CHAPTER 7

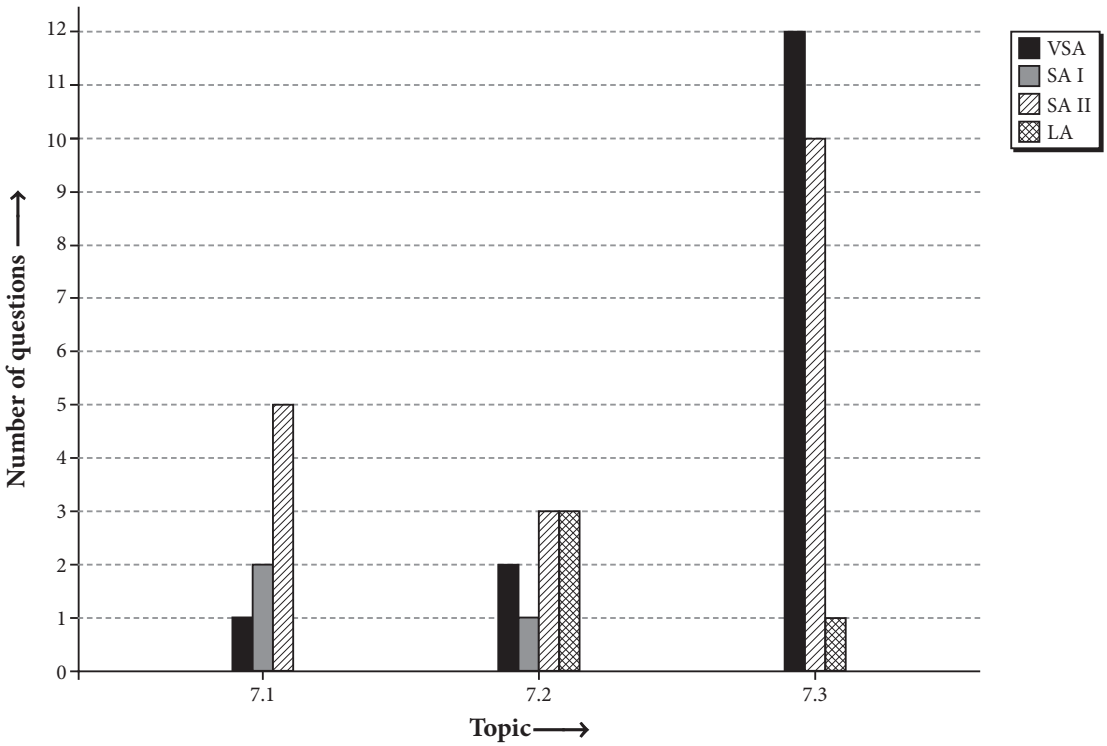
Control and Coordination*

7.1 Animals-Nervous System

7.2 Coordination in Plants

7.3 Hormones in Animals

Topicwise Analysis of Last 10 Years' CBSE Board Questions (2020-2011)



- Maximum weightage is of *Hormones in Animals.*
- Maximum VSA and SA II type questions were asked from *Hormones in Animals*.
- Maximum LA type questions were asked from *Coordination in Plants*.

QUICK RECAP

- All movements in living organisms occur in response to changes in the environmental factors. All living organisms respond and react to environmental factors (stimuli) such as light, heat, cold, sound, smell, taste, pressure, etc., and this response involves **coordination** of many organs in our body.
- **Coordination in animals:** Unicellular organisms respond to environmental stimuli

** This chapter is not a part of the Board Examination 2020-21 syllabus.*

by moving towards or away from it. Such response is termed as **taxis**. Movement towards the source of stimulus is positive taxis and movement away from stimulus is negative taxis. In lower multicellular organisms, coordination takes place through nervous system.

- **Coelenterates** – diffused nervous system is present which is made up of epidermal and gastrodermal nerve net of nerve cells.
- **Flatworms** – ladder type nervous system is present which is made up of ganglionated nerve ring and nerve cords.
- **Annelids** – Central nervous system (CNS) is present which comprises of circumpharyngeal nerve ring and a nerve cord.
- **Insects** - CNS consist of circumoesophageal nerve ring and nerve cord.
- In higher animals, control and coordination is provided by **nervous** and **endocrine** system.

Control and coordination in humans: There are two systems of coordination of activities in humans : nervous system and endocrine system.

- Both the systems of coordination, consist of a number of organs working together in a systematic way.

Human Nervous System: Human nervous system is the most complex system. The main parts of the nervous system are: **brain**, **spinal cord** and **nerves**. The sense organs can be considered to be other organs of the nervous system because they help in the functioning of the nervous system. We receive a variety of information from the environment around us through the sense organs. There are five sense organs in our body : eyes, ears, nose, tongue and skin. The sense organs contain receptors. A **receptor** is a cell (or a group of cells) in a sense organ which is sensitive to a particular type of stimulus. Different sense organs contain receptors for detecting different stimuli.

- The common types of receptor are photoreceptors (detect light, present in eyes), phonoreceptors (detect sound, present in ears), olfactory receptors (detect smell, present in nose), gustatory receptors (detect taste, present in tongue) and thermoreceptors (detect heat or cold, present in skin).
- **Neurons** are the structural and functional unit of nervous system. Neuron is the longest cell in human body.

Components of Neuron

Cell body

The cell body of a neuron is also called **cyton** which is broad, rounded, pyriform or stellate part of the neuron. It has abundant cytoplasm, called **neuroplasm** which contains **Nissl's granules** and a relatively large, spherical **nucleus** and is mainly concerned with metabolic maintenance and growth. It also receives nerve impulses from dendrites and transmits them to axon.

Dendrites

These are several short, tapering, much branched protoplasmic processes stretching out from the cell body of a neuron. Here sensation (information) is acquired which then travels as an electric impulse towards the cell body.

Axon

It is a single, very long, cylindrical nerve fibre of uniform diameter arising from the cell body. At its terminal end, axon is highly branched. Axon terminals are often knob-like and these may end in nerve fibres that form synapses with dendrites of other neurons. The axon conducts nerve impulses away from the cell body.

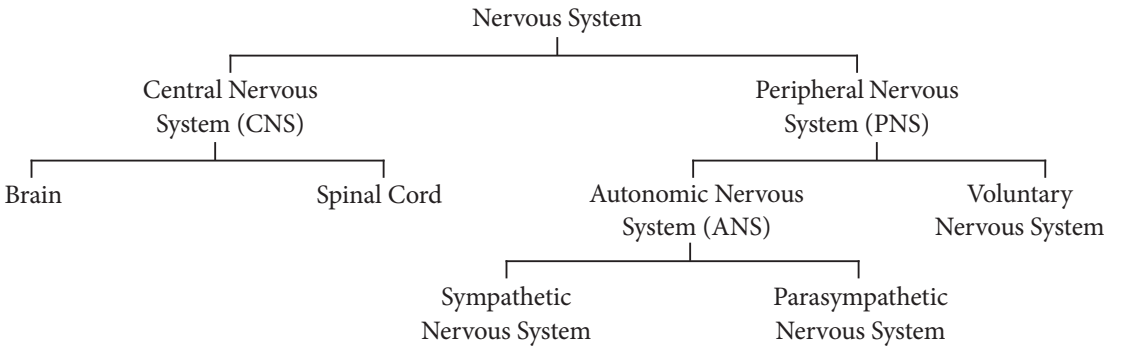
Types of neuron

Sensory (receptor) : Transmits impulse from sensory cells to CNS.

Motor (effector) : Transmits impulse from CNS to muscle cells.

Relay or **Connector** : Serves as link between sensory and motor neurons.

- The classification of human nervous system into various parts is given in the following chart:



Flow Chart : Main parts of human nervous system

- **Central nervous system :** The central nervous system (CNS) consists of the brain and the spinal cord.

CNS

Brain

- Brain is the highest coordinating centre in the body. The brain is located inside the skull of our body (at the top of the spinal cord). It is protected by a bony box in the skull called **cranium**. It is surrounded by three membranes called **meninges,** which help to protect it . The space between the membranes (or meninges) is filled with a **cerebro-spinal fluid** which protects the brain from mechanical shocks. Pairs of cranial nerves arise from the brain.
- The brain is broadly divided into three regions: **forebrain, midbrain** and the **hindbrain**. The forebrain consists mainly of **cerebrum**. The midbrain does not have any further divisions. It consists of two fibre tracts called **crura cerebri** which connect hindbrain with forebrain. The hindbrain consists of three parts called **pons, cerebellum** and **medulla**.
- The cerebrum (or forebrain) is the main thinking part of the brain. It is the site of our faculties such as learning, reasoning, intelligence, personality and memory. All our thoughts, sensations, actions and movements are controlled by the cerebrum.
- The midbrain controls reflex movements of the head, neck and trunk in response to visual and auditory stimuli. It also controls the reflex movements of the eye muscles, changes in pupil size and shape of the eye lens.
- Pons varolii takes part in regulating respiration. Cerebellum helps in maintaining posture and balance of the body.
- Medulla oblongata controls various involuntary actions such as heart beat (blood circulation), breathing, blood pressure and peristaltic movements of alimentary canal. Medulla is also the controlling centre for reflexes such as swallowing, coughing, sneezing, secretion of saliva and vomiting.

Spinal cord

Spinal cord is a cylindrical structure that begins in continuation with the medulla oblongata of brain and extends downwards upto early part of lumbar region. It then extends to the end of vertebral column as fibrous connective called **filum terminale**.

It is enclosed in a bony cage called **vertebral column**. Spinal cord is also surrounded by membranes called **meninges**. As many as 31 pairs of nerves arise from the spinal cord. The spinal cord is concerned with spinal reflex actions and the conduction of nerve impulses to and from the brain.

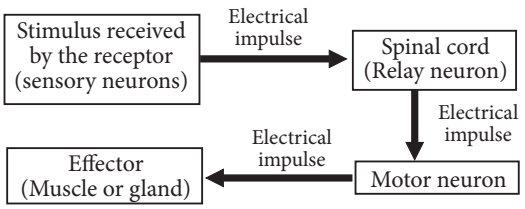
Spinal cord performs two important functions: it conducts sensory and motor impulses to and from the brain and it acts as a centre for the reflex actions. Thus, it reduces brain's work.

- **Peripheral nervous system :** All the nerves of the body together make up the peripheral nervous system (PNS). **Voluntary peripheral nervous system** is under the control of will. It consists of nerves that arise directly from CNS connecting different body parts for voluntary (conscious) control of the brain. **Autonomic nervous system** or **involuntary peripheral nervous system** on the other hand, is not under the control of human will. It develops from branches of some cranial and spinal nerves called **visceral nerves**. The autonomic nervous system (ANS) is subdivided into two parts:
  (i) Sympathetic nervous system
  (ii) Parasympathetic nervous system

Peripheral nervous system consists of three types of nerve

- **Cranial nerves** arise from the brain and spread to various parts of the head. They are 12 pairs in number. Cranial nerves I, II and VIII are sensory nerves; cranial nerves III, IV, VI, XI and XII are motor nerves; and cranial nerves V, VII, IX and X are mixed nerves (containing both sensory and motor nerve fibres).
- 31 pairs of **spinal nerves** arise from the spinal cord along most of its length and spread throughout the body (except, head region). They are all mixed nerves as they carry both sensory and motor nerve fibres.
- Many activities of the internal organs such as heart, kidney, lungs, urinary bladder, blood vessels, glands, etc., are controlled by specific set of nerves called **visceral nerves** which mostly arise from spinal cord but a few from the brain also. These form the autonomic nervous system.

- **Reflex action and reflex arcs :** The simplest form of response in the nervous system is reflex action. This is a rapid, automatic response to a stimulus which is not under the voluntary control of the brain. It is described as an involuntary action which aims to protect ourselves. A knee jerk, movement of diaphragm (during respiration), coughing, yawning, blinking of eyes and sneezing are all reflex actions. Coughing is a reflex action which clears our windpipe. The pupils of our eyes get smaller in bright light. This protects the retina of our eyes from damage due to too much light.



Flow chart : Depicting a reflex action

- The pathway taken by nerve impulses in a reflex action is called the **reflex arc**. Reflex arcs allow rapid response.

- **Human Endocrine System :** Endocrine system is comprised of endocrine glands and the hormones released by them.
- **Hormones :** These are the chemical substances which coordinate the activities of living organisms and also their growth. The various characteristics of hormones are:
- They are secreted in small amounts by the endocrine glands.
- They are poured directly into the blood and carried throughout the body by circulatory system.
- They have their effects at the sites different from the sites where they are made. So, they are also called chemical messengers.
- They act on specific tissues or organs (called target organs).
- They coordinate the activities of the body and also its growth.
- **Endocrine glands :** A gland is a structure (cell, tissue or organ) which secretes certain useful chemicals or substances in the body. There are two types of gland in the body: **exocrine gland** and **endocrine gland**. Exocrine glands are the glands having ducts whereas endocrine glands are ductless glands.

Table: Endocrine glands – Their hormones and functions

Endocrine glands	Hormones secreted	Principal functions
1. Hypothalamus	(a) Releasing hormones (RH)	Stimulate anterior/ intermediate pituitary to secrete hormones.
	(b) Inhibiting hormones (IH)	Inhibit the secretion of hormones from anterior / intermediate pituitary gland.
2. Pituitary gland • It has three lobes. It is attached to the lower surface of the brain.		
(i) Anterior lobe • It produces six hormones.	(a) Growth hormone (GH) or Somatotropic hormone (STH)	Controls the overall development or growth of the body, muscles, bones and tissues. Lack of this hormone (hypoactivity) causes **dwarfness**. Its excessive secretion (hyperactivity) causes excessive growth of bones making the person very tall **(gigantism)**.
	(b) Thyroid stimulating hormone (TSH)	Controls the growth and functioning of the **thyroid gland**. Stimulates the thyroid gland to produce **thyroxine**.
	(c) Adrenocorticotropic hormone (ACTH)	Stimulates the adrenal cortex to secrete cortisol hormone.
	(d) Gonadotropic hormone (i) Follicle stimulating hormone (FSH)	In males, it stimulates the process of **spermatogenesis** (sperm formation). In females, it stimulates the follicle cells in the ovaries to develop into **mature eggs**.
	(ii) Luteinising hormone (LH)	In males, it stimulates the secretion of male hormone, **testosterone** (sex hormone in males). In females, it stimulates the secretion of **oestrogen** and **progesterone** (sex hormones in females).
	(e) Prolactin hormone (PRL)	Stimulates mammary gland development during pregnancy and milk production after child birth in females.
(ii) Intermediate lobe	Melanocyte stimulating hormone (MSH)	Stimulates the synthesis of melanin in the skin.
(iii) Posterior lobe	(a) Oxytocin	Stimulates contraction of smooth muscles at the time of child birth. It also helps in milk ejection (lactation) from the mammary glands.
	(b) Vasopressin or Antidiuretic hormone (ADH)	Regulates water and electrolyte balance in body.
3. Pineal gland • It lies between the two cerebral hemispheres of the brain.	Melatonin	Regulates circadian rhythm.

4. Thyroid gland • It is situated in the neck region on the ventral side of the body. It has two lateral lobes, one on either side of the trachea.	(a) Thyroxine or T_4 and Triiodothyronine or T_3	T_3 and T_4 stimulate the rate of cellular oxidation and metabolism.
	(b) Calcitonin	Calcitonin lowers calcium level by suppressing release of calcium ions from the bones, when calcium level is high in blood.
5. Parathyroid gland • These are four small oval bodies which lie embedded in the lobes of the thyroid gland.	Parathyroid hormone (PTH) or parathormone.	Regulates calcium and phosphate levels in the blood. When blood calcium level is below normal, it mobilises the release of calcium into the blood from bones. It has an action opposite to that of calcitonin on calcium metabolism.
6. Thymus gland • It is situated in the upper chest near the front side of the heart. • It undergoes gradual atrophy in the adult.	Thymosin	Stimulates the development and differentiation of lymphocytes (white blood cells).
7. Adrenal gland • In human beings, a pair of adrenal glands are present, one on top of each kidney, so, also called suprarenals. Each adrenal gland has an outer part called the **cortex** and an inner part, **medulla**.		
(i) Adrenal cortex • It secretes 3 groups of steroid hormones.	(a) Glucocorticoids	Regulate the metabolism of protein, fats and carbohydrates in the body and the level of blood sugar.
	(b) Mineralocorticoids (Aldosterone)	Regulate water and mineral balance in body.
	(c) Sexcorticoids	Stimulate the development of secondary sexual characters both in males and females.
(ii) Adrenal medulla • It secretes 2 hormones.	Adrenaline (Epinephrine) and Noradrenaline (Nor-epinephrine)	Both these hormones together control emotions, fear, anger, blood pressure, heart beat, respiration and relaxation of smooth muscles.
8. Pancreas • It is a compound gland in the abdominal region located posterior to the stomach. Its endocrine part is **Islets of Langerhans**, which secretes 2 hormones.	(a) Insulin	Regulates the conversion of glucose to glycogen, *i.e.*, it lowers blood glucose level.
	(b) Glucagon	Regulates the conversion of glycogen back to glucose, *i.e.*, it increases blood glucose level.

9. Ovaries • These are a pair of glands present in the lower abdominal region in females.	(a) Oestrogen	Plays an important role in ovulation. It is responsible for development of secondary sexual characteristics in females like mammary glands, voice, hair pattern, etc.
	(b) Progesterone	Helps in the preparation of uterus for the reception of fertilised ovum. Also helps in the maintenance of pregnancy.
10. Testes • These are extra-abdominal in position. • The **interstitial** or **Leydig's cells** present in testes produce the male hormone.	Testosterone	Stimulates spermatogenesis, regulates the growth, development and functioning of accessory sex organs and controls the secondary sexual characteristics in males, such as enlargement of penis and scrotum, growth of facial and pubic hair and enlargement of larynx that causes deepening of voice.

- **Feedback mechanism:** The timing and amount of hormones released by various glands are controlled by the 'feedback mechanism' which is in-built in our body. For example, if the sugar level in the blood rises too much, they are detected by the cells of pancreas which respond by producing and secreting more insulin into blood. And as the blood sugar falls to a certain level, the secretion of insulin is reduced automatically.

Control and coordination in plants: Plants coordinate their behaviour against environmental changes by using hormones. The hormones in plants coordinate their behaviour by affecting their growth. And the effect on growth of the plant can result in the movement of its part like shoot (stem) or root, etc. The plants respond to various stimuli very slowly by growing. Hence, in most of the cases, the response of a plant to a stimulus cannot be observed immediately. It usually takes a considerable time to observe the effect of a stimulus on a plant.

- **Plant hormones (or Phytohormones):** The plant hormones coordinate the activities of the plant by controlling one or the other aspect of the growth of the plant. So, they are also known as plant growth substances. The growth of a plant can be divided into three stages: **cell division**, **cell enlargement** and **cell differentiation** (or cell specialisation), and these stages have particular locations in a plant. There are 5 major types of phytohormone. These phytohormones with their functions are discussed in the given table:

Table : Plant hormones and their functions

Plant hormones	Functions
Auxins	These promote cell enlargement and cell differentiation in plants. These promote stem and fruit growth. These regulate important plant growth movements, *i.e.*, tropisms. These induce parthenocarpy (*i.e.*, the formation of seedless fruits without fertilisation) in number of plants.
Gibberellins	These promote cell enlargement and cell differentiation in plants in the presence of auxins. These also promote growth in stems and fruits. Rossette plants (*i.e.*, plants that show profuse leaf development but reduced internode growth) show bolting and flowering when treated with gibberellins. These also induce parthenocarpy in many plants.
Cytokinins	These promote cell division in plants. These play vital role in the morphogenesis in plants. These help in breaking the dormancy of seeds and buds. These delay the ageing in leaves. These promote the opening of stomata. These also promote fruit growth.
Ethylene	It promotes growth and ripening of fruits. It helps in breaking the dormancy in buds and seeds. It stimulates the formation of separation layer (abscission zone) in leaves, flowers and fruits. It promotes yellowing and senescence of leaves.
Abscisic acid (ABA)	It promotes the dormancy in seeds and buds and thus inhibits growth. It also promotes the closing of stomata and thus affects wilting of leaves. It also promotes the falling of leaves (abscission) and senescence in leaves.

Plant movements : Plants do not show locomotion (movement of the entire body). However, movements of the individual parts or organs of a plant (like shoot, root, leaves, etc.) are possible when they are subjected to some external stimuli like light, force of gravity, chemical substances, water and touch, etc. These movements of the plant parts are usually caused by an unequal growth in their two regions by the action of plant hormones, under the influence of the stimulus. When a plant part shows movement, it remains attached to the main body of the plant.

Types of plant movements

Nastic movements
Movements independent of growth.

Tropic movements
Movements due to growth.

Phototropism
Phototropism is the directional movement or orientation of the plant part in response to light stimulus. If the plant part moves towards light, it is called as positive phototropism. Alternatively, if the plant part moves away from light, it is called as negative phototropism. Example. (i) Stem or shoot of a growing plant moves towards light and thus shows positive phototropism. (ii) Roots of a plant move away from light and thus show negative phototropism.

Seismonastic movements
Such movements occur in response to touch (shock). These movements are very quick and are best seen in 'touch-me-not' plant (*Mimosa pudica*), also called '*Chhui-mui*' or '*Lajwanti*' or 'sensitive plant'.

Geotropism
Geotropism is the directional movement or orientation of the plant part in response to gravity. If the plant part moves in the direction of gravity, it is called as positive geotropism. Alternatively, if the plant part moves against the direction of gravity, it is termed as negative geotropism. Example : (i) Roots of a plant move downward in the soil in the direction of gravity and thus show positive geotropism. (ii) The stem or shoot of a plant shows movement against the direction of gravity and thus shows negative geotropism.

Nyctinastic movements
The movements involving the diurnal variations in the position of flowers and leaves of many plants in day and night are called nyctinastic or sleep movements. Nyctinastic movements include photonastic movements and thermonastic movements.

Photonastic movements
If the diurnal variations in the position of plant parts (*e.g.*, flowers and leaves) are caused by the light stimulus, such non-directional movements are called photonastic movements. Example is dandelion flower.

Thermonastic movements
If the diurnal variations in the position of plant parts (*e.g.*, flowers and leaves of plants) are caused by the change in temperature of the surroundings, such non-directional movements are called thermonastic movements.

Chemotropism
It is the directional movement or orientation of the plant part in response to chemical stimulus. If the plant part moves towards the chemical stimulus, it is called positive chemotropism. On the other hand, if the plant part moves away from the chemical stimulus, it is called negative chemotropism. Example: During the process of fertilisation, growth of pollen tube towards the ovule in the ovary is an example of positive chemotropism.

Hydrotropism
It is the directional movement or orientation of the plant part in response to water stimulus. If the plant part moves towards the water stimulus, it is called as positive hydrotropism. On the other hand, if the plant part moves away from the water stimulus, it is called as negative hydrotropism. Example:Bending of roots of the plant towards water signifies positive hydrotropism.

Thigmotropism
It is the directional response of plant parts to the touch of an object. It is often seen in plants having tendrils. Tendrils are positively thigmotropic which means that they grow towards things they happen to touch. Examples: Bitter gourd, bottle gourd, grape vine, etc.

Flow chart : Types of plant movements

Previous Years' CBSE Board Questions

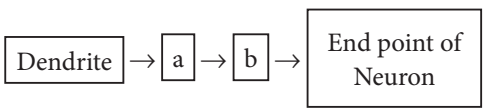
7.1 Animals-Nervous System

VSA (1 mark)

1. Which is the largest and most prominent part of the brain? *(Board Term I, 2013)*

SA I (2 marks)

2. (a) Name one gustatory receptor and one olfactory receptor in human beings.
(b) Write a and b in the given flow chart of neuron through which information travels as an electrical impulse.



(2018)

3. Write the main functions of the following :
(a) sensory neuron (b) cranium
(c) vertebral column (d) motor neuron.
(Board Term I, 2017)

SA II (3 marks)

4. Why does the flow of signals in a synapse from axonal end of one neuron to dendritic end of another neuron take place but not in the reverse direction? Explain. *(AI 2019)*

5. "Reflex arcs continue to be more efficient for quick responses". Justify this statement giving reason. *(Board Term I, 2017)*

6. (a) Define reflex arc.
(b) Trace the sequence of events which occur in our body when a bright light is focussed on your eyes.
(Board Term I, 2016)

7. (a) Draw a neat diagram of a neuron and label (i) dendrite and (ii) axon.
(b) Which part of the human brain is:
(i) the main thinking part of the brain?
(ii) responsible for maintaining the posture and balance of the body?
(Board Term I, 2015)

8. Mention three major regions of brain. Write one function of each. *(Board Term I, 2014)*

7.2 Coordination in Plants

VSA (1 mark)

9. State one example of chemotropism.
(Board Term I, 2015)

10. What is meant by tropic movements?
(Board Term I, 2013)

SA I (2 marks)

11. State the two types of movements seen in plants. Give one example of each type.
(Board Term I, 2016)

SA II (3 marks)

12. Define geotropism. Draw a labelled diagram of a plant showing geotropic movement of its parts. *(2020)*

13. What are plant hormones? Name the plant hormones responsible for the following :
(i) Growth of stem
(ii) Promotion of cell division
(iii) Inhibition of growth
(iv) Elongation of cells *(Delhi 2019)*

14. Define phototropism. Name the plant hormone which is responsible for phototropism. *(Board Term I, 2016)*

LA (5 marks)

15. (a) What are phytohormones? List four types of phytohormones. Where are these hormones synthesised?
(b) What happens when a growing plant detects light? Explain in brief.
(Board Term I, 2017)

16. List the sequences of events that occur when a plant is exposed to unidirectional light, leading to bending of a growing shoot. Also name the hormone synthesised and the type of movement that takes place.
(Board Term I, 2016)

17. (a) Define reflex arc. Draw a flow chart showing the sequence of events which occur during sneezing.
(b) List four plant hormones. Write one function of each. *(Board Term I, 2014)*

7.3 Hormones in Animals

VSA (1 mark)

Answer question numbers **18** to **21** on the basis of your understanding of the following information and related studied concepts :

Thyroid gland is a bilobed structure situated in our neck region. It secretes a hormone called thyroxine. Iodine is necessary for the thyroid gland to make thyroxine. Thyroxine regulates carbohydrates, protein and fat metabolism in the body. It promotes growth of body tissues also. When there is an excess of thyroxine in the body, a person suffers from hyperthyroidism and if this gland is underactive it results in hypothyroidism. Hyperthyroidism is diagnosed by blood tests that measure the levels of thyroxine and Thyroid Stimulating Hormone (TSH). Hypothyroidism is caused due to the deficiency of iodine in our diet resulting in a disease called goitre. Iodised salt can be included in our diet to control it.

18. Where is thyroid gland situated?

19. State the function of thyroxine in human body.

20. What is hyperthyroidism?

21. How can we control hypothyroidism?

(2020)

Question numbers **22** to **25** are based on table given below. Study the table in which the levels of Thyroid Stimulating Hormone (TSH) in women are given and answer the questions that follow on the basis of understanding of the following paragraph and the related studied concepts :

Age Range	Normal (mU/L)	Low (mU/L)
18-29 years	0.4-2.34 mU/L	< 0.4 mU/L
30-49 years	0.4-4.0 mU/L	< 0.4 mU/L
50-79 years	0.46-4.68 mU/L	< 0.46 mU/L

Women are at greater risk for developing abnormal TSH levels during menstruation, while giving birth and after going through menopause. Around 5% of women in the United States have some kind of thyroid problem compared to 3% of men. Despite claims that high TSH increases your risk for heart disease, a 2013 study found no link between high TSH and heart diseases. But a 2017 study showed that older women are especially at risk for developing thyroid cancer if they have high TSH levels along with thyroid nodules.

22. A 35 years old woman has TSH level 6.03 mU/L. What change should she bring in her diet to control this level?

23. When do women face a greater risk of abnormal TSH level?

24. State the consequence of low TSH level.

25. Name the mineral that is responsible for synthesis of hormone secreted by thyroid gland. *(2020)*

Question numbers **26** to **29** are based on the table and related information in the passage given below :

Thyroid Stimulating Hormone (TSH) stimulates thyroid gland to produce thyroxine. Study the table given below.

Table : TSH levels during pregnancy

Stage of pregnancy	Normal (mU/L)	Low (mU/L)	High (mU/L)
First trimester	0.2-2.5	< 0.2	2.5 - 10
Second trimester	0.3-3.0	< 0.3	3.01 - 4.5
Third trimester	0.8-5.2	< 0.8	> 5.3

It is important to monitor TSH levels during pregnancy. High TSH levels and hypothyroidism can especially affect chances of miscarriage. Therefore, proper medication in consultation with a doctor is required to regulate/control the proper functioning of the thyroid gland.

26. Give the full form of TSH.

27. State the main function of TSH.

28. Why do TSH levels in pregnant women need to be monitored?

29. A pregnant woman has TSH level of 8.95 mU/L. What care is needed for her?

(*2020)*

SA II (3 marks)

30. A squirrel is in a scary situation. Its body has to prepare for either fighting or running away. State the immediate changes that take place in its body so that the squirrel is able to either fight or run. *(2020)*

31. Why is chemical communication better than electrical impulses as a means of communication between cells in a multicellular organisms? *(2020)*

32. A cheetah, on seeing a prey moves towards him at a very high speed. What causes the movement of his muscles? How does the chemistry of cellular components of muscles change during this event? *(2020)*

33. Name the hormones secreted by the following endocrine glands and specify one function of each: (a) Thyroid (b) Pituitary (c) Pancreas. *(2018)*

34. (a) How does chemical coordination take place in animals?
(b) It is advised to use iodised salt. Give reason. *(Board Term I, 2017)*

35. (a) An old man is advised by his doctor to take less sugar in his diet. Name the disease from which the man is suffering. Mention the hormone due to imbalance of which he is suffering from this disease. Which endocrine gland secretes this hormone?
(b) Name the endocrine gland which secretes growth hormone. What will be the effect of the following on a person
(i) deficiency of growth hormone
(ii) excess secretion of growth hormone?
(Board Term I, 2016)

36. Name the hormone required for the following. Also mention the name of endocrine gland from which that hormone is secreted:
(a) Lowering of blood glucose.
(b) Development of moustache and beard in human males.
(c) Metabolism of carbohydrates, fats and proteins. *(Board Term I, 2015)*

37. (a) Complete the following table:

	Name of the hormone	Gland which secretes the hormone	Functions of the hormone
(i)	Thyroxine	Thyroid	_____
(ii)	Growth Hormone	_____	Regulates growth and development of the body
(iii)	Insulin	Pancreas	_____

(b) List three characteristics of animal hormones. *(Board Term I, 2015)*

38. List in tabular form three differences between nervous control and chemical control. *(Board Term I, 2013)*

39. A gland secretes a particular hormone. The deficiency of this hormone in the body causes a particular disease in which the blood sugar level rises.
(i) Name the gland and the hormone secreted by it.
(ii) Mention the role played by this hormone.
(iii) Name the disease caused due to deficiency of this hormone. *(Board Term I, 2013)*

LA (5 marks)

40. (a) Name one organ each where growth hormone is synthesised in man and plant.
(b) List the sequence of events that occur when a plant is exposed to unidirectional light, leading to bending of a growing shoot. Also name the hormone and the type of movement. *(Board Term I, 2014)*

Detailed Solutions

1. Cerebrum is the largest and most prominent part of the brain.

2. (a) Gustatory receptors are receptors for taste present in taste buds on tongue and olfactory receptors are the receptors for smell present in nasal chambers.

(b) Dendrite → a → b → End point of Neuron

In the given flow chart, a is cyton and b is axon.

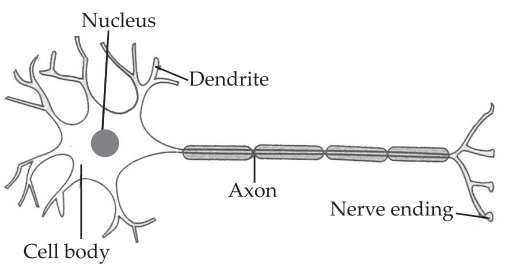
3. (a) Sensory neuron occur in sense organs and receive stimuli through their dendrites. The sensory neurons transmit impulses towards the central nervous system (brain and spinal cord) with the help of their axons.
(b) Cranium : The bones of cranium or brain box protect the brain from mechanical injury.
(c) Vertebral column : Major function of the vertebral column is protection of the spinal cord and carries the weight of the upper body.
(d) Motor neuron : The dendrites of these neurons synapse with axons of interneurons in central nervous system. They transmit impulses from central nervous system towards effectors (muscles or glands). The latter respond to stimuli.

4. At the synapse, (functional junction between neurons) axon terminal comes in close proximity to the dendron terminal of next neuron. Axon terminal is expanded to form pre-synaptic knob and the other dendrite terminal forms post-synaptic depression.
In between the two, lies a narrow fluid filled space called synaptic cleft. As the nerve impulse reaches the pre-synaptic knob, the synaptic vesicles get stimulated to release neurotransmitter in the synaptic cleft. The neurotransmitter molecules diffuse across the gap to come in contact with post-synaptic membrane. In this way, nerve impulse passes across the minute gap to stimulate dendron of other neuron. The synapse acts as a one-way valve to conduct impulse in one direction only. This is so because chemical substance called neurotransmitter is secreted only on one side of the gap, *i.e.*, on axon's side. It carries impulse across the synapse and passes it to the dendron of the other neuron. In this way, impulses travel across the neurons only in one direction, *i.e.*, from axon of one neuron to dendron of other neuron through a synapse.

5. Reflex action is an automatic and spontaneous response to a stimulus. The pathway taken by nerve impulses and responses in a reflex action is called a reflex arc. It consists of receptor, sensory nerve (afferent), spinal cord, motor nerve (efferent) and effector (muscles or glands). Reflex arc is evolved in animals because the thinking process of the brain is not fast enough. Reflex arc enables the body to give quick responses to harmful stimuli so that chances of damage to body are decreased. It also prevents overloading of brain, so prevents its fatigue. Many animals have very little or none of the complex neuron network needed for thinking. So, it is likely that reflex arc has evolved as an efficient way of functioning in the absence of true thought processes. However, even after complex neuron networks have came into existence, reflex arcs continue to be more efficient for quick responses.

6. (a) The pathway taken by the nerve impulses in a reflex action, from receptor organ to spinal cord and back to effector organ of reflex action is called reflex arc. Receptor organ could be a sense organ such as eyes, skin, etc., and effector organ could be muscles, glands, etc.
(b) When a bright light is focussed on eye, receptor cell receives the stimulus and an impulse is generated. This impulse is passed on to sensory neuron, then it goes to brain, brain sends the impulse to the motor neuron which contracts the pupil. Sequence of events can be summarised as :
Photoreceptors in eye → Sensory (Receptor) neuron → Brain → Motor (Effector) neuron → Eye muscle → Constriction of pupils

7. (a) Diagrammatic representation of a neuron is as follows:



(b) (i) Forebrain which includes cerebrum, olfactory lobes and diencephalon, is the main thinking part of the brain.
(ii) Cerebellum, part of hindbrain is responsible for maintaining the posture and balance of the body.

8. Brain is divided into three main regions forebrain, midbrain and hindbrain.
(i) Forebrain consists of cerebrum, olfactory lobes and diencephalon. Its main function is thinking and controlling various activities such as touch, smell, hearing, speech and sight.
(ii) Midbrain controls reflex movements of the head, neck and trunk in response to visual and auditory stimuli.

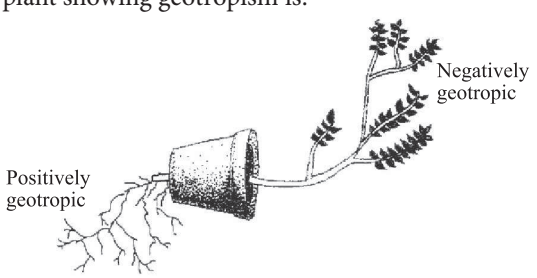
(iii) Hindbrain has three centres called pons, cerebellum and medulla. This part is responsible for regulating respiration, maintaining posture and balance of body and controlling involuntary actions such as heartbeat, breathing, swallowing, coughing, sneezing, vomiting, etc.

9. Growth of pollen tube towards the ovule due to chemical stimulus during the process of fertilisation in a flower is an example of chemotropism.

10. Directional movements or orientations of specific part of a plant in response to external stimuli are called tropisms or tropic movements.

11. Two types of movements seen in plants are:
(i) Nastic movements are movements independent of growth that are non-directional and occur due to turgor changes, *e.g.*, closing of leaves in response to touch stimulus in 'touch me not' plant.
(ii) Tropic movements or tropism are movements due to growth, that are directional and very slow, *e.g.*, movement of a part of the plant in response to light.

12. Geotropism refers to the upward and downward growth of shoots and roots respectively in response to the pull of earth or gravity. If the plant part moves in the direction of gravity, it is called positive geotropism. Likewise, if the plant part moves against the direction of gravity, it is termed as negative geotropism. Shoots are usually negatively geotropic and roots are usually positively geotropic. A well labelled diagram of plant showing geotropism is:



13. Plant hormones or phytohormones are chemical substances produced naturally in plants and capable of translocation and regulating one or more physiological processes when present in low concentration. These are also known as plant growth substances or plant growth regulators.

The plant hormones responsible for different functions are as follows:
(i) Growth of stem : Gibberellins (Gibberellic acid) promote growth in stems.
(ii) Promotion of cell division : Cytokinins promote cell division in plants.
(iii) Inhibition of growth : ABA (Abscisic acid) promotes dormancy in seeds as well as in buds and thus inhibits growth.
(iv) Elongation of cells : Auxin and cytokinin both cause cell elongation.

14. Phototropism is the movement of a part of the plant in response to light. Shoots generally grow towards light and are said to be positively phototropic, while roots grow away from light and are said to be negatively phototropic.
The growth movement of the plant part (stem) is caused by the action of auxin hormone. Auxin causes cell elongation. Thus, causing growth of stem towards the light stimulus.

15. (a) Phytohormones are chemical substances produced naturally in plants and are capable of translocation and regulating one or more physiological processes when present in low concentration. Plant hormones help to coordinate growth, development and responses to the environment. Plant hormones are also known as plant growth substances or plant growth regulators.
Types of hormone and their site of synthesis are as follows :

	Plant hormone	**Site of Synthesis**
(i)	Auxin	Auxin hormone is synthesised by the meristematic tissue at the tip of the stem and roots.
(ii)	Gibberellins (Gibberellic acid)	Gibberellins are synthesised in young leaves, roots and shoots and transported to other parts of the plant.
(iii)	Cytokinin	It is synthesised in roots and transported to shoot region through xylem.

(iv)	Ethylene	It is formed in almost all plant parts - roots, leaves flowers, fruits, seeds, etc.
(v)	Abscisic acid	It is produced in many parts of the plant but more abundantly inside the chloroplast of green cells.

(b) Plants respond to light by showing growth movement towards light (phototropism). This growth movement of the plant part (stem) is caused by the action of auxin hormone. The auxin hormone is synthesised in the meristematic tissue at the tip of the stem. Auxin diffuses uniformly down the stem in plants that are kept in the open and receive sunlight from above. Due to presence of auxin equally on both the sides, the stem grows up straight because both the sides of the stem show growth at the same place. But when sunlight is unidirectional, auxin gets accumulated towards the shady region of the shoot. This causes the cells to elongate and stem to bend towards light.

16. *Refer to answer 15 (b).*

17. (a) Reflex arc is defined as the pathway or route taken by nerve impulses in a reflex action. Sequences of events that occur during sneezing can be depicted as :

Foreign particles sensed by olfactory receptors in the nasal cavity
↓
Sensory nerve impulse activated by olfactory receptors
↓
Sensory impulse carried to the spinal cord by sensory nerve
↓
Spinal cord neurons analyse the impulse and transmit them to motor neurons
↓
Motor nerve conducts these impulses from CNS to effectors
↓
Effectors like radial muscles of diaphragm and intercostal muscle of ribs respond causing forceful expiration through lungs
↓
Sneeze

(b) Four plant hormones are:
(i) Auxins : These promote cell enlargement and cell differentiation in plants. These also promote stem and fruit growth.
(ii) Gibberellins : These promote cell enlargement and cell differentiation in plants in the presence of auxins. These also promote growth in stems and fruits.
(iii) Cytokinins : These promote cell division in plants. These play vital role in the morphogenesis in plants.
(iv) Ethylene : It promotes growth and ripening of fruits. It helps in breaking the dormancy in buds and seeds.

18. Thyroid gland is situated in our neck region.

19. Thyroxine regulates carbohydrate, protein and fat metabolism in the body. It promotes growth of body tissues also.

20. Hyperthyroidism occurs when there is excess of thyroxine in the body.

21. Hypothyroidism can be controlled by using iodised salt.

22. (a) A 35 year old woman with TSH level 6.03 mU/L means she is suffering hypothyroidism. Iodised salt can be included in her diet to control it.

23. Women are at greater risk for developing abnormal TSH levels during menstruation, while giving birth and after going through menopause.

24. The low TSH level means that there is an excess of thyroxine (hyperthyroidism) in the body secreted by thyroid gland. So, the pituitary gland starts producing less TSH.

25. Thyroid gland makes a hormone called thyroxine, which contains iodine.

26. The full form of TSH is Thyroid Stimulating Hormone.

27. TSH stimulates thyroid gland to produce thyroxine.

28. TSH levels in pregnant women need to be monitored as high TSH levels and hypothyroidism can increase chances of miscarriage.

29. A pregnant women with high TSH level needs proper medication in consultation with a doctor to control the proper functioning of thyroid gland.

30. When squirrel is in a scary situation then its nervous system stimulates the adrenal glands to secrete more adrenaline hormone into blood.

This adrenaline hormone increases heartbeat, breathing rate, blood flow into muscles and causes liver to put more stored glucose into its blood. All these actions of adrenaline hormone produces a lot of energy in squirrel's body. In this way, squirrel prepares itself for fighting or running away action.

31. In animals, the message communicated in the form of nerve impulses, from receptors to central nervous system and from latter to effectors is very quick. But nerve impulses can reach only those animal cells which are connected by the nervous tissue. These cells after generation and transmission of nerve impulses, take sometime to reset their mechanism before a new impulse is generated and transmitted. It means, cells cannot continuously generate and transmit electrical impulses. This is the reason most multicellular organisms use another means of communication called chemical communication. In chemical communication information spreads out throughout the body by blood and its effects lasts longer. Chemical communication is however slow but it can reach all the cells of body regardless of nervous connections.

32. The cheetah senses its prey by photoreceptors and the information is sent to the central nervous system. The response is then carried by neurons. Along with nervous system, the hormonal system also plays a role. Adrenaline hormone produced by the adrenal glands triggers the flight or fight action. On seeing a prey, these hormones are released into the cheetah's blood stream. It speeds up heartbeat, breathing increases blood flow into leg muscles and causes liver to put more stored glucose into cheetah's blood. All these actions of adrenline hormone produces a lot of energy which helps cheetah to run fast.

33. (a) Thyroid gland secrete three hormones : thyroxine (T_4), triiodothyroxine (T_3) and calcitionin. Thyroxine and triiodothyronine maintain the basal metabolic rate (BMR) of the body by regulating the rate of oxidation of carbohydrates, fats and proteins and production of energy in our body. They promote growth of body tissues and development of mental faculties.
Calcitonin regulate the concentration of calcium and phosphorus in the blood.
(b) Pituitary secretes following hormones :
(i) Growth hormone (GH) or somatotropic hormone controls the overall development of body, muscles, bones and tissues.
(ii) Thyroid stimulating hormone (TSH) controls growth and functions of thyroid gland.
(iii) Adrenocorticotropic hormone (ACTH) stimulates adrenal cortex to secrete cortisol hormone.
(iv) Follicle stimulating hormone (FSH) in males, stimulates sperm formation and in females, development of follicle cells into mature eggs.
(v) Luteinising hormone (LH) stimulates secretion of testosterone in males and estrogen and progesterone in females.
(vi) Prolactin hormone (PRL) responsible for growth of mammary glands and milk production in females.
(vii) Melanocyte stimulating hormone (MSH) stimulates the synthesis of melanocytes.
(viii) Oxytocin stimulates lactation after child birth.
(ix) Vasopressin regulates water balance in body fluids.
(c) Pancreas secretes following hormones :
(i) Insulin regulates the conversion of glucose to glycogen, *i.e.*, it lowers the blood glucose level.
(ii) Glucagon is responsible for regulation of glycogen to glucose, *i.e.*, increase blood glucose level.

34. (a) The endocrine system consists of specialised glands (endocrine glands) which brings about control by sending chemical messengers termed hormones. These glands secrete hormones directly into the blood. Hormones reach the target organs *via* blood and regulate the activities of these organs, thus coordinating the functioning of living organisms and also their growth.
(b) Iodine is necessary for the making of thyroxine hormone by thyroid gland. Therefore, deficiency of iodine in the diet can cause deficiency of thyroxine hormone in the body.

35. (a) Old man who is advised by his doctor to take less sugar in his diet is suffering from diabetes mellitus that occurs due to imbalance of insulin hormone. Endocrine part of islets of Langerhans in pancreas secrete insulin hormone.
(b) Growth hormone (GH) or somatotropic hormone (SH) is secreted by pituitary gland.
Effect of the following on a person:
(i) Deficiency of growth hormone (hypoactivity) causes dwarfness.
(ii) Excess secretion of growth hormone (hyperactivity) causes excessive growth of bones making the person very tall (gigantism).

36. (a) The hormone that lowers blood sugar level is insulin. The function of insulin hormone is to lower the blood sugar level (or blood glucose level, *i.e.*, it controls the metabolism of sugar. It is secreted by the endocrine part of pancreas called islets of Langerhans.
(b) Testes secretes the male sex hormone called testosterone, which is responsible for development of male sex organs and male features such as deeper voice, moustache, beard and body hair.
(c) Thyroxine hormone is synthesised by thyroid gland. Thyroxine controls the rate of metabolism of carbohydrates, fats and proteins.

37. (a) (i) Functions of thyroxine hormone is regulation of carbohydrates, protein and fat metabolism.
(ii) Gland that secretes growth hormone is pituitary gland.
(iii) Function of insulin is to regulate the conversion of glucose to glycogen, *i.e.*, it lowers blood glucose level.
(b) Three characteristics of animal hormones are:
(i) Hormones are synthesised by endocrine glands and secreted directly into the blood stream.
(ii) They are produced at a place other than the site of action. They travel through blood and have specific action on a specific target organ.
(iii) Chemically the hormones may be peptides, proteins, amines or steroids.

38. Differences between nervous control and chemical control are as follows:

S. No.	Nervous control	Chemical control
(i)	Information travels rapidly in a fraction of second.	Information travels slowly.
(ii)	Information is sent as an electrical impulse along axon and as a chemical across synapse.	Information is sent as a chemical messenger called hormone, *via* blood stream.
(iii)	Information is directed to specific receptors which can be one or a few nerve fibres, gland cells or other neurons.	Information is spread throughout the body by blood from which the target cells or organs pick it up.
(iv)	Effect of message usually lasts for a very short while.	Effect of message usually lasts longer.

39. (i) Pancreas secretes insulin hormone.
(ii) Insulin regulates the conversion of glucose to glycogen, *i.e.*, it lowers blood glucose level.
(iii) Deficiency of insulin hormone causes diabetes mellitus.

40. (a) In man, growth hormone is synthesised by pituitary gland which is present below the brain. Growth hormone controls the growth of human body.
In plants, auxins promote the plant growth. Auxins are produced by growing apices of the stems and roots. They migrate to the regions of their action, and initiate cell division and cell elongation.
(b) (i) When a plant is exposed to unidirectional light, the shoot tips synthesise phytohormone called auxin.
(ii) Auxins slowly diffuse towards the shady side.
(iii) As auxins help the plant to grow, cells on the shady side grow longer than the ones which are exposed to light.
(iv) Hence, causing the plant to bend towards light. This type of movement caused due to hormone auxin is called phototropism.
Shoots generally grow towards the light hence show positive phototropism and roots grow away from light and show negative phototropism.