in the brain ?
9. Which cells are responsible for scotopic vision?

Short Answer Questions-I (2 marks each)

10. Distinguish between electrical synapses and chemical synapses.
11. What is iris ? Give the function of iris.
12. What is organ of corti ? Where is it located ?
13. Differentiate between cerebrum and cerebellum.
14. What is synapse ? Name its two types.

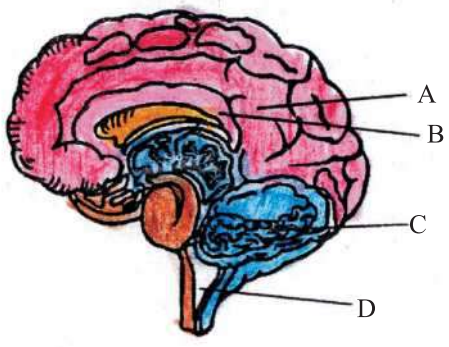
15. Fill in the blanks in the different columns A to D :

Part/Organ	Function
Pinna	.....(A).....
.....(B).....	Equalise the pressure on either side of ear drum.
Cone cells	.....(C).....
.....(D).....	regulate amount of light to pass into the eye.

16. Why are grey matter and white matter contained in human nervous system named so ?

Short Answer Questions-II (3 marks each)

17. Observe the diagram given below and answer the following questions :



(i) Label the parts A, B, C & D.

(ii) Give the function of C and D.

(iii) Name the layers which wrap this organ.

18. What is a synapse ? How does the nerve impulse cross the chemical synapse ?

19. Give the function of the following :

(i) Cerebrum (ii) Hypothalamus (iii) Mid brain

20. What is meant by reflex action ? Name the components of a reflex arc in correct sequence from receptor upto effector. Support your answer by a diagram.

21. Draw a diagram of V.S. of human eye and label the following :

Iris, Retina, Cornea, Blind spot, Ciliary body and Vitreous chamber.

Long Answer Questions (5 mark each)

22. Describe in detail, how conduction of nerve impulse takes place through a nerve fibre.

Case Study based questions :

23. Read the following and answer any four questions from 23 (i) to 23 (v) given below :

Ajinomoto, the most popular ingredients commonly used in Chinese dishes as a taste enhancer is otherwise known as mono sodium glutamate (MGS). Excessive consumption of Ajinomoto can cause various harmful effects such as hypertension, effect on Brain and nerves, nausea, headache, sleeping disorders and cancer. As glutamate can serve as a neurotransmitter, high intake of MSG can adversely affect the brain and nerves. In our body neurotransmitters are involved in carrying nerve impulses across a chemical synapse. Common neurotransmitters are epinephrine, adrenaline, acetylcholine, dopamine and GABA. When an impulse arrives at the axon terminal, it stimulates the movement of synaptic vesicles towards the presynaptic membrane, where they fuse and release their neurotransmitters in the synaptic cleft. Now these neurotransmitters bind to their specific receptors present on the postsynaptic membrane, which opens ion channels. Thus signal is transmitted across the synapse. In electrical synapse signal can flow directly from one neuron to another.

(i) Identify the harmful effects of excessive consumption of ajinomoto :

(a) Hypertension

(b) Headache

(c) Effects nerves

(d) All of them

(ii) Ajinomoto serves as a _____ neurotransmitter :

(a) Glutamate

(b) GABA

(c) Dopamine

(d) Acetyl choline

(iii) Interaction between neurons occurs commonly across junctions called :

(a) Action potential (b) Synapse

(c) Axon terminal (d) Juxtaposition

(iv) Receptor site for neurotransmitters are present on :

(a) Presynaptic membrane

(b) Tips of axons

(c) Postsynaptic membrane

(d) Membrances of synaptic vesicles

(v) **Assertion :** Transmission of nerve impulse across a synapse is accomplished by neurotransmitters.

Reason : Transmission across a chemical synapse usually requires neurotransmitters because there is a small space, synaptic cleft that separates one neuron from another.

(a) Both assertion & reason are true, and the reason is the correct explanation of the assertion.

(b) Both assertion and reason are true, but the reason is not the correct explanation of the assertion.

(c) Assertion is true but reason is false

(d) Both the assertion and reason are false

(SRT) Assertion and Reason type Questions-II : (1 mark each)

In each of the following questions, two statements are given, one is Assertion and other is Reason. Mark the correct answer as :

(a) Both assertion & reason are true, and the reason is the correct explanation of the assertion.

(b) Both assertion and reason are true, but the reason is not the correct explanation of the assertion.

(c) Assertion is true but reason is false

(d) Both the assertion and reason are false

24. **Assertion :** The space between the cornea and the lens is called the vitreous chamber.

Reason : The space between the lens and retina is called the aqueous chamber.

25. **Assertion :** The Eustachian tube helps in equalizing the pressure on either side of the ear drum.

Reason : The Eustachian tube connects the middle ear cavity with the pharynx.

Answers

(SRT) Select Response Type Question (1 mark each)

1. (b) Endolymph
2. (c) Fovea
3. (c) Piameter

CONSTRUCTED RESPONSE TYPE (CRT)

Very Short Answers (1 mark each)

4. Cerebrum
5. Corpus callosum
6. Rhodopsin
7. Because each synapse allows impulse to cross it in a single direction.
8. At the base of thalamus.
9. Rods

Short Answers-I (2 marks each)

10. Refer Point to remember of support material.
11. Refer Point to remember of support material.
12. Refer Point to remember of support material.
13. Refer Point to remember of support material.
14. Junction between two nerves Chemical synapse and electrical synapse
15. (A) To collect sound waves (B) Eustachina tube
    (C) Colour vision (D) Iris
16. Refer Point to remember of support material.

Short Answers-II (3 marks each)

17. (i) A : Cerebrum C : Cerebellum

B : Corpus callosum D : Medulla oblongata

(ii) C : Balancing of body and maintain posture

D : Vomiting , coughing, breathing, salivation or any other correct answer (anyone).

(iii) Pia mater, arachnoid and dura mater.

18. Refer Point to remember of support material.

19. Refer Point to remember of support material.

20. Refer Point to remember of support material.

21. Refer Point to remember of support material.

Long Answer (5 marks)

22. Refer Point to remember of support material.

23. (i) (d) All of them

(ii) (a) Glutamate

(iii) (b) synapse

(iv) (c) post synaptic membrane

(v) (a) Both assertion & reason are true, and the reason is the correct explanation of the assertion

Assertion Reason Type II Answer.

24. (d) Both the assertion and reason are false

25. (a) Both assertion & reason are true, and the reason is the correct explanation of the assertion.