

Control and Coordination

Class 10 - CBSE Science | Chapter 6 | Worksheet & Test Paper

15 MCQs | 8 board questions | 7 practice problems

Video lesson, notes and an interactive quiz: learn.ultimatetools.io

SECTION A - Multiple Choice Questions (1 mark each)

1. Which part of a neuron picks up the information first?

- (a) The dendrite
- (b) The axon
- (c) The cell body
- (d) The nerve ending

2. At a synapse, the electrical impulse is carried across the gap by:

- (a) A spark that jumps the gap
- (b) The dendrite touching the next axon
- (c) A chemical released by the nerve ending
- (d) The blood flowing past the neurons

3. Which of the following is NOT a reflex action?

- (a) Blinking when something comes near the eye
- (b) Writing your name on a sheet of paper
- (c) Withdrawing the hand from a hot plate
- (d) Watering of the mouth at the smell of food

4. The correct pathway of a reflex arc is:

- (a) Receptor -> motor neuron -> spinal cord -> sensory neuron -> muscle
- (b) Receptor -> spinal cord -> sensory neuron -> motor neuron -> muscle
- (c) Muscle -> sensory neuron -> spinal cord -> motor neuron -> receptor
- (d) Receptor -> sensory neuron -> spinal cord -> motor neuron -> muscle

5. A person is able to walk in a straight line but suddenly begins to stagger and lose balance. Which part of the brain is most likely affected?

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

6. Blood pressure, salivation and vomiting are controlled by the:

- (a) Cerebrum
- (b) Cerebellum
- (c) Medulla
- (d) Spinal cord

7. Why does the reflex arc bypass the thinking part of the brain?

- (a) Because the brain cannot receive signals from the skin
- (b) Because the spinal cord is closer to the receptor than the brain
- (c) Because a reflex uses hormones rather than nerve impulses
- (d) Because thinking is slow and the delay could cause injury

8. The folding of the leaves of the touch-me-not plant when touched is:

- (a) A tropic movement caused by growth
- (b) Independent of growth and temporary
- (c) Caused by the hormone auxin
- (d) A permanent change in the leaf

9. Roots of a plant are:

- (a) Positively phototropic and negatively geotropic
- (b) Negatively hydrotropic and positively phototropic
- (c) Positively geotropic and positively hydrotropic
- (d) Negatively geotropic and negatively hydrotropic

10. A shoot bends towards light because auxin:

- (a) Collects on the shaded side and makes those cells grow longer
- (b) Collects on the lit side and makes those cells grow longer
- (c) Is destroyed by the light falling on the shoot
- (d) Moves down to the roots and pulls the shoot over

11. Which plant hormone INHIBITS growth?

- (a) Auxin
- (b) Gibberellin
- (c) Cytokinin
- (d) Abscissic acid

12. The growth of the pollen tube down the style towards the ovule is an example of:

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

13. Iodine is essential in our diet because it is needed to make:

- (a) Insulin
- (b) Adrenaline
- (c) Thyroxine
- (d) Growth hormone

14. When you are suddenly frightened, adrenaline causes all of the following EXCEPT:

- (a) A faster heartbeat
- (b) More blood being sent to the skeletal muscles
- (c) A faster rate of breathing
- (d) More blood being sent to the digestive system

15. The secretion of insulin by the pancreas is controlled by:

- (a) The pituitary gland, which instructs the pancreas
- (b) A feedback mechanism based on the blood sugar level
- (c) Nerve impulses arriving from the spinal cord
- (d) The amount of thyroxine present in the blood

SECTION B - Board-style Questions

1. Draw a labelled diagram of a neuron and mark the direction in which the nerve impulse travels. How does the impulse cross from one neuron to the next? [5 marks]

2. What is a reflex action? Draw a labelled diagram of the reflex arc involved when a person touches a hot object, and explain why such actions do not involve the thinking part of the brain. [5 marks]

3. Name the three regions of the human brain and give two functions of each of the cerebrum, the cerebellum and the medulla. How is the brain protected from injury? [5 marks]

4. Explain, step by step, how a plant shoot bends towards light. Name the hormone responsible. [3 marks]

5. Distinguish between tropic and nastic movements in plants, giving one example of each. Include the role of growth and whether the movement is permanent. [3 marks]

6. (a) Why is the use of iodised salt advisable? (b) What happens if the pituitary gland secretes too little growth hormone in a child? (c) Name the hormone that prepares the body for a fight-or-flight situation and state two of its effects. [3 marks]

7. How is the timing and amount of hormone released regulated in the body? Explain with the example of insulin. [3 marks]

8. Compare control by the nervous system with control by hormones, giving three points of difference. Why is a chemical means of communication necessary at all when the nervous system already exists? [5 marks]

SECTION C - Practice Problems

1. A student pricks her finger on a pin and pulls her hand away instantly, and only afterwards says 'ouch'. Explain the pathway of the response, and account for the delay before she feels the pain.

Hint: Which structure completed the response, and which one produced the sensation?

2. A potted plant is placed inside a cardboard box that has a single small hole cut in one side. After a few days the shoot is found growing out through the hole. Name the response, and explain it in terms of a plant hormone.

Hint: Where does the auxin end up, and what does auxin do to cells?

3. A potted plant is laid on its side on a windowsill and left for several days. Describe what happens to the shoot and to the root, and name the responses involved.

Hint: Two different stimuli act here - and the shoot and root respond oppositely to each.

4. The leaves of the touch-me-not plant fold when touched, and a shoot bends towards light. Both are movements in plants, yet they are fundamentally different. Give three differences.

Hint: Consider growth, speed, and whether the direction of the stimulus matters.

5. Two children are the same age. One is much shorter than normal for their age, while the other has a visibly swollen neck. Name the gland and the hormone involved in each case, and state the cause.

Hint: One is a hormone of growth; the other needs a mineral from the diet.

6. Explain why an animal cannot rely on nerve impulses alone, and must also have a hormonal system. Give two reasons, and one example of something a hormone controls that nerves could not.

Hint: Think about which cells a nerve can actually reach, and what happens to a nerve cell right after it fires.

7. A person is suddenly confronted by a snake. Describe the hormonal response, naming the hormone and the gland, and explain how each of its three main effects helps the person.

Hint: The body is preparing for one of two things - running or fighting.

ANSWER KEY

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Section A - MCQ answers

1. (a) The dendrite

The impulse travels in one direction only: dendrite → cell body → axon → nerve ending. The dendrites are the branching tips that acquire the information.

2. (c) A chemical released by the nerve ending

The impulse cannot jump the gap. It makes the nerve ending release a chemical, which crosses the synapse and starts a fresh electrical impulse in the next cell. This also makes the impulse one-way.

3. (b) Writing your name on a sheet of paper

Writing is a voluntary action, controlled by the thinking part of the brain (the cerebrum). The other three are sudden, automatic responses that are not under the control of the thinking brain.

4. (d) Receptor → sensory neuron → spinal cord → motor neuron → muscle

The sensory neuron carries the impulse IN to the spinal cord, a relay neuron passes it across, and the motor neuron carries the command OUT to the effector muscle. Sensory always precedes motor.

5. (a) Cerebellum

The cerebellum is responsible for posture, balance and the precision of voluntary movements. The medulla handles involuntary actions such as blood pressure, and the cerebrum does the thinking.

6. (c) Medulla

The medulla, in the hind-brain, controls involuntary actions of this kind. The cerebellum controls posture and balance; the cerebrum is the thinking part.

7. (d) Because thinking is slow and the delay could cause injury

The thinking process of the brain takes longer. For an urgent stimulus such as a burn, that delay would cause harm, so the spinal cord completes the arc. The brain is informed afterwards, which is why the pain is felt a moment later.

8. (b) Independent of growth and temporary

This is a nastic movement. The cells change shape by changing their water content - swollen cells become flabby - so it needs no growth, it is fast, and the leaves open again later.

9. (c) Positively geotropic and positively hydrotropic

Roots grow downward towards gravity (positively geotropic) and turn towards a source of water (positively hydrotropic). They grow AWAY from light, so they are negatively phototropic.

10. (a) Collects on the shaded side and makes those cells grow longer

Auxin diffuses away from the bright side to the shaded side, where it causes cell elongation. The shaded side therefore becomes longer than the lit side, and the shoot bends towards the light.

11. (d) Abscissic acid

Abscissic acid is the odd one out - it inhibits growth and causes the wilting of leaves. Auxin, gibberellins and cytokinins all promote growth.

12. (b) Chemotropism

Chemotropism is growth in response to a chemical stimulus, and the pollen tube growing towards the ovule is the standard NCERT example.

13. (c) Thyroxine

The thyroid gland needs iodine to make thyroxine, which regulates carbohydrate, fat and protein metabolism. A deficiency of iodine causes goitre, which is why iodised salt is recommended.

14. (d) More blood being sent to the digestive system

Adrenaline diverts blood AWAY from the digestive system and skin, towards the skeletal muscles, which need it for the fight-or-flight response. The heartbeat and breathing rate both increase.

15. (b) A feedback mechanism based on the blood sugar level

The timing and amount of hormone secretion are regulated by feedback. When blood sugar rises, the pancreas detects it and secretes more insulin; as the level falls, secretion is reduced.

Section B - Model answers

1. Draw a labelled diagram of a neuron and mark the direction in which the nerve impulse travels. How does the impulse cross from one neuron to the next?

The diagram must label the DENDRITES, the CELL BODY (with its nucleus), the AXON and the NERVE ENDINGS, with an arrow showing the impulse travelling from the dendrites, through the cell body, along the axon, to the nerve endings - one direction only. HOW THE IMPULSE ARISES: the information acquired at the end of the DENDRITIC TIP sets off a CHEMICAL REACTION, and this chemical reaction CREATES the electrical impulse;

the impulse then travels from the dendrite to the cell body and onward along the axon. Crossing to the next neuron: the nerve endings of one neuron and the dendrites of the next are separated by a small gap called a SYNAPSE. The electrical impulse cannot jump this gap. On reaching the nerve ending it causes the release of a CHEMICAL, which diffuses across the synapse and starts a NEW electrical impulse in the dendrite of the next neuron. Because the chemical is released on one side only, the impulse can travel in one direction alone.

2. What is a reflex action? Draw a labelled diagram of the reflex arc involved when a person touches a hot object, and explain why such actions do not involve the thinking part of the brain.

A REFLEX ACTION is a sudden, rapid and automatic (involuntary) response to a stimulus, which is not under the control of the thinking part of the brain. The diagram should show and label: the heat RECEPTOR in the skin of the hand, the SENSORY NEURON carrying the impulse to the SPINAL CORD, the RELAY NEURON inside the spinal cord, the MOTOR NEURON carrying the impulse out, and the EFFECTOR - the muscle of the arm - which contracts and withdraws the hand. WHY the brain is bypassed: the thinking process of the brain is comparatively slow, because it involves many neurons. For an urgent stimulus such as a burn, that delay would be long enough to cause injury. The spinal cord therefore completes the connection directly, giving a much faster response, and the brain is informed afterwards - which is why the pain is felt a moment after the hand has already been withdrawn.

3. Name the three regions of the human brain and give two functions of each of the cerebrum, the cerebellum and the medulla. How is the brain protected from injury?

The three regions are the FORE-BRAIN, the MID-BRAIN and the HIND-BRAIN. CEREBRUM (fore-brain): (i) it is the thinking part of the brain - the seat of memory, reasoning and decisions; (ii) it receives sensory impulses from all the receptors and has separate areas for hearing, smell, sight and touch. CEREBELLUM (hind-brain): (i) it maintains posture and balance; (ii) it gives precision to voluntary actions, such as walking in a straight line or picking up an object. MEDULLA (hind-brain): (i) it controls involuntary actions such as blood pressure and heartbeat; (ii) it controls salivation and vomiting. PROTECTION: the brain is enclosed in a bony box called the cranium (skull), and inside it lies in a fluid-filled balloon-like cushion which absorbs shocks; the spinal cord is similarly protected inside the vertebral column (backbone).

4. Explain, step by step, how a plant shoot bends towards light. Name the hormone responsible.

The hormone responsible is AUXIN, which is synthesised at the tip of the growing shoot and promotes the elongation of cells. Step by step: (1) light falls on one side of the shoot; (2) auxin diffuses AWAY from the bright side and accumulates on the SHADED side of the shoot; (3) auxin makes cells grow longer, so the cells on the shaded side elongate MORE than the cells on the illuminated side; (4) since one side of the shoot is now longer than the other, the shoot bends TOWARDS the light. This directional growth movement in response to light is called phototropism, and the shoot is said to be positively phototropic.

5. Distinguish between tropic and nastic movements in plants, giving one example of each. Include the role of growth and whether the movement is permanent.

TROPIC movements are DIRECTIONAL - the direction of the movement is determined by the direction of the stimulus. They are caused by GROWTH, they are slow, and they are PERMANENT. Example: a shoot bending towards light (phototropism), or a root growing downward (geotropism). NASTIC movements are NON-DIRECTIONAL - the direction of the response does not depend on the direction of the stimulus. They are INDEPENDENT of growth, they are very fast, and they are TEMPORARY. Example: the folding of the leaves of the touch-me-not plant (*Mimosa pudica*) when it is touched, which is caused by a change in the water content of the cells rather than by growth.

6. (a) Why is the use of iodised salt advisable? (b) What happens if the pituitary gland secretes too little growth hormone in a child? (c) Name the hormone that prepares the body for a fight-or-flight situation and state two of its effects.

(a) Iodine is essential for the thyroid gland to make the hormone THYROXINE, which regulates the metabolism of carbohydrates, fats and proteins. If the diet lacks iodine, thyroxine cannot be made in sufficient amounts and the person is likely to develop GOITRE, in which the neck appears swollen. Iodised salt supplies the iodine needed. (b) Too little growth hormone during childhood results in DWARFISM - the person's growth is stunted and they remain much shorter than normal. (c) ADRENALINE, secreted by the adrenal glands. Two effects: the heartbeat increases so that more oxygen is supplied to the muscles, and blood is diverted away from the digestive system and skin towards the skeletal muscles; the rate of breathing also increases.

7. How is the timing and amount of hormone released regulated in the body? Explain with the example of insulin.

It is regulated by a FEEDBACK MECHANISM. The gland itself detects the condition that its hormone controls, and adjusts its secretion accordingly. Example: the level of sugar in the blood is monitored by the cells of the PANCREAS. If the blood sugar level RISES - for instance after a meal - these cells detect the rise and secrete MORE INSULIN. Insulin causes the cells to take up and store glucose, so the blood sugar level FALLS. As the level comes down, the pancreas detects this too and REDUCES the secretion of insulin. In this way the blood sugar is automatically kept within a narrow range, without any conscious control.

8. Compare control by the nervous system with control by hormones, giving three points of difference. Why is a chemical means of communication necessary at all when the nervous system already exists?

THREE DIFFERENCES: (1) MEDIUM - the nervous system transmits information as ELECTRICAL impulses along neurons, whereas the endocrine system transmits it as CHEMICAL hormones. (2) ROUTE and REACH - nerve impulses travel only along nervous tissue and so reach only the cells connected to it, whereas hormones are released into the BLOOD and are carried to every cell of the body. (3) SPEED and DURATION - nervous control is extremely rapid but its effect is brief, whereas hormonal control is slower to act but its effect lasts much longer. WHY CHEMICAL COMMUNICATION IS NECESSARY: electrical impulses have two limitations - they reach only those cells that are connected by nervous tissue, and after a nerve cell has generated and transmitted an impulse it needs time to reset itself before it can fire again. Therefore, for information that must reach EVERY cell, or that must be maintained steadily over a long period (such as growth or the control of blood sugar), a chemical means of communication is essential.

Section C - Solutions

1. A student pricks her finger on a pin and pulls her hand away instantly, and only afterwards says 'ouch'. Explain the pathway of the response, and account for the delay before she feels the pain.

Pain receptors in the skin of the finger detect the stimulus and a SENSORY NEURON carries the impulse to the SPINAL CORD. There a RELAY neuron passes it directly to a MOTOR NEURON, which carries the command to the arm muscle; the muscle contracts and the hand is withdrawn. This whole reflex arc is completed by the spinal cord WITHOUT waiting for the brain, which is why the withdrawal is instant. The sensation of pain, however, is produced only when the impulse also travels UP the spinal cord to the brain and is interpreted by the cerebrum. Because that takes longer than the reflex arc, she feels the pain a moment AFTER her hand has already moved.

2. A potted plant is placed inside a cardboard box that has a single small hole cut in one side. After a few days the shoot is found growing out through the hole. Name the response, and explain it in terms of a plant hormone.

This is PHOTOTROPISM - a tropic (growth) movement in response to light, and the shoot is positively phototropic. Explanation: light enters only through the hole, so it falls on one side of the shoot. AUXIN, made at the shoot tip, diffuses AWAY from the illuminated side and accumulates on the SHADED side. Auxin promotes the elongation of cells, so the cells on the shaded side grow LONGER than those on the lit side. With one side longer than the other, the shoot bends towards the light - and therefore grows out through the hole. The movement is caused by growth, so it is slow and permanent.

3. A potted plant is laid on its side on a windowsill and left for several days. Describe what happens to the shoot and to the root, and name the responses involved.

The SHOOT turns and grows UPWARDS, away from the pull of gravity - it is NEGATIVELY GEOTROPIC. It will also grow towards the light coming through the window, being POSITIVELY PHOTOTROPIC. The ROOT turns and grows DOWNWARDS, in the direction of gravity - it is POSITIVELY GEOTROPIC - and it grows away from the light, being negatively phototropic; it will also grow towards moisture in the soil, being positively hydrotropic. Both are TROPIC movements: they are directional, caused by growth, slow, and permanent.

4. The leaves of the touch-me-not plant fold when touched, and a shoot bends towards light. Both are movements in plants, yet they are fundamentally different. Give three differences.

(1) GROWTH: the folding of the touch-me-not leaves is INDEPENDENT of growth - the cells simply change shape by changing their water content - whereas the bending of the shoot is CAUSED by growth, with cells on one side elongating more than on the other. (2) SPEED and PERMANENCE: the leaf folding is almost immediate and TEMPORARY, and the leaves reopen later; the bending of the shoot is SLOW and PERMANENT. (3) DIRECTION: the leaf folding is NASTIC - the direction of the response does not depend on the direction of the touch; the bending of the shoot is TROPIC - the direction of the response IS determined by the direction of the light.

5. Two children are the same age. One is much shorter than normal for their age, while the other has a visibly swollen neck. Name the gland and the hormone involved in each case, and state the cause.

The SHORT child: the gland is the PITUITARY and the hormone is GROWTH HORMONE. If the pituitary secretes too little growth hormone during childhood, the growth of the body is stunted and the person remains a dwarf. (If it secretes too much, the person grows abnormally tall - gigantism.) The child with the SWOLLEN NECK: the gland is the THYROID and the hormone is THYROXINE. Thyroxine regulates the metabolism of carbohydrates, fats and proteins, and IODINE is essential for making it. If the diet is deficient in iodine, thyroxine cannot be made in adequate amounts and the person develops GOITRE, in which the neck appears swollen. This is why the use of iodised salt is advised.

6. Explain why an animal cannot rely on nerve impulses alone, and must also have a hormonal system. Give two reasons, and one example of something a hormone controls that nerves could not.

REASON 1: electrical impulses travel only along NERVOUS TISSUE, so they can reach only those cells that are connected to a nerve - not every cell in the body. REASON 2: after a nerve cell has generated and transmitted an impulse it needs TIME to reset itself before it can fire again, so a nerve cannot maintain a steady, continuous signal. Hormones have neither limitation: they are released into the BLOOD, which carries them to every cell, and their effect can be sustained over long periods. EXAMPLE: the growth of the body, controlled by growth hormone, must act on cells throughout the body over many years - something nerve impulses could never do. (Blood sugar control by insulin, or the changes at puberty brought about by testosterone and oestrogen, are equally good examples.)

7. A person is suddenly confronted by a snake. Describe the hormonal response, naming the hormone and the gland, and explain how each of its three main effects helps the person.

The hormone is ADRENALINE, secreted by the ADRENAL GLANDS, which sit above the kidneys. It is secreted directly into the blood and prepares the body for a 'fight-or-flight' situation. (1) The HEARTBEAT INCREASES, so more oxygenated blood is delivered per minute to the tissues that need it. (2) Blood is DIVERTED AWAY from the digestive system and the skin, and towards the SKELETAL MUSCLES - digestion is not urgent at this moment, while the muscles need extra oxygen and glucose to run or to fight. (3) The RATE OF BREATHING INCREASES, because the diaphragm and rib muscles contract more, taking in more oxygen for the extra respiration the muscles are about to carry out. Together these changes make more energy available to the muscles, very quickly.

