

Neural Control and Coordination — Assignment 2

Class 11 Biology · Higher-difficulty challenge set + integrated problems · Answer key included · Narayan Gurukul Academy

Instructions: (1) Attempt all questions; start with the topic-wise challenge set, then attempt the integrated (multi-topic) problems.
(2) Give all answers with correct SI units. $g = 10 \text{ m/s}^2$ unless stated.
(3) A final answer key is provided at the end — try the full set before checking it.

Part A — Topic-wise challenge questions

Organisation of the Nervous System

1. Distinguish between the somatic and autonomic nervous systems.
2. Distinguish between the sympathetic and parasympathetic systems.
3. Describe the organisation of the nervous system.

Structure of a Neuron

1. Draw and label the structure of a neuron.
2. State the functions of dendrites and axons.
3. Describe the structure of a neuron.

Types of Neurons and Nerve Fibres

1. Distinguish between sensory and motor neurons.
2. Classify neurons on the basis of structure.
3. Describe the types of neurons.

The Synapse and Chemical Transmission

1. Distinguish between electrical and chemical synapses.
2. State the role of acetylcholine at a synapse.
3. Explain chemical transmission across a synapse.

Receptors: Taste, Smell and Vision

1. Distinguish between rods and cones.
2. Explain how taste is perceived.
3. Describe the receptors for taste, smell and vision.

Central Nervous System: The Brain

1. Distinguish between the cerebrum and cerebellum.
2. State two functions of the medulla oblongata.
3. Describe the structure and functions of the human brain.

The Spinal Cord and Reflex Action

1. Distinguish between reflex action and voluntary action.
2. Name the parts of a reflex arc.
3. Explain a reflex arc with an example.

Nerve Impulse and Movements in Plants

1. Distinguish between resting potential and action potential.
2. Name two types of tropic movements.
3. Explain the conduction of a nerve impulse.

Part B — Integrated problems (multi-topic)

1. Describe the organisation of the nervous system.
2. Describe the structure of a neuron and the functions of its parts.
3. Distinguish between sensory and motor neurons, and classify neurons by structure.
4. Explain chemical transmission across a synapse.
5. Describe the structure and functions of the human brain.
6. Explain a reflex arc with an example.

Answer Key

Organisation of the Nervous System

Somatic controls voluntary movements; autonomic controls involuntary activities. Sympathetic prepares the body for 'fight or flight'; parasympathetic restores calm and 'rest and digest'. The nervous system is divided into the central (brain and spinal cord) and peripheral (somatic and autonomic) nervous systems; the autonomic is further divided into sympathetic and parasympathetic.

Structure of a Neuron

Labelled parts: cyton (cell body), dendrites (receive impulses), axon (transmits away), myelin sheath and nodes of Ranvier. Dendrites carry impulses towards the cyton; the axon carries impulses away. A neuron has a cyton with nucleus and Nissl bodies, branched dendrites that receive impulses, and a long axon (with myelin sheath and nodes of Ranvier) ending in nerve terminals.

Types of Neurons and Nerve Fibres

Sensory (afferent) carry impulses towards the CNS; motor (efferent) carry impulses away from the CNS. By structure: unipolar, bipolar and multipolar. Sensory neurons carry impulses from receptors to the CNS; motor neurons carry impulses from the CNS to effectors; interneurons connect them within the CNS. Structurally, neurons are unipolar, bipolar or multipolar.

The Synapse and Chemical Transmission

Electrical synapses pass current directly through gap junctions; chemical synapses use neurotransmitters across the synaptic cleft. Acetylcholine is released from the presynaptic terminal and binds receptors on the postsynaptic membrane, generating a new impulse. A synapse has a presynaptic membrane, synaptic cleft and postsynaptic membrane; on arrival of an impulse, vesicles release neurotransmitter into the cleft, which binds the postsynaptic membrane and transmits the impulse one-way.

Receptors: Taste, Smell and Vision

Rods (dim-light vision, contain rhodopsin) versus cones (colour vision, high light). Taste is perceived by taste buds on the tongue sensing dissolved chemicals. Taste buds on the tongue sense dissolved chemicals (sweet, sour, salty, bitter); olfactory epithelium in the nose senses volatile chemicals; the retina has rods (dim light) and cones (colour).

Central Nervous System: The Brain

Cerebrum: intelligence, memory, voluntary movement; cerebellum: balance and coordination. Medulla oblongata controls respiration and cardiovascular reflexes. The brain has forebrain (cerebrum, thalamus, hypothalamus), midbrain and hindbrain (cerebellum, pons, medulla). The cerebrum is the largest part; the cerebellum maintains posture and balance; the medulla controls respiration, heartbeat and other involuntary actions.

The Spinal Cord and Reflex Action

Reflex action is rapid and involuntary; voluntary action is deliberate and controlled by the cerebrum. A reflex arc has receptor, sensory neuron, CNS, motor neuron and effector. The spinal cord is a tubular structure protected by the vertebral column, conducting impulses to and from the brain; a reflex arc is the route taken by an impulse in a reflex action, e.g. withdrawing the hand from a hot object.

Nerve Impulse and Movements in Plants

Resting potential: polarised membrane (outside +, inside –); action potential: depolarisation as the impulse passes. Two tropic movements: phototropism and geotropism. A nerve impulse is a wave of depolarisation transmitted along the axon; the sodium-potassium pump maintains the resting potential. Plant movements include tropic movements (growth in response to stimuli, e.g. phototropism, geotropism) and nastic movements (e.g. the touch-me-not plant).

Integrated problems

1: CNS (brain, spinal cord) + PNS (somatic, autonomic); autonomic → sympathetic and parasympathetic. 2: Cyton, dendrites (receive), axon (transmit), myelin sheath, nodes of Ranvier. 3: Sensory towards CNS, motor away; unipolar/bipolar/multipolar. 4: Neurotransmitter (acetylcholine) crosses the synaptic cleft from presynaptic to postsynaptic side, transmitting one-way. 5: Forebrain, midbrain, hindbrain; cerebrum (intelligence), cerebellum (balance), medulla (respiration/heartbeat). 6: Receptor → sensory neuron → CNS → motor neuron → effector; e.g. withdrawing the hand from a hot object.