

# Chemical Coordination and Integration

## Multiple Choice Questions (MCQs)

**Q. 1** Select the right match of endocrine gland and their hormones among the options given below

| Column I           | Column II             |
|--------------------|-----------------------|
| A. Pineal          | 1. Epinephrine        |
| B. Thyroid         | 2. Melatonin          |
| C. Ovary           | 3. Estrogen           |
| D. Adrenal medulla | 4. Tetraiodothyronine |

### Codes

- A B C D  
 (a) 4 2 1 3  
 (c) 3 2 1 4

- A B C D  
 (b) 2 4 1 3  
 (d) 2 4 3 1

### 💡 Thinking Process

*Endocrine glands lack ducts, hence are called ductless glands. Their secretion are called hormones.*

**Ans. (d)** **Pineal gland** secretes a hormone called **melatonin**. It is involved in regulating biological rhythm and sleep-wake cycle.

**Thyroid gland** secretes a hormone called **tetraiodothyronine**. It primarily regulates metabolism of body.

**Ovary** secretes **estrogen** which is involved in growth and **stimulation** of female secondary sex organs and also in the development of growing ovarian follicles.

**Adrenal medulla** secretes **epinephrine** and norepinephrine in response to stress or in any kind of emergency situations.

**Q. 2** Which of the following hormones is not secreted by anterior pituitary?

- (a) Growth hormone (b) Follicle stimulating hormone  
(c) Oxytocin (d) Adrenocorticotrophic hormone

**💡 Thinking Process**

The pituitary gland is divided anatomically into two parts, i.e., **adenohypophysis** and a **neurohypophysis** which are involved in secretion of different hormones accordingly.

**Ans. (c)** **Oxytocin** is the hormone of anterior pituitary origin. It acts on the smooth muscles of uterus and stimulates their contraction also plays role in milk secretion.

**Follicle stimulating hormone** stimulates growth of ovarian follicles whereas, in the female and spermatogenesis in the male.

**Growth Hormone** Stimulates body growth by promoting the synthesis and deposition of proteins in tissues and also in the growth of bones and muscles.

**Adrenocorticotrophic Hormone** stimulates adrenal cortex of adrenal gland to produce glucocorticoid and mineralocorticoid.

**Q. 3** Mary is about to face an interview. But during the first five minutes before the interview she experiences sweating, increased rate of heart beat, respiration, etc. Which hormone is responsible for her restlessness?

- (a) Estrogen and progesterone (b) Oxytocin and vasopressin  
(c) Adrenaline and noradrenaline (d) Insulin and glucagon

**💡 Thinking Process**

Adrenaline hormone is responsible for "flight or fight" response in our body.

**Ans. (c)** Mary, during her first five minutes before interview experiences sweating, increased heart rate and respiration because she is having stress which leads to release of **emergency hormones** or **hormones of flight and fight**, i.e., adrenaline and noradrenaline. These hormones stimulate the breakdown of glycogen resulting in increase concentration of glucose in blood.

**Estrogen and progesterone** Estrogen regulates growth and development of female sex organs, female secondary structure, mammary gland development and progesterone supports pregnancy.

**Oxytocin and vasopressin** Oxytocin is involved in contraction of smooth muscles of uterus at the time of child birth in females and acts mainly on mammary gland for milk ejection. Vasopressin stimulates the absorption of water and electrolytes by distal tubules in kidney and also reduces loss of water.

**Insulin and glucagon** are the peptide hormones. **Insulin** decrease blood glucose level and **glucagon** is involved in increasing normal glucose levels in the blood.

**Q. 4** The steroid responsible for balance of water and electrolytes in our body is

- (a) insulin (b) melatonin  
(c) testosterone (d) aldosterone

**💡 Thinking Process**

In humans steroid hormones are derived from cholesterol. Cholesterol is stored and produced in liver and is transported (in cells as High Density Lipoprotein or HDL) and Low Density Lipoprotein (LDL).

**Ans. (d)** **Aldosterone** acts at the renal tubules stimulating the reabsorption of  $\text{Na}^+$ , water and excretion of  $\text{K}^+$  and phosphate ion. Thus, it helps in maintenance of electrolytes, body fluid volume, osmotic pressure and blood pressure.

**Insulin** is a peptide hormone, that plays an important role in maintaining the normal blood glucose levels.

**Testosterone** is the male sex hormone, stimulating male features like muscular growth, growth of facial and axial hair, aggressiveness, low pitch of voice, etc, and spermatogenesis.

**Melatonin** hormone has a very important role in regulating 24 hours (diurnal) rhythm of our body.

**Q. 5** Thymosin is responsible for

- (a) raising the blood sugar level
- (b) raising the blood calcium level
- (c) differentiation of T-lymphocytes
- (d) decrease in blood RBCs

**Ans. (c)** **Thymosins** play a major role in the differentiation of T-lymphocytes, which provide cell mediated immunity. It also promotes antibody production to provide **humoral immunity**. It hastens attainment of sexual maturity.

**Q. 6** In the mechanism of action of a protein hormone, one of the second messengers is

- (a) Cyclic AMP
- (b) Insulin
- (c)  $\text{T}_3$
- (d) Gastrin

**Ans. (a)** **Cyclic AMP** is one of the second messengers involved in the action of a protein hormone. *The other three options are incorrect as*

**Insulin** regulates glucose homeostasis.

**$\text{T}_3$**  regulates the metabolic rate of the body and thus, helps in maintaining Basal Metabolic Rate (BMR).

**Gastrin** is a peptide hormone, that stimulates the secretion of **hydrochloric acid** and **pepsinogen**.

**Q. 7** Leydig cells produce a group of hormones called

- (a) androgens
- (b) estrogens
- (c) aldosterone
- (d) gonadotropins

**Ans. (a)** The **Leydig cells** or **interstitial cells**, which are present in the interstitial spaces of testis produce a group of hormones called **androgens** mainly **testosterone**.

**Estrogen is secreted by growing follicles in ovaries and** stimulates growth and development of female secondary sex organs.

**Aldosterone** is secreted by adrenal gland helps in maintaining electrolytes in the body fluid, volume, osmotic pressure and blood pressure.

**Gonadotropins** are secreted by anterior pituitary gland and stimulate the gonadal activity. These include LH and FSH.

**Q. 8** Corpus luteum secretes a hormone called

- (a) prolactin      (b) progesterone      (c) aldosterone      (d) testosterone

**Ans. (b)** **Corpus luteum** secretes a hormone called as **progesterone** which supports pregnancy and stimulates development the **mammary gland** for the milk production in female.

**Prolactin** also known as luteotropic hormone, its a protein hormone that is involved in production of milk in females. The source for prolactin secretion is anterior pituitary gland.

**Testosterone** stimulates muscular growth, growth of facial and axillary hair, aggressiveness, low pitch of voice, etc. The source for the secretion of testosterone is **Leydig cells** or **interstitial cells**.

**Aldosterone** is secreted by adrenal cortex and plays a role in reabsorption of sodium ions, etc.

**Q. 9** Cortisol is secreted from

- (a) pancreas      (b) thyroid      (c) adrenal      (d) thymus

**Ans. (c)** **Cortisol** is secreted from the adrenal gland. The **zona fasciculata** region of adrenal cortex secretes **cortisol**, **corticosterone** and **cortisone**. These hormones are involved in maintaining glucose homeostasis.

**Pancreas** is a composite gland which secretes insulin glucagon and somatostatin

**Thyroid gland** secretes thyroxin or tetraiodothyronine ( $T_4$ ) and triiodothyronine ( $T_3$ ), which regulate the metabolic rate of the body and maintain basal metabolic rate. It also secretes calcitriol

**Thymus** secretes thymosin, involved in providing cell mediated immunity to the body.

**Q. 10** A hormone responsible for normal sleep-wake cycle is

- (a) epinephrine      (b) gastrin      (c) melatonin      (d) insulin

**Ans. (c)** **Melatonin** hormone plays a very important role in maintaining the normal rhythms of sleep-wake cycle.

**Gastrin** is secreted by the endocrine cells present in the gastrointestinal tract and stimulates the secretion of hydrochloric acid and pepsinogen.

**Epinephrine** is secreted from the adrenal gland and acts as a stress relieving hormone at the time of stress condition in the body.

**Insulin** secreted from pancreas is involved in maintaining glucose homeostasis.

**Q. 11** Hormones are called chemical signals that stimulate specific target tissues. Which is the correct location of these receptors in of protein hormones?

- (a) Extra cellular matrix      (b) Blood  
(c) Plasma membrane      (d) Nucleus

**Thinking Process**

*Hormones produce their effects on target tissue by binding to specific proteins called hormone receptor.*

**Ans. (c)** Hormone receptor are located in the target tissue only and are present on the plasma membrane/cell membrane of the target cell.

**Q. 12** Match the following columns.

| Column I                     | Column II                         |
|------------------------------|-----------------------------------|
| A. Epinephrine               | 1. Stimulates in muscle growth    |
| B. Testosterone              | 2. Decrease in blood pressure     |
| C. Glucagon                  | 3. Breakdown of in liver glycogen |
| D. Atrial natriuretic factor | 4. Increases heart beat           |

**Codes**

A B C D  
 (a) 2 1 3 4  
 (c) 1 2 3 4

A B C D  
 (b) 4 1 3 2  
 (d) 1 4 2 3

**Ans. (b)** **Epinephrine** increases heart beat and also called as **stress hormone**.

**Testosterone** stimulates muscle growth, as a secondary sex character in males.

**Glucagon** leads to breakdown of the glycogen content in liver. It is secreted from pancreas.

**Atrial Natriuretic Factor** decrease blood pressure by vasodilation

**Q. 13** Which of the following do not play any role in calcium balance in the human body?

- (a) Vitamin-D (b) Parathyroid hormone  
 (c) Thyrocalcitonin (d) Thymosin

**Ans. (d)** **Thymosin hormone** has no role in regulation of blood calcium homeostasis. It plays a major role in the differentiation of T-lymphocytes, which provides cell mediated immunity. While, vitamin-D, thyrocalcitonin and parathyroid hormone plays a vital role in maintaining calcium homeostasis by regulating blood calcium levels.

**Q. 14** All the following organs in mammals does not one consists of a central 'medullary' region surrounded by a cortical region.

- (a) ovary (b) adrenal (c) liver (d) kidney

**Ans. (c)** **Liver**, the largest gland of body surrounded by the abdominal cavity, is the only organs from the above mentioned options that does not consist of a central 'medullary' region, surrounded by a cortical region.

Rest three options, *i.e.*, ovary, adrenal and kidney bear a prominent 'medullary and cortical region'.

**Q. 15** Which of the following conditions is not linked to deficiency of thyroid hormone?

- (a) Cretinism (b) Goitre (c) Myxoedema (d) Exophthalmia

**Ans. (d)** **Exophthalmia**, is a condition, that is not linked to deficiency of thyroid hormone. but to over secretion of thyroid hormone, but to oversecretion of thyroid hormone. In this condition there is a bulging of the eye anteriorly out of the orbit.

This is due to an increase in the amount of white blood cells (lymphocytes) in the eye and swelling due to excess accumulation of thyroid hormone, result the eyeballs being forced forward out of the eye sockets (orbits) whereas, cretinism, goitre and myxoedema are the diseases linked to thyroid deficiency.

## Very Short Answer Type Questions

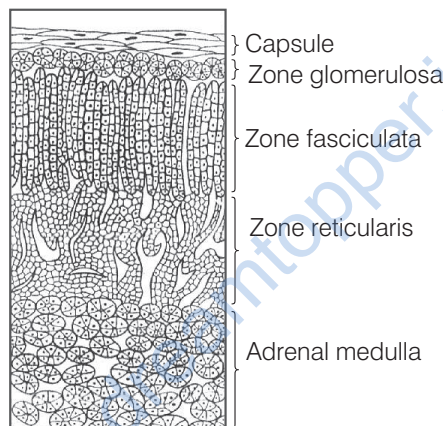
**Q. 1** There are many endocrine glands in human body. Name the glands which is absent in male and the one absent in female.

**Ans.** In males a pair of testis is present in the scrotal sac. Testes perform dual functions as a **primary sex organ** as well as an **endocrine gland**. This gland is absent in females.

In females a pair of ovaries is present which are located in the abdomen. Ovary is the primary female sex organ which produces ovum during menstrual cycle and act as an endocrine gland in producing hormone like **estrogen** and **progesterone**. This gland is absent in males.

**Q. 2** Which of the two adrenocortical layers, zona glomerulosa and zona reticularis lies outside enveloping the other?

**Ans.** **Zona glomerulosa** (outer layer) envelops zona reticularis (inner layer) from the outside.



**Diagram depicting different zones in adrenal gland**

**Q. 3** What is erythropoiesis? Which hormone stimulates it?

**Ans.** **Erythropoiesis** is the process of formation of RBC. Peptide hormone **erythropoietin** secreted from the juxtaglomerular cells of kidney stimulates erythropoiesis.

**Q. 4** Name the only hormone secreted by pars intermedia of the pituitary gland.

**Ans.** **Pars intermedia** of pituitary gland secretes only one hormone called Melanocyte Stimulating Hormone (MSH). This hormone causes dispersal of pigment granules in the pigment cells, thereby darkening the colour in certain animals like fishes and amphibians.

**Q. 5** Name the endocrine gland that produces calcitonin and mention the role played by this hormone.

**Ans.** Calcitonin/thyrocalcitonin is a 32 amino acid, linear polypeptide hormone that is produced in humans primarily by the **parafollicular cells** of the thyroid gland. It checks excess  $\text{Ca}^{2+}$  and phosphate in plasma by decreasing mobilisation from bones.

Deficiency of calcitonin results in osteoporosis or loss of bone density (due to dissolution of parathormone).

**Q. 6** Name the hormone that helps in cell-mediated immunity.

**Ans.** Thymosins play a major role in the development and differentiation of **T-lymphocytes**, which provide cell-mediated immunity. Thymosins also hastens attainment of sexual maturity.

**Q. 7** What is the role of second messenger in the mechanism of protein hormone action?

**Ans.** The hormones that are derivatives of amino acids, polypeptides or proteins are called peptide hormones. These being insoluble in lipids can not enter the target cell.

These act at the surface of target cell as primary messengers and bind to the cell-surface receptor forming the hormone-receptor complex.

*It involves following steps*

- (i) Hormone called **first messenger** attaches to the cell surface receptor protein on the outer surface of plasma membrane of the target cell, forming a hormone-receptor complex.
- (ii) This complex activates the enzyme adenylyl cyclase.
- (iii) Adenylyl cyclase catalyses the conversion of ATP to cyclic AMP on the inner surface of plasma membrane.
- (iv) **cAMP** serves as the **second messenger** or intracellular hormonal mediator delivering information inside the target cells. This activates appropriate cellular enzyme system by **cascade effect**. Which induces the cell machinery to perform its specialised function.
- (v) cAMP has a very short existence. It is rapidly degraded by the cAMP phosphodiesterase.

Water soluble hormones, such as amines, peptides, proteins and glycoproteins exert their control through the cyclic AMP. These are quick acting hormones and produce immediate effect.

**Q. 8** State whether true or false

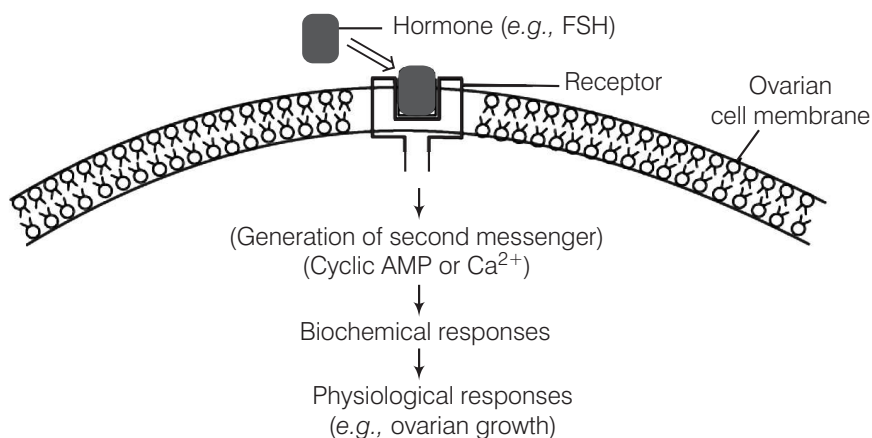
- (a) Gastrointestinal tract, kidney and heart also produce hormones.
- (b) Pars distalis produces six trophic hormones.
- (c) B-lymphocytes provide cell-mediated immunity.
- (d) Insulin resistance results in a disease called diabetes mellitus.

**Ans.** (a) **Gastrointestinal tract, kidney and heart** also produce hormones other than endocrine glands hence, the statement is True. GI tract secretes hormones such as gastrin, secretin, cholecysto kienin etc., Kidney secretes renin and erythropoectin. Heart secretes anti-natriuretic factor

(b) **Pars distalis** produces six trophic hormones, *i.e.*, Growth Hormone (GH) Prolactin (PRL), Thyroid Stimulating Hormone (TSH), Adrinocortico Trophic Hormone (ACTH), Luteinising Hormone (LH) and Follicle Stimulating Hormone (FSH) hence, the statement is True.

(c) **T-lymphocytes** are involved in providing cell-mediated immunity not **B-lymphocytes** hence, the statement is False.

- (d) The Insulin Dependent Diabetes Mellitus (IDDM) is caused by the failure of beta cells to produce adequate amount of insulin hence, results in a disease called **diabetes mellitus**. So, the statement is True.



- Q. 9** A patient complains of constant thirst, excessive passing of urine and low blood pressure. When the doctor checked the patients' blood glucose and blood insulin level, the level were normal or slightly **low**. The doctor diagnosed the condition as diabetes insipidus. But he decided to measure one more hormone in patients blood. Which hormone does the doctor intend to measure?

**Thinking Process**

*Pancreas is a composite gland which acts both as exocrine and endocrine gland. The endocrine pancreas consist of **Islets of Langerhans**. The two main types of cells in the 'Islet of Langerhans are called  **$\alpha$ -cells** and  **$\beta$ -cells**.'*

- Ans.** It is also known as hyperglycaemia hormone, and its action is opposite to that of insulin. Excess of glucose in blood suppress the secretion of glucose, whereas fall in glucose level starts glucose production (since, doctor find the slight low level of blood glucose)

- Q. 10** Correct the following statements by replacing the term **underlined**.

- Insulin is a **steroid** hormone.
- TSH is secreted from the **corpus luteum**.
- Tetraiodothyronine** is an emergency hormone.
- The **pineal gland** is located on the anterior part of the kidney.

- Ans.** (a) Insulin is a **peptide** hormone  
 (b) TSH is secreted from the **pars distalis region of pituitary**.  
 (c) **Adrenaline** is an **emergency** hormone.  
 (d) The **adrenal gland** is located on the anterior part of the kidney.



**Q. 11** Match the following columns.

| Column I          | Column II                |
|-------------------|--------------------------|
| A. Oxytocin       | 1. Amino acid derivative |
| B. Epinephrine    | 2. Steroid               |
| C. Progesterone   | 3. Protein               |
| D. Growth hormone | 4. Peptide               |

**Ans.** The correct matching is as follows

| Column I          | Column II             |
|-------------------|-----------------------|
| A. Oxytocin       | Peptide               |
| B. Epinephrine    | Amino acid derivative |
| C. Progesterone   | Steroid               |
| D. Growth hormone | Protein               |

## Short Answer Type Questions

**Q. 1** What is the role-played by luteinising hormones in males and females respectively?

### 💡 Thinking Process

*LH and FSH stimulate gonadal activity and hence are called gonadotropins.*

**Ans.** In males, luteinising hormone (LH) stimulates the synthesis and secretion of hormones called **androgens** from testis. Androgens along with FSH (Follicle Stimulating Hormone) regulate **spermatogenesis**.

In females, LH induces ovulation of fully mature follicles (Graafian follicles) and maintains the corpus luteum, formed from the remnants of the Graafian follicles after ovulation. Which secretes progesterone.

**Q. 2** What is the role of second messenger in hormone action?

**Ans.** Refer to Q. 7 of very short answer type questions.

**Q. 3** On an educational trip to Uttaranchal, Ketki and her friends observe that many local people were having swollen necks, Please help Ketki and her friends to find out the solutions to the following questions.

- which probable disease are these people suffering from?
- How is it caused?
- What effect does this condition have on pregnancy?

**Ans.** (a) People with swollen necks are suffering from **goitre due to deficiency of iodine** in the their bodies.

(b) **Iodine** is essential for the synthesis of thyroid hormones- $T_3$  and  $T_4$  which are iodinated forms of tyroxine. Deficiency of **iodine** in our diet results in hypothyroidism and enlargement of the thyroid gland occurs place.

(c) **Hypothyroidism** during pregnancy causes defective development and abnormalities in growing baby like stunted growth (cretinism) mental retardation, low intelligence quotient (IQ) abnormal skin, deafmutism, etc.

**Q. 4** George comes on a vacation to India from US. The long journey disturbs his biological system and he suffers from jet lag. What is the cause of his discomfort?

**💡 Thinking Process**

*The melatonin hormone secreted by the pineal gland is also called as 'sleep hormone' as it promotes sleep-wake cycle.*

**Ans.** Jet lag is caused by the disruption of the body clock as it is out of synchronisation because of the unfamiliar time zone of the destination. The body experiences different patterns of light and dark conditions than it is normally used to, which disrupts the natural sleep-wake cycle.

Melatonin is a hormone that plays a key role in body rhythms and causes jet lag. After the sun sets, eyes perceive darkness and alert the hypothalamus to begin releasing melatonin, which promotes sleep. Conversely, when the eyes perceive sunlight, they tell the hypothalamus to withhold melatonin production.

However, the hypothalamus can not readjust its schedule instantly and it may take several days, to overcome this problem.

**Q. 5** Inflammatory responses can be controlled by a certain steroid. Name the steroid, its source and also its other important functions.

**Ans. Glucocorticoids**, particularly cortisol, produce anti-inflammatory reactions and suppress the immune response. The source for glucocorticoids is the middle zone, which is the widest of three zones, in adrenal cortex called zona fasciculata.

The functions of glucocorticoids as the name suggests they is that they affect carbohydrate metabolism and metabolism of proteins and fats. They stimulate gluconeogenesis, lipolysis and proteolysis.

They also inhibit cellular uptake and utilisation of amino acids. Cortisol is also called **stress hormone** as it copes with stress.

**Q. 6** Old people have weak immune system. What could be the reasons?

**💡 Thinking Process**

*Thymus plays a major role in the development of the immune system.*

**Ans.** The thymus gland is a lobular structure located on the dorsal side of the heart and the aorta. It is derived from the endoderm of the embryo. Thymus secretes a hormone named thymosin which stimulates the development of White Blood Cells (WBCs), involved in producing immunity.

Thymus is degenerated in old individuals, resulting in decreased production of thymosin. As result the immune system becomes weak, in old people.

**Q. 7** What are the effects of hypothyroidism (observed during pregnancy) on the development and maturation of a growing baby?

**Ans. Hypothyroidism** during pregnancy cause defective development and maturation of the growing baby leading to a stunted growth (cretinism), mental retardation, low intelligence Quotient (IQ), abnormal skin, deafmutism, etc.

**Q. 8** Mention the difference between hypothyroidism and hyperthyroidism.

**💡 Thinking Process**

*Thyroid gland is the largest endocrine gland located in the neck region. The hormones secreted by thyroid gland are involved in variety of functions.*

**Ans.** Differences between hypothyroidism and hyperthyroidism are as follows

| Hypothyroidism  | Hyperthyroidism   |
|---|---|
| <p>It is the insufficient secretion of thyroid hormones causing cretinism in children and myxoedema in adults</p>   | <p>This syndrome arises as the body tissues and are exposed to excessive levels of <math>T_3</math> and <math>T_4</math>.</p> <p>The main effects are due to increased metabolic rate. The gland enlarges and may develop single or multiple hormone secreting cells such as in Grave's disease and toxic nodular goitre</p>  |
| <p><b>Cretinism</b> is associated with the retarded mental and physical development. The child receives hormones from the mother before birth, so appears normal at first, but within a few weeks or months, it becomes evident that physical and mental development is retarded.</p> <p>Symptoms are disproportionately short limbs, a large protruding tongue, coarse dry skin, poor abdominal muscle tone and an umbilical hernia.</p> | <p><b>Exophthalmic goitre</b> (Grave's disease) is the most common cause solid of thyrotoxicosis in adults. It affects, women more commonly than men. High levels of thyroxine are secreted, which are not subjected to the normal secretion of TRH from the hypothalamus and TSH from the anterior pituitary.</p> <p><b>Exophthalmus</b> (Protrusion of the eyeballs) due to the deposition of excess fat and fibrous tissue behind the eyes, is often present in Grave's disease. In severe cases, the eyelids may not completely cover the eyes during blinking of the conjunctiva and thus, predisposed to infection.</p> |
| <p><b>Myxoedema</b> (Gull's disease), this conditions is common in adults and five times more common in females than in males.</p> <p>It results in an abnormally low metabolic rate and lack of response to demand for increased energy, by muscles, during exercise.</p> <p>Mental and physical processes become slower, skin become coarse, the hair lacks lustre, becomes brittle and tends to fall out.</p>                          | <p><b>Toxic nodular goitre</b> (Plummer's disease) is associated with excess secretion of thyroxine leading to the general effects of increased metabolic rate.</p>   |

## Long Answer Type Questions

**Q. 1** A milkman is very upset one morning as his cow refuses to give any milk. The milkman's wife gets the calf from the shed. On feeding by the calf, the cow gave sufficient milk. Describe the role of endocrine gland and pathway associated with this response?

**Ans.** Suckling by the calf creates a **neuroendocrine reflex** which results in increase of oxytocin from the neurohypophysis. Oxytocin is synthesised in the hypothalamus in specific nuclei, the paraventricular nucleus and the supra optic nucleus (a cluster of nerve cells in the brain is often called a nucleus).

Neurons in this region (hypothalamic nuclei) synthesise the oxytocin precursor and package it into vesicles. The oxytocin concentration in the blood normally, gets increased within 1-2 min, after the udder stimulation.

It brings about contraction of smooth muscles of the udder resulting in the milk flow. A direct intra-udder function of oxytocin like hormone would do the same function.

*It can be summarised as follows*

Udder (suckling stimulus) → Brain (hypothalamus) → Neurohypophysis → Blood (oxytocin) → Udder (smooth muscles) → Milk flow.

**Q. 2** A sample of urine was diagnosed to contain high content of glucose and ketone bodies. Based on this observation, answer the following

- which endocrine gland and hormone is related to this condition?
- name the cells on which this hormone acts
- what is the condition called and how can it be rectified?

### Thinking Process

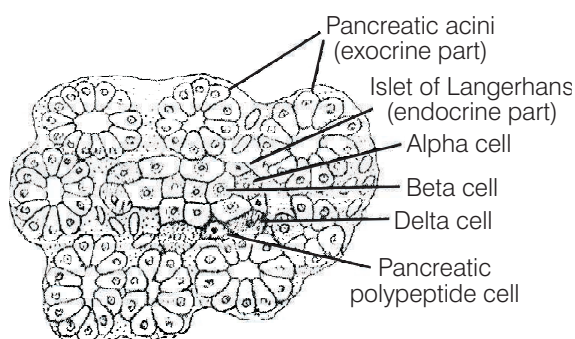
*Pancreas is a composite gland which acts both as exocrine and endocrine gland. It plays a role in maintaining blood glucose levels.*

**Ans. (a)** The pancreas is associated with this condition and the related hormone is insulin.

The pancreas consists of 'islets of Langerhans'. The two main type of cells in islets of Langerhans are  $\alpha$ -cells and  $\beta$ -cells.  $\alpha$ -cells secrete **glucagon** while  $\beta$ -cell secrete **insulin**.

**Insulin** is a peptide hormone, which plays a major role in the regulation of glucose homeostasis. It decreases the level of glucose in blood by increasing the rate at which glucose is transported out of blood and into the cell.

When insulin is dysfunctional or not produced adequately glucose uptake is hampered and hence glucose appear in urine along with ketone bodies.



**Endocrine gland**

- (b) Insulin hormone mainly acts on hepatocytes (liver cells) and adipocytes (cells of adipose tissue) and enhances cellular glucose up take and utilisation.
- (c) Prolonged hyperglycemic condition leads to a complex disorder called **diabetes mellitus** which is associated with loss of glucose through urine and formation of harmful compounds known as ketone bodies due to protein metabolism.

Diabetic patients are successfully treated with **insulin therapy**. It lowers the blood glucose levels and give relief to the patients.

**Q. 3** Calcium plays a very important role in the formation of bones. Write on the role of endocrine glands and hormones responsible for maintaining calcium homeostasis.

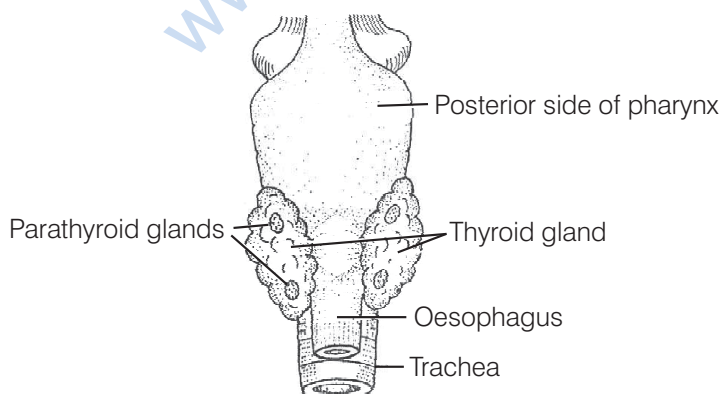
**Ans.** The endocrine glands and hormones that are responsible for maintaining calcium homeostasis, are thyroid and parathyroid glands and their associated hormones are **calcitonin** and **Parathyroid Hormone (PTH)**.

- (i) **Parathyroid glands** are the glands developed from the endoderm of the embryo. The cells of parathyroid glands are of two types, *i.e.*, **chief cells** and **oxyphil cells**. The chief cells of the parathyroid glands secrete parathyroid hormone (PTH).

This hormone (PTH) is involved in regulating calcium and phosphate balance between the blood and other tissue. It mobilises the release of calcium into the blood from bones. PTH increases calcium reabsorption by the body organs like intestine and kidneys.

- (ii) **Thyroid gland** is the largest endocrine gland located anterior to the thyroid cartilage of the larynx in the neck. This gland plays a vital role in maintaining calcium homeostasis. It releases thyrocalcitonin hormone produced by the parafollicular cells, also called 'C' cells.

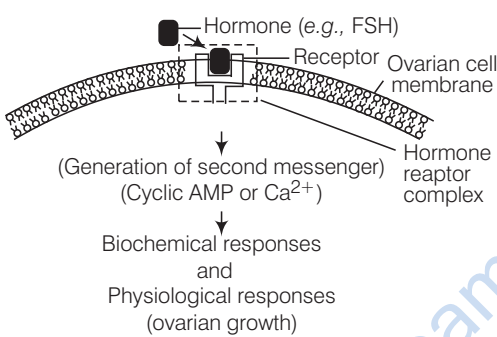
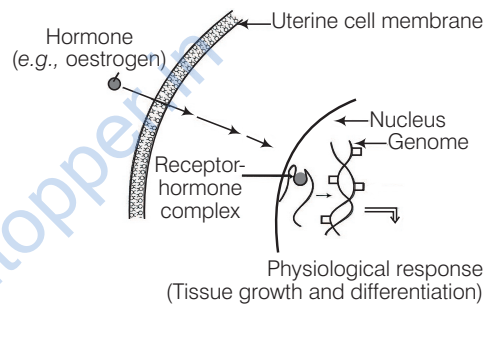
This hormone is secreted when the calcium level in blood gets high. It is a 32 amino acid peptide hormone that lowers the calcium level by suppressing release of calcium ions from the bones. Thus, calcitonin has an action opposite to that of the parathyroid hormone on calcium homeostasis.



**Diagram illustrating parathyroid glands and thyroid gland**  
(Occupying the posterior surface of thyroid gland)

**Q. 4** Illustrate the differences between the mechanism of action of a protein and a steroid hormone.

**Ans.** Differences between the mechanism of action of a peptide and a steroid hormone are as follows

| Peptide Hormone Action  | Steroid Hormone Action  |
|---|---|
| <p>Peptide hormones interact with membrane bound receptors.</p> <p>They generate second messengers (e.g. cyclic AMP, <math>IP_3</math>, <math>Ca^{2+}</math>, etc.)</p> <p>The second messengers regulate cellular metabolism.</p> <p>e.g.<br/>oxytocin insulin, glucagon, vasopressin. etc,</p>  | <p>They interact with intracellular receptors to form hormone receptor complex</p> <p>They regulate gene expression or chromosomes function by the interaction of hormone receptor complex with the genome.</p> <p>Cumulative biochemical actions results in physiological and development effects.</p> <p>e.g., cortisol, testosterone, estrogen and progesterone.</p>  |

**Q. 5** Hypothalamus is a super master endocrine gland. Elaborate.

**Ans.** **Hypothalamus** is a very small but extremely important part of the diencephalon that is involved in the mediation of **endocrine, autonomic** and **behavioural function**.

It contains several groups of neurosecretory cells called nuclei which produce hormones. Hypothalamus provides anatomical connection between the nervous and endocrine system. It controls the release of major hormones by the hypophysis which are summarised below

- (i) **Adrenocorticotrophic Releasing Hormone (ARH)** It stimulates the anterior lobe of pituitary gland to secrete **Adrenocorticotrophic Hormone (ACTH)**. **ACTH** stimulates the synthesis and secretion of steroid hormones called glucocorticoids by adrenal glands.
- (ii) **Thyrotropin Releasing Hormone (TRH)** It stimulates the anterior lobe of pituitary gland to release **Thyroid Stimulating Hormone (TSH)**.
- (iii) **Growth Hormone Releasing Hormone** It stimulates the anterior lobe of the pituitary gland to release growth hormone or somatostatin.
- (iv) **Gonadotropin Releasing Hormone** It stimulates the anterior lobe of the pituitary gland to release gonadotropic hormones (FSH and LH).
- (v) **Prolactin Releasing Hormone (PRH)** It stimulates the anterior lobe of the pituitary gland to secrete prolactin.
- (vi) **MSH Releasing Hormone** It stimulates the intermediate lobe of the pituitary gland to secrete Melanocyte Stimulating Hormone (MSH)

These hormones released from hypothalamus are involved in the process like temperature regulation, control of water balance in body, sexual behaviour and reproduction, control of daily cycles in physiological state, behaviour and mediation of emotional responses. Hence, hypothalamus is called as super master endocrine gland of body.