

Students Learning Outcomes

After Studying this chapter, students will be able to:

- Describe the nervous system and its role.
- Discuss the central nervous system and peripheral nervous system.
- Outline the types of neurons with diagrams.
- Define a stimulus with examples.
- State that nerve impulses are electrical signals that travel across neuron.
- Define and sketch synapses.
- Introduce neurotransmitters.
- Explain through sketching a diagram the involvement of the nervous system when a person accidentally touches something painfully hot and withdraws their hands as a reflex.
- Explain the endocrine system.
- Identify the major endocrine glands and hormones with their functions.

Subjective Type Questions

Long Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

Q.1: Define Coordination. Briefly explain the components of coordinated action.

Ans. Coordination: Coordination means integration among different parts of the body and their response to stimuli in order to keep harmony with the environment.

Coordinated action: A coordinated action has five components:

(i) Stimulus (ii) Receptor (iii) Coordinator (iv) Effector (v) Response

- **Stimulus:** Any change in external or internal environment, which can initiate a response in the body is called a stimulus.

Examples: Touch, light, sound, heat, cold, pressure, infection etc are the stimuli.

- **Receptor:** The organ, tissue or cell which receives stimuli is called the receptor. Receptors send the messages of stimulus to coordinators.

Example: Ears are the receptors for the stimulus of sound.

- **Coordinator:** A coordinator receives information from receptors and sends messages to particular organs for proper action.

Example: In nervous coordination, brain and spinal cord are coordinators. In chemical coordination, endocrine glands are the coordinators.

- **Effectors:** These are the parts of the body which receive coordinator's message and perform specific actions.

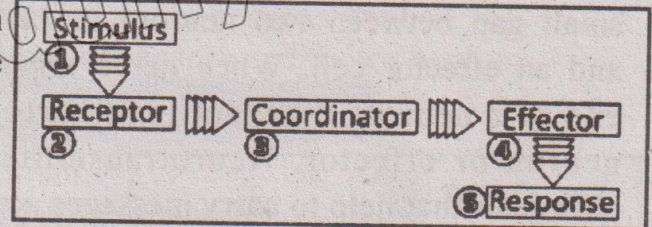
Q. Define Synapse.

Ans. The junction between two neurons and between a neuron and another cell is called synapse.

Example: In nervous coordination, muscles and glands are the effectors. While in chemical coordination, different tissues of the body act as effectors.

- **Response:** A response is the action performed by effectors, on receiving the message from coordinator.

Example: Pulling our hand away from something very hot is a response.



5.1 Neurons - The units of Nervous System

Q.2: Describe the structure of a neuron and support your answer with a labeled diagram.

Ans. Neurons: Neurons or nerve cells are the cells that transmit messages in the body in the form of nerve impulses.

Nerve impulse: It is a wave of electrochemical changes that travels across the membranes of neurons.

Structure of Neuron:

Major structural Components: A neuron consists of three major parts:

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

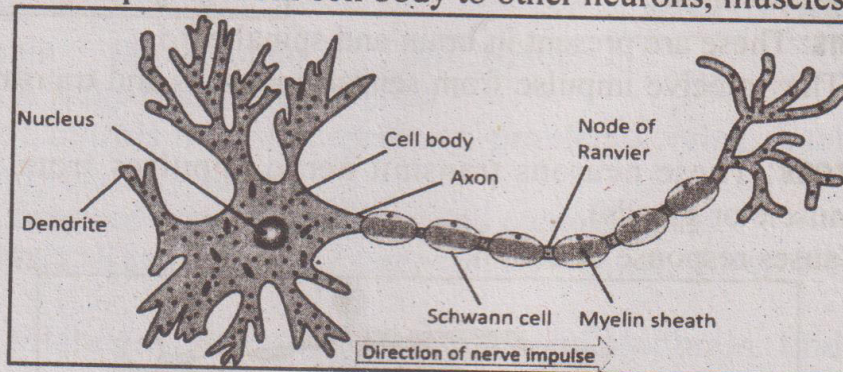
Cell body: The cell body contains the nucleus, other organelles and most of cytoplasm.

Dendrites: Small branches which project from the cell body are called dendrites. They transmit nerve impulse towards cell body.

Axon: Axon is a long branch from cell body. Its terminal end is further branched. Axon transmits nerve impulses from cell body to other neurons, muscles or glands:

Q. In central nervous system which parts of neuron form gray and white matter?

Ans. In the Central Nervous System (CNS), myelinated axons form the white matter, and the non-myelinated axons, dendrites and cell bodies form the grey matter



A Model Neuron (Motor)

Cells of neurons: Neurons are supported by specialized cells called neuroglia.

Example: Schwann cells are a type of neuroglia.

Myelin Sheaths: Schwann cells produce insulating covering called myelin sheaths over the membrane of axons.

Myelinated and non-myelinated axons: Axons which are covered by myelin sheath are called myelinated. The axons which are not covered with myelin sheath are called non-myelinated.

Nodes of Ranvier: The myelin sheath is interrupted at intervals by small gaps called nodes of Ranvier.

Q.3: Explain briefly Synapse and Neurotransmitters.

Ans. Synapse and Neurotransmitters: A synapse is a small gap between two neurons or between a neuron and an effector cell. When nerve impulse reaches the end of a neuron, it cannot jump directly to the next neuron or effector. Neurotransmitters are special chemicals that help to carry messages across a synapse.

When a nerve impulse reaches the end of a neuron, it releases neurotransmitters. They travel across the synapse and attach to the next neuron or effector cell. It helps the nerve impulse continue its journey.

Examples of neurotransmitters include dopamine serotonin and acetylcholine

Q.4: What are the differences and similarities among the three types of neurons.

Ans. Similarities among all types of Neurons:

- (i) All types of neurons have same basic structure i.e. dendrites, cell body and axons.
- (ii) They are all designed to transmit electrical signals called nerve impulses.
- (iii) They all communicate through synapses and neurotransmitters to pass messages to next cells.
- (iv) All neurons are supported by specialized cells, called neuroglia.

Differences among the types of Neurons:

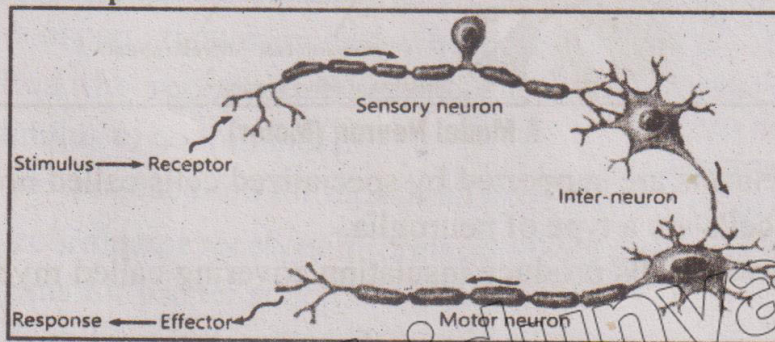
- (i) **Sensory Neurons:** They transmit nerve impulses from receptors to the CNS (central nervous system).
Function: Detect stimuli.

- (ii) **Inter-neurons:** These are present in brain and spinal cord.

Function: They receive impulse from sensory neurons and transmit them to motor neurons.

- (iii) **Motor neurons:** These neurons transmit nerve impulses from inter-neurons to effectors (muscle or glands).

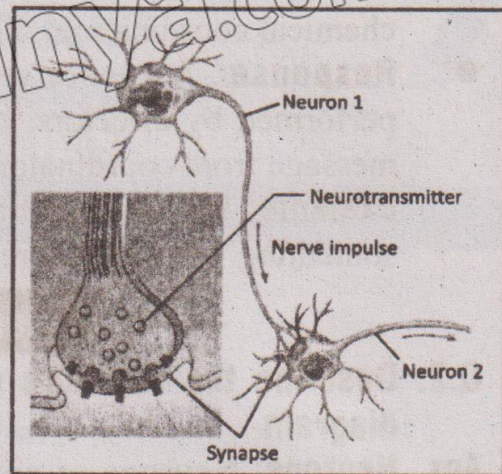
Function: Causes response or action.



Types of Neuron

Q.5: What are nerves? How different types of nerves are helpful in coordination and communication.

Ans. Nerve: A nerve is a collection of axons that are enveloped by a covering or connective tissue.



Nerves arise from brain and spinal cord make the Peripheral Nervous System (PNS).

Types of Nerves:

- (i) **Sensory nerves:** Sensory nerves contain the axons of sensory neurons only.
- (ii) **Motor nerves:** Motor nerves contain the axons of motor neurons only.
- (iii) **Mixed nerves:** Mixed nerves contain the axons of sensory and motor neurons.

5.2

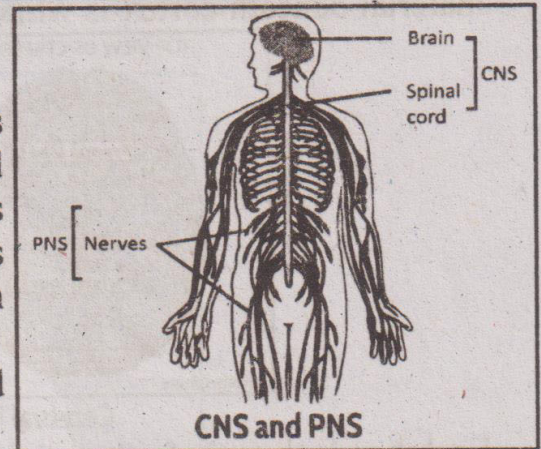
Divisions of the Nervous System

Q.6: Briefly describe the division of nervous system.

Ans. Divisions of the Nervous System:

There are two major components of nervous system i.e., central nervous system (CNS) and peripheral nervous system (PNS). The CNS comprises of brain and spinal cord. The PNS consists of nerves that arise from brain and spinal cord and spread in different parts of body.

All these components are made of neurons and supporting (neuroglial) cells.



Q.7: Write the major functions of the forebrain, midbrain and hindbrain.

Ans. Brain: Brain is present inside cranium (Part of skull).

Meninges: Inside cranium, brain is covered by three layers of membranes, collectively called meninges. Meninges protect the brain from harmful substances.

Ventricles: Brain contains fluid-filled cavities called ventricles. The ventricles of brain are continuous with the central canal of spinal cord. Fluid within ventricles and central canal is called cerebrospinal fluid (CSF).

Major parts of brain: The brain can be divided into three major parts:

- (i) Forebrain (ii) Midbrain (iii) Hindbrain

(i) **Forebrain:** It is the largest area of brain.

Cerebrum: Controls thinking, speaking, problem solving, intelligence, feelings, learning and voluntary actions.

Thalamus: Involved in pain perception and consciousness.

Hypothalamus: Regulates body temperature, hunger, thirst, sleep and emotional stress.

(ii) **Midbrain:** Midbrain connects the forebrain and hindbrain. Midbrain enables the body to make adjustments to movements. It is also responsible for sleep/wake, alertness and temperature regulation.

(iii) **Hindbrain:** Hindbrain consists of medulla oblongata, cerebellum and pons.

Cerebellum: Coordinates balance and muscle movement.

Medulla oblongata: Controls autonomic functions such as heartbeat, heart rate, breathing and blood pressure. It also controls reflexes such as vomiting, coughing, sneezing.

Pons: Pons regulates alertness, sleep and wakefulness.

Q.8: Write a descriptive note on forebrain also explain its major parts.

Ans. Forebrain: It is the largest area of brain. Following are the major parts of this

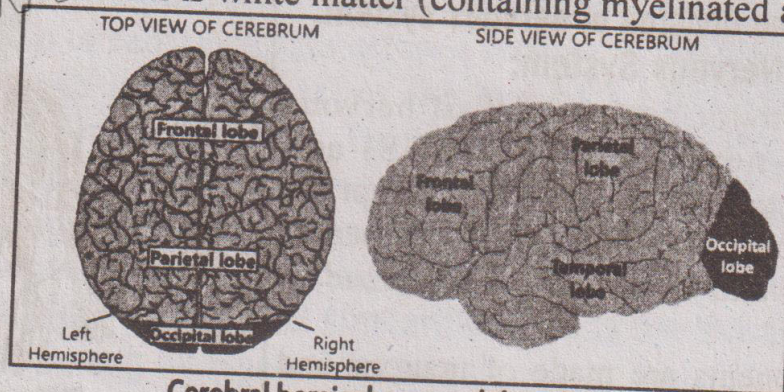
Q. What is the weight of average adult human brain?

Ans. The average adult human brain weighs 1.4 kg, or about 2% of total body weight. It contains about 100 billion neurons.

region:

- (i) Cerebrum 2. Thalamus 3. Hypothalamus

1. **Cerebrum:** Cerebrum is the largest part of forebrain. A deep groove (longitudinal tissue) divide the cerebrum into right and left cerebral hemispheres. The upper layer of both hemispheres is highly folded and is called cerebral cortex. It is made of grey matter (containing cell bodies and non-myelinated axons). The material beneath cortex is white matter (containing myelinated axons).



Cerebral hemispheres and the 4 lobes

- Each hemisphere is further divided into four lobes.
- (i) **Frontal lobe** contains regions for problem solving, judgment, speaking and movements.
 - (ii) **Parietal lobe** has regions for language and touch.
 - (iii) **Temporal lobe** contains regions which deal with memory, learning, feelings and hearing.
 - (iv) **Occipital lobe** has regions for vision and color perception.

Q. How messages are received in brain?
Ans. Each hemisphere receives information from the opposite side of the body and sends message to that side. For example, the sensation of a touch on the right hand is received by the left hemisphere.

Thalamus: Thalamus is a structure wrapped by the cerebrum.

Function: It conveys information coming from receptors to the cerebrum. Thalamus is also involved in pain perception and consciousness.

Hypothalamus: It lies above midbrain and just below thalamus. In human, it is about the size of an almond.

Function: It regulates body temperature, hunger, thirst, sleep and emotional states. It also controls the secretions of the major endocrine gland i.e. pituitary gland.

Q.9: Explain the structure and functions of the midbrain and hindbrain.

Ans. Midbrain: The midbrain is located between forebrain and hindbrain, So, it is a bridge between these two parts.

Function:

- (i) Midbrain conveys information between forebrain and hindbrain.
- (ii) It enables the body to make adjustments to movements.
- (iii) It is responsible for sleep/wake, alertness and temperature regulation.

Hindbrain: Hindbrain consists of three parts. It controls all automatic body functions.

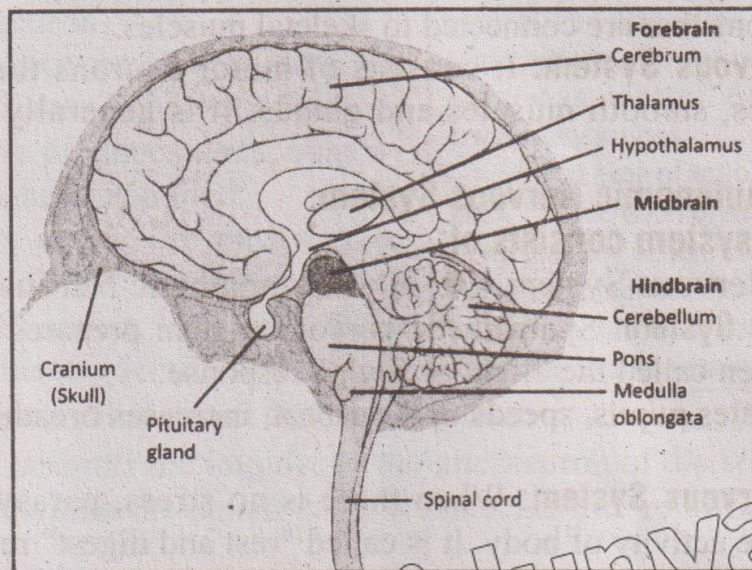
- (i) **Medulla oblongata:** It is on the top of the spinal cord. It transmits impulses between spinal cord and the higher parts of brain. It controls autonomic functions such as heartbeat, heart rate, breathing and blood pressure it also controls reflexes such as vomiting, coughing and sneezing.

(ii) **Cerebellum:** It is behind medulla oblongata. It is the second largest part. Its surface is highly folded.

Functions: It coordinates balance and muscle movements.

(iii) **Pons:** It is present on the top of medulla.

Functions: It makes connection between the spinal cord and cerebellum and between cerebrum and cerebellum. It also regulates alertness, sleep and wakefulness.



Structure of Brain

Q.10: Describe the structure of the spinal cord and draw its structural layout.

Ans. Spinal cord: Spinal cord is a tubular bundle of nerves that starts from brain and extends to lower back. It is located in vertebral column. It is also covered by meninges.

Structure of spinal cord: The outer region of spinal cord is made of white matter. The central region is made of grey matter. It is butterfly shaped and surrounds the central canal. Thirty one pairs of spinal nerves arise from spinal cord. All the spinal nerves are mixed nerves because each contains axons of both sensory and motor neurons.

Dorsal root and ventral root: The dorsal root contains sensory axons and a ganglion where cell bodies are located. The ventral root contains axons of motor neurons.

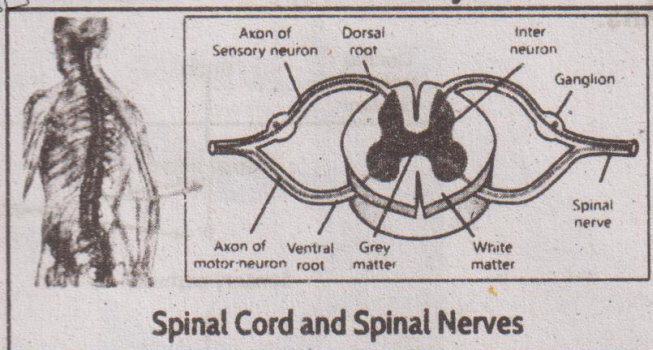
Functions of spinal cord:

- (i) Spinal cord transmit impulses between brain and body parts.
- (ii) It acts as a coordinating centre for some simple reflexes.

Q.11: Explain Peripheral Nervous system (PNS) including sensory and motor pathways.

Ans. Peripheral Nervous System (PNS): It is composed of nerves and their ganglia. Human has 12 pairs of cranial nerves and 31 pairs of spinal nerves.

Cranial and spinal nerves: Some cranial nerves are sensory, some are motor and some are



Q. Define brain stem.

Ans. Medulla oblongata, pons, and midbrain connect the rest of brain to spinal cord. They are collectively called brainstem.

mixed. All spinal nerves are mixed.

Sensory and Motor Pathways:

Sensory Pathway: Conducting impulses from receptors to CNS.

Motor Pathway: Conducting impulses from CNS to effectors.

Systems of Motor Pathway: Motor Pathway has two systems.

- (i) Somatic Nervous System
 - (ii) Autonomic Nervous System
- (i) **Somatic Nervous System:** It controls conscious and voluntary actions. It includes all the motor neurons that are connected to skeletal muscles.
- (ii) **Autonomic Nervous System:** It consists of motor neurons that are connected to cardiac muscles, smooth muscles and glands. It is generally without conscious control.

Further division of Autonomic Nervous System:

Autonomic nervous system consists of:

- Sympathetic Nervous System
- Parasympathetic Nervous system

Sympathetic Nervous System: Sympathetic nervous system prepares body in emergency situations. This is often called the "fight or flight" response.

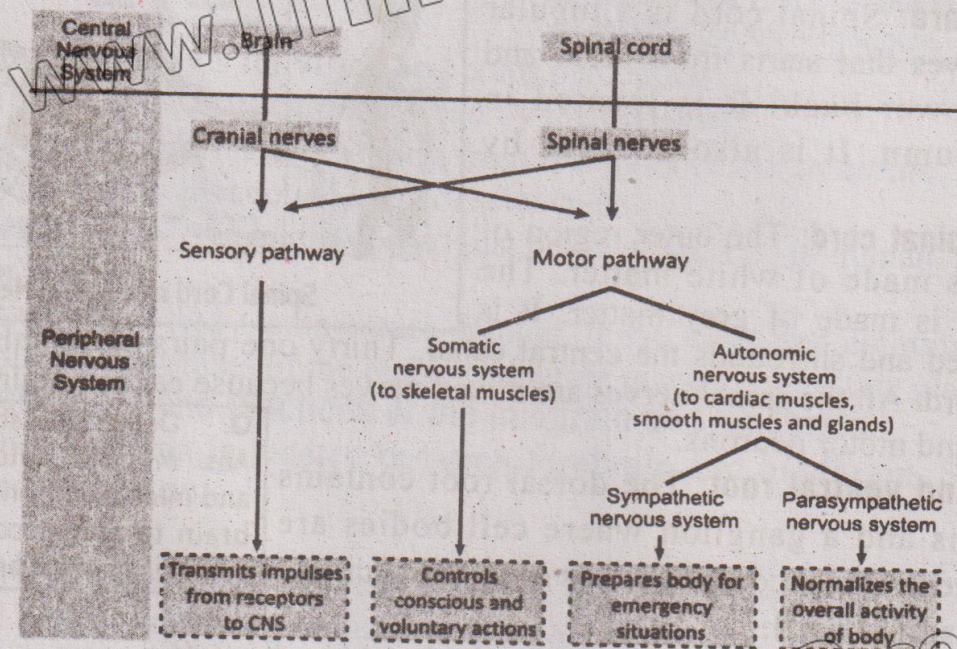
- ☆ This system dilates pupils, speeds up heartbeat, increases breathing rate and inhibits digestion.

Parasympathetic Nervous System: When there is no stress, parasympathetic nervous system normalizes the activity of body. It is called "rest and digest" response.

- ☆ It causes pupils to contract, promotes digestion and normalizes the rate of heartbeat.

Q.12: Draw the flow sheet diagram of Divisions of Nervous System.

Ans.



The Divisions of Nervous System

Q.13: What is meant by reflex action? Describe an example of reflex action and identify reflex arc in this example.

Ans. Reflex Action: A reflex action is a quick, involuntary response in which brain is not involved. Reflex actions are controlled by a reflex arc.

Example: We pull our hand away from a hot flame without thinking about it. It is a reflex

action and happens in a following way.

Detection: Skin receptors detect the stimulus of heat.

Transmission: A sensory neuron sends a nerve impulse to an inter-neuron of spinal cord.

Relay: The interneuron transmits the nerve impulses to motor neuron.

Execution: The motor neuron carries the nerve impulse to effector (muscle of arm).

Result: The effectors produces a response by contracting. So, our hand is pulled.

Reflex arc: Reflex arc is the pathway of neurons over which the nerve impulses travel during a reflex action. Using the above example the components identified are:

Receptor: Skin receptors that detect the stimulus heat.

Sensory neurons: Transmits the impulse to the interneuron of the spinal cord.

Interneuron: Found within the spinal cord, it transmits the impulse from sensory neuron to motor neuron.

Motor neuron: Carries the impulse from the spinal cord to the effectors.

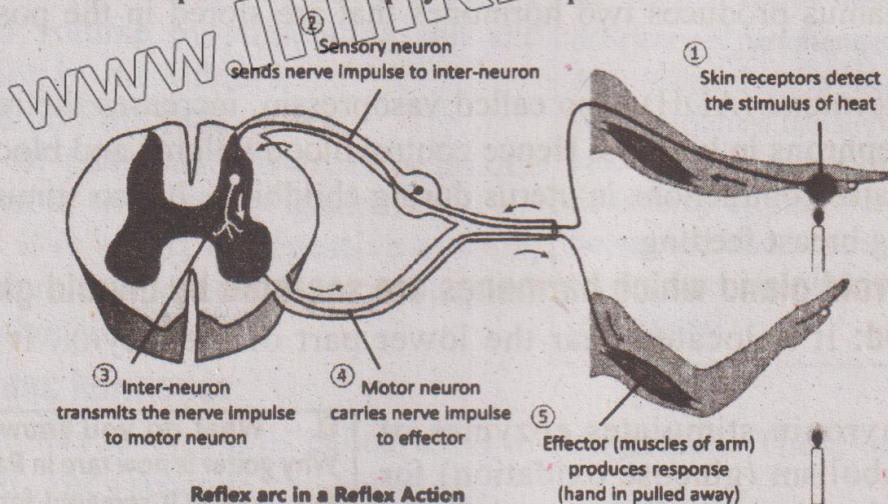
Effector: The muscle that produces the physical response.

Q. Differentiate between voluntary and involuntary actions.

Ans. When a receptor is stimulated, it sends information to the brain. The higher centres of brain (regions of cerebrum) analyse the information and send messages for appropriate actions. Such actions are under our conscious control and are called voluntary actions while some regions of brain control actions without any conscious control. Such actions are called involuntary actions

Q. What type of action is saliva secretion?

Ans. The secretion of saliva from salivary glands is an involuntary action. When we start chewing food in mouth, brain sends message to salivary glands to secrete saliva. It can also happen when we smell, see or even imagine food.



5.3

Endocrine System

Q.14: Briefly explain the Endocrine System.

Ans. Endocrine System: It is the another system responsible for coordination in animals. The endocrine system consists of special endocrine glands which produce and secrete hormones. Hormones are the chemicals released from endocrine gland, which regulate different body functions like growth, reproduction, and glucose level in blood etc.

The endocrine glands do not have ducts to pour their hormones. That is why; they are also called ductless glands. They secrete hormones into blood which carries them to different parts of the body.

Q.15: State the hormones of pituitary gland and write their functions.

Ans. Pituitary Gland: It is small gland present in the brain. It is suspended from the hypothalamus by a short stalk. There are two lobes of pituitary gland i.e., anterior lobe and posterior lobe.

Q. What do you know about Naseer Soomro?

Ans. Naseer Soomro was once the tallest man in Pakistan. He was born normal size, but developed pituitary gland problem at the age of 10. His pituitary gland produced excess amounts of the Growth Hormone.

Hormones of Anterior Lobe of Pituitary:

- (i) **Growth hormone (GH)** stimulates the growth of muscle, bone, and other tissues. If growth hormone is produced more than normal, it results in extra growth in body. This condition is called gigantism. On the other hand, if growth hormone is produced less than normal, it results in less growth in body. This condition is known as dwarfism.
- (ii) **Adreno-cortico-tropic hormone (ACTH)** stimulates the adrenal cortex gland to produce its hormones.
- (iii) **Thyroid-stimulating hormone (TSH)** stimulates the thyroid gland to produce its hormone (thyroxine) which controls metabolism.
- (iv) **Luteinizing hormone (LH)** is needed for the release of egg cells from ovary (ovulation) in females. In males, it stimulates the testes to produce sex hormones. Anterior lobe also produces follicle stimulating hormone (FSH) that is involved in the reproductive system.

Hormones of Posterior Lobe of Pituitary:

The hypothalamus produces two hormones that are stored in the posterior lobe of pituitary gland.

- (i) **Antidiuretic hormone (ADH)**, also called vasopressin, increases the reabsorption of water from nephrons in kidneys. Hence control blood volume and blood pressure.
- (ii) **Oxytocin** initiates contractions in uterus during childbirth. It also stimulates the flow of milk during breast feeding.

Q.16: Describe thyroid gland which hormones are secreted by thyroid gland?

Ans. Thyroid gland: It is located near the lower part of the larynx. It secretes two hormones:

- (i) **Thyroxin:** Thyroxin stimulates enzymes of cellular metabolism (glucose oxidation) for energy production. It increases basal metabolic rate and produces heat.

If thyroxin is less produced: If thyroxin is produced less than the required amount, cellular metabolism slows down. It results in lethargy, weight gain and low heart rate and low body temperature.

If more thyroxin is produced: If more thyroxin is produced than required, cellular metabolism becomes faster. It results in weight loss; high blood pressure, high heart rate and high body temperature.

- (ii) **Calcitonin:** Calcitonin stimulates the transfer of calcium ions from blood to bone

Q. What do you know about goiter? Why goiter is now rare in Pakistan?

Ans. Iodine is required for the production of thyroxine. If a person lacks iodine in diet, thyroid gland cannot make hormone. In this condition, thyroid gland enlarges. This disorder is called goitre. Goitre is not rare in Pakistan because iodine is added to commercially available table salt.

where the calcium ions can be used to generate bone tissue. In this way calcitonin acts to decrease blood calcium levels.

Q.17: Write notes on adrenal glands.

Ans. Adrenal Glands: An adrenal gland is located above each kidney. Each adrenal gland has an inner core, the medulla and an outer layer the cortex.

Adrenal gland parts:

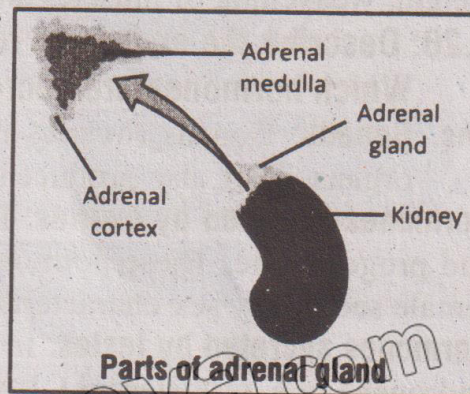
- (i) Inner core (ii) Medulla (iii) Cortex

Hormones of adrenal Medulla: Adrenal medulla produces two hormones

- (i) Epinephrine (ii) Nor-epinephrine

These hormones take part in emergency response of sympathetic nervous system.

When a person is in emergency, the medulla releases its hormones to prepare the body for "fight or flight" response. These hormones increase heart rate, blood pressure, blood glucose level and blood flow to the heart and lungs. They also stimulate enlargement of the bronchioles and dilation of the pupils.



Hormones of adrenal cortex: Adrenal cortex secrete two hormones:

- (i) **Cortisol:** It promotes the production of glucose from proteins.
(ii) **Aldosterone:** Aldosterone raises blood pressure and volume by stimulating salt and water retention by the kidneys.

Q18. Write a note on Pancreas.

Ans. Dual nature of pancreas: Pancreas is unique because it functions as two types of glands:

Exocrine glands: It is a part of digestive system, where it plays the role of ducted (exocrine) gland and secretes digestive enzymes.

Islets of Langerhans hormones:

Pancreas also has special cells called islets of Langerhans. These cells function as an endocrine gland. They secrete two hormones:

- (i) Insulin (ii) Glucagon

- (i) **Insulin:** Insulin lowers the blood glucose level by stimulating body cells to store glucose or use it for energy.
(ii) **Glucagon:** Glucagon stimulates release of glucose from liver into the blood stream.

Q.19: What is Diabetes Mellitus? Describe its types and symptoms.

Ans. Diabetes Mellitus: In diabetes mellitus, the cells are unable to obtain glucose resulting in high blood glucose concentration.

Type-1 Diabetes: In type-1 diabetes mellitus, the pancreas does not produce required insulin. Such patients are treated with daily injections of insulin.

Q. Write about the production and deficiency of parathormone?

Ans. When there is more parathormone, more calcium is transferred from bones to blood. So, the bones become weak. The deficiency of parathormone results in decreased blood calcium level. It leads to tetany (muscle twitching, cramps and convulsions).

Type-2 Diabetes: In type-2 diabetes, insulin is produced but the target cells do not respond to it. This type of diabetes can be controlled through exercise and diet.

Symptoms: In diabetes, excess glucose inhibits water reabsorption by the kidneys, producing large amounts of urine. It results in dehydration and can cause kidney damage. Excess glucose may also lead to imbalance in water and salt concentration in body. The patients also experience loss of body weight, weakening of muscles and tiredness.

Q. For what purpose blood glucose concentration Test is performed?

Ans. Blood Glucose Concentration (BGC)

Test: The amount of glucose in blood is measured by this test. It is used to diagnose diabetes. Blood glucose may be measured on a fasting basis (collected after an 8 to 10 hour fast), randomly (anytime) and after a meal. The results of some BGC tests are given here.

Q.20: Describe the endocrine role of the gonads in human body. (OR)

Which hormones are secreted by ovaries and testes?

Ans. Gonads: Gonads (ovaries in females and testes in males) are gamete - producing organs. They also produce sex hormones.

Hormones secreted by ovaries: In females, the ovaries secrete hormones called estrogen and progesterone. These hormones cause the release of egg from the ovary and regulate female secondary sex characteristics (e.g. development of breast).

Hormones secreted by testes: In males, the testes secrete a group of sex hormones called androgens (e.g. testosterone). It regulates male secondary sex characteristics (e.g. growth of hair on face and coarseness of voice etc.).

Q.21: Write down the summary of Major Endocrine glands and discuss their functions in human body.

Ans.

Major Endocrine Glands and Their Functions

Gland	Hormone	Functions
Anterior lobe of pituitary	Growth hormone	Regulates development of muscles and bones
	Adrenocorticotrophic hormone	Stimulates secretion of cortisol and aldosterone by the adrenal cortex
	Thyroid stimulating hormone	Stimulates the thyroid gland to produce its hormone
	Luteinizing	stimulates the ovary to release egg stimulates the testes to produce sex hormones
Posterior lobe of Pituitary	Antidiuretic hormone	increases the reabsorption of water from nephrons
	Oxytocin	Initiates contractions in uterus during childbirth Stimulates flow of milk from breasts
Thyroid	Thyroxine	Stimulates enzymes of cellular metabolism
	Calcitonin	Decreases blood calcium concentration
Parathyroid	Parathormone	increases blood calcium concentration
Adrenal medulla	Epinephrine	Initiate body's response to stress and the "fight-or-flight" response to danger
	Norepinephrine	
Adrenal cortex	Cortisol	Promotes production of glucose from proteins
	Aldosterone	Promotes salt and water retention by the kidneys

Pancreas	Insulin	Lowers the blood glucose level by stimulating body cells to store glucose or use it
	Glucagon	Stimulates release of glucose from liver into blood
Ovaries	Oestrogen and Progesterone	Cause the release of egg from the ovary and regulate female secondary sex characteristics
Testes	Androgens (Testosterone)	Regulate male secondary sex characteristics

Objective Type Questions

Additional MCQ's

Multiple Choice Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

5.1 Neurons - The unit of nervous system

- What is the correct sequence of a coordinated action?
 - Receptor → Stimuli → Coordinator → Response → Effector
 - Stimulus → Receptor → Coordinator → Effector → Response
 - Coordinator → Stimulus → Receptor → Effector → Response
 - Stimulus → Coordinator → Receptor → Response → Effector
- The example of stimuli is:
 - Ear
 - Brain
 - Cold
 - Muscle
- In chemical coordination, which of the following acts as a coordinator?
 - The Brain
 - Spinal Cord
 - Muscles
 - Endocrine Glands
- Which parts of the body typically act as effectors in nervous coordination?
 - Eyes and ears
 - Brain and spinal cord
 - Muscles and glands
 - Sensory neurons
- A coordinated action ends at:
 - Stimulus
 - Response
 - Effectors
 - Coordinated action
- The cells that transmit messages in the body are known as:
 - Muscle cells
 - Red blood cells
 - White blood cells
 - Nerve cells
- A neuron consists of how many major parts?
 - Two
 - Three
 - Four
 - Five
- Part of neuron which takes impulses towards cell body is called:
 - Dendrites
 - Axons
 - Ganglia
 - Myelin sheath
- The myelin sheath is formed by:
 - Dendrites
 - Axons
 - Nodes of Ranvier
 - Schwann cells
- In central Nervous system (CNS) myelinated axons form:
 - Grey matter
 - White matter
 - Neuroglia
 - Dendrites

11. Which of the following is the example of neurotransmitter?
(a) Ganglia (b) Axon (c) Dendrite (d) Dopamine
12. Which type of neurons transmit nerve impulses from receptors to the CNS?
(a) Inter-neurons (b) Motor neurons (c) Sensory neurons (d) Mixed neurons
13. Inter-neurons are present in:
(a) Brain (b) Spinal cord (c) Heart (d) Both a and b
14. The group of cell bodies are called:
(a) Schwann cells (b) Dendrites (c) Myelin sheath (d) Ganglia
15. Mixed nerves contain the axons of:
(a) Sensory neurons (b) Motor neurons (c) Inter-neurons (d) Both a and b

5.2

Divisions of the Nervous System

16. How many major components of nervous system are present in human body?
(a) Two (b) Three (c) Four (d) Infinite
17. All human activities are under the control of:
(a) Heart (b) Backbone (c) Stomach (d) Brain
18. Inside cranium, brain is covered by three layers of membranes, collectively called:
(a) Dendrites (b) Meninges (c) Ventricles (d) Cerebrum
19. The largest part of Human Brain is:
(a) Forebrain (b) Midbrain (c) Hind brain (d) Medulla
20. The weight of average adult human brain is:
(a) 1kg (b) 1.2kg (c) 1.4kg (d) 1.6kg
21. How many neurons are present in an adult human brain?
(a) 10 billion (b) 100 billion (c) 1 trillion (d) 100 million
22. The largest part of forebrain is:
(a) Cerebrum (b) Thalamus
(c) Hypothalamus (d) Cerebral hemisphere
23. Which lobe of brain deals with memory, learning, feelings and hearing?
(a) Frontal lobe (b) Parietal lobe (c) Temporal lobe (d) Occipital lobe
24. In humans hypothalamus is about the size of an:
(a) Date (b) Almond (c) Grain seed (d) walnut
25. Which part of brain is responsible for sleep/wake, alertness and temperature regulation?
(a) Forebrain (b) Midbrain (c) Hindbrain (d) Thalamus
26. This is not the part of the hindbrain:
(a) Pons (b) Cerebellum
(c) Cerebrum (d) Medulla oblongata
27. Which part of brain is present on the top of medulla:
(a) Midbrain (b) Pons (c) Cerebrum (d) Thalamus
28. A tubular bundle of nerves that starts from brain and extends to lower back:
(a) Brain (b) Back bone (c) Spinal Cord (d) Endocrine gland
29. The dorsal root of spinal cord contains:
(a) Sensory axons (b) Ganglion (c) Motor neurons (d) Both a and b

30. Ventral root contains axons of:
 (a) Inter neurons (b) Sensory neurons (c) Motor neurons (d) Mixed neurons
31. How many pairs of cranial nerves are present in humans?
 (a) 10 (b) 12 (c) 31 (d) 22
32. The number of spinal nerves in humans are:
 (a) 24 pairs (b) 12 pairs (c) 31 pairs (d) 16 pairs
33. Somatic nervous system controls:
 (a) Voluntary actions (b) Involuntary actions
 (c) Both a and b (d) None of these
34. Which system is activated during emergency situations to prepare the body for action?
 (a) Parasympathetic (b) Somatic (c) Sympathetic (d) Central
35. Actions under our conscious control are analyzed by:
 (a) The spinal cord only (b) The higher centers of brain
 (c) The sympathetic nervous system
 (d) Motor neurons connected to smooth muscles
36. A pathway of neurons over which the nerve impulses travel during a reflex action is called:
 (a) Endocrine system (b) Reflex action
 (c) Reflex arc (d) Autonomic nervous system

5.3

Endocrine System

37. Chemicals released from endocrine gland are:
 (a) Mutants (b) Nutrients (c) Hormones (d) Vitamins
38. The small gland present in brain is:
 (a) Thyroid gland (b) Pituitary gland (c) Adrenal gland (d) Pancreas
39. If growth hormone is produced more than normal the condition is called:
 (a) Dwarfism (b) Cancer (c) Tuberculosis (d) Gigantism
40. Which hormone is responsible for the release of egg cells from ovary in females?
 (a) Adreno-cortico-trophic hormone (b) Thyroid stimulating hormone
 (c) Luteinizing hormone (d) Growth hormone
41. Antidiuretic hormone is also known as:
 (a) Luteinizing hormone (b) Thyroxine
 (c) Oxytocin (d) Vasopressin
42. Beneath the larynx in human neck, name of gland is:
 (a) Parathyroid (b) Thyroid (c) Adrenal (d) Pancreas
43. Hormone increasing the level of calcium ions in blood is:
 (a) Adrenalin (b) Calcitonin (c) Parathormone (d) Oxytocin
44. The hormone which decreases the level of calcium in blood:
 (a) Calcitonin (b) Thyroxine (c) Parathormone (d) Thyroid
45. Gland located above each kidney is:
 (a) Parathyroid gland (b) Adrenal gland
 (c) Thyroid gland (d) Pituitary gland

46. Islets of Langerhans was discovered in:
 (a) 1769 (b) 1869 (c) 1896 (d) 1854
47. Which hormone is also called emergency hormone?
 (a) Insulin (b) Oxytocin (c) Calcitonin (d) Adrenalin
48. Insulin lowers:
 (a) Calcium level (b) Oxygen level (c) Blood glucose (d) Iodine level
49. After 8–10 hours fast the normal blood glucose level is:
 (a) 70 to 99mg (b) 140 to 160mg (c) 100 to 125 mg (d) 140 to 200mg
50. Testes and ovaries are called:
 (a) Glands (b) Gonads (c) Gametes (d) Embryo
51. Male gonads are called:
 (a) Sperms (b) Eggs (c) Ovaries (d) Testes
52. Ovaries secrete hormone:
 (a) Androgen (b) Testosterone (c) Estrogen (d) Oxytocin
53. Which hormone develops the male secondary sex characters?
 (a) Testosterone (b) Estrogen (c) Progesterone (d) Insulin

Answers

- | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|
| 1. (b) | 2. (c) | 3. (d) | 4. (c) | 5. (b) | 6. (b) | 7. (b) |
| 8. (a) | 9. (d) | 10. (b) | 11. (d) | 12. (c) | 13. (d) | 14. (d) |
| 15. (d) | 16. (a) | 17. (d) | 18. (b) | 19. (a) | 20. (c) | 21. (b) |
| 22. (a) | 23. (c) | 24. (b) | 25. (b) | 26. (c) | 27. (b) | 28. (c) |
| 29. (d) | 30. (c) | 31. (b) | 32. (c) | 33. (a) | 34. (c) | 35. (b) |
| 36. (c) | 37. (c) | 38. (b) | 39. (d) | 40. (c) | 41. (d) | 42. (b) |
| 43. (c) | 44. (a) | 45. (b) | 46. (b) | 47. (d) | 48. (c) | 49. (a) |
| 50. (b) | 51. (d) | 52. (c) | 53. (a) | | | |

Additional Short Questions

Short Answer Questions prepared in the light of new Examination Techniques
 (Knowledge, Understanding, Application, Analytical & Conceptual)

5.1 Neurons - The unit of nervous system

1. Write down the names of the components of coordinated action with correct sequence.

Ans. A coordinated action has five components.

1. Stimulus 2. Receptor 3. Coordinator 4. Effector 5. Response

2. Differentiate between a receptor and an effector.

Ans. **Receptor:** The organ, tissue or cell which receives stimuli is called the receptor.

For example: Ears are the receptors for the stimulus of sound.

Effector: These are the parts of the body which receives coordinator's message and perform specific actions.

For example: In nervous coordination muscles and glands are the effectors.

3. **Explain the role of a "coordinator" in both nervous and chemical coordination.**

Ans. A coordinator receives information from receptors and send messages to particular organs for proper actions.

- In nervous coordination brain and spinal cord are coordinators.
- In chemical coordination, endocrine glands are the coordinators.

4. **What is meant by response?**

Ans. Response: A response is the action performed by effectors, on receiving the message from coordinator.

For example: Pulling our hand away from something very hot.

5. **What is coordination? Where coordination occurs?**

Ans. Coordination: Coordination means integration among different parts of the body and their response to stimuli in order to keep harmony with the environment.

Coordination occurs in all multicellular organisms.

6. **Differentiate between Nerve cells and nerve impulse.**

Ans. Nerve cells: Neurons or nerve cells are the cells that transmit messages in the body in the form of nerve impulse.

Nerve impulse: Nerve impulse is a wave of electrochemical changes that travel across the membranes of neurons.

7. **What are the major parts of neuron?**

Ans. A neuron consists of three major parts i.e. cell body, dendrites and axons.

8. **What is the function of myelin sheath in neuron?**

Ans. Myelin sheath is an insulator so the membrane coated with this sheath does not conduct nerve impulse. In such a neuron impulses jump over the areas of myelin going from node to node.

9. **What are nodes of Ranvier?**

Ans. Nodes of Ranvier: The myelin sheath is interrupted at intervals by small gaps called nodes of Ranvier.

10. **What do you know about synapse and neurotransmitter?**

Ans. Synapse: A synapse is a small gap between two neurons or between a neuron and an effector cell.

Neurotransmitter: Neurotransmitters are special chemicals that help to carry messages across a synapse.

Examples of neurotransmitters are dopamine and serotonin.

5.2

Divisions of the Nervous System

11. **How would you distinguish between central nervous system (CNS) and peripheral nervous system (PNS)?**

Ans. Central Nervous System (CNS): CNS comprises of brain and spinal cord.

Peripheral Nervous System (PNS): PNS consists of nerves that arise from brain and spinal cord and spread in different parts of body.

12. **How brain is protected?**

Ans. Brain is present inside cranium (part of skull). Inside cranium brain is covered by

three layer of membranes collectively called meninges. Meninges protect the brain from harmful substances.

13. Describe shortly about forebrain.

Ans. Forebrain is the largest part of brain. There are three major parts of forebrain.

(i) Cerebrum (ii) Thalamus (iii) Hypothalamus

Forebrain is responsible for thinking, memory and reasoning. It receives sensory information. It acts as coordinator.

14. Describe briefly the composition and location of cerebrospinal fluid (CSF).

Ans. The cerebrospinal fluid (CSF) is a fluid found within ventricles (fluid filled cavities) of the brain. These ventricles are continuous with the central canal. CSF is the specific fluid that fills both these brain cavities and the central canal of the spinal cord.

15. Cerebral hemisphere is divided into how many lobes name them.

Ans. Each hemisphere is divided into four lobes.

(i) Frontal lobe

(ii) Parietal lobe

(iii) Temporal lobe

(iv) Occipital lobe

16. Write down the functions of frontal lobe and parietal lobe.

Ans. Frontal lobe: This lobe contains regions for problem solving, judgment, speaking and movements.

Parietal lobe: Parietal lobe has regions for language and touch.

17. Discuss the functions of temporal lobe.

Ans. The temporal lobe contains regions which deal with memory, learning, feelings and hearing.

18. Write a short note on midbrain.

Ans. Midbrain: It is located between forebrain and hindbrain.

Function:

☆ Midbrain enables the body to make adjustments to movements.

☆ It is responsible for sleep/wake, alertness and temperature regulation.

19. Differentiate medulla oblongata, cerebellum and pons on the basis of their functions.

Ans. Medulla oblongata:

☆ It transmits nerve impulses between spinal cord and higher parts of brain.

☆ It controls autonomic functions such as heartbeat, heart rate, breathing and blood pressure.

Cerebellum:

☆ It coordinates balance and muscle movements.

Pons:

☆ It regulates alertness, sleep and wakefulness.

20. Discuss a few lines about spinal cord.

Ans. Spinal cord: It is a tubular bundle of nerves that starts from brain and extends to lower back. It is located in vertebral column. It is covered by meninges. It acts as coordinating centre for simple reflexes. It is butterfly shaped and surrounds the

central canal.

21. What do you know about the dorsal root and the ventral root of spinal cord?

Ans. **Dorsal root:** The dorsal root contains sensory axons and a ganglion where cell bodies are located.

Ventral root: Ventral root contains axons of motor neurons.

22. Which pathways are followed by cranial and spinal nerves?

Ans. The cranial and spinal nerves make two pathways.

(i) Sensory Pathway (Conducting impulses from receptors to CNS)

(ii) Motor Pathway (Conducting impulses from CNS to effectors)

23. How would you differentiate between sympathetic and parasympathetic nervous system.

Ans.

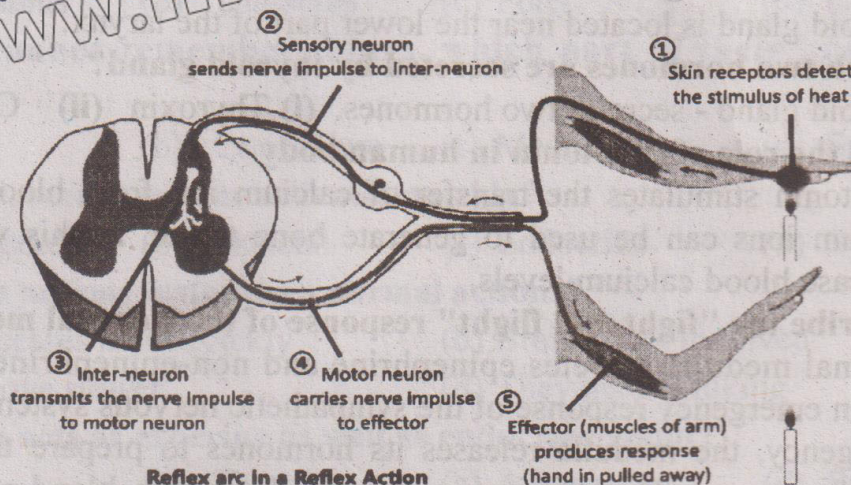
Sympathetic Nervous System	Parasympathetic Nervous System
Sympathetic Nervous system prepares body in emergency situations.	Parasympathetic nervous system normalizes the body activity.
It is often called "fight or flight."	It is often called "rest and digest".
This system dilates pupils, speeds up heartbeat, increase breathing rate and inhibits digestion.	It causes pupils to contract, promotes digestion and normalizes the rate of heartbeat.

24. Define reflex arc.

Ans. **Reflex arc:** A reflex arc is the pathway of neurons over which the nerve impulses travel during a reflex action.

25. Draw a pathway of reflex action.

Ans.



5.3

Endocrine System

26. What are hormones?

Ans. **Hormones:** Hormones are the chemicals, released from endocrine gland, which regulate different body functions like growth, reproduction and glucose level in blood etc.

27. Why endocrine glands are called ductless glands?

Ans. The endocrine glands do not have ducts to pour their hormones. That is why; they

are called ductless glands.

28. Name the hormones secreted by anterior lobe of pituitary gland.

Ans. The anterior lobe of pituitary gland secretes;

- (i) Growth Hormone (GH)
- (ii) Adreno-cortico-trophic hormone (ACTH)
- (iii) Thyroid stimulating hormone (TSH)
- (iv) Luteinizing Hormone (LH)

29. Write any two effects of Growth hormone on human body.

Ans. Gigantism: If growth hormone is produced more than normal, it results in extra growth in body. This condition is called gigantism.

Dwarfism: If growth hormone is less produced than normal it results in less growth in body. This condition is known as dwarfism.

30. What is the role of Luteinizing hormone in human body?

Ans. Luteinizing hormone (LH): It is needed for the release of egg cells from ovary (ovulation) in females. In males, it stimulates the testes to produce sex hormones.

31. Which two hormones are secreted by hypothalamus? Write down their functions.

Ans. The hypothalamus produces two hormones that are stored in posterior lobe of pituitary gland.

(i) **Antidiuretic hormone (ADH):** It is also called vasopressin. It increases the reabsorption of water from nephrons in kidneys.

(ii) **Oxytocin:** It initiates contractions in uterus during childbirth. It also stimulates the flow of milk during breast feeding.

32. Where thyroid gland is located?

Ans. Thyroid gland is located near the lower part of the larynx.

33. Which two hormones are secreted by thyroid gland?

Ans. Thyroid gland - secretes two hormones. (i) Thyroxine (ii) Calcitonin

34. State the role of calcitonin in human body.

Ans. Calcitonin stimulates the transfer of calcium ion from blood to bone, where the calcium ions can be used to generate bone tissue. In this way calcitonin acts to decrease blood calcium levels.

35. Describe the "fight and flight" response of the Adrenal medulla.

Ans. Adrenal medulla secretes epinephrine and non-epinephrine. The hormones take part in emergency response of the sympathetic nervous system. When a person is in emergency, the medulla releases its hormones to prepare the body for "fight or flight" response. These hormones increase heart rate, blood pressure, blood glucose level etc.

36. Write the function of insulin and glucagon.

Ans. Insulin: Insulin lowers the blood glucose level by stimulating body cells to store glucose or use it for energy.

Glucagon: Glucagon stimulates release of glucose from liver into the bloodstream.

37. Differentiate between type-1 and type-2 diabetes.

Ans. Type-1 diabetes:

★ In this type, the pancreas does not produce required insulin.

☆ Such patients are treated with daily injections of insulin.

Type-2 diabetes:

☆ In this type, insulin is produced but the target cells do not respond to it.

☆ This type of diabetes can be controlled through exercise and diet.

38. What are gonads? Write down the names of male and female gonads.

Ans. Gonads: Gonads are gamete-producing organs. They also produce sex hormones. Testes are male gonads and ovaries are female gonads.

39. Name the hormones secreted by Ovaries and testes.

Ans. Hormones secreted by ovaries: Ovaries secrete hormones called estrogen and progesterone.

Hormones secreted by testes: Testes secrete a group of sex hormones called androgens (e.g. testosterone).

Exercise Questions (Solved)

A. Select the correct answers for the following questions.

- 1. Schwann cells are the supporting cells for neurons. They make:**
(a) Cell body (b) Axon (c) Myelin sheath (d) Dendrites
- 2. Which part of the brain controls balance while riding a bicycle?**
(a) Cerebrum (b) Medulla (c) Cerebellum (d) Spinal cord
- 3. Which part of brain is responsible for sensations of temperature, hunger, thirst, and sleep?**
(a) Hypothalamus (b) Thalamus (c) Pons (d) Cerebellum
- 4. If a patient cannot remember things, which part of their brain may be affected?**
(a) Cerebrum (b) Cerebellum (c) Medulla (d) Spinal cord
- 5. During danger, which system activates quickly?**
(a) Parasympathetic (b) Skeletal (c) Endocrine (d) Sympathetic
- 6. Why are reflex actions faster than normal actions?**
(a) Brain processes them quickly (b) Brain is not involved
(c) Signals move slower (d) They need thinking
- 7. Which of these acts as exocrine as well as endocrine gland?**
(a) Pituitary (b) Thyroid (c) Adrenal (d) Pancreas
- 8. The chemical messengers of the endocrine system are called;**
(a) Neuro Transmitters (b) Hormones (c) Neurons (d) Enzymes
- 9. What could happen if hormone of parathyroid gland were missing?**
(a) Low calcium levels (b) High blood sugar
(c) Weak muscles (d) Poor digestion
- 10. Which endocrine gland prepares the body for "fight or flight" response?**
(a) Thyroid (b) Pituitary (c) Adrenal (d) Pancreas

- | | | | | |
|--------|--------|--------|--------|---------|
| 1. (c) | 2. (c) | 3. (a) | 4. (a) | 5. (d) |
| 6. (b) | 7. (d) | 8. (b) | 9. (a) | 10. (c) |

B. Write short answers.

1. Define stimulus with examples.

Ans. Stimulus: Any factor in external or internal environment, which can initiate a response in the body is called a stimulus.

For example: Touch, light, sound, infection etc. are the stimuli.

2. Differentiate between sensory, motor, and inter-neurons.

Ans. Sensory neurons: Sensory neurons transmit nerve impulses from receptors to the CNS.

Inter-neurons: Inter-neurons receive impulses from sensory neurons and transmit them to motor neurons.

Motor neurons: Motor neurons transmit nerve impulses from inter-neurons to effectors (muscles or glands).

3. Define reflex action and the reflex arc.

Ans. Reflex action: Reflex actions are the quick involuntary response in which brain is not involved.

Reflex arc: Reflex arc is the pathway of neurons over which the nerve impulses travel during a reflex action.

4. Differentiate between the following:

(a) Dendrite and axon

(b) Cerebrum and Cerebellum

(c) Thalamus and Hypothalamus

Ans. (a) Dendrite and axon

Dendrites: Small branches which project from the cell body are called dendrites. They transmit nerve impulses towards cell body.

Axon: Axon is a long branch from cell body. Its terminal end is further branched. Axon transmits nerve impulses from cell body to other neurons, muscles and glands.

(b) Cerebrum and Cerebellum

Cerebrum: Cerebrum is the largest part of forebrain

☆ A deep groove divides the cerebrum into right and left cerebral hemispheres.

☆ Cerebrum involves in problem solving, speaking, learning, hearing, vision and color perception.

Cerebellum:

☆ It is the second largest part.

☆ Its surface is highly folded.

☆ It coordinates balance and muscle movements.

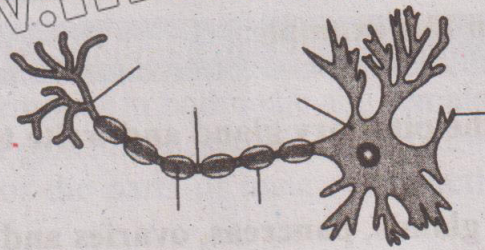
(c) Thalamus and Hypothalamus:

Ans. Thalamus: Thalamus is a structure wrapped by the cerebrum. It conveys information coming from receptors to the cerebrum. Thalamus is also involved in

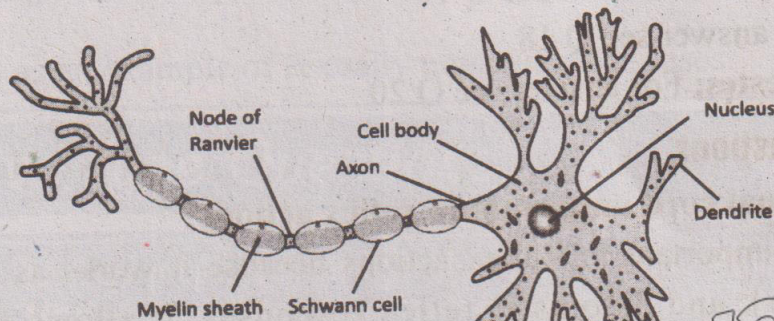
pain perception and consciousness.

Hypothalamus: Hypothalamus lies above midbrain and just below thalamus. It regulates body temperature, hunger, thirst, sleep and emotional states. It also controls the secretions of pituitary gland.

5. Identify the diagram and labels the different parts.



Ans.

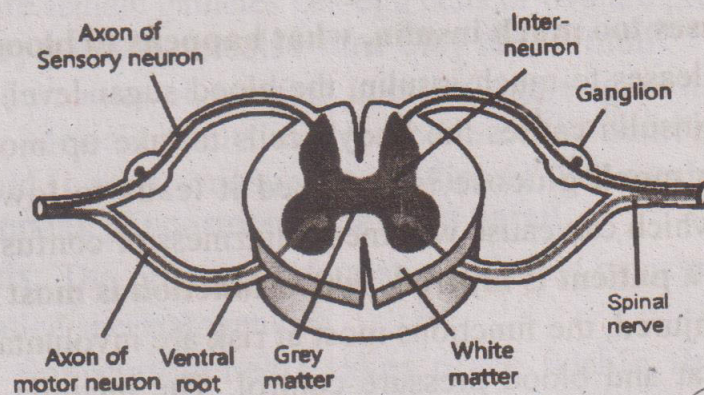


Motor Neuron

6. Identify the following diagram, and locate the white matter, grey matter, three types of neuron, and ganglia.



Ans.



Spinal cord and spinal nerves

- C. Write answers in detail.

1. Describe the structure of a neuron and support your answer with a labelled diagram.

Ans. For answer see Q's 02

2. What are the differences and similarities among the three types of neurons?

Ans. For answer see Q's 04

3. Write the major functions of the forebrain, midbrain, and hindbrain.

Ans. For answer see Q's 07

4. What is meant by reflex action? Describe an example of reflex action and identify the reflex arc in this example.

Ans. For answer see Q's 13

5. State the hormones of the pituitary gland and write their functions.

Ans. For answer see Q's 15

6. Write notes on adrenal glands, pancreas, ovaries and testes.

Ans. Adrenal glands: For answer see Q 17

Pancreas: For answer see Q 18

Ovaries and testes: For answer see Q 20

D. Inquisitive questions

1. Why is the spinal cord important in reflex actions?

Ans. Spinal cord is important in Reflex actions because it works as a primary control centre for quick and automatic reflex responses. It allows for an immediate response to a stimulus without waiting for the brain to process it. This significantly reduces time and protect the body for injury such as pulling your hand away from something hot.

2. Why is adrenaline called an "emergency hormone"?

Ans. Adrenalin (epinephrine) is released by the adrenal glands during emergency or high-stress, "fight or flight" situations. It prepares the body for an emergency by increasing heart rate, boosting blood flow to muscles and raising blood glucose levels to provide an instant burst of energy.

3. If pancreas releases too much insulin, what happens to blood sugar?

Ans. If the pancreas releases too much insulin, the blood sugar level drops too low. This happens because insulin causes the body's cells to take up more glucose from the blood. When too much glucose is removed it leads to low blood sugar level (hypoglycemia), which can cause weakness, dizziness or confusion.

4. If the medulla of a patient is injured, which function is most at risk?

Ans. If the medulla is injured, the functions most at risk are involuntary activities such as breathing, heartbeat and blood pressure control. The medulla controls these vital functions, so damage to it can seriously affect breathing, heart rate and blood pressure, It can be fatal.
