CHAPTER 7

Control and Coordination

Class 10 Science | NCERT Exemplar - Complete Solved Study Guide

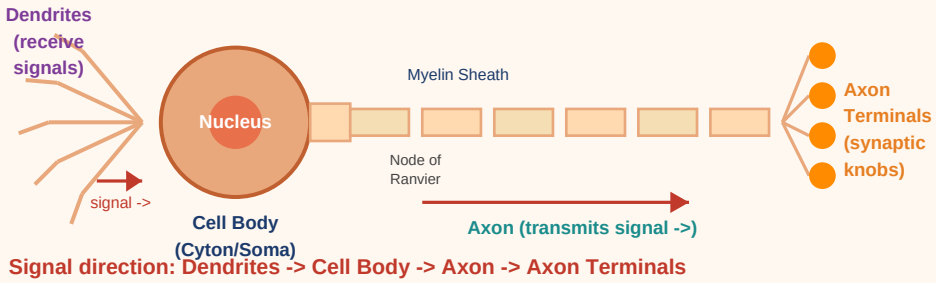
[GLOS] Key Terms / Glossary

Neuron	The structural and functional unit of the nervous system; consists of cell body, dendrites, and axon.
Dendrite	Short branched projections of a neuron that RECEIVE nerve impulses from other neurons.
Axon	Long fibre that TRANSMITS nerve impulses AWAY from the cell body to the next neuron or effector.
Synapse	Tiny gap between the axon terminal of one neuron and the dendrite of the next; signal crosses via neurotransmitters.
Reflex Action	An automatic, rapid, involuntary response to a stimulus; e.g., withdrawing hand from hot object.
Reflex Arc	The pathway: Receptor -> Sensory neuron -> CNS -> Motor neuron -> Effector.
Cerebrum	Largest part of forebrain; controls thinking, memory, reasoning, voluntary actions, hearing, sight, smell.
Cerebellum	Part of hindbrain; controls posture, balance, and coordination of voluntary movements.
Medulla Oblongata	Part of hindbrain; controls involuntary actions: heart rate, breathing, blood pressure, vomiting, salivation.
Tropism	Directional growth movement in plants in response to an external stimulus (light, gravity, water, chemicals, touch).
Hormone	Chemical messenger secreted by endocrine glands directly into blood; coordinates body functions.
Auxin	Plant hormone produced at shoot tip; causes cell elongation; responsible for phototropism.
Abscisic Acid	Plant growth INHIBITOR; causes stomata closure during drought; promotes leaf fall; "stress hormone."

Insulin	Hormone from pancreas (beta cells); lowers blood glucose by promoting glucose absorption into cells.
Thyroxin	Thyroid hormone containing iodine; regulates metabolism; deficiency -> goitre (iodine deficiency).
Adrenaline	"Fight or flight" hormone from adrenal glands; raises heart rate, blood pressure; prepares body for emergency.

Neuron Structure

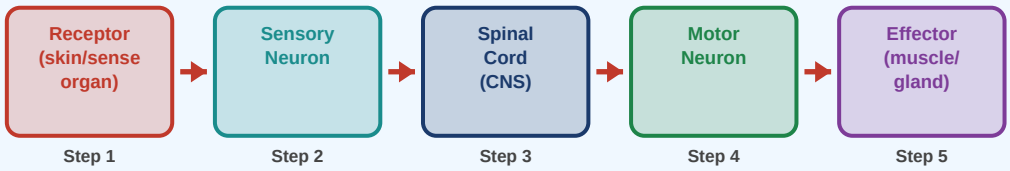
Structure of a Neuron



Signal direction: Dendrites -> Cell Body -> Axon -> Axon Terminals

■ Reflex Arc

Reflex Arc -- Components and Signal Flow



Example: Hot pan touch -> pain receptor -> sensory neuron -> spinal cord -> motor neuron -> hand muscle withdraws

Types of Tropisms

Types of Tropisms in Plants

Tropism	Description
Phototropism	Shoot grows TOWARDS light; root grows A
Geotropism	Root grows DOWN (towards gravity)
Hydrotropism	Root grows TOWARDS water
Chemotropism	n tube growth towards ovule Growth towards chemical stimulus; e.g., po
Thigmotropism	) Tendril coils around support (touch-sensitiv

Plant Hormones

Plant Hormones (Phytohormones)

Hormone	Source	
Auxin (IAA)	Shoot tip	Cell elongation; phototropism; apic
Gibberellin	Young leaves/embryo	Stem elongation; seed germinatio
Cytokinin	Root tip	Promotes cell division (cytokinesis
Abscisic Acid (ABA)	Leaves, fruits	INHIBITS growth; promotes leaf/fr
Ethylene	Ripening fruits	Promotes fruit ripening; leaf fall; u

SECTION A ❖ Multiple Choice Questions (Q. 1-33)

Q.1. Which of the following statements is correct about receptors?

(a) Gustatory receptors detect taste while olfactory receptors detect smell

(b) Both gustatory and olfactory receptors detect smell

(c) Auditory receptors detect smell and olfactory receptors detect taste

(d) Olfactory receptors detect taste and gustatory receptors detect smell

[ANS] Answer: (a)

Gustatory receptors are taste buds on the tongue -- they detect **taste**.
Olfactory receptors are in the nasal cavity -- they detect **smell**.
Auditory receptors detect sound (hearing). All other options incorrectly swap these functions.

[TIP] **Exam Tip:** Gustatory = Gusto = taste (tongue). Olfactory = Olfaction = smell (nose). Auditory = hearing (ear). Learn these root words!

Q.2. Electrical impulse travels in a neuron from:

(a) Dendrite -> Axon -> Axonal end -> Cell body

(b) Cell body -> Dendrite -> Axon -> Axonal end

(c) Dendrite -> Cell body -> Axon -> Axonal end

(d) Axonal end -> Axon -> Cell body -> Dendrite

[ANS] Answer: (c) Dendrite -> Cell body -> Axon -> Axonal end

The correct direction of electrical impulse within a single neuron:
Dendrites (receive signal) -> Cell body (soma) -> Axon -> Axon terminals
Dendrites collect incoming signals from the environment or other neurons. The cell body integrates the signal. The axon conducts it to the axon terminals which then release neurotransmitters into the synapse.

[TIP] **Exam Tip:** Direction in ONE neuron: D -> CB -> A -> AT (Dendrite -> Cell Body -> Axon -> Axon Terminal). NEVER reverse!

Q.3. In a synapse, chemical signal is transmitted from:

(a) Dendritic end of one neuron to axonal end of another neuron

(b) Axon to cell body of the same neuron

(c) Cell body to axonal end of the same neuron

(d) Axonal end of one neuron to dendritic end of another neuron

[ANS] Answer: (d)

At a synapse:
* The **axonal end (pre-synaptic)** of neuron A releases neurotransmitters into the synaptic cleft
* The neurotransmitters diffuse across the gap
* They bind to receptors on the **dendritic end (post-synaptic)** of neuron B
* This generates a new electrical impulse in neuron B
So: axonal end of one -> dendritic end of next.

[TIP] **Exam Tip:** Synapse signal: AXONAL END -> (chemical) -> DENDRITIC END. Axon releases; dendrite receives. This is ONE-WAY!

Q.4. In a neuron, conversion of electrical signal to a chemical signal occurs at/in:

(a) Cell body
(b) Axonal end
(c) Dendritic end
(d) Axon

[ANS] Answer: (b) Axonal end

At the **axonal end (synaptic terminal/knob)**:
* The arriving electrical impulse triggers vesicles to release neurotransmitters (chemical molecules)
* These chemicals diffuse across the synaptic gap
* At the dendrite of the next neuron, they trigger a new electrical impulse
So the conversion: **electrical -> chemical** happens at the **axonal end**.

[TIP] **Exam Tip:** Axonal end = site of electrical -> chemical conversion. Dendritic end = site of chemical -> electrical conversion. Both conversions happen at the synapse!

Q.5. Which is the correct sequence of components of a reflex arc?

(a) Receptors -> Muscles -> Sensory neuron -> Motor neuron -> Spinal cord
(b) Receptors -> Motor neuron -> Spinal cord -> Sensory neuron -> Muscle
(c) Receptors -> Spinal cord -> Sensory neuron -> Motor neuron -> Muscle
(d) Receptors -> Sensory neuron -> Spinal cord -> Motor neuron -> Muscle

[ANS] Answer: (d)

The correct sequence of the reflex arc:
Receptor -> Sensory neuron -> Spinal cord -> Motor neuron -> Effector (muscle/gland)
* Receptor: detects stimulus
* Sensory neuron: carries impulse TO spinal cord (afferent)
* Spinal cord: integrates signal (relay neuron)
* Motor neuron: carries impulse FROM spinal cord to muscle (efferent)
* Muscle: produces response (contraction/withdrawal)

[TIP] **Exam Tip:** "RSSMM" -- Receptor, Sensory, Spinal cord, Motor, Muscle. Or: "Receptors SENSE, Spinal cord MEDIATES, Motor Moves."

Q.6. Which of the following statements are TRUE?
(i) Sudden action in response to environment = reflex action
(ii) Sensory neurons carry signals from spinal cord to muscles
(iii) Motor neurons carry signals from receptors to spinal cord
(iv) Path from receptor to muscle/gland = reflex arc

(a) (i) and (ii)
(b) (i) and (iii)
(c) (i) and (iv)
(d) (i), (ii) and (iii)

[ANS] Answer: (c) (i) and (iv)

* (i) OK Reflex action = sudden, automatic response to stimulus (e.g., hand withdrawal from hot object)
* (ii) X WRONG: Sensory neurons carry signals FROM receptors TO spinal cord (not from spinal cord to muscles)
* (iii) X WRONG: Motor neurons carry signals FROM spinal cord TO muscles (not from receptors to spinal cord)
* (iv) OK Reflex arc = path from receptor -> sensory neuron -> CNS -> motor neuron -> effector

[TIP] **Exam Tip:** Sensory = Smell = S = To Spinal cord. Motor = Muscle = M = From spinal cord to Muscle. Common confusion in exams!

Q.7. Which of the following statements are TRUE about the brain?
(i) Main thinking part = hind brain
(ii) Hearing, smell, memory, sight centres in forebrain
(iii) Involuntary actions (salivation, vomiting, BP) controlled by medulla in hindbrain
(iv) Cerebellum does NOT control posture/balance

(a) (i) and (ii)
(b) (i), (ii) and (iii)
(c) (ii) and (iii)
(d) (iii) and (iv)

[ANS] Answer: (c) (ii) and (iii)

* (i) X WRONG: Main thinking part = **CEREBRUM in FOREBRAIN**, not hindbrain
* (ii) OK Forebrain (cerebrum) contains centres for hearing, smell, memory, sight, and voluntary actions
* (iii) OK Medulla oblongata (hindbrain) controls involuntary actions: salivation, vomiting, blood pressure, heartbeat
* (iv) X WRONG: Cerebellum DOES control posture and balance of the body

[TIP] **Exam Tip:** Brain parts: Cerebrum = thinking (forebrain). Cerebellum = balance (hindbrain). Medulla = involuntary (hindbrain). Learn these 3 pairs!

Q.8. Posture and balance of the body is controlled by:

(a) Cerebrum
(b) Cerebellum
(c) Medulla
(d) Pons

[ANS] Answer: (b) Cerebellum

The **cerebellum** is located at the back of the brain (hindbrain). It coordinates muscular activities, maintains body posture and balance, and ensures smooth, precise voluntary movements. When the cerebellum is damaged, a person cannot maintain balance or coordinate movements properly.

[TIP] **Exam Tip:** Cerebellum = Balance + Coordination. Cerebrum = Thinking. Medulla = Involuntary. Pons = connects brain parts. Learn these 4!

Q.9. Spinal cord originates from:

(a) Cerebrum
(b) Medulla
(c) Pons
(d) Cerebellum

[ANS] Answer: (b) Medulla

The spinal cord is a direct downward extension of the **medulla oblongata**. The medulla is the lowermost part of the brain stem, and the spinal cord continues from it downward through the vertebral column. Together, the brain and spinal cord form the Central Nervous System (CNS).

[TIP] **Exam Tip:** Medulla -> Spinal cord (directly connected). Medulla is at the base of the brain; spinal cord extends below it.

Q.10. The movement of shoot towards light is:

(a) Geotropism
(b) Hydrotropism
(c) Chemotropism
(d) Phototropism

[ANS] Answer: (d) Phototropism

Phototropism = response to **light**. Shoots show **positive phototropism** (grow towards light).
* Auxin accumulates on the shaded side of the shoot -> cells on shaded side elongate more -> shoot bends towards light
* Geotropism = gravity; Hydrotropism = water; Chemotropism = chemicals

[TIP] **Exam Tip:** Photo = light, Geo = gravity/earth, Hydro = water, Chemo = chemicals, Thigmo = touch. Suffix "-tropism" = directional growth.

Q.11. The main function of abscisic acid in plants is to:

(a) Increase the length of cells

(b) Promote cell division

(c) Inhibit growth

(d) Promote growth of stem

[ANS] Answer: (c) Inhibit growth

Abscisic Acid (ABA) is a plant **growth inhibitor**. Its key functions:
* Inhibits growth and promotes dormancy
* Triggers stomata closure during water stress
* Promotes leaf fall (abscission) and fruit drop
* Called the "stress hormone" of plants
Auxins promote elongation, gibberellins promote stem growth, cytokinins promote cell division.

[TIP] **Exam Tip:** ABA = stress hormone = INHIBITOR. Auxin, Gibberellin, Cytokinin = PROMOTERS. ABA is the odd one out!

Q.12. Which of the following is NOT associated with growth of plants?

(a) Auxin

(b) Gibberellins

(c) Cytokinins

(d) Abscisic acid

[ANS] Answer: (d) Abscisic acid

Auxin, gibberellins, and cytokinins are all **growth promoters**:
* Auxin -> cell elongation
* Gibberellins -> stem elongation, seed germination
* Cytokinins -> cell division
Abscisic acid (ABA) is a **growth inhibitor** -- it DOES NOT promote growth. It promotes dormancy, stomatal closure, and leaf/fruit fall.

[TIP] **Exam Tip:** 3 promoters + 1 inhibitor: Auxin + Gibberellin + Cytokinin = growth. ABA = NO growth. This is frequently asked!

Q.13. Iodine is necessary for the synthesis of which hormone?

(a) Adrenaline

(b) Thyroxin

(c) Auxin

(d) Insulin

[ANS] Answer: (b) Thyroxin

Thyroxin (thyroid hormone, T4) contains **4 iodine atoms** in its structure -- it is iodine-dependent.
The thyroid gland absorbs iodine from blood to synthesise thyroxin.
* Iodine deficiency -> thyroid gland cannot make enough thyroxin -> gland enlarges trying to compensate -> **Goitre**
Adrenaline is from adrenal gland (no iodine needed). Insulin is from pancreas (no iodine). Auxin is a plant hormone.

[TIP] **Exam Tip:** Thyroxin needs IODINE. No iodine = goitre (swollen neck). This is why salt is iodized (iodised salt)!

Q.14. Choose the INCORRECT statement about insulin:

(a) It is produced from pancreas

(b) It regulates growth and development of the body

(c) It regulates blood sugar level

(d) Insufficient secretion of insulin will cause diabetes

[ANS] Answer: (b) It regulates growth and development of the body

Option (b) is **incorrect**. Insulin does NOT regulate growth and development -- that is the role of **Growth Hormone** (from pituitary).
Correct facts about insulin:
* (a) OK Produced by beta cells of the islets of Langerhans in the **pancreas**
* (c) OK Lowers blood glucose level (signals cells to absorb and store glucose)
* (d) OK Insufficient insulin -> blood sugar stays high -> **Diabetes mellitus**

[TIP] **Exam Tip:** Insulin -> controls BLOOD SUGAR (not growth). Growth hormone -> controls GROWTH. Deficiency of insulin -> DIABETES.

Q.15. Select the mis-matched pair:

(a) Adrenaline : Pituitary gland

(b) Testosterone : Testes

(c) Estrogen : Ovary

(d) Thyroxin : Thyroid gland

[ANS] Answer: (a) Adrenaline : Pituitary gland

Adrenaline is produced by the **Adrenal glands** (located on top of kidneys), NOT the pituitary gland.
* Pituitary gland produces: Growth hormone, TSH, FSH, LH, ADH, Oxytocin
* Correct pairs: Testosterone -> Testes OK; Estrogen -> Ovary OK; Thyroxin -> Thyroid OK

[TIP] **Exam Tip:** Adrenaline = Adrenal gland (above kidneys). Do NOT confuse adrenal with pituitary! "Adrenal" = "ad-renal" = "near the kidney".

Q.16. The shape of guard cells changes due to change in the:

(a) Protein composition of cells

(b) Temperature of cells

(c) Amount of water in cells

(d) Position of nucleus in cells

[ANS] Answer: (c) Amount of water in cells

Guard cells change shape based on their **water content (turgor pressure)**:
* Water IN -> guard cells swell (turgid) -> bend outward (inner wall is thicker) -> **stomata open**
* Water OUT -> guard cells shrink (flaccid) -> straighten -> **stomata close**
This was covered in Chapter 6 as well -- a cross-chapter connection!

[TIP] **Exam Tip:** Guard cells: turgor (water) -> shape change -> stomata open/close. Water = key driver. This appears in BOTH Ch.6 and Ch.7!

Q.17. The growth of tendril in pea plants is due to:

(a) Effect of light

(b) Effect of gravity

(c) Rapid cell divisions in tendril cells AWAY from the support

(d) Rapid cell divisions in tendril cells IN CONTACT with the support

[ANS] Answer: (c) Rapid cell divisions in tendril cells AWAY from the support

Tendrils show **thigmotropism** (touch-sensitive growth). When one side of the tendril touches a support:
* Cells **in contact** with the support grow SLOWLY (inhibited by contact)
* Cells **away from** the support divide rapidly -> grow faster on the outer side
* This unequal growth causes the tendril to **coil around the support**
This is mediated by auxin redistribution.

[TIP] **Exam Tip:** Tendril coiling: cells AWAY from support grow FASTER -> tendril curves towards support. Unequal growth = curling/bending!

Q.18. The growth of pollen tubes towards ovules is due to:

(a) Hydrotropism

(b) Chemotropism

(c) Geotropism

(d) Phototropism

[ANS] Answer: (b) Chemotropism

Chemotropism is growth in response to a **chemical stimulus**.
Pollen tubes grow towards ovules because ovules (and surrounding style tissue) release chemical substances (sugars, calcium ions) that attract the pollen tube. This directed growth towards chemical gradients is a classic example of chemotropism.

[TIP] **Exam Tip:** Pollen tube -> ovule = chemotropism (chemical gradient). Sunflower tracking sun = phototropism. Root towards water = hydrotropism.

Q.19. The movement of sunflower following the path of the sun is due to:

(a) Phototropism

(b) Geotropism

(c) Chemotropism

(d) Hydrotropism

[ANS] Answer: (a) Phototropism

Sunflower's tracking of the sun is a well-known example of **phototropism**. The flower head (and young stem) moves from east to west during the day, always facing the sun. Auxin is redistributed to the shaded side -> cells on shaded side elongate -> stem bends towards light. Note: This solar tracking is more accurately called **heliotropism** -- a type of phototropism.

[TIP] **Exam Tip:** Sunflower tracks sun = phototropism. Young sunflowers track sun; mature sunflowers face east permanently.

Q.20. The substance that triggers the fall of mature leaves and fruits from plants is:

(a) Auxin

(b) Gibberellin

(c) Abscisic acid

(d) Cytokinin

[ANS] Answer: (c) Abscisic acid

Abscisic acid (ABA) promotes the formation of the abscission zone at the base of leaf petioles and fruit stalks. This causes the breakdown of cells at that point -> leaves and fruits detach and fall.
ABA also promotes seed dormancy and inhibits germination. "Abscisic" refers to "abscission" (falling off).

[TIP] **Exam Tip:** ABA = Abscisic Acid = ABscission (leaf/fruit fall) + stress response. The "ABA" letters help remember "AB-scission"!

Q.21. Which of the following statements about transmission of nerve impulse is **INCORRECT**?

(a) Nerve impulse travels from dendritic end towards axonal end

(b) At the dendritic end, electrical impulses release chemicals that generate impulse at axonal end of another neuron

(c) Chemicals released from axonal end cross synapse and generate impulse in dendrite of another neuron

(d) A neuron transmits impulses not only to another neuron but also to muscle and gland cells

[ANS] Answer: (b)

Option (b) is **incorrect** because it states chemicals are released at the DENDRITIC end -- this is wrong!
Correct statement: Electrical impulse at the **AXONAL END** (not dendritic) triggers release of chemicals (neurotransmitters) into the synapse -> these cross the gap -> generate new impulse in the DENDRITIC end of next neuron.
Options (a), (c), (d) are all correct statements.

[TIP] **Exam Tip:** AXONAL end = neurotransmitter RELEASE site. DENDRITIC end = neurotransmitter RECEPTION site. Very common exam trap!

Q.22. Involuntary actions in the body are controlled by:

(a) Medulla in forebrain

(b) Medulla in midbrain

(c) Medulla in hindbrain

(d) Medulla in spinal cord

[ANS] Answer: (c) Medulla in hindbrain

The **medulla oblongata** is part of the **hindbrain** (along with cerebellum and pons). It controls involuntary actions such as:
* Heart rate regulation
* Breathing
* Blood pressure
* Vomiting
* Salivation
* Swallowing
These are vital life functions that don't require conscious thought.

[TIP] **Exam Tip:** Medulla oblongata = HINDBRAIN = involuntary control. Cerebrum = FOREBRAIN = voluntary/conscious. Easy: Medulla = behind = hind brain.

Q.23. Which of the following is NOT an involuntary action?

(a) Vomiting

(b) Salivation

(c) Heart beat

(d) Chewing

[ANS] Answer: (d) Chewing

Chewing is a **voluntary action** -- you consciously decide to chew and control the jaw muscles.
Involuntary actions (not under conscious control):
* Vomiting (medulla reflex)
* Salivation (can be partly triggered by thought, but the secretion itself is involuntary)
* Heartbeat (controlled by medulla; you cannot consciously stop it)
Chewing requires conscious initiation and control.

[TIP] **Exam Tip:** Chewing = voluntary (you control it). Heartbeat, breathing (rate), salivation, vomiting = involuntary (you cannot consciously stop them).

Q.24. When a person suffers from severe cold, he/she cannot:

(a) Differentiate taste of apple from ice cream

(b) Differentiate smell of perfume from agarbatti

(c) Differentiate red light from green light

(d) Differentiate a hot object from a cold object

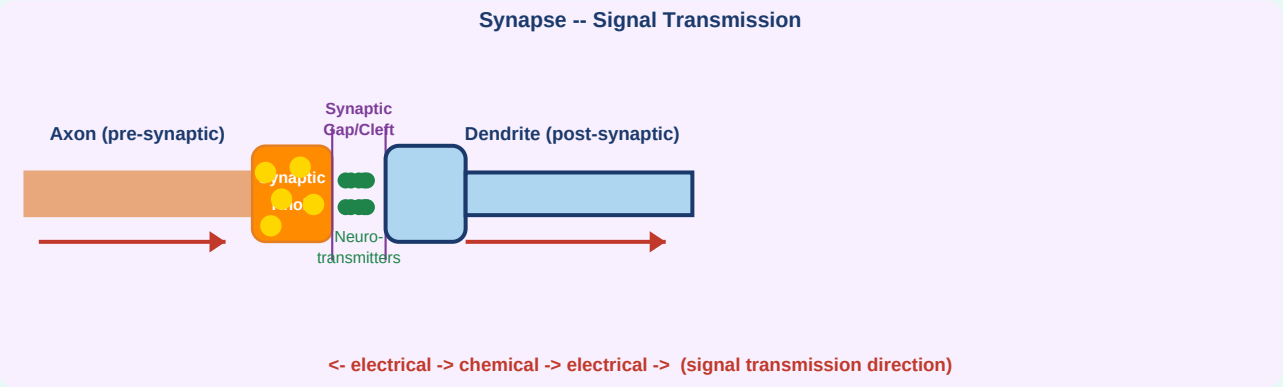
[ANS] Answer: (b) Differentiate smell of perfume from agarbatti

During a severe cold (blocked nose), the **olfactory receptors** in the nasal cavity are impaired because mucus blocks odour molecules from reaching them. Smell is severely reduced or absent.
Interestingly, much of what we perceive as "taste" is actually smell -- when you cannot smell, food also seems tasteless! But the options ask about the PRIMARY receptor affected -- which is the olfactory (smell) receptor.

[TIP] **Exam Tip:** Common cold -> blocked nose -> olfactory receptors blocked -> cannot smell. Food also seems "tasteless" because smell contributes to taste perception!

Q.25. What is the correct direction of flow of electrical impulses? (Four neuron diagrams a, b, c, d are shown in Fig 7.1)

[ANS] Answer: (c) -- Signal flows from axon end of left neuron -> dendrite of right neuron



Explanation:
In Fig 7.1, option (c) shows arrows pointing from RIGHT to LEFT, which in the context of the diagram means: from the axonal end of one neuron -> across synapse -> to the dendritic end of the next neuron.

The correct direction of signal flow is always:
Dendrites -> Cell body -> Axon -> Axon terminal -> (synapse) -> Dendrites of next neuron

Signal travels from axonal end of pre-synaptic neuron to dendritic end of post-synaptic neuron. This is a one-way street due to neurotransmitters being released only from axon terminals.

Q.26. Which statement is NOT true about thyroxin?

(a) Iron is essential for the synthesis of thyroxin
(b) It regulates carbohydrates, protein and fat metabolism in the body
(c) Thyroid gland requires iodine to synthesise thyroxin
(d) Thyroxin is also called thyroid hormone

[ANS] Answer: (a) Iron is essential for the synthesis of thyroxin

Option (a) is **FALSE**. **Iodine** (not iron) is essential for thyroxin synthesis. Each thyroxin molecule contains 4 iodine atoms.

True statements about thyroxin:

* (b) OK It regulates metabolism of carbohydrates, proteins, and fats
* (c) OK Thyroid gland absorbs iodine to make thyroxin
* (d) OK Thyroxin = thyroid hormone (T4)

Iron deficiency -> anaemia (affects haemoglobin, not thyroxin).

[TIP] **Exam Tip:** Thyroxin needs IODINE (4 atoms per molecule). Iron is for HAEMOGLOBIN. Classic confusion -- iron vs iodine!

Q.27. Dwarfism results due to:

(a) Excess secretion of thyroxin

(b) Less secretion of growth hormone

(c) Less secretion of adrenaline

(d) Excess secretion of growth hormone

[ANS] Answer: (b) Less secretion of growth hormone

Growth Hormone (GH/Somatotropin) from the anterior pituitary controls overall body growth, especially bone and muscle.

* **Less GH during childhood** -> stunted bone growth -> **Dwarfism (Pituitary Dwarfism)**
* **Excess GH during childhood** -> excessive growth -> **Gigantism**
* **Excess GH after puberty** -> enlarged hands, feet, face -> **Acromegaly**

Thyroxin deficiency in childhood causes cretinism (stunted mental and physical growth), not dwarfism.

[TIP] **Exam Tip:** Growth hormone (pituitary): less = dwarfism, excess = gigantism (in children). Important to know both!

Q.28. Dramatic body changes at puberty are mainly because of secretion of:

(a) Oestrogen from testes and testosterone from ovary

(b) Estrogen from adrenal gland and testosterone from pituitary

(c) Testosterone from testes and estrogen from ovary

(d) Testosterone from thyroid and estrogen from pituitary

[ANS] Answer: (c) Testosterone from testes and estrogen from ovary

Sex hormones and their correct sources:

* **Testosterone**: produced by **testes** in males -> causes male secondary sexual characteristics (voice deepening, facial hair, muscle development, sperm production)
* **Estrogen (Oestrogen)**: produced by **ovaries** in females -> causes female secondary sexual characteristics (breast development, widening of hips, menstrual cycle)

All other options mix up the glands and hormones.

[TIP] **Exam Tip:** Testosterone -> Testes (T -> T). Estrogen -> Ovary (E -> O). Simple matching! Both increase significantly at puberty.

Q.29. A doctor advised insulin injection because:

(a) His blood pressure was low

(b) His heart was beating slowly

(c) He was suffering from goitre

(d) His sugar level in blood was high

[ANS] Answer: (d) His sugar level in blood was high

Insulin is the hormone that LOWERS blood glucose level by:
* Signalling cells (especially liver and muscle) to absorb glucose from blood
* Promoting conversion of glucose to glycogen (glycogenesis)
* Inhibiting glucose production in liver

High blood sugar = diabetes mellitus -> insulin injection needed.
Goitre -> thyroxin needed. Low blood pressure -> adrenaline/other treatment. Slow heartbeat -> not treated with insulin.

[TIP] **Exam Tip:** High blood sugar -> insulin needed. Low blood sugar -> glucagon (also from pancreas) needed. Diabetes -> insulin deficiency.

Q.30. The hormone which increases fertility in males is called:

(a) Oestrogen

(b) Testosterone

(c) Insulin

(d) Growth hormone

[ANS] Answer: (b) Testosterone

Testosterone is the primary male sex hormone (androgen) produced by the testes. It:
* Promotes sperm production (spermatogenesis)
* Develops male reproductive organs
* Causes secondary sexual characteristics (beard, deep voice, muscle mass)
* Increases male fertility
Oestrogen is the primary female hormone from ovaries.

[TIP] **Exam Tip:** Testosterone = male fertility hormone. Produced by TESTES. Estrogen = female hormone. Produced by OVARIES.

Q.31. Which of the following endocrine glands is unpaired?

(a) Adrenal

(b) Testes

(c) Pituitary

(d) Ovary

[ANS] Answer: (c) Pituitary

The **pituitary gland** is a single (unpaired) gland located at the base of the brain.
Paired endocrine glands (one on each side):
* Adrenal glands: 2 (one above each kidney)
* Testes: 2 (in males)
* Ovaries: 2 (in females)
Other unpaired glands: Thyroid, Thymus, Pineal, Pancreas
Pituitary = 1 (at base of brain, in the sella turcica of the skull)

[TIP] **Exam Tip:** Pituitary = unpaired (only 1). Adrenal, Testes, Ovaries = paired (2 each). Also thyroid is technically one but has two lobes.

Q.32. Junction between two neurons is called:

(a) Cell junction
(b) Neuromuscular junction
(c) Neural joint
(d) Synapse

[ANS] Answer: (d) Synapse

The tiny gap between two neurons (where signal crosses from one to the next) is called a **synapse**.
* Synapse = "to clasp/join" (Greek)
* A neuromuscular junction is where a motor neuron meets a muscle (different from synapse between two neurons)
* Cell junction and neural joint are not correct biological terms for this structure

[TIP] **Exam Tip:** Neuron-Neuron junction = SYNAPSE. Neuron-Muscle junction = Neuromuscular junction. Different names for different junctions!

Q.33. In humans, life processes are controlled and regulated by:

(a) Reproductive and endocrine systems
(b) Respiratory and nervous systems
(c) Endocrine and digestive systems
(d) Nervous and endocrine systems

[ANS] Answer: (d) Nervous and endocrine systems

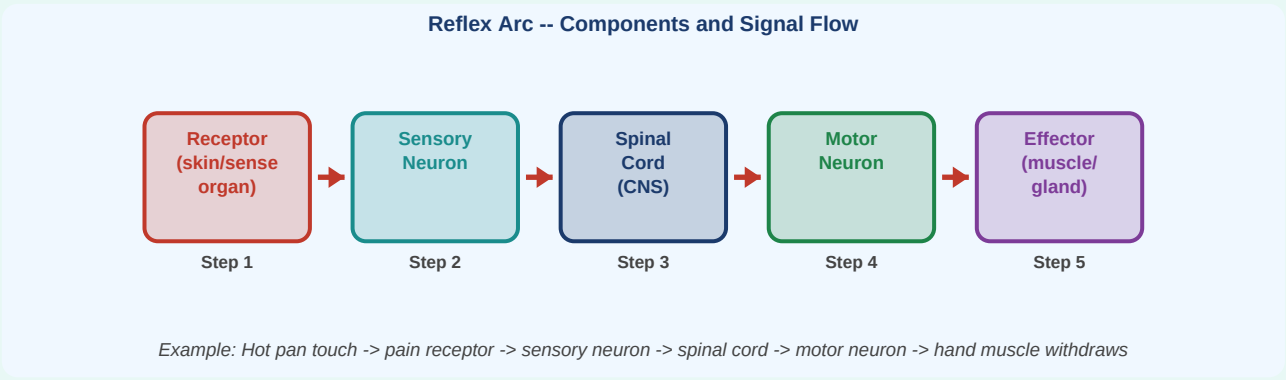
The two control systems of the human body:
* **Nervous system**: Fast electrical signals; controls rapid responses (reflexes, voluntary actions); uses neurons and neurotransmitters
* **Endocrine system**: Slow chemical signals (hormones in blood); controls long-term processes (growth, metabolism, reproduction, stress response)
Together they coordinate all life processes. The other options mix unrelated systems.

[TIP] **Exam Tip:** NERVOUS = fast (electrical) + short-term. ENDOCRINE = slow (hormonal/chemical) + long-term. Together = complete control system!

SECTION B ❖ Short Answer Questions (Q. 34-44)

Q.34. Label the parts (a), (b), (c), (d) and show the direction of flow of electrical signals in the reflex arc diagram (Fig. 7.2 -- shows hot pan -> hand withdrawal reflex).

Labels for the reflex arc diagram (Fig. 7.2):



Example: Hot pan touch -> pain receptor -> sensory neuron -> spinal cord -> motor neuron -> hand muscle withdraws

(a) Sensory neuron -- carries impulse from receptor (skin of hand) to spinal cord
(b) Spinal cord (CNS) -- processes the signal; relay neuron connects sensory to motor
(c) Motor neuron -- carries impulse from spinal cord to effector (muscle)
(d) Muscle (effector) -- contracts; hand withdraws from hot pan

Direction of signal flow:
Hot pan (stimulus) -> Receptor in skin -> (a) Sensory neuron -> (b) Spinal cord -> (c) Motor neuron -> (d) Muscle -> Hand withdraws (response)

Q.35. Name the plant hormones responsible for:
(a) Elongation of cells (b) Growth of stem
(c) Promotion of cell division (d) Falling of senescent leaves

(a) Elongation of cells -> AUXIN (IAA)
Auxin causes cells to elongate by loosening cell walls, allowing cells to take up more water and expand.

(b) Growth of stem -> GIBBERELLIN
Gibberellins cause dramatic stem elongation; used in agriculture to increase plant height and seedless fruit production.

(c) Promotion of cell division -> CYTOKININ
Cytokinins promote cytokinesis (cell division); also delay leaf ageing (senescence).

(d) Falling of senescent (ageing) leaves -> ABSCISIC ACID (ABA)
ABA promotes formation of the abscission layer at the base of leaves -> leaves detach and fall.

[TIP] **Exam Tip:** Plant hormones: Auxin->elongation, Gibberellin->stem growth, Cytokinin->cell division, ABA->leaf fall. Learn all 4 pairs!

Q.36. Label the endocrine glands in the figure (Fig. 7.3).

Endocrine Glands and Locations:

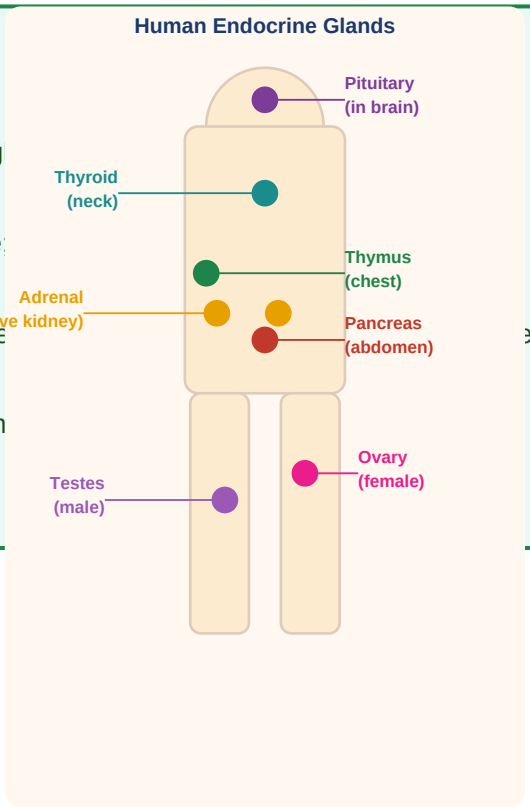
(a) Pituitary gland
Located at the base of brain; "master gland"; controls other g

(b) Thyroid gland
Located in the neck; secretes thyroxin (T3, T4); needs iodine

(c) Adrenal gland
Located above kidneys (one pair); secretes adrenaline (epine

(d) Pancreas (Islets of Langerhans)
Located near stomach; both exocrine (digestive enzymes) an

Also shown in human body diagram -> right:



Q.37. In Fig. 7.4, three diagrams (a), (b), (c) show plants in pots under unidirectional light. Which appears most accurate and why?

Answer: Figure (c) appears most accurate.

Why (c) is most accurate:
When a plant is exposed to light from one side, **auxin** redistributes from the illuminated side to the shaded side of the shoot tip.

* Shaded side: MORE auxin -> MORE cell elongation
* Illuminated side: LESS auxin -> LESS cell elongation
* Unequal growth -> shoot bends **towards the light source**

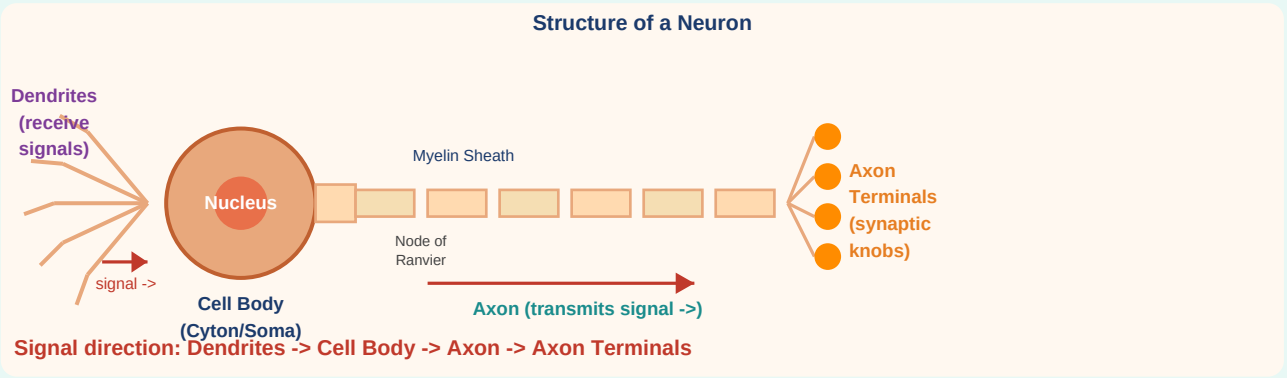
Figure (c) correctly shows the shoot bending TOWARDS the light source at a moderate angle, with the shoot tip curving but not fully horizontal. This is how phototropism actually looks.

* (a) may show bending AWAY from light (incorrect -- shoots show positive phototropism)
* (b) may show no bending or bending at wrong angle
* (c) correctly shows positive phototropism -- shoot bends towards the light

[TIP] **Exam Tip:** Shoots show POSITIVE phototropism (toward light). Roots show NEGATIVE phototropism (away from light). Auxin accumulates on shaded side.

Q.38. Label the parts of a neuron in Figure 7.5.
(a) shown at top branches, (b) shown at cell body, (c) along the axon, (d) at the end)

Labels for neuron diagram (Fig. 7.5):



(a) Dendrites -- Tree-like short projections that receive nerve impulses
(b) Cell body (Cyton/Soma) -- Contains the nucleus and major organelles; integrates signals
(c) Axon (with myelin sheath) -- Long fibre that conducts impulse away from cell body
(d) Axon terminals (Synaptic knobs) -- Release neurotransmitters to pass signal to next neuron

---

Q.39. Match the terms of Column (A) with those of Column (B):
(a) Olfactory receptors (b) Thermo receptors (c) Gustato receptors (d) Photoreceptors
(i) Tongue (ii) Eye (iii) Nose (iv) Skin

(a) Olfactory receptors -> (iii) Nose
Olfactory receptors in the nasal epithelium detect odour molecules dissolved in mucus.

(b) Thermoreceptors -> (iv) Skin
Thermoreceptors (heat/cold receptors) in the skin detect temperature changes.

(c) Gustatory (Gustato) receptors -> (i) Tongue
Taste buds on the tongue contain gustatory receptors that detect sweet, sour, salty, bitter, umami.

(d) Photoreceptors -> (ii) Eye
Rods and cones in the retina of the eye are photoreceptors that detect light and colour.

[TIP] **Exam Tip:** Receptor types: Olfactory=smell/nose, Gustatory=taste/tongue, Photoreceptors=light/eye, Thermoreceptors=temperature/skin, Auditory=sound/ear.

Q.40. What is a tropic movement? Explain with an example.

Tropic movement (Tropism) is a directional growth response of a plant organ (or part) towards or away from an external stimulus.

Key features of tropic movements:
* Permanent, growth-based movement (unlike nastic movements which are reversible)
* Caused by unequal distribution of auxin
* Can be positive (towards stimulus) or negative (away from stimulus)
* Involves differential cell elongation on opposite sides

Example: Phototropism (response to light)
When a plant shoot is illuminated from one side:
1. Auxin migrates from the light side to the shaded side of the shoot tip
2. Higher auxin concentration on shaded side -> more cell elongation
3. Cells on illuminated side elongate less
4. Unequal growth -> shoot tip bends TOWARDS the light source
This is POSITIVE phototropism.

Other examples:
* Geotropism: roots grow downward (positive geotropism) due to gravity
* Hydrotropism: roots grow towards water
* Chemotropism: pollen tube grows towards ovule

[TIP] **Exam Tip:** Tropism = permanent, directional, GROWTH movement. Nastic movement = non-directional, temporary (e.g., touch-me-not Mimosa). Know the difference!

Q.41. What will happen if intake of iodine in our diet is low?

Iodine deficiency leads to GOITRE -- a swelling in the neck (enlarged thyroid gland).

Chain of events:
1. **Low iodine intake** in diet
2. Thyroid gland **cannot synthesise thyroxin** (needs 4 iodine atoms per molecule)
3. Blood thyroxin levels fall
4. Pituitary gland releases excess **TSH (thyroid stimulating hormone)** to compensate
5. Thyroid gland over-works and **ENLARGES** in an attempt to produce more thyroxin
6. Visible **swelling in front of neck = GOITRE**

Other effects of iodine deficiency:
* Sluggish metabolism (weight gain, fatigue, feeling cold)
* In pregnant women: can cause cretinism in babies (stunted mental/physical development)
* Prevention: use of **iodised salt** in daily diet

[TIP] **Exam Tip:** Iodine deficiency -> goitre (enlarged thyroid). Prevention = iodised salt. Cretinism = severe iodine deficiency in infants. Very important health fact!

Q.42. What happens at the synapse between two neurons?

The synapse is the site of signal transfer between neurons -- electrical signal is converted to chemical and back to electrical.

Step-by-step events at the synapse:

Step 1: Electrical impulse arrives
The electrical nerve impulse travels along the axon and reaches the **axon terminal (synaptic knob)** of the pre-synaptic neuron.

Step 2: Release of neurotransmitters
The electrical impulse triggers membrane-bound **synaptic vesicles** to fuse with the axon terminal membrane and release **neurotransmitters** (chemical messengers like acetylcholine) into the **synaptic cleft**.

Step 3: Diffusion across synapse
Neurotransmitters diffuse across the tiny gap (20-40 nm) to reach the post-synaptic membrane (dendrite of next neuron).

Step 4: New electrical impulse
Neurotransmitters bind to specific receptors on the dendritic membrane -> ion channels open -> new electrical impulse generated in the next neuron.

Summary: Electrical -> Chemical -> Electrical

[TIP] **Exam Tip:** Synapse events: Electrical arrives at axon -> neurotransmitters released -> cross gap -> bind to dendrite receptors -> new electrical impulse. One-way only!

Q.43. Answer the following:
(a) Hormone responsible for female puberty changes
(b) Dwarfism results due to deficiency of which hormone?
(c) Blood sugar rises due to deficiency of which hormone?
(d) Iodine is necessary for which hormone?

(a) Female puberty changes -> OESTROGEN (Estrogen)
Secreted by ovaries; causes breast development, widening of hips, menstrual cycle onset, other female secondary sexual characteristics.

(b) Dwarfism -> Growth Hormone (GH/Somatotropin) deficiency
From anterior pituitary gland; insufficient GH during childhood -> stunted skeletal growth -> pituitary dwarfism.

(c) High blood sugar -> Insulin deficiency
From beta cells of pancreas (Islets of Langerhans); without insulin, cells cannot absorb glucose -> blood sugar stays high -> Diabetes mellitus.

(d) Iodine -> Thyroxin (thyroid hormone)
From thyroid gland; each molecule needs 4 iodine atoms; deficiency -> goitre.

[TIP] **Exam Tip:** Quick reference: Estrogen->puberty (female), GH->growth/dwarfism, Insulin->blood sugar/diabetes, Thyroxin->iodine/goitre. These 4 are exam staples!

Q.44. Answer the following:
(a) Endocrine gland associated with brain
(b) Gland secreting digestive enzymes AND hormones
(c) Endocrine gland associated with kidneys
(d) Endocrine gland present in males but not in females

(a) Endocrine gland in brain -> Pituitary gland
Located at the base of the brain (in the sella turcica); "master gland"; controls most other endocrine glands.

(b) Secretes BOTH digestive enzymes and hormones -> Pancreas
Exocrine function: digestive enzymes (lipase, amylase, trypsin) via pancreatic duct into small intestine.
Endocrine function: insulin and glucagon from islets of Langerhans directly into blood.

(c) Endocrine gland associated with kidneys -> Adrenal glands
Paired glands sitting on top of each kidney; adrenal cortex (steroids) + adrenal medulla (adrenaline).

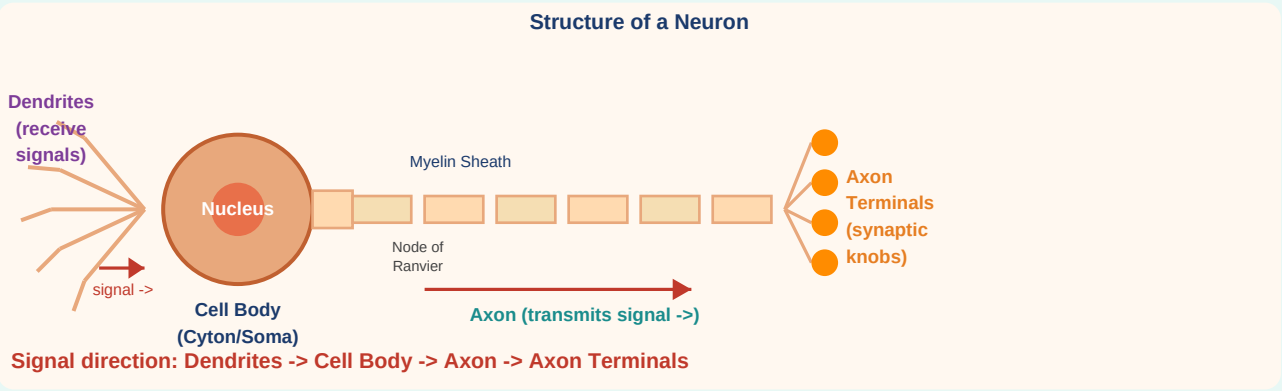
(d) Endocrine gland in males only -> Testes
Testes are present only in males; produce testosterone (male sex hormone) and sperm.

[TIP] **Exam Tip:** Pancreas = both exocrine (enzymes) + endocrine (insulin/glucagon). Adrenal = above kidneys = adrenaline. These 4 are frequently asked!

SECTION C ❖ Long Answer Questions (Q. 45-53)

Q.45. Draw the structure of a neuron and explain its function.

Structure of a Neuron:



Parts and Functions:

1. Dendrites: Multiple short, branched projections from cell body; RECEIVE electrical signals from other neurons or from sense organs; increase surface area for signal reception.

2. Cell Body (Cyton/Soma): Contains nucleus and organelles (mitochondria, ER, ribosomes); nucleus controls cell activities; cell body INTEGRATES incoming signals; generates new impulse.

3. Axon: Single long projection; CONDUCTS electrical impulse away from cell body; covered by myelin sheath (fatty insulation) in many neurons for faster conduction; gaps in myelin = Nodes of Ranvier.

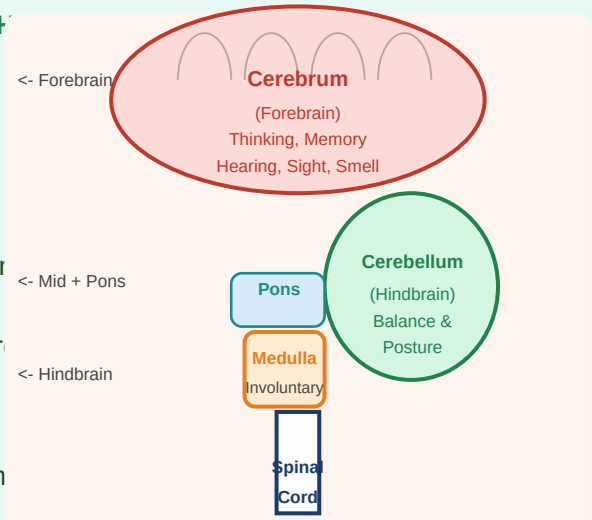
4. Myelin Sheath: Fatty layer around axon; produced by Schwann cells; acts as electrical insulator; speeds up signal conduction (saltatory conduction).

5. Axon Terminals (Synaptic knobs): Branched endings of axon; contain synaptic vesicles full of neurotransmitters; RELEASE neurotransmitters into synapse to pass signal to next neuron.

Overall function: A neuron is the structural and functional unit of the nervous system. It receives, integrates, and transmits electrical signals (nerve impulses) to coordinate body functions. A single impulse travels: Dendrites -> Cell body -> Axon -> Axon terminals at speeds up to 120 m/s.

Q.46. What are the major parts of the brain? Mention the functions of different parts.

The brain has three major regions: Forebrain, Midbrain, H



A. FOREBRAIN

Cerebrum (largest part):

* Main thinking, conscious, reasoning centre
* Controls voluntary actions
* Contains centres for: sight, hearing, smell, taste, touch, mer
* Divided into two hemispheres (left and right)
* Surface has folds (gyri) and grooves (sulci) for increased ar

Hypothalamus:

* Controls body temperature, hunger, thirst, sleep, emotions
* Links nervous system to endocrine system via pituitary glan

B. MIDBRAIN

* Connects forebrain to hindbrain
* Controls visual and auditory reflexes
* Maintains alertness

C. HINDBRAIN

Cerebellum:

* Controls posture, balance, and coordination of voluntary movements
* Ensures smooth, precise muscular actions

Pons:

* Bridge between cerebellum and medulla
* Involved in breathing regulation

Medulla Oblongata:

* Controls involuntary vital functions: heartbeat, breathing, blood pressure, vomiting, salivation, coughing
* Connects brain to spinal cord

Q.47. What constitutes the central and peripheral nervous systems? How are CNS components protected?

CENTRAL NERVOUS SYSTEM (CNS):

Consists of:

* **Brain**: protected within the skull (cranium)
* **Spinal cord**: protected within the vertebral column (backbone)

The CNS is the processing centre -- it integrates all incoming information and coordinates responses.

PERIPHERAL NERVOUS SYSTEM (PNS):

Consists of:

* All nerves that branch out from the CNS to every part of the body
* **Cranial nerves** (12 pairs): from brain to head, neck, and organs
* **Spinal nerves** (31 pairs): from spinal cord to body trunk and limbs

PNS is divided into:

* Somatic nervous system: voluntary movements
* Autonomic nervous system: involuntary (heart, glands, digestive organs)

PROTECTION OF CNS COMPONENTS:

Brain is protected by:

* **Cranium (skull)**: hard bony case surrounding the brain
* **Meninges**: three protective membranes (dura mater, arachnoid, pia mater)
* **Cerebrospinal fluid (CSF)**: cushioning fluid between meninges; acts as shock absorber

Spinal cord is protected by:

* **Vertebral column (backbone)**: 33 vertebrae form a bony tunnel
* **Meninges**: same three protective membranes
* **CSF**: fills the space and provides cushioning

[TIP] **Exam Tip:** CNS = Brain + Spinal cord. PNS = all nerves outside. Brain protected by skull + CSF. Spinal cord by vertebral column + CSF.

Q.48. Mention one function for each: (a) Thyroxin (b) Insulin (c) Adrenaline (d) Growth hormone (e) Testosterone

Hormone	Source Gland	Key Function	Deficiency Effect
Thyroxin	Thyroid gland	Regulates body metabolism (carbohydrates, proteins, fats); needed for normal growth and development	Goitre (iodine deficiency); cretinism in infants
Insulin	Pancreas (beta cells)	Lowers blood glucose; stimulates cells to absorb and store glucose as glycogen	Diabetes mellitus (high blood sugar)
Adrenaline	Adrenal gland (medulla)	"Fight or flight": raises heart rate, dilates pupils, increases blood flow to muscles, suppresses digestion	Poor stress response
Growth Hormone (GH)	Pituitary (anterior)	Stimulates growth of bones, muscles, organs; increases protein synthesis	Dwarfism (deficiency); Gigantism (excess)

Testosterone	Testes	Development of male reproductive organs; male secondary sexual characteristics; sperm production	Infertility; lack of secondary sexual characteristics

Q.49. Name various plant hormones. Also give their physiological effects on plant growth and development.

Five major plant hormones (phytohormones):

Plant Hormones (Phytohormones)

Hormone	Source	Function
Auxin (IAA)	Shoot tip	Cell elongation; phototropism; apical dominance; causes bending towards light
Gibberellin	Young leaves/embryo	Stem elongation; seed germination; breaks dormancy; increases plant height
Cytokinin	Root tip	Promotes cell division (cytokinesis); delays ageing (senescence) of leaves
Abscisic Acid (ABA)	Leaves, fruits	INHIBITS growth; promotes leaf/fruit fall (abscission); closes stomata during drought; "stress hormone"
Ethylene	Ripening fruits	Promotes fruit ripening; leaf fall; used to ripen fruits commercially

Detailed effects:

1. Auxin (IAA -- Indole Acetic Acid):

* Produced at shoot tips and young leaves
* Causes cell elongation by loosening cell walls (promotes water uptake -> cell expands)
* Causes phototropism (bending towards light): auxin accumulates on shaded side -> more elongation
* Causes geotropism in roots: high auxin concentration inhibits root growth
* Apical dominance: high auxin from tip suppresses lateral bud growth
* Used in rooting powders and herbicides

2. Gibberellins:

* Dramatic stem elongation -- used to produce dwarf plants to normal size
* Breaks seed dormancy -> promotes germination
* Promotes flowering and fruit development
* Used in agriculture to produce seedless grapes

3. Cytokinins:

* Promote cell division (cytokinesis) -- named for "cytokinesis"
* Delay senescence (ageing) of leaves
* Work with auxin to regulate growth
* Promote lateral bud growth

4. Abscisic Acid (ABA):

* Plant growth INHIBITOR
* Triggers stomatal closure during water stress (drought)
* Promotes seed dormancy
* Promotes leaf and fruit abscission (falling off)
* "Stress hormone" of plants

5. Ethylene:

* Promotes fruit ripening -> used commercially to ripen fruits
* Triggers leaf and petal fall
* Inhibits elongation
* A GAS at room temperature (unique among plant hormones)

[TIP] **Exam Tip:** 5 plant hormones: Auxin, Gibberellin, Cytokinin, ABA, Ethylene. First 3 = promoters. ABA = inhibitor. Ethylene = ripening/fall.

Q.50. What are reflex actions? Give two examples. Explain a reflex arc.

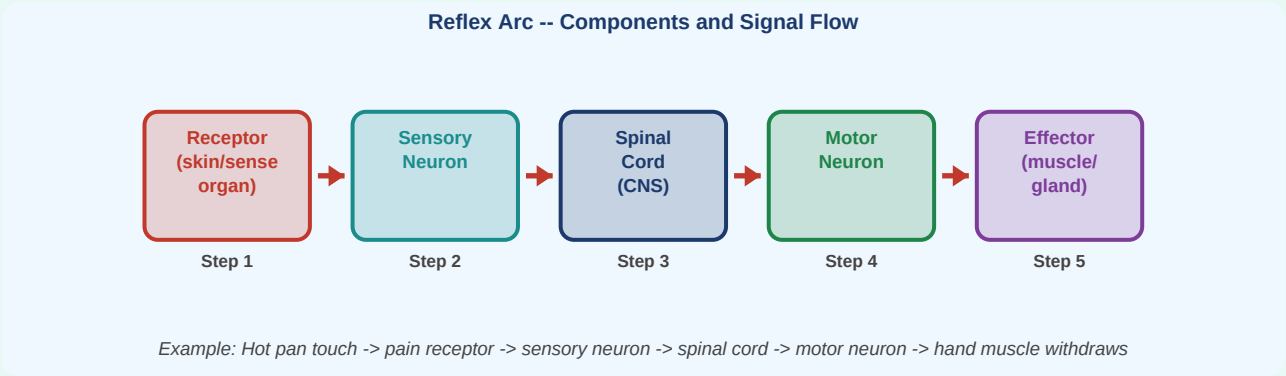
REFLEX ACTION:
A reflex action is a rapid, automatic, involuntary response to a stimulus that does not require conscious thinking. The brain is NOT involved in initiating the response (though the brain becomes aware of it afterward).

Why reflexes bypass the brain:
Reflexes are processed at the level of the spinal cord (or brainstem). This makes them faster -- there is no delay from impulse reaching the brain and waiting for a decision.

Two Examples of Reflex Actions:

1. **Withdrawal reflex:** Touching a hot pan -> immediately withdrawing the hand before the brain registers pain
2. **Knee-jerk reflex:** Tapping the tendon below the kneecap -> leg kicks forward automatically

REFLEX ARC:
The reflex arc is the neural pathway through which a reflex action is carried out.



Steps in a reflex arc (hot pan example):
1. **Stimulus:** Hot pan touches skin
2. **Receptor:** Pain/heat receptor in skin detects the stimulus and generates electrical impulse
3. **Sensory (afferent) neuron:** Carries impulse FROM receptor TO spinal cord
4. **Relay neuron:** In spinal cord; connects sensory to motor neuron
5. **Motor (efferent) neuron:** Carries impulse FROM spinal cord TO effector
6. **Effector:** Muscle contracts -> hand withdraws
7. Brain receives information about the pain (after response has already occurred)

[TIP] **Exam Tip:** Reflex arc: 5 components -- Receptor, Sensory neuron, Spinal cord (CNS), Motor neuron, Effector. Reflexes are faster BECAUSE they bypass the brain decision centre!

Q.51. "Nervous and hormonal systems together perform the function of control and coordination in human beings." Justify.

Both systems are essential and complementary -- neither alone is sufficient.

NERVOUS SYSTEM's contribution:
* Uses **electrical signals** (nerve impulses) through neurons
* **Extremely fast** (up to 120 m/s)
* Controls **immediate, short-duration responses** (reflexes, voluntary actions)
* Examples: withdrawal from pain, movement of muscles, perception of senses
* Targets: specific cells, tissues, or organs (precise control)

ENDOCRINE SYSTEM's contribution:
* Uses **chemical signals** (hormones) transported through blood
* **Slower** (hormones travel via bloodstream)
* Controls **long-duration, widespread processes**
* Examples: growth (GH), reproduction (testosterone/estrogen), blood sugar (insulin), stress response (adrenaline), metabolism (thyroxin)
* Targets: entire body or specific organs (general control)

How they work together:
* Adrenaline (hormone): triggered by NERVOUS system sensing danger -> hormone amplifies and sustains the response
* Insulin release: nervous system signals pancreas to release insulin after a meal
* Hypothalamus: bridge between nervous system and endocrine system; controls pituitary gland
* Together they ensure both rapid AND sustained coordination of all life processes

[TIP] **Exam Tip:** Key comparison: Nervous = fast, electrical, short-term, specific. Hormonal = slow, chemical, long-term, widespread. Together = complete control!

Q.52. How does chemical coordination take place in animals?

Chemical coordination in animals is achieved through the ENDOCRINE SYSTEM using HORMONES.

What are hormones?
Hormones are chemical messengers secreted by endocrine (ductless) glands **directly into the bloodstream**. They travel through blood to reach target organs/cells where they produce specific effects.

Mechanism of chemical coordination:
1. A stimulus is detected (by nervous system or by the endocrine gland itself)
2. The appropriate endocrine gland secretes a specific hormone
3. Hormone enters the bloodstream and circulates throughout the body
4. Hormone reaches target organ/cell that has specific receptors for it
5. Hormone binds to receptor -> triggers specific cellular response
6. After function is done, hormone is broken down by liver/kidneys (homeostasis)

Key endocrine glands and their roles in coordination:

* **Pituitary**: master gland; controls thyroid, adrenal, gonads
* **Thyroid**: regulates metabolic rate throughout the body
* **Pancreas**: regulates blood sugar (insulin lowers, glucagon raises)
* **Adrenal**: coordinates emergency (stress) response
* **Testes/Ovaries**: coordinate reproductive development and function

Characteristics of hormonal coordination:
* Slow response (seconds to hours)
* Long-lasting effect
* Affects entire body or large areas
* Cannot be reversed quickly (unlike nerve signals)
* Feedback mechanisms maintain hormone levels (homeostasis)

Q.53. Why is the flow of signals in a synapse from axonal end to dendritic end, and NOT the reverse?

Because neurotransmitters are stored ONLY in the axon terminals, NOT in the dendrites.

Detailed explanation:
Signal transmission across a synapse is a ONE-WAY process due to the **asymmetric structure of the synapse**:

Pre-synaptic side (axon terminal):
* Contains **synaptic vesicles** -- membrane-bound sacs filled with neurotransmitters
* Has machinery to RELEASE neurotransmitters (calcium-triggered exocytosis)
* Contains the enzymes to synthesise neurotransmitters

Post-synaptic side (dendritic end):
* Contains **receptor proteins** specific to the neurotransmitters
* Has NO synaptic vesicles
* Has NO mechanism to release neurotransmitters
* Can only RECEIVE and RESPOND to neurotransmitters

Why signal cannot go in reverse:
Since synaptic vesicles with neurotransmitters exist ONLY on the axon terminal side (pre-synaptic), and receptors for these neurotransmitters are ONLY on the dendritic side (post-synaptic), the chemical signal can only travel one way -- axon -> dendrite. There is no mechanism for the reverse direction.

This one-way nature ensures **precise control of nerve impulse direction** in neural circuits.

[TIP] **Exam Tip:** ONE-WAY because: vesicles ONLY in axon (release site). Receptors ONLY in dendrite (receive site). This structural asymmetry = unidirectional signal!

[WARN] Common Mistakes & Exam Tips

[ERR] Sensory vs Motor neuron

Sensory = Towards CNS (afferent). Motor = Away from CNS (efferent). Students often get these backwards! Remember: Sensory SENDS to CNS; Motor MOVES effector.

[ERR] Cerebrum vs Cerebellum

Cerebrum = thinking/memory/voluntary. Cerebellum = balance/coordination. "Bell" in cerebellum -> balance. Both start with "cereb" -- know the difference!

[ERR] Adrenaline vs Adrenal

Adrenaline is the HORMONE. Adrenal GLAND produces it. It is NOT from the pituitary. Adrenaline = adrenal + ine.

[ERR] ABA is a growth INHIBITOR

Auxin, Gibberellin, Cytokinin = PROMOTERS. ABA = INHIBITOR. Do NOT say ABA promotes growth -- this is wrong!

[ERR] Iodine -> Thyroxin (NOT insulin)

Iodine deficiency -> goitre (thyroid). Insulin deficiency -> diabetes (pancreas). These are TWO DIFFERENT hormones from TWO DIFFERENT glands!

[ERR] Reflex bypass brain (but not spinal cord)

Reflexes bypass the brain for a FASTER response, but they DO involve the spinal cord. "Reflexes bypass the CNS" is WRONG -- spinal cord IS part of CNS!

[ERR] Tropism vs Nastic movement

Tropism = directional, growth-based, permanent (phototropism). Nastic = non-directional, reversible (Mimosa leaf closing). Know both!

[ERR] Axonal end releases; dendritic end receives

Chemical signal flows: Axonal end -> releases neurotransmitter -> synaptic gap -> Dendritic end receives. This is ONE-WAY, not reversible.

[REV] Quick Revision -- Chapter 7 at a Glance

Topic	Key Points
Neuron signal direction	Dendrites -> Cell body -> Axon -> Axon terminals
Synapse signal	Axonal end releases neurotransmitter -> crosses gap -> dendrite receives -> new electrical signal
Reflex arc sequence	Receptor -> Sensory neuron -> Spinal cord -> Motor neuron -> Effector
Brain: Forebrain	Cerebrum: thinking, memory, voluntary actions, senses

Brain: Hindbrain	Cerebellum: balance. Medulla: involuntary (heartbeat, breathing)
Plant hormones (4)	Auxin->elongation, Gibberellin->stem growth, Cytokinin->cell division, ABA->inhibition/leaf fall
Thyroxin	Thyroid gland; needs IODINE; regulates metabolism; deficiency = goitre
Insulin	Pancreas; lowers blood sugar; deficiency = diabetes mellitus
Adrenaline	Adrenal gland (above kidneys); fight-or-flight; raises heart rate
Growth Hormone	Pituitary; controls body growth; deficiency = dwarfism; excess = gigantism
Testosterone/Estrogen	Testes/Ovaries; puberty changes; male/female sex characteristics
Tropisms	Photo (light), Geo (gravity), Hydro (water), Chemo (chemicals), Thigmo (touch)

[KEY] MCQ Answer Key Summary (Q. 1-33)

Q.No	Ans	Q.No	Ans	Q.No	Ans	Q.No	Ans	Q.No	Ans
Q.1	**(a)**	Q.2	**(c)**	Q.3	**(d)**	Q.4	**(b)**	Q.5	**(d)**
Q.6	**(c)**	Q.7	**(c)**	Q.8	**(b)**	Q.9	**(b)**	Q.10	**(d)**
Q.11	**(c)**	Q.12	**(d)**	Q.13	**(b)**	Q.14	**(b)**	Q.15	**(a)**
Q.16	**(c)**	Q.17	**(c)**	Q.18	**(b)**	Q.19	**(a)**	Q.20	**(c)**
Q.21	**(b)**	Q.22	**(c)**	Q.23	**(d)**	Q.24	**(b)**	Q.25	**(c)**
Q.26	**(a)**	Q.27	**(b)**	Q.28	**(c)**	Q.29	**(d)**	Q.30	**(b)**
Q.31	**(c)**	Q.32	**(d)**	Q.33	**(d)**				

✦ Control your preparation -- Coordinate your success! ✦