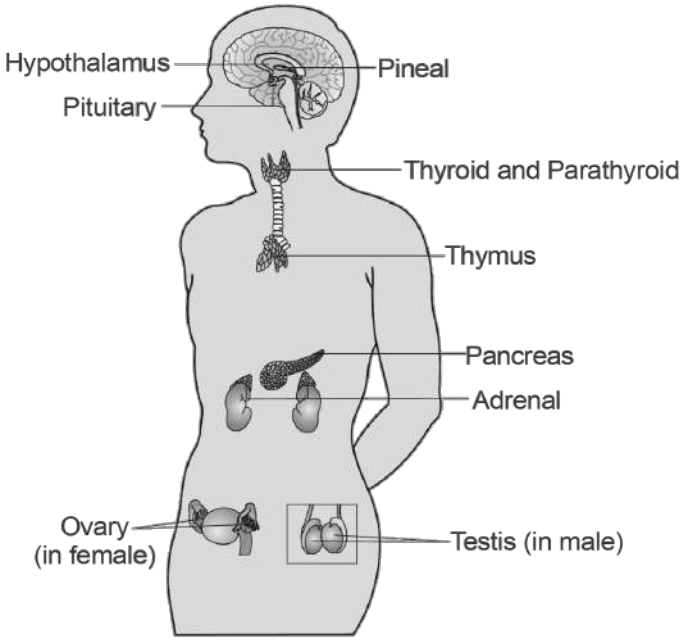
Chemical Coordination and Integration

- The neural system and the endocrine system jointly co-ordinate and regulate the physiological functions in the body.
- The neural co-ordination is fast, very exact and short lived, whereas chemical co-ordination is usually slow, widespread and long lasting.
- *All cells of our body are not innerverted by nerve fibres but the cellular function need to be continuously regulated so a special kind of coordination and integration has to be provided. This function is carried out by hormones. The neural system and the endocrine system jointly coordinate and regulate the physiological functions in the body.*
- Glands are of three types-
  - **(i) Exocrine Glands** are glands with ducts which secretes digestive enzyme, milk, sweat etc.
  - **(ii) Endocrine Glands** are ductless glands and pour their secretion directly into blood. Their secretions are called **hormones**.
  - **(iii) Heterocrine/Mixed Glands :** They have both exocrine and endocrine tissues.



Location of endocrine glands

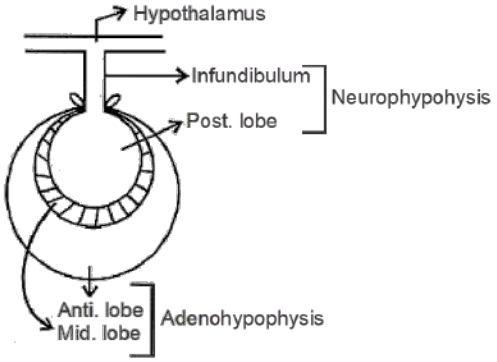
- **Organised Endocrine Gland :** Where hormone producing cells present in cluster/tissue, they are called organised endocrine gland.
  Examples : Pituitary, Pineal, Thyroid, Parathyroid, Thymus, Adrenal, Pancreas and **Gonads.**
- **Non-Organised Endocrine Gland :** Where hormone producing cells are present in scattered form, they are called non-organised or diffused endocrine tissue.
  Example : Heart, Liver, Kidney, Gastrointestinal tract.

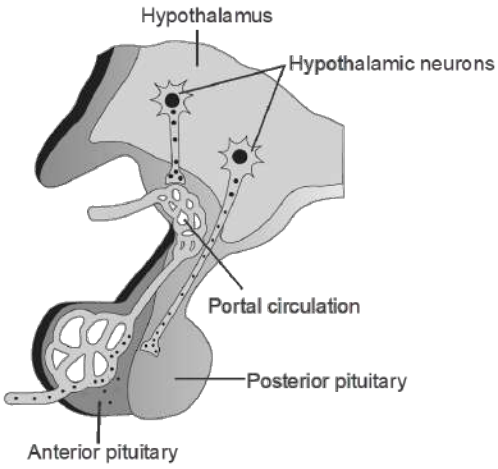
Hormone :

- Hormones are also called "***Primary Messengers***" or "***Chemical Messengers***".
- **Classical Definition :** Hormones are chemicals produced by endocrine glands and released into the blood and transported to a distantly placed target organs.
- **Modern Scientific Definition : Hormone are non-nutrient chemicals which act as intercellular messenger and are produced in trace amount.**
- Mostly hormones are water soluble but some are lipid soluble and are easily diffusible in tissues.
- Produced in very small quantity because these are very reactive substances.
- They can not be stored in body (Except thyroxine)
- Hormones are destroyed after use i.e. hormones can not be reused in the body.

- Liver and kidneys separate hormones from blood and decompose them. The product formed after decomposition is excreted with urine.
- Hormones are **Non-Antigenic** & **Non-Species Specific** substances.
- Usually, hormones do not participate in the metabolic activities of target cells but they affect and control the activity level of these target cells.
  On the basis of their chemical nature, hormones can be divided into groups:
  (i) Peptide, polypeptide, protein hormones (e.g. Insulin, Glucagon, Pituitary hormones, Hypothalamic hormones, etc.)
  (ii) Steroids (e.g., Cortisol, Testosterone, Estradiol and Progesterone)
  (iii) Iodothyronines (Thyroid hormones)
  (iv) Amino-acid derivatives (e.g. Epinephrine)

Pituitary Gland (Hypophysis)





- It is situated in the ***sella–turcica*** of sphenoid bone. It is **ectodermal** in origin.
- This gland is attached to the hypothalamus through a stalk which is called as **infundibulum**.
- It is divided anatomically into an two parts.

Adenohypophysis (Anterior pituitary)	**Neurohypophysis** (Posterior Pituitary)
• Contributes 75% part of total	• Contributes 25% of total
• Consists of **pars distalis** (Anterior lobe) and **pars intermedia** (middle lobe)	• Consists of **infundibulum** and **pars nervosa**.
• Developed from a pouch of foregut (Ectodermal)	• Developed as an outgrowth of hypothalamus (Ectodermal)
• Works under regulation of hypothalamus through **portal circulation**	• Works direct under **neural regulation** of hypothalamus.
• It secretes 6 trophic hormones	• Stores and releases 2 hypothalamic hormones

- In Human's pars intermedia is almost merged with pars distalis.
- ***Hypophyseal Portal Vein*** collects the blood from hypothalamus and supplies to the ***anterior pituitary***.

Hormones of Pituitary Gland and Their Action on Target Organs

Part of Pituitary	S.No.	Hormones	Target Organs	Principal Action
Adenohypophysis (Anterior Pituitary)	(1)	**Human growth hormone (GH)**	General body cells	Growth of body cells specially of bones of limbs, stimulates protein synthesis and inhibits protein breakdown; hydrolysis of fat, retards use of blood glucose for ATP production (Hyperglycemic hormones)
	(2)	**Thyroid stimulating hormone (TSH)**	Thyroid gland	Growth of throid gland and controls secretion of thyroid hormones
	(3)	**Adrenocorticotropic hormone (ACTH)**	Adrenal cortex	Growth of adrenal cortex and secretion of glucocorticoids from it
	(4) **Gonado-tropins**	**(i) Follicle stimulating hormone (FSH)**	Gonads	In males, stimulates spermatogenesis. In females, growth of ovarian follicles
		Interstitial cell stimulating hormone (ICSH)	Testis	In males, secretion of testosterone
		(ii) Luteinising hormone (LH)	Gonads	It triggers ovulation, stimulates conversion of ruptured follicles into corpus luteum
	(5)	**Prolactin (PRL)**	Mammary glands	stimulates milk production and secretion
	(6)	**Melanocyte stimulating hormone (MSH)**	Melanocytes in skin	Stimulates cutanous pigmentation by dispresion of melanin granules, No significant role in humans.
Neurohypophysis (Posterior Pituitary)	No hormones synthesised here. Its hormones are synthesised in hypothalamus	**Oxytocin (OT)**	Mammary glands and uterus	Stimulates contraction of uterine muscles during birth; initiates ejection of milk
		Antidiuretic hormone (ADH) or Vasopressin	kidneys and blood vessels	Stimulates reabsorption of water and reduction of urine volume, stimulates constriction of blood vessels and thus increases blood pressure

Disorder Related to GH are :

(i) Dwarfism : The failure of secretion of growth hormone from an early age stops the growth of long bones and of the body prematurely; this makes the patient dwarf.

(ii) Gigantism : On the other hand, excessive secretion of this hormone from childhood turns the patient into a gaint with abnormal elongation of all long bones.

(iii) Acromegaly : Over secretion of the growth hormone after adolescence causes abnormal elongation of long bones of arms, hands, legs, and lower jaw, and a gorilla-like appearance.

Hormones of Posterior Lobe of Pituitary (Neurohypophysis) :

The posterior pituitary releases two hormones vassopressin (ADH) and oxytocin. In fact, they are synthesised in some hypothalamic neurons and remain stored in their axon terminals inside the

posterior lobe. Nerve impulses that propagate along axon and reach axon terminals trigger exocytosis of the secretory vesicles storing these hormones.

(A) Vasopressin : Whenever the blood osmotic pressure rises due to the loss of water from the body, these neurons are stimulated to release vasopressin into the blood in the posterior lobe. Vasopressin is also known as Antidiuretic Hormone (ADH) because it reduces the volume of urine by increasing the reabsorption of water from the urine in the distal convoluted tubules, collecting tubules and collection ducts in the kidney. This it does by rendering the walls of those tubules permeable to water. Failure of secretion of vasopressin leads to a reduced renal reabsorption of water and a consequent elimination of a large volume of very dilute (hypotonic) urine; this diseases is known as **Diabetes Insipidus** although the volume of urine is increased, no glucose appears in the urine of such patients. Besides its antidiuretic effect of reducing the urinary volume, vasopressin also enhances arterial blood pressure by causing constriction or narrowing of arterioles.

(B) Oxytocin (Pitocin): The other posterior lobe hormone, viz oxytocin is secreted into the blood when the hypothalamic neurons are stimulated either due to the distension of uterus by the full term foetus of due to the sucking of the breast by the infant. Oxytocin contracts the smooth muscles of uterus and mammary glands. Uterine contractions stimulated by oxytocin at the end of pregnancy, help in the child-birth. The oxytocin induced contractions of the mammary gland muscles help in the flow of stored milk from the mammary gland to the mouth of the suckling infant. Even sight and sound of baby can cause a nursing mother to secrete this hormone. Therefore, oxytocin is also called, **'milk ejection hormone' and birth hormone'.**

Hypothalamus

The hypothalamus is the basal part of diencephalon (forebrain) and it regulates a wide spectrum of body functions. It contains several groups of neurosecretory cells called **nuclei** which produce hormones. These hormones regulate the synthesis and secretion of pituitary hormones. However, the hormones produced by hypothalamus are of two types, the **releasing hormones** (which stimulate secretion of pituitary hormones) and the **inhibiting hormones** (which inhibit secretions of pituitary hormones). For example a hypothalamic hormone called **Gonadotrophin releasing hormone (GnRH)** stimulates the pituitary synthesis and release of gonadotrophins (FSH and LH). On the other hand, **somatostatin** from the hypothalamus, inhibits the release of growth hormone (GH) from the pituitary. These hormones originating in the hypothalamic neurons, pass through axons and are released from their nerve endings. These hormones reach the pituitary gland through a portal circulatory system and regulate the functions of the anterior pituitary. The **posterior pituitary** is under the **direct neural regulation** of the hypothalamus.

Releasing or Inhibiting Hormones of Hypothalamus and their Roles, Factors and Specific Hormones they Control :

Releasing or Inhibiting Hormone	Control and Regulation of Anterior Pituitary Hormones
Thyrotropin releasing hormone (TRH)	Stimulates TSH secretion
Growth hormone releasing hormone (GHRH)	Stimulates secretion of GH
Growth hormone inhibiting hormone (GHIH) **(Somatostatin)**	Inhibits secretion of GH
Gonadotropin releasing hormone (GnRH)	Stimulates secretion of FSH and LH
Prolactin releasing hormone (PRH)	Stimulates prolactin secretion
Prolactin inhibiting hormone (PIH)/Dopamine	Inhibits prolactin secretion
Corticotropin releasing hormone (CRH)	Stimulates ACTH secretion
MSH releasing hormone (MRH)	Stimulates MSH secretion
MSH inhibiting hormones (MRH)	Inhibits MSH secretion

Concept Builder

1. Which of the following hormones is/are stored in posterior pituitary?

(1) Somatostatin (2) Vassopressin (3) Oxytocin (4) Both (2) and (3)

2. Which of the following is incorrect match?

(1) Thyroxine – Iodinated tyrosine

(2) Aldosterone – Polypeptide hormone

(3) Estrogen – Steroid hormone

(4) Thyrotropin – Glycoprotein hormone

3. Which of the following hormones prevent water loss in urine?

(1) Oxytocin (2) Vasopressin (3) ACTH (4) Somatostatin

4. Which of the following lobes of the pituitary atrophies during foetal development and is smaller in adults?

(1) Pars distalis (2) Pars intermedia (3) Adenohypophysis (4) Neurohypophysis

5. Which of the following pituitary hormones is known to have diabetogenic effect and increases blood glucose level?

(1) TSH (2) LH (3) GH (4) PRL

6. Pituitary gland is lodged in a bony cavity of which skull bone?

(1) Temporal (2) Occipital (3) sphenoid (4) Parietal

7. Which of the following statements is incorrect?

(1) Pars intermedia atrophies in humans

(2) Pituitary gland is lodged in sella turcica

(3) Neurohypophysis synthesis two hromones

(4) Neurohypophysis consists of nervous tissue.

8. All of the following are synthesised by hypothalamus except one-

(1) ADH (2) Oxytocin (3) Pitocin (4) Prolactin

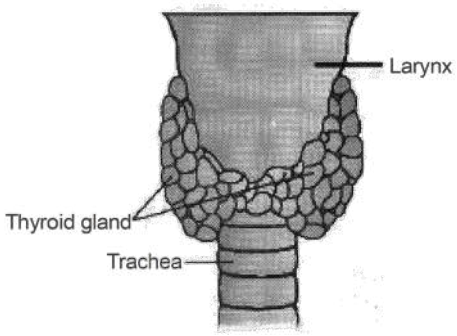
9. Which of the following hormone stimulates glucocorticoid secretion from adrenal cortex?

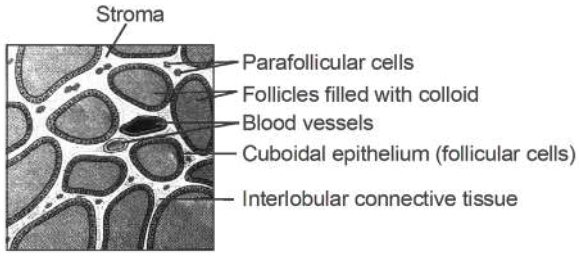
(1) ACTH (2) MSH (3) PRL (4) FSH

Concept Builder (Answer-Key)									
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Ans.	4	2	2	2	3	3	3	4	1

Thyroid Gland

- It is the ***largest endocrine gland*** *in the body*.
- It is ***endodermal*** *in origin*.
- This is *situated at the ventro-lateral side of the joint of trachea and larynx in the neck region of man.* It is bilobed or H-shaped. Both of its lobes are connected by non-glandular flap of a connective tissue called **isthmus.**





The microscopic structure of the thyroid gland

- Each lobe of thyroid gland is made up of connective tissue. (Stroma) and many round **follicles** of glandular cells.
- A layer of cuboidal glandular cells is found in the wall of follicles. An iodised colloidal substance **Thyroglobulin** is filled in the cavity of these follicles. ***Thyroglobulin*** is ***glycoprotein*** in nature.
- *Thyroid is the only endocrine gland in the body which stores its hormone in its inactive state.*

Production of Hormones in Follicles :

T_3 = Tri Iodo thyronine (20%)

T_4 = Tetra Iodo thyronine (80%) or Thyroxine

- T_3 and T_4 are derivative of tyrosine amino acid.

- Secretion of T_4 is comparatively more than T_3 and T_3 **hormone is four times more effective than T_4 hormone.** T_4 changes into T_3 on reaching in the tissues.

Parafollicular Cells or C-Cells :

- These cells are scattered between thyroid follicles in stromal tissue. These cells are of endocrine nature.
- These cells secrete **thyrocalcitonin or Calcitonin hormone (TCT)**. It is a **protein (Non-Iodinated)**.
- Thyrocalcitonin enhances the deposition of Ca^{++} in bones and increases the rate of excretion of Ca^{++} in urine, thus reduces Ca^{++} level in blood **(Hypocalcemic Hormone)**
- This hormone is antagonistic to ***Parathormone (PTH)***.

Functions of Thyroxine :

1. **Growth** → **Physical** – Promotes elongation of bones, growth of muscles and visceral organs.
   → **Mental** – Development and maturition of CNS.
   → **Sexual** – Development and functioning of gonads.
2. **Metabolism :**
   (i) Fat :
   - Enhances enzyme activity for both synthesis & predominantly catabolism of fats (lipolysis) to increase energy/ATPs/heat/calorie production.

(ii) Carbohydrate :

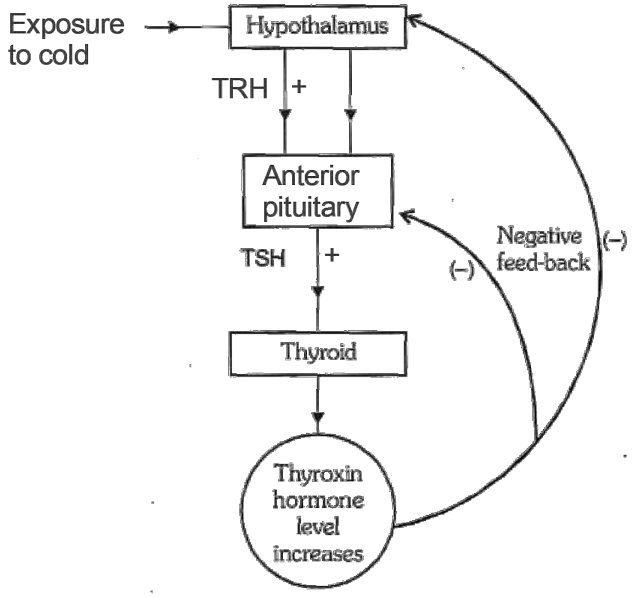
- Reduces glucose consumption in body cells.

(iii) Protein :

- Both catabolism & anabolism but at optimum concentration of thyroxin, **anabolism** is dominant. Thus it promotes constructive work in body.

3. **Basal Metabolic Rate :**
   Thyroxine regulates the **Basal metabolic rate (BMR)** in the body.
   BMR : BMR refers to the minimum amount of energy in the form of calories that our body requires to complete its normal function.
   BMR increases → Body Temp. increase (calorigenic hormone) → loses weight.
4. **Blood :** Stimulate erythropoisis in bone marrow.
5. **Gonads :** Thyroxine also influences menstrual cycle.

Regulation of Thyroid Hormone Secretion :



Thyroid Disorders

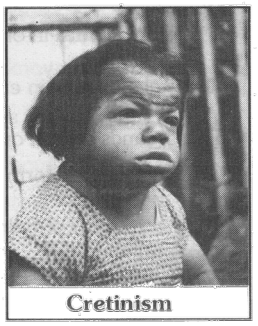
1. **Hypothyroidism :**

(i) Simple/Colloid Goitre : If there is deficiency of iodine in food then thyroid gland try to absorbs more and more iodine from blood and enlarges in size called **simple goitre.**

- Goitre is found more abundantly in the persons who live on mountain slopes, because iodine (at that place) flows along with water. When most of the people in slope areas show the symptoms of this disease therefore it is also called **endemic goitre**.
- Persons who take sea foods, never show the symptoms of goitre.

Simple goitre

(ii) **Thyroid Dwarfism or Cretinism :** Hypothyroidism during pregnancy causes defective development and maturation of the growing baby leading to *stunted growth*, mental retardation, low *intelligence quotient*, *abnormal skin, deaf-mutism*, etc.


Cretinism

(iii) **Thyroid Myxoedema** (Gull's Disease)**: In adults,** hypothyroidism causes obesity, low HBR, lack of alertness and menstrual cycle becomes irregular in women.

Hashimoto's Disease : Autoimmune disorder of Thyroid gland is called Hashimoto's disease.

2. **Hyperthyrodism Disorder :**

- **Exopthalmic Goitre or (Grave's Disease, or Basedow's Disease) :** Exopthalmic goitre is a form of hyperthyroidism, characterised by enlargement of the thyroid gland, **protrusion of the eyeballs**, increased basal metabolic rate, and weight loss.

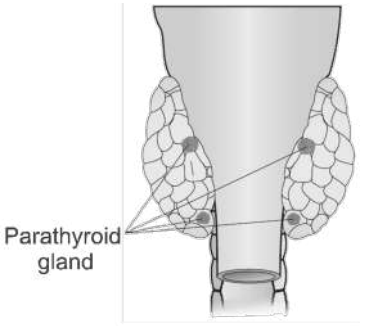

(Exopthalmic Goitre)

Parathyroid Gland

Parathyroids :

- These are four small pea sized glands situated very close to the thryoid.

  They secrete a hormone called **parathormone or collip's hormone (PTH).** They are under the feedback control of blood calcium level. A fall in blood calcium stimulates them to secrete parathormone, a rise in blood calcium inhibits parathormone secretion from them.



Diagrammatic view of the position of parathyroid (Dorsal view)

- Parathoromone increases the concentration of calcium ions in the blood plasma, because it mobilises more calcium from the bones to the plasma and reduces urinary elimination of calcium. It is secreted whenever the plasma Ca^{2+} concentration falls and restores the Ca^{2+} concentration to normal in the plasma. On the other hand, it increases phosphate elimination in the urine and consequently lower the phosphate concentration in the plasma. Thus, parathormone regulates the metabolism of calcium and phosphorus.

Calcium Homeostasis :

(i) A higher than normal level of calcium ions (Ca^{2+}) in blood stimulates parafollicular cells of the thyroid gland

(ii) They release more **calcitonin** as blood Ca^{2+} level rises.

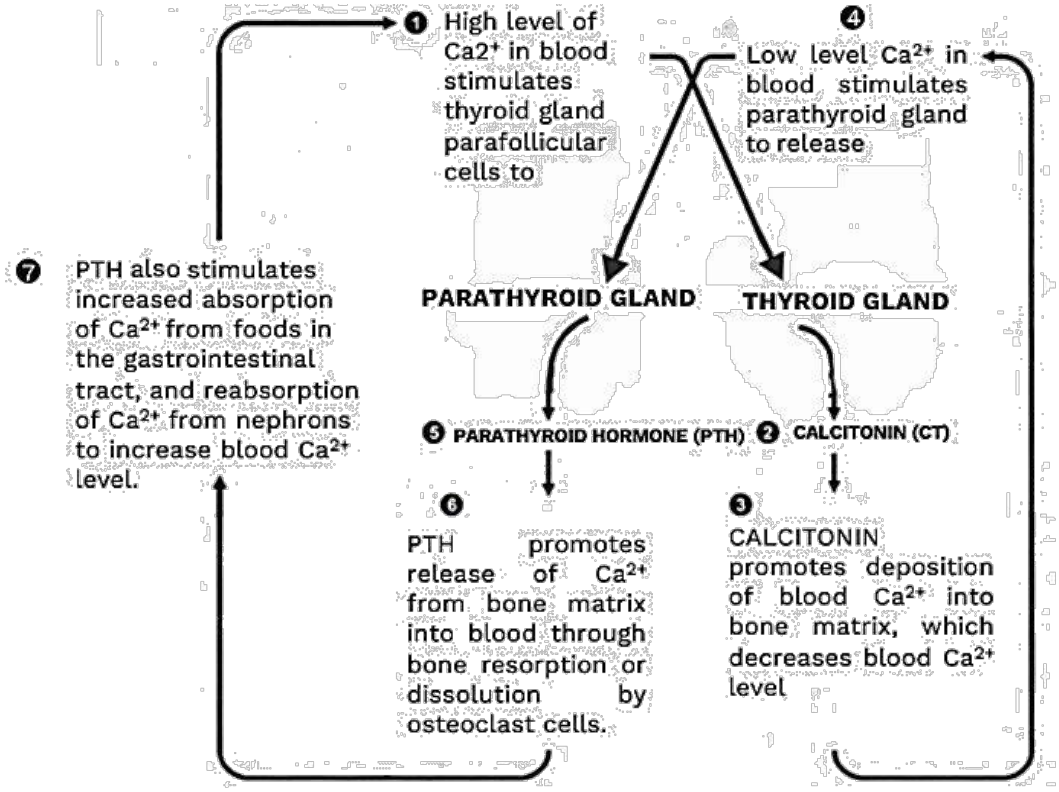
(iii) Calcitonin promotes deposition of blood Ca^{2+} into the matrix of bone tissue. This decreases blood Ca^{2+} level.

(iv) A lower than normal level of Ca^{2+} in blood stimulates principal cells of the parathyroid gland.

(v) They release more parathyroid hormone (PTH) as blood Ca^{2+} level falls.

(vi) PTH promotes release of Ca^{2+} from bone matrix into the blood through bone resorption or dissolution by osteoclast cells and retards loss of Ca^{2+} in the urine. These actions help raise the blood level of Ca^{2+}.

(vii) PTH also increased absorption of Ca^{2+} from foods in the gastrointestinal tract, which helps increase the blood level of Ca^{2+}.



Hormonal Regulation of Calcium Homeostasis by Calcitonin (CT) Parathyroid Hormone (PTH), and Calcitriol

- Calcium is key element in many physiological functions like **proper permeability of cell membrane, muscular activities, nerve impulse conduction, heart heat, blood coagulation, bone formation, fertilization of ova** etc.
- Maintenance of proper calcium level under "homeostasis" is in fact, a combined function of **parathormone, thyrocalcitonin** and **vitamin D_3 (cholecalciferol).**
- Parathormone stimulates the **osteoclast** cells to feed upon bones, these cells remove unnecessary parts of bones by dissolving and phagocytosis thus change asymmetrical bone into symmetrical bone.
- Just opposite to it, **thyrocalcitonin** (TCT) hormone works **antagonistically** to oppose the **parathormone**. Thyrocalcitonin reduces the amount of Ca^{++} in blood by increasing the excretion of Ca^{++} in urine and by reducing destruction of bone.

Disorder of Parathyroid :

Parathyroid tetany

Hypoparathyroidism :

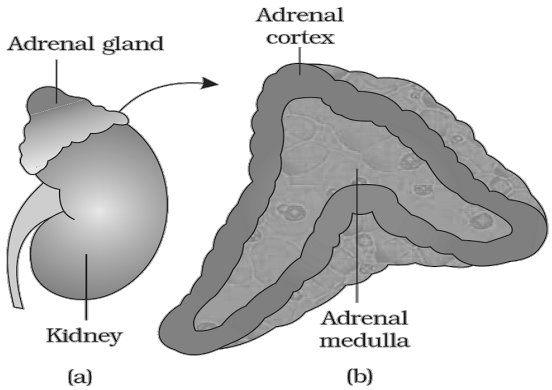
Parathyroid Tetany : If the parathyroids fail to secrete sufficient amount of parathormone, the concentration of parathormone, the concentration of calcium ions falls abnormally in the plasma. This increases the excitability of nerves and muscles due to deficiency of Ca^{2+} which causes depolarisation without usual stimulus. Consequently, sustained contractions (tetany) of the muscles of larynx, face, hands and feet are produced. This disease is called **parathyroid tetany**. It can also develop due to accidental damage to the parathyroid or their blood supply during surgery.

Hyperparathyroidism (Osteoporosis) :

The parathyroid tumours secrete excessive amount of parathormone, which causes increased mobilisation of bone minerals into the blood which makes bones weak, porous and spongy. It leads rise in the concentration of calcium ions in the plasma, and deposition of calcium in kidney tubules and other soft tissues.

Adrenal Glands

- It is found on the head (anterior most part) of both the kidneys, therefore, it is also called **suprarenal gland**.
- Adrenal gland is **ecto-mesodermal** in origin.
- Whole gland is surrounded by a fibrous capsule.
- It is divided into 2 parts :



Diagrammatic representation of: (a) Adrenal gland on kidney, (b) Section showing two parts of adrenal gland

Adrenal Cortex	Adrenal Medulla
Outer thick part (80 – 90%)	Inner thin part (10 – 20%)
Mesodermal origin	Made up of nervous tissue (Ectodermal)
Secretes steroid hormones (corticoids)	Secrets 2 proteinaceous hormones
Works under regulation of pituitary gland (ACTH)	Works direct under neural regulation

Adrenal Cortex :

Most of the cells of this part are fatty. This portion is divided into three regions from periphery to centre.

(i) Outer - Zona Glomerulosa : Secretes **Mineralocorticoid** hormones

(ii) Middle - Zona Fasciculata :

This zone secretes **glucocorticoid** hormones. In this region polyangular cells are arranged in the layers.

(iii) Inner - Zona Reticularis : Cells of this region are spread in the form of a network, and secretes a small amount of **sex hormones**.

1. **Mineralocorticoids:** These corticoids related with water and electrolyte balance (Na, K, Cl etc.)
   - Main hormone of this group is **Aldosterone**.
   - **Aldosterone:** (Salt Retaining Hormone) : Mainly act on DCT and collecting duct of uriniferous tubule by activating Na^+ K^+ pump and stimulates reabsorption of Na^+ and water. It also promotes excretion of K^+ and phosphate ions through urine. Thus aldosterone help in maintenance of electrolyte; blood volume, osmotic pressure of blood and blood pressure.
   - Hyposecretion of aldosterone hormone causes loss of Na^+, Cl^- and water by the urine and increase K^+ level in blood and reduced blood pressure **(Hypotension)**.

2. **Glucocorticoids:**
   - Main hormone of this group is ***Cortisol. (Life Saving Hormone Under Trauma Condition)***.

(i) Metabolism

- **Carbohydrate :-** *Stimulate gluconeogenesis and increases sugar in blood (hyperglycemic hormone)*
- **Fat metabolism :-** Stimulates **lipolysis** in adipose tissue.
- **Protein metabolism** Stimulates proteolysis and inhibits cellular up take and utilisation of amino acids.

(ii) This hormone is "**Anti-Inflammatory**". This prevent the actions of WBC and collagen fibres in tissues, so used in diseases like oedema, arthritis / Rheumatism.

(iii) This hormone is **Immuno-Suppressive**, because it check the immune reactions by antibodies. Now a days, cortisols are used in **transplantation of organs**. it is also used in the treatment of allergy.

(iv) Cortisol is also involved in maintaining the **cardio-vascular system** as well as the **kidney functions**.

(v) Cortisol stimulates the **RBC production**.

3. **Sex - Hormones (Sex Corticoids) :**
   - They are secreted in very small amount by zone reticularis.
   - Male hormones are called **androgens** and female hormones are called **oestrogens**.
   - Adrenal secretes both androgens and oestrogens in both the sexes which promotes **sexual growth** during childhood.
   - But sex hormones secreted by gonads inactivate the sex hormone of opposite sex secreted by adrenal gland.

- These hormones stimulate the muscles, external genitalia and sexual behaviour.
- Male hormone secreted by adrenal gland is mainly **dehydroepiandrosterone [DHEA]**.
- Female sex hormone secreted by adrenal gland is **estradiol** (main oestrogen).

Adrenal Medulla :

- The adrenal medulla consists of nervous tissue (Ectodermal) and contains modified sympathetic neurons which have lost normal processes and have acquired a glandular function. These cells are called **chromaffin cells.**
- Sympathetic system activates adrenal medulla during emergency or stress condition. It secretes two hormones - **Adrenaline** or **Epinephrine** (80%) and **noradrenaline** or **Nor-epinephrine** (20%).
- *These are collectively called **catecholamine**.*
- **Adrenaline**/Epinephrine is the main **emergency or fight-flight response** hormone which prepares our body to face that emergency situation. (Accident, excitement, mental stress, shock, anger, fear, restlessness, severe pain etc.)

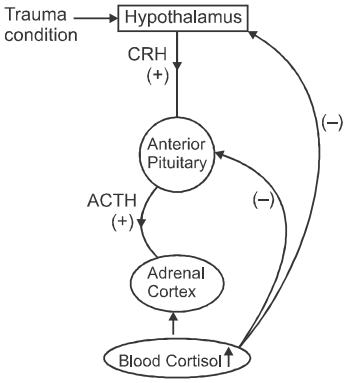
Functions of Adrenaline :

(1) It increases **alertness** and **pupilary dilation**. It constricts the erecter pilli muscle of hair, and hair are raised **(Piloerecton)** and increases sweating by stimulating sweat glands.
(2) Increases the heart beat, the strength of heart contraction and thus circulation of blood becomes faster.
(3) The hormone stimulates the trachea and bronchi muscles to relax, as a result of it, rate of breathing is increased. So adrenaline hormone is used to cure asthma. **(Bronchodilator)**
(4) The hormone enhances the flow of blood by *vasodilation* of blood vessels of brain, heart, lungs, liver and skeletal muscles. It constricts the blood vessels of skin (*Vaso constriction*).
(5) It also stimulates the breakdown of glycogen (**Glycogenolysis**) resulting in an increased concentration of glucose in blood. It also stimulate the breakdown of lipids and proteins.
(6) The hormone stimulates contraction in spleen, as a result of it, spleen pours its stored blood into blood stream.
(7) It checks the secretion of saliva and reduces the peristaltic movements in alimentary canal.

- **Noradrenaline or Norepinephrine Hormone :**
  - It acts as vasoconstrictor, thus increases the blood pressure. **Exception - Coronary artery of heart.**

Control of Adrenal Secretion :

- **ACTH** of anterior Iobe of pituitary gland controls the hormones secreted by adrenal cortex, mainly **glucocorticoids**.
- Secretion of mineralocorticoids is controlled by **Renin hormone** secreted by kidneys. (RAAS)
- Pituitary gland does not control the secretion of adrenal medulla hormones, the adrenal medulla hormones secretion is controlled by nervous system.



Regulation of cortisol secretion by negative feed back mechanism

Disorders:

(i) Hyposecretion:

Addison's Disease: It is due to removal of adrenal cortex or deficiency of corticoids. It is characterised by hypoglycemia, acute weakness, increased susceptibility to stress and fatigue. It is also characterised by the hyperpigmentation / bronze colour of skin.

(ii) Hypersecretion:

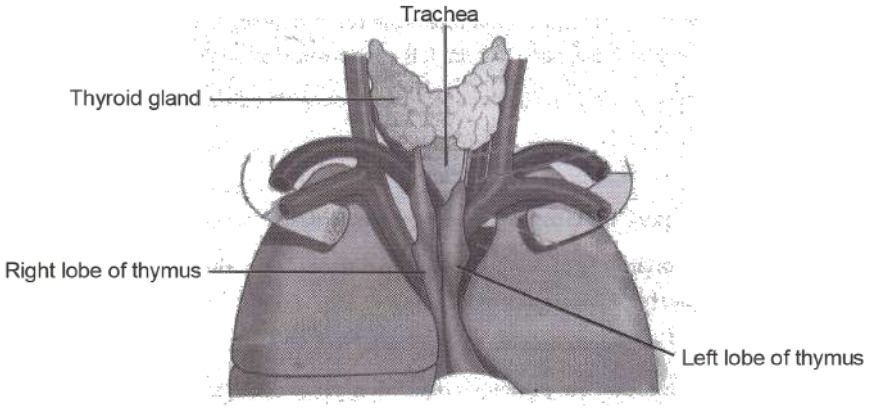
Cushing's Syndrome (Disease) : Over secretion of cortisol leads to the excess break down of body fat (lipolysis). The fat is deposited in unusual body areas like face and upper abdominal region which is characterised by - moon face, fish mouth, buffalo hump.

Conn's Disease :

Excessive secretion of aldosterone from an adrenal cortical tumour produce aldosteronism. This disease is characterised by a high plasma Na^+, low plasma K^+, rise in blood volume and high blood pressure.

Thymus Gland :

- It is **endodermal** in origin.
- Thymus is a **bilobed gland** located between lungs (mediastinal space) behind sternum on the **ventral side of heart and aorta**.
- It plays a major role in development of immune system.
- It is quite large at the time of birth but keep reducing in size with age and **by the time puberty is attained, it reduces to a very small size. As a result with the increase in age the immune response gradually become weak.**



"Thymus gland" in adult

- Thymus gland secretes a peptide hormone called **thymosin or thymin hormone.**
- After the birth, **T-Cells** or **T-lymphocytes** are matured in thymus gland and get stored in **secondary** lymphatic organs like spleen, payer's patches, lymph nodes, MALT etc.
- Thymosin hormone stimulates the maturation of T-lymphocytes to destroy the antigens produced by bacteria or pathogen.

- Thymus provide **cell mediated immunity** (Cellular immunity) and also promote production of antibodies to provide **humoral immunity**. So, thymus is also called **"Throne of immunity"** or **"Training school of T-lymphocytes"**.
- According to one of the theories of Ageing the decline or disappearance of Thymus gland by middle age is the primary cause of **ageing**.

Pineal Body (Epiphysis) :

- It is situated at the dorsal side of diencephalon (Epithalamus) a part of forebrain. It is **ectodermal** in origin.
- Pineal body secretes a hormone **melatonin,** which is an amino acid derivative.

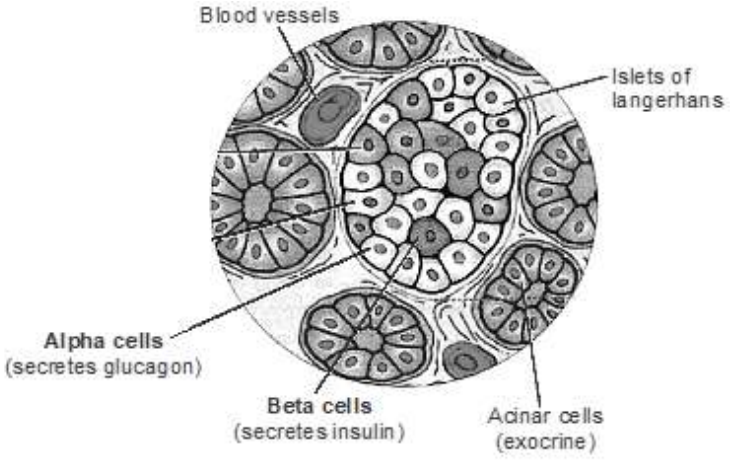
Functions:

(1) Melatonin plays a very important role in the regulation of a **diurnal / circadian rhythm biological clock,** for example normal rhythm of sleep wake cycle, body temperature etc.
   - It is proved that the level of melatonin rises during periods of darkness and falls during periods of light.

(2) Melatonin also influence **metabolism, pigmentation, menstrual cycle** & **defence capability**.
   - Maximum development of pineal body up to 7 year & then it starts reducing in size & at the age of 14 year crystals of $CaCO_3$ are deposited in interstitial tissue, these are called "**Brain sand**".

Pancreas

- It is **endodermal** in origin.
- **Position :** Pancreas is a pink coloured mixed gland (heterocrine) situated in the loop of deodenum in abdominal cavity.
- It consists of numerous spherical units called **acini**.
- Acini form **99%** part of pancreas gland. These are **exocrine** in nature and secretes digestive enzymes.
- There are found numerous clusters of hormone secreting cells scattered between the acini, which are called **Islets of Langerhans (1 to 2 million cell).** They form only **1%** part of the gland. These were discovered by **Langerhans.**



Pancreatic islet with surrounding acine showing different cells

- Each islet of Langerhans has 3-4 types of cells
  (A) **Alpha Cells (α - cells) :** They secrete **glucagon** hormone.
  (B) **Beta Cells (β - cells) :** They secrete **Insulin** hormone.
  (C) **Delta Cells (δ - cells) or Gamma cells (γ - cells) :**
  They secrete **somatostatin** hormone which regulates the activities of α - cells and β - cells.

(1) Insulin:

- It plays a major role in the regulation of glucose homeostasis. Normal concentration of sugar in blood is **90 – 110 mg. per 100 ml.** of blood.
- Insulin acts mainly on **hepatocytes** and **adipocytes** (cells of adipose tissue).

Effect on Metabolism (BMR) :

(1) Carbohydrate : Reduces blood glucose level (**Hypoglycemic**)

(i) Insulin stimulates the permeability and consumption of glucose in all somatic cells.

(ii) Insulin inhibits gluconeogenesis.

(iii) Promotes **glycogenesis (Glucose → Glycogen)** in **liver** and the **muscles** and inhibits glycogenolysis

(2) Fat : Insulin promotes fat synthesis called *lipogenesis* and inhibits lipolysis.

(3) Protein : Insulin promotes protein synthesis by promoting uptake of amino acid by liver and muscle cell. It also promotes synthesis of nucleic acids.

(a) Hyposecretion of Insulin : [Diabetes Mellitus or Sugar Disease]

Hyperglycemia : Due to hyposecretion of insulin, body cells can not use the sugar stored in blood. So amount of sugar increases in blood and this is called **Hyperglycemia**.

- **Glycosuria :** Glucose is excreted through urine, if amount of glucose exceeds from 180 mg/dl in the blood, this is known as "**Glycosuria**".
- **Polyuria :** Reabsorption of H_2O in kidney reduces and micturition frequency increases, It is called **polyuria**.
- **Polydipsia :** Excess urination at short intervals causes dehydration Therefore, patient feels excessive thirst called polydipsia.
- **Polyphagia :** excessive hunger.
- **Ketoacidosis :** Due to active and incomplete decomposition of fats in fatty tissues, ketone bodies are formed.
- **Ketonuria :** Excretion of toxic ketone bodies through urine.
- The combined effect of ketoacidosis, dehydration and hyperglycemia may cause **diabetic coma** to the patient, patient becomes unconscious and even may die.
- Insulin hormone is given to the patient by injection **(subcutaneously)** in this disease, Insulin given orally is not effective, because it gets digested in the alimentary canal like other proteins.

(i) Type - I diabetes or **Insulin-dependent diabetes mellitus (IDDM)**

- Caused by deficiency of insulin.
- Can be treated by insulin-therapy.
- It is an example of auto immune disorder.

(ii) Type - II diabetes or **non-insulin-dependent diabetes mellitus (NIDDM)**

- It is initially caused by decreased sensitivity of receptors of target tissue to the metabolic effect of insulin. This reduced sensitivity to insulin is often called **insulin resistance.**
- World diabetes day - 14 November

(b) Hypersecretion of Insulin :

- Due to hypersecretion of insulin amount of glucose decreases in blood. (**Hypoglycemia**)
- In hypoglycemia stage, body cells take more and more glucose from blood. So need of glucose for nervous system, retina of eye, genital epithelium is not fulfilled, as a result of that patient looses his reproductive power and sight. Due to excess irritation in brain cells, patient feels exhausted, unconsciousness, cramps and the patient may even die.

2. **Glucagon:**
   - This is secreted by **α-cells**.
   - Glucagon acts mainly on the liver cells (hepatocytes). It is antagonistic to insulin.
   - Glucagon is a **hyperglycemic factor. It** reduces cellular consumption of glucose and increases the amount of sugar (glucose) in blood.
   - It stimulates ***gluconeogenesis*** in liver, as a result of that amount of glucose in the blood increased.
   - It decomposes the glycogen into glucose in liver. (stimulates ***glycogenolysis***).
   - It stimulates ***lipolysis*** of fats in fatty tissues.
   - The secretion of insulin and glucagon is controlled by a negative feed back. When amount of sugar is increased in blood, then insulin is secreted by β-cells. As a result of it, when amount of glucose is reduced in blood, then glucagon is secreted by α-cells.

Gonads and Other Organs Which Secrete Hormones

1. **Testis:**
   - A pair of testis is present in the scrotal sac (outside abdomen) of male individuals. Testis performs dual functions as a primary sex organ as well as an endocrine gland.
   - The **Leydig cells** or **interstitial cells,** which are present in the intertubular spaces produce a group of hormones called **androgens** mainly **testosterone**.
   - Androgens play a major stimulatory, role in the process of **spermatogenesis** (formation of spermatozoa). Androgens act on the central neural system and influence the male sexual behaviour **(libido)**.
   - Androgens regulate the development, maturation and functions of the male accessory sex organs like epididymis, vas deferens, seminal vesicles, prostate gland, urethra etc.
   - These hormones also promote development of secondary sex characters like muscular growth, growth of facial, axiallary hair, aggressiveness, low pitch of voice etc in males.
   - These hormones produce anabolic (synthetic) effects on protein and carbohydrate metabolism.

2. **Ovary:**
   - Females have a pair of ovaries located in the abdomen. Ovary is the primary female sex organ which produces one ovum during each menstrual cycle.
   - In addition, ovary also produces two groups of steroid hormones called **estrogen** and **progesterone.**
   - Ovary is composed of ovarian follicles and stromal tissues. The estrogen is synthesised and secreted mainly by the growing ovarian follicles.
   - After ovulation, the ruptured follicle is converted to a structure called ***corpus luteum,*** which secretes mainly ***progesterone.***
   - Estrogens produce wide ranging actions such as stimulation of growth and activities of female secondary sex organs, development of growing ovarian follicles, appearance of female secondary sex characters (e.g., high pitch of voice), mammary gland development etc. Estrogens also regulate female sexual behaviour. Progestrone supports pregnancy.
   - Progesterone also acts on the mammary glands and stimulates the formation of alveoli (sac-like structures which store milk) and milk secretion.

3. **Heart:**
   The atrial wall of our heart secretes a very important peptide hormone called **atrial natriuretic factor (ANF),** also called **blood pressure lowering hormone**. When blood pressure is increased, ANF is secreted from heart wall and causes dilation of the blood vessels. *This reduces the blood pressure*.

4. **Kidney:**
   The juxtaglomerular cells of kidney produce a peptide hormone called **erythropoietin** which *stimulates erythropoiesis (formation of RBC).*

5. **Gastro Intestinal Tract (GIT):**
   Endocrine cells present in different parts of the gastro intestinal tract secrete four major peptide hormones, namely **gastrin, secretin, cholecystokinin (CCK)** and **gastric inhibitory peptide (GIP)**
   - **Gastrin** act on the gastric glands and stimulates the secretion of HCl and pepsinogen.
   - **Secretin** acts on the exocrine pancreas and stimulates secretion of water and bicarbonate ions in pancreatic Juice.
   - **CCK** acts on both pancreas and gall bladder and stimulates the secretion of pancreatic enzymes and bile juice from gall bladder respectively.
   - **GIP** inhibits gastric secretion and motility.
   - Several other non-endocrine tissues secrete hormones called **growth factors.** These factors are essential for the normal growth of tissues and their repairing/regeneration.

Concept Builder

1. Which of the following hormones is known to have calorigenic effect?
(1) T_3 & T_4 (2) TCT (3) PTH (4) Calcitriol

2. Which of the following is caused due to hypersecretion of thyroxine hormone?
(1) Goitre (2) Exophthalmic goitre
(3) Cretinism (4) Myxoedema

3. Which of the following hormones regulate calcium balance in body?
(1) TCT (2) PTH (3) ADH (4) Both (1) & (2)

4. Which of the following is incorrect about IDDM?
(1) It commonly develops in younger people
(2) It is an autoimmune disorder
(3) It Results in deficiency of insulin
(4) It is due to less sensitivity of target cells to insulin

5. Which of the following is/are correct statement(s) about the non- iodised hormone secreted by thyroid gland:
(1) It is secreted by parafollicular cells (2) It is hypercalcaemic hormone
(3) It is antagonistic to PTH (4) All of these

6. Which of the following secretes mineralocorticoids from adrenal cortex?
(1) Zona glomerulosa (2) Zona fasciculata
(3) Zona reticularis (4) Both (1) & (2)

7. Which of the following is not the function of insulin?
(1) Increases glycogenesis (2) Increases glycogenolysis
(3) Promote oxidation of glucose (4) Controls sugar level in our blood.

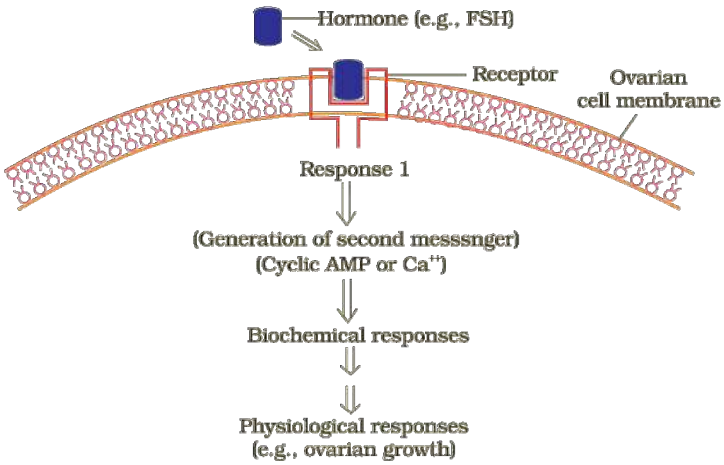
8. Which of the following is not secreted by islets of Langerhans ?
(1) Glucagon (2) Insulin (3) Somatostatin (4) Releasing hormones

Concept Builder (Answer-Key)								
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Ans.	3	2	4	4	4	1	2	4

Mechanism of Hormone Action

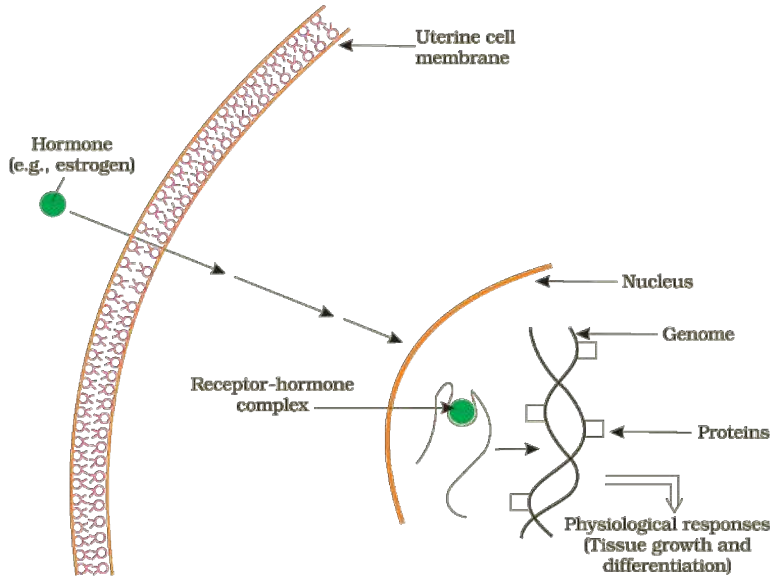
- Once hormone enters into blood stream it can reach almost upto any cell in the body.
- However, each hormone affects only certain kind of cells, which is called as **target cells**.
- All hormones do not act in the same way due to different location of their receptor.
- Hormones are two Types :
  (i) Water Soluble Hormones
  (ii) Lipid Soluble Hormones
    - *Hormones produce their effects on target tissues by binding to specific proteins called* ***hormone receptors*** *located in the target tissues only. Hormone receptors present on the cell membrane of the target cells are called* ***membrane-bound receptors*** *and the receptors present inside the target cell are called* ***intracellular receptors,*** *mostly nuclear receptors (present in the nucleus).*
    - *Binding of a hormone to its receptor leads to the formation of a* ***hormone-receptor complex****.*
    - *Each receptor is specific to one hormone only and hence receptors are specific.*
    - *Hormone-Receptor complex formation leads to certain biochemical changes in the target tissue. Thus, target tissue metabolism and physiological functions are regulated by hormone.*

1. **Water Soluble Hormones** (eg : Proteinaceous hormones except thyroxin) : They interact with membrane bound receptor and normally do not enter into the target cell, but generate **secondary messenger** (e.g. cyclic AMP, IP_3, Ca^{++} etc.) which in turn regulate cellular metabolism.



(a)

2. **Lipid Soluble Hormone** (eg : Steroid, Iodothyronine) : They interact with intracellular receptors **(mostly nuclear).**
    - Mostly regulate gene expression or chromosome function by the interaction of hormone receptor complex with the genome. Cumulative biochemical action results in physiological and developmental effects.



(b)

Diagrammatic Representation of The Mechanism of Hormone Action :
(a) Protein or Water Soluble Hormone (b) Steroid or Lipid Soluble Hormone

- ***The action of lipid soluble hormones is slower and long lasting than the action of water soluble hormones.***

Extra Points

- **Synergistic Hormone –** When two or more hormone complement the function of each other and both are needed for full expression of hormone effect.
  Example: Insulin and growth hormone/Thyroxin have synergestic effect for body growth.
  Estrogen, progesterone, prolactin and oxytocin have synergistic effect for physical growth of mammary gland.
- **Antagonistic hormone –** When two hormones oppose the actions of each other.
  Example : Insulin and glucagon
  Parathyroid hormone and Calcitonin
  MSH and melatonin
- There are some hormones which never comes into blood stream but always remain in tissue fluid or ECF.
  (i) Neurohormone : These are secreted by axon ends of nerve cells. e.g. Acetylcholine and Norepinephrine.
  (ii) Prostaglandin : These are called *local hormones*. These are fatty acid derivatives and found in tissue of Kidneys, gonads, seminal vesicles, thymus, brain etc. These stimulate contraction of smooth muscles.
  (iii) Kinins : These are chemicals which are secreted by any organ of body at the time of chemical change in ECF and reduce the B.P. by expanding blood vessels. These also reduce the time of blood clotting. **(First aid hormone)**
    - **Simmond's Disease :** This condition is due to atrophy of the anterior lobe of pituitary gland. (Deficiency of growth hormone in adults.)

- Adrenal gland is also known as **4 - S gland (S**ugar metabolism, **S**alt retaining actions, **S**ex hormones, **S**tress reactions**).**
- In the presence of thyroxine and insulin, growth hormones becomes more active and help in body growth. In this way this hormone is important for the growth of body.
- The **cortisol** hormone of adrenal cortex serves to maintain the body in living condition and recover it from the severe effects of stress reactions. Thus, an increased output of cortisol is "**life saving**" in "**shock conditions**".
- The hormones of **adrenal medulla** prepare the animal for **f**ear, **f**ight or **f**light in emergency conditions. (by excess secretion of these hormones) Adrenaline hormone is called **3F = FFF hormone** and adrenal gland is called "**triple F gland**" (FFF gland).

Concept Builder

1. Thyroxin brings about effects on target cells by :
(1) Altering gene expression (2) Activating adenyl cyclase
(3) Activating guanylate cyclase (4) Activating G-protein

2. Which of the following works in association with cytoplasmic or nuclear receptors?
(1) Insulin (2) Somatostatin (3) Oxytocin (4) Estrogen

3. In which of the following gland(s), tissue mass is differentiated into cortex and medulla?
(1) Adrenal (2) Pituitary (3) Liver (4) Testis

4. Which of the following hormone(s) is/are responsible for maintaining corpus luteum?
(1) LH (2) Estrogen (3) Progesterone (4) Prolactin

5. Which of the following hormone works from outside the cell?
(1) Estrogen (2) Cortisol (3) Insulin (4) Thyroxine

6. Male hypogonadism results in?
(1) Deficiency of androgens (2) Low activity of sertoli cells
(3) Low activity of Leydig cells (4) All of these

7. Which of the following is/are correct about catecholamines?
(a) Water soluble (b) Lipid soluble
(c) Work through second messengers (d) Alter gene expression
(1) (a) & (d) only (2) (a) & (c) only (3) (a), (c) & (d) only (4) (b) & (d) only

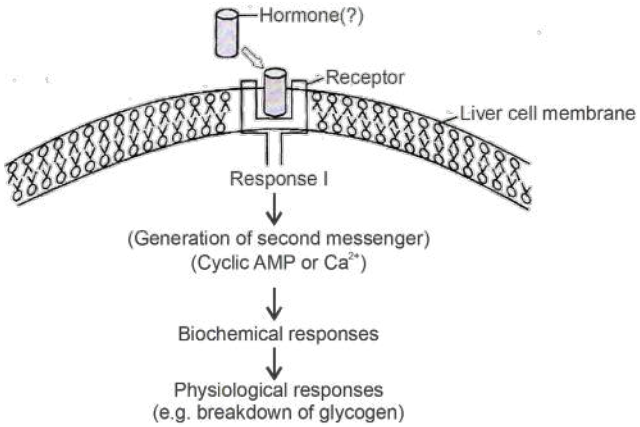
Concept Builder (Answer-Key)							
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Ans.	1	4	1	1	3	4	2

Exercise - I

(A) Hormones and Hormone Action

1. Which of the following characteristics is not mentioned in current scientific definition of hormone?
(1) Non-antigenic substance
(2) Non-nutrient chemical
(3) Act as intercellular messenger
(4) Produced in trace amount

2. In following hormonal mechanism hormone could be :



(1) Adrenaline
(2) Progesterone
(3) Estrogen
(4) Aldosterone

3. First discovered hormone:
(1) Thyroxine (2) Adrenaline
(3) Secretin (4) Insulin

4. Following are the example of organised gland except:
(1) Pituitary (2) Pineal
(3) Thyroid (4) Kidney

5. Which of the following is not a steroid hormone?
(1) Androgen
(2) Aldosterone
(3) Estrogen
(4) Gonadotropins

6. Abnormal growth of bones due to hypersecretion of growth hormone in adult is known as :
(1) Acromegaly (2) Dwarfism
(3) Gigantism (4) Both (1) and (2)

7. Which of the following is not an endocrine gland?
(1) Pancreas
(2) Adrenal gland
(3) Thyroid gland
(4) Salivary gland

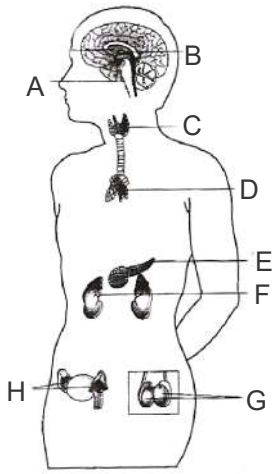
8. Mark the incorrect statement regarding the modern definition of hormones:
(1) Non-nutrient chemicals that acts as intercellular messengers
(2) Produced in traces as they are highly reactive
(3) Chemicals produced by exclusive endocrine glands
(4) Modern definition covers a number of new molecules in addition to the hormones secreted by the organised endocrine glands

9. Hormones produced by adrenal cortex and gonads (sex hormone) are chemically :
(1) Proteinaceous
(2) Steroids
(3) Glycoprotein
(4) Catecholamines

10. Which of the following hormones is not proteinaceous is nature?
(1) TSH (2) Aldosterone
(3) LH (4) FSH

11. Beside cAMP, which one of the following molecules acts as a "second messenger" in biological system?
(1) Ca^{2+} (2) ATP
(3) cDNA (4) cGTP

12. In the following diagram, identify those glands (A to H), which secrete steroid hormones?



(1) C,D,F (2) B, D, G
(3) F, G, H (4) B, C, H

13. Which of the following hormone is polypeptide?
(1) LH (2) FSH
(3) Insulin (4) Thyroxine

14. If receptor molecule is removed from target organ for hormone action, the target organ will :
(1) Continue to respond but require higher concentration of hormone.
(2) Continue to respond but in opposite way.
(3) Continue to respond without any difference.
(4) Not respond to hormone.

15. Which one of the following hormone can change the chromosomal functions by binding with their receptors?
A. Cortisol B. Iodothyronine
C. Testosterone D. Estradiol
(1) Only C & D
(2) Only A, B and C
(3) All A, B, C & D
(4) Only A & B

Pituitary Gland and Hypothalamus

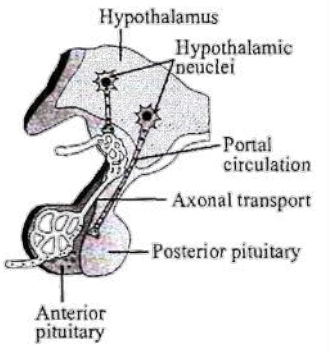
16. During summer season, which hormone concentration is maintained at high level?
(1) Insulin (2) Glucogon
(3) ADH (4) Relaxin

17. Secretion of which of the following thyroid hormone is not regulated by pituitary TSH?
(1) Thyroxin
(2) Tetra-iodo-thyronine
(3) Tri-iodo-thyronine
(4) Thyrocalcitonin

18. Which of the following is not a correct combination of the hormone with its source organ and target organ?

	Hormone	Source organ	Target organ
(1)	Somatostatin	Hypothalamus	Adenohypophysis
(2)	FSH	Ovary	Uterus
(3)	TSH	Adenohypophysis	Thyroid
(4)	ACTH	Pituitary gland	Adrenal cortex

19. Find out incorrect labelling in following diagram:



(1) Axonal transport and Anterior pituitary
(2) Portal circulation and Posterior pituitary
(3) Anterior pituitary and Posterior pituitary
(4) Portal circulation and Axonal transport

20. Pituitary gland does not control the secretory activity of:
(1) Thyroid (2) Adrenal cortex
(3) Adrenal medulla (4) Testes

21. Which of the following is correctly matched ?
(1) GH → controls BMR
(2) FSH → Stimulates spermatogenesis
(3) Oxytocin → brings about ovulation
(4) Relaxin → stimulate lactation

22. Which one is incorrect for hypothalamus?
(1) Basal part of diencephlon
(2) Regulate a very narrow spectrum of body functions
(3) Neural control of posterior pituitary
(4) Release somatostatin for GH Inhibition

23. Neurohypophysis releases :
(1) MSH
(2) ACTH
(3) Oxytocin and prolactin
(4) Vasopressin and oxytocin

24. Hormone secreted by pituitary gland are chemically:
(1) All proteinaceous
(2) All steroid in nature
(3) Complex compounds of proteins and carbohydrates
(4) Some steroid and some protein

25. The same hormone can be known by various names given in which set :
(1) Secretin, enterokinin, gastrin
(2) Gametokinetic factor, testosterone, Prolactin
(3) ADH, pitressin and vasopressin
(4) Oxytocin, tri-iodo-thyronine, thyroxine

26. Gonadotrophic hormone is produced by:
(1) Interstitial cells of testis
(2) Adrenal cortex
(3) Adenohypophysis
(4) Posterior part of thyroid

27. If amount of ADH decrease in blood, micturition :
(1) Remains unchanged (2) Decreases
(3) Increases (4) None

28. Urine concentration is controlled by:
(1) Oxytocin (2) ADH
(3) MSH (4) ACTH

29. The follicle stimulating hormone is secreted from :
(1) Posterior lobe of pituitary gland
(2) Reproductive gland
(3) Thyroid gland
(4) Anterior lobe of pituitary gland

30. Vasopressin is responsible for :
(1) Controlling Oogenesis
(2) Regulating blood pressure and act on the nephron tubules
(3) Regulating formation of pigment
(4) Controlling spermatogenesis

31. The main function of prolactin hormone is to :
(1) Influence the activity of thyroid gland
(2) Control development of graffian follicles
(3) Initiate and maintain secretion of milk by mammary gland
(4) Cause ejection of milk

32. The hormones of neurohypophysis are formed in :
(1) Pars intermedia
(2) Pars distalis
(3) Neurosecretory nuclei of hypothalamus
(4) Neurohypophysis

33. Which of the following hormone helps in facultative water reabsorption by nephrons?
(1) MSH (2) FSH
(3) ADH (4) ACTH

34. Diabetes insipidus disease is caused due to the deficiency of hormones released by :
(1) Pituitary (2) Adrenal
(3) Pancreas (4) Thyroid

35. MSH Produced by the pars intermedia of pituitary causes in lower vertebrates :
(1) Darkening of skin
(2) Light colouration of skin
(3) Metachrosis
(4) Both (1) and (3)

36. Hormone responsible for lactation is also known as :
(1) Lactogenic Hormone
(2) Prolactin
(3) Mammotropic Hormone
(4) All

37. Growth hormone of pituitary is more effective in:
(1) Presence of thyroxine
(2) Absence of thyroxine
(3) Absence of Insulin
(4) Presence of adrenaline

38. MSH is secreted in man by which part of pituitary?
(1) Pars distalis
(2) Pars intermedia
(3) Posterior lobe of Pituitary
(4) Neurohypophysis

39. Hypersecretion of GH or STH leads to:
(1) Dwarf & Acromegaly
(2) Goitre, Sterility
(3) Cretinism, Myxoedema
(4) Gigantism & Acromegaly

40. Oxytocin is secreted from :
(1) Adenohypophysis (Anterior lobe)
(2) Pars distalis
(3) Hypothalamus
(4) Neurohypophysis

41. Which one hormone of the pituitary of the human controls the protein metabolism and growth of skeleton?
(1) Iodo thyroxine
(2) Luteotrophic hormone
(3) Growth hormone
(4) Oxytocin

42. Secretion of estrogen is controlled by:
(1) HCG (2) Progesterone
(3) LH (4) F.S.H.

43. Which gland secretion is under nervous control?
(1) Adrenal cortex (2) Anterior pituitary
(3) Posterior pituitary (4) Pineal body

44. Match the hormone in column-I with their function in column-II.

Column I	Column II
(a) FSH	(i) Prepare endometrium for implantation
(b) LH	(ii) Development of female secondary sexual characters
(c) Progesterone	(iii) Contraction of uterine wall
(d) Estrogen	(iv) Development of corpus luteum
	(v) Maturation of graafian follicle

(1) a-v, b-iv, c-i, d-ii
(2) a-iii, b-iv, c-i, d-ii
(3) a-iv, b-iii, c-ii, d-i
(4) a-i, b-ii, c-iii, d-iv

45. Which of the following hormone can not cross the plasma membrane of target cell?
(1) Thyroxine (2) Adrenaline
(3) Cortisol (4) Estrogen

46. Which of the following group of hormone is produced by glandular cells of adenohypophysis?
(1) Growth hormone and prolactin
(2) FSH and ADH
(3) Prolactin and Somatostatin
(4) FSH and GnRH

47. An adenohypophysis hormone which is regulated by feedback mechanism is:
(1) Oxytocin (2) TSH
(3) Vasopressin (4) Cortisol

48. Which of the following hormones stimulates the secretion of milk from female?
(1) LH (2) prolactin
(3) oxytocin (4) progesterone

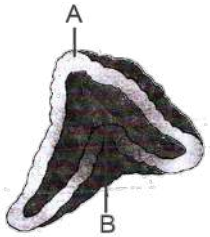
49. Hypersecretion of growth hormone during childhood lead to:
(1) Acromegaly
(2) Cushing syndrome
(3) Circus midgets
(4) Gigantism

50. Thyrotropin - releasing hormone (TRH) is produced by :
(1) Pituitary (2) Thyroid
(3) Neurohypophysis (4) Hypothalamus

51. Gonadotropic hormone are :
(1) Estrogen and progesterone
(2) Luteinizing hormone and follicle stimulating hormone
(3) Testosterone and androsterone
(4) Prolactin and Luteotropin

Thyroid, Parathyroid and Adrenal Glands

52. Given below is a sectional view of adrenal gland, mark the option with correct informations about the structures labelled as A and B in the same?



	A	B
(1)	Secretes Catecholamines	Secretes corticoides
(2)	Regulated by Pituitary gland	Regulated by our will power
(3)	Secretes steroid hormones	Secretes hormones of fight and flight
(4)	Ectodermal in origin	Mesodermal in origin

53. Largest endocrine gland is :
(1) Adrenal gland (2) Thyroid gland
(3) Thymus (4) Pituitary

54. The secretion of PTH in man is regulated by :
(1) Circulating level of sodium
(2) Circulating level of potassium
(3) Circulating level of calcium
(4) Circulating level of magnisium

55. The basal metabolic rate (BMR) in body cells is regulated by :
(1) Parathyroid (2) Thyroid
(3) Pituitary (4) Thymus

56. Which of the following is largest gland in adult man?
(1) Thymus (2) Liver
(3) Thyroid (4) Pancreas

57. Which of the following hormone maintains proper ratio of sodium and potassium in blood ?
(1) ADH (2) TSH
(3) PTH (4) Aldosterone

58. The hormones responsible for regulation of calcium and phosphorous metabolism is secreted by :
(1) Pancreas (2) Thyroid
(3) Thymus (4) Parathyroid

59. Diabetic patients are successfully treated with :
(1) GH therapy
(2) More amount of thyroxine
(3) Insulin therapy
(4) (2) and (3) both

60. Hypothyroidism in adults causes :
(1) Addison's disease (2) Myxoedema
(3) Sterility (4) Cretinism

61. Which gland stores hormone in intercellular space before its secretion into blood ?
(1) Pancreas (2) Thyroid
(3) Testis (4) Ovary

62. Find out incorrect :
(1) Pituitary - FSH
(2) Thyroid - T_4
(3) Ovary - Calcitonin
(4) Islets of Langerhans - insulin

63. Goiter is caused by the abnormal functioning of :
(1) Pancreas (2) Adrenals
(3) Pituitary (4) Thyroid

64. Which of the following gland is Ectodermal in origin?
(1) Pituitary gland
(2) Pineal body
(3) Adrenal medulla
(4) All of the above

65. Cretinism is due to abnormal secretion of :
(1) Thyroid stimulating hormone
(2) Thyroxine
(3) Calcitonin
(4) Parathormone

66. Which of the following hormone is not soluble in water?
(1) Parathyroid hormone
(2) Thyroxine
(3) A.D.H.
(4) Oxytocin

67. Which gland is related with development of immune system :
(1) Adrenal (2) Thyroid
(3) Parathyroid (4) Thymus

68. The vitamin which works along with para thyroid hormone is :
(1) Vitamin C (2) Calciferol
(3) Tocopherol (4) Vitamin - B_{12}

69. Hypersecretion of parathyroid hormone result in
(1) Stronger bones due to increased incorporation of calcium in them
(2) Deposition of calcium in various skeleton structure
(3) No effect on the constitution of bones
(4) Weaker bones due to increased removal of calcium from them

70. One of the following is correct statement :
(1) T_4 is more active than T_3
(2) T_3 is more active than T_4
(3) T_3 and T_4 are produced in the same amount
(4) T_3 is also called Thyroxin

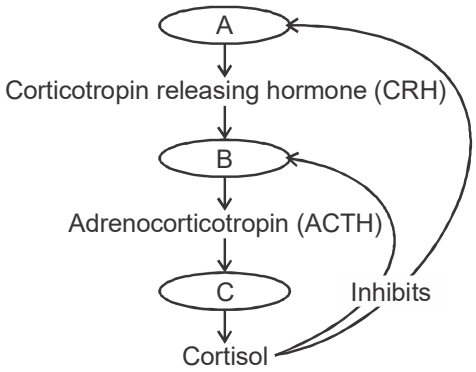
71. BMR is increased mainly by :
(1) Melatonin
(2) Adrenaline
(3) Growth Hormone
(4) Thyroxine

72. Function of thyrocalcitonin :
(1) To reduce the calcium level in blood
(2) To increase the calcium level in blood
(3) Oppose the action of thyroxine
(4) Maturation of gonads

73. Parathyroid hormone :
(1) Is produced by the thyroid gland
(2) Is released when blood calcium levels fall
(3) Stimulates osteoblasts to lay down new bone
(4) Stimulates calcitonin release.

74. Adrenaline or Epinephrine is :
(1) Secreted from pancreas and decreases heart beat
(2) Secreted from adrenal medulla and increases heart beat
(3) Secreted from adrenal medulla and decreases heart heat
(4) Secreted from pancreas and increases heart beat

75. Which glands are indicated as A, B and C in the given figure?



(1) A-Hypothalamus B-Anterior pituitary C-Adrenal cortex.
(2) A-Hypothalamus B-Anterior pituitary C-Adrenal medulla
(3) A-pituitary B-Thyroid C-Pineal
(4) A-Pituitary B-Thyroid C-Parathyroid

76. Epinephrine and norepinephrine together known as :
(1) Steroid (2) Protein
(3) Catecholamine (4) None

77. A tumour in the adrenal zona glomerulosa can cause hypersecretion of hormones produced in that region. Which of the following might you expect to find in a patient with such a tumour?
(1) Increased blood sodium levels
(2) Increased blood glucose levels
(3) Decreased blood calcium levels
(4) Increased dehydration

78. The function of norepinephrine is :
(1) Almost similar to epinephrine
(2) Similar to ADH
(3) Opposite to epinephrine
(4) Opposite to ADH

79. Which one of the following is wrongly matched?

	Gland	Function
(1)	Progesterone	Maintains corpus Luteum
(2)	Aldosterone	Na^+ reabsorption and K^+ excretion
(3)	Oxytocin	Uterine contraction & milk ejection
(4)	Glucocorticoids	Anti-inflammatory hormone

80. Catecholamines secreted by adrenal medulla in response to any kind of stress performs all the following functions except one?
(1) Increases alertness, pupilary dilation and piloerection.
(2) Stimulates breakdown of glycogen into glucose.
(3) Increases micturition by causing contraction of bladder muscles.
(4) Increases heart beat and the strength of heart contraction.

81. Adrenal cortex also controls the carbohydrate metabolism through :
(1) Adrenaline
(2) Noradrenaline
(3) Glucocorticoids
(4) Mineralo Corticoids

82. Which of the following is not an organised endocrine gland -
(1) Pancreas (2) Liver
(3) Thyroid (4) Adrenal

83. Which gland is mainly concerned with salt equilibrium (Na^+-K^+) in body ?
(1) Anterior pituitary (2) Pancreas
(3) Adrenal (4) Thyroid

84. Which of the following hormone is secreted when blood pressure increases abnormally :
(1) ANF (2) ADH
(3) Aldosterone (4) Cortisol

85. Which gland secretes steroid hormones along with peptide hormones?
(1) Thyroid (2) Parathyroid
(3) Pituitary (4) Adrenals

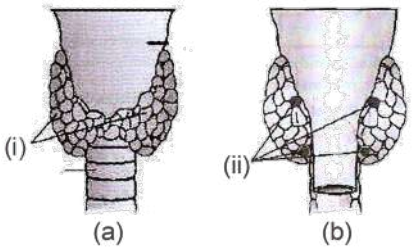
86. Life saving hormone are secreted by:
(1) Pituitary (2) Pineal
(3) Adrenals (4) Thyroid

87. Corticosteroids are secreted by :
(1) Adrenal gland (2) Pineal gland
(3) Pituitary gland (4) Thyroid gland

88. Blood pressure is controlled by :
(1) Thyroid (2) Thymus
(3) ANF (4) Parathyroid

89. Which of the following disease is not related to thyroid gland ?
(1) Goitre (2) Cretinism
(3) Myxoedema (4) Acromegaly

90. Select the option with correct identification of the gland (a) and (b) shown below and function.



Option:

	Gland	Function
(1)	(i) Thyroid	Secretes corticoides
(2)	(ii) Thyroid	Promotes the stunted growth of growing baby during pregnancy
(3)	(i) Parathyroid	Decreases the Ca^{+2} level in bone
(4)	(ii) Parathyroid	Increase the Ca^{+2} level in blood

91. Grave's disease is due to :
(1) Hyperactivity of thyroid gland
(2) Hypoactivity of adrenal cortex
(3) Hyperactivity of adrenal medulla
(4) Hypoactivity of islets of langerhans

92. Moon face, hyperglycemia are characteristic of :
(1) Grave's disease
(2) Addison's disease
(3) Conn's disease
(4) Cushing's disease

93. Muscular tetany can be caused by deficiency of :
(1) Oxytocin
(2) STH
(3) ADH
(4) Parathyroid hormone

94. Addison's disease is caused due to:
(1) Hypersecretion of adrenal cortical hormones
(2) Hypersecretion of growth hormone
(3) Hypersecretion of thymus
(4) Hypo-secretion of adrenal cortex

95. Para-thyroid hormone is a :
(1) Peptide (2) Carbohydrate
(3) Lipid (4) Steroid

96. We know that the thyroxine controls metabolism in body. An autoimmune disease where the body's own antibodies attack the cells of the thyroid is called :
(1) Hyperthyroidism
(2) Hashimoto's disease
(3) Grave's disease
(4) Turner syndrome

Thymus, Pineal, Pancreas and Gonads

97. Thymus gland develops from embryonic:
(1) Mesoderm (2) Endoderm
(3) Ectoderm (4) Ecto-mesoderm

98. I.C.S.H. in male acts on :
(1) Cells of Leydig (2) Sertoli cells
(3) Spermatids (4) Spermatogonia

99. Melatonin is a hormone produced by:
(1) Adrenal gland (2) Pituitary gland
(3) Pineal gland (4) Thymus gland

100. Hassal's corpuscles are found in :
(1) Pineal body (2) Thymus gland
(3) Thyroid gland (4) Adrenal gland

101. Mammals born without a thymus gland fail to manufacture :
(1) B - Lymphocytes
(2) T - Lymphocytes
(3) Plasma cells
(4) Basophils

102. If thymectomy is done during adulthood than what possibility?
(1) Immunosuppressant
(2) Die immediately
(3) No adverse effect
(4) Myasthenia gravis

103. Thymosin stimulates maturation of :
(1) B-lymphocytes (2) Erythrocytes
(3) T-lymphocytes (4) Melanocytes

104. A hormone with site of activity is liver-changing glucose into glycogen is produced by :
(1) Pituitary (2) Thymus
(3) Parathyroid (4) Pancreas

105. Which gland is both exocrine as well as endocrine?
(1) Pituitary
(2) Mammary gland
(3) Thyroid
(4) Pancreas

106. Oversecretion of glucagon causes :
(1) Tetany
(2) Diabetes insipidus
(3) Acromegaly
(4) Hyperglycemia

107. Glucagon is secreted by:
(1) β (beta) cells of islets of Langerhans
(2) α (alpha) cells of islets of Langerhans
(3) γ cells of pancreas
(4) Adrenal cortex

108. Which of the following is not function of insulin?
(1) Increase glycogenesis
(2) Increase glycogenolysis
(3) Increase up take of amino acid by liver and muscle
(4) Enhance cellular glucose uptake and utilisation.

109. Which hormone has anti insulin effect?
(1) Cortisol (2) Oxytocin
(3) Aldosterone (4) Glucagon

110. Diabetic coma is due to hyposecretion of insulin in which :
(1) Glucose level increased in blood
(2) Keto acidosis take place
(3) Dehydration process start
(4) All the above

111. Choose the correct match:
(1) Hypothyroidism–Conn's disease
(2) Hyperthyroidism–Grave's disease
(3) Hypocorticoidism–Cushing disease
(4) Hypercorticoidism–Addison's disease

112. A patient of diabetes mellitus drink more water and he eliminates extra amount of which-substance from blood:
(1) Protein (2) Sugar
(3) Fat (4) Hormone

113. "Brain sand" is found in :
(1) Thyroid (2) Thymus
(3) Pineal body (4) Pituitary

114. Which one of the following endocrine gland functions as a biological clock and neuro-secretory transducer?
(1) Adrenal gland (2) Thyroid gland
(3) Pineal gland (4) Thymus gland

115. Which of the following hormone is not synthesised by hypothalamus.
(1) ACTH inhibitory hormone
(2) Prolactin releasing hormone
(3) GnRH
(4) TSH releasing hormone

116. A patient of diabetes mellitus excretes glucose in urine even when he kept in a carbohydrate free diet. It is because :
(1) Fats are catabolised to form glucose
(2) Amino acids are anabolised in liver
(3) Amino acids are discharged in blood stream from liver
(4) Glycogen from muscles are discharged in blood stream from liver

117. Which of the following disease is not caused by hyper/hyposecretion of hormone?
(1) IDDM (2) NIDDM
(3) Acromegaly (4) Myxoedema

118. The modern idea about ageing is that our body slowly loses the power of defence against the invasion of germs and pathogens. This process starts by the disappearance of which organ?
(1) Spleen (2) Thymus gland
(3) Pituitary gland (4) Parathyroid gland

119. Which of the following hormones secreted by pancreas?
(1) Insulin and glucagon
(2) Epinephrine and nor-epinephrine
(3) Thyroxin and melatonin
(4) Prolactin and oxytocin

120. The effect caused by non-functioning of islets of Langerhans :
(1) Heart beat rate increase
(2) Increased BMR
(3) Hyperglycaemia
(4) tetani

121. Diabetes mellitus shows following symptoms :
(1) Polyurea (2) Polydipsia
(3) Polyphagia (4) All of these

122. The "erythropoietin" hormone regulates:
(1) Blood pressure
(2) Water level of blood
(3) Glucose level of blood
(4) Rate of formation of red blood cells

123. Which of the following hormone is not secreted by gastro-intestinal tract?
(1) Gastrin (2) Secretin
(3) Cholecystokinin (4) Erythropoietin

124. Which one of the following pairs is not correctly matched?
(1) Pineal body : Melatonin
(2) Leydig cells : Androgen
(3) Intestine : Secretin
(4) Neurohypophysis : Prolactin

125. Atrial wall of the heart muscle secret's a peptide hormone to reduce the blood pressure, which is:
(1) Cholecystokinin
(2) Erythropoietin
(3) Atrial natriuretic factor
(4) Epinephrine

126. Secretin stimulates the activity of:
(1) Liver (2) Gastric gland
(3) Pancreas (4) Gall-bladder

127. Which hormone stimulates contraction of gall bladder?
(1) CCK-PZ (2) GIP
(3) Gastrin (4) Secretin

128. A group of compounds now recognized as local hormones are:
(1) Prostaglandins (2) Protacyclins
(3) Cytokinins (4) Substance 'P'

129. Placenta produces which hormone?
(1) GH (2) Gastrin
(3) ACTH (4) Progesterone

130. Female hormone is :
(1) Progesterone
(2) Estrogen
(3) Estradiol
(4) All of these

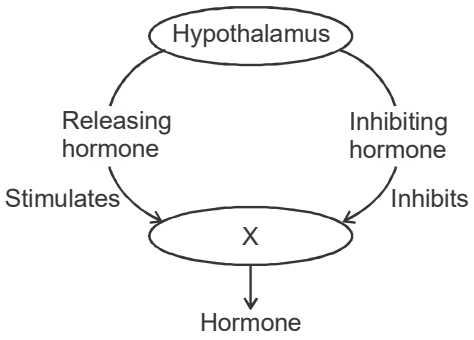
131. Which of the following steroid sex hormone influenced secondary sex organs and is main feminizing harmone?
(1) Progesterone (2) Oestrogen
(3) LH (4) LTH

ANSWER-KEY																										
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
Ans.	1	1	3	4	4	1	4	3	2	2	1	3	3	4	3	3	4	2	4	3	2	2	4	1	3
Que.	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
Ans.	3	3	2	4	2	3	3	3	1	4	4	1	2	4	4	3	4	3	1	2	1	2	2	4	4
Que.	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**
Ans.	2	3	2	3	2	2	4	4	3	2	2	3	4	4	2	2	4	2	4	2	4	1	2	2	1
Que.	**76**	**77**	**78**	**79**	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
Ans.	3	1	1	1	3	3	2	3	1	4	3	1	3	4	4	1	4	4	4	1	2	2	1	3	2
Que.	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**
Ans.	2	3	3	4	4	4	2	2	4	4	2	2	3	3	1	1	2	2	1	3	4	4	4	4	3
Que.	**126**	**127**	**128**	**129**	**130**	**131**																			
Ans.	3	1	1	4	4	2																			

Exercise - II

1. Steroid hormones :
(1) Have only cell surface receptors
(2) Need secondary messenger
(3) Have receptors within the nucleus
(4) Are produced by only adrenal cortex

2. In the given figure, what is indicated as 'X'?



(1) Thyroid
(2) Parathyroid
(3) Anterior pituitary
(4) Posterior pituitary

3. Which of the following is correct ?
(A) Pars distalis produces GH, PRL, TSH, ACTH, LH, FSH
(B) Pars intermedia secretes only one hormone called melatonin
(C) Posterior lobe of pituitary is also called as pars nervosa
(D) Posterior pituitary, stores and releases two hormones called oxytocin and vasopressin
(1) A, B, C (2) B, C, D
(3) A, C, D (4) B and C

4. Both adrenaline and cortisol are secreted in response to stress. Which of the following statements is same for both of these hormones?
(1) They are hyperglycemic and increase blood glucose
(2) They are secreted by the adrenal cortex
(3) Their secretion is regulated by pituitary ACTH
(4) They are steroid in nature

5. Pineal gland is not related with:
(1) Body temperature
(2) Defence capability
(3) Metabolism
(4) Kidney functions

6. The hormones that initiates ejection of milk, stimulates milk production and growth of ovarian follicles are respectively known as :
(1) PRL, oxytocin and LH
(2) Oxytocin, PRL and FSH
(3) Oxytocin, LH and FSH
(4) PRH, oxytocin and LH

7. Pituitary hormone that stimulates reabsorption of water and electrolyte by the distal tubules of kidneys is :
(1) Oxytocin (2) Aldosterone
(3) Cortisol (4) Vasopressin

8. Find out correctly matched :
(A) Thymus – Antibody mediated immunity
(B) PTH – Ca^{+2} absorption
(C) Adrenal – glucocorticoids
(D) Thyroid – Anti-inflammatory response
(1) A, B, D (2) A, B, C
(3) B, C, D (4) A, C, D

9. How many statements are correct regarding parathyroid gland ?
(a) Four parathyroid gland present on ventral side of thyroid gland
(b) It secretes parathormone which is steroidal in nature
(c) It increase blood Ca^{++} level
(d) It act on bone and stimulate bone resorption
(1) One (2) Two (3) Three (4) Four

10. Which of the following condition is not consider with hypothyroidism?
(1) Irregular menstrual cycle
(2) Development of nodules in gland
(3) Cretinism
(4) Low intelligence quotient in growing baby

11. Find out incorrect match of hormone with respective function:

	Hormone	Function
(1)	**Melatonin**	Sleep wake cycle and body temperature
(2)	**FSH**	Growth of ovarian follicles
(3)	**Adrenaline**	Increase concentration of glucose in blood.
(4)	**Progesterone**	Stimulate growth and activities of female secondary sex organs

12. Both are secreted by same organs:
(1) Insulin and glucagon
(2) Adrenalin and glucagon
(3) Adrenalin and Insulin
(4) Glucagon and growth hormone

13. All of the following are functions of adrenaline except:
(1) Increases blood supply in skeletal muscle
(2) Contraction of urinary bladder
(3) Breakdown of glycogen
(4) Increased heart rate

14. Which is not a pair of antagonistic hormones?
(1) Melatonin – MSH
(2) Insulin – Glucagon
(3) Cortisol – Aldosterone
(4) PTH – TCT

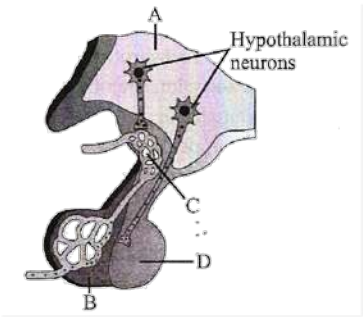
15. Hashimoto disease is related with :
(1) Adrenal gland is destroyed
(2) Thyroid gland is destroyed
(3) Kidney is destroyed
(4) Pancreas is destroyed

16. Which of the following hormone enhances retention of water by the kidneys?
(1) Oxytocin
(2) α-MSH
(3) Adrenocorticotropic hormones
(4) Vasopressin

17. Which of the following hormone is released in the blood stream has a stimulating effect on the entire immunity of body?
(1) Cortisol (2) Aldosterone
(3) Thymosin (4) ACTH

18. Which of the following hormones inhibits gastric secretion and inhibits the gastric motility?
(1) Secretin
(2) Gastric inhibitory peptide (GIP)
(3) Enterogastrone
(4) Gastrin

19.



Which of the following option in given table is correct identification of the structures labelled as A, B, C and D and their corresponding function in the above figure?

(1)	(A) Hypothalamus	Produce Prolactin hromone
(2)	(B) Posterior pituitary	Release FSH and LH
(3)	(C) Portal circulation	Supply blood from hypothalamus to posterior pituitary
(4)	(D) Posterior pituitary	Release oxytocin and vasopressin

20. How many of the following hormones act through secondary messenger Cortisol, thyroxin, ANF, PTH, TCT, MSH, ADH, FSH, Oxytocin, Testosterone, estrogen, aldosterone ?
(1) 6 (2) 7
(3) 5 (4) 8

21. Which one control the pumping actions of heart?
(1) Testosterone (2) Cortisol
(3) Aldosterone (4) ACTH

22. Group of hormones which is related with cytoplasmic bounded receptors?
(1) Hypothalamic hormones and epinephrine
(2) Thyroid hormone and estradiol
(3) Insulin and glucagon
(4) GH and MSH

23. Action of adrenaline is faster than estrogen because:
(1) Adranaline crosses cell membrane rapidly
(2) It acts through secondary messenger
(3) It acts direcytly on genes
(4) It is lipid soluble

24. Which hormones produced by adrenal cortex affects blood pressure?
(1) Cortisol
(2) Aldosterone
(3) Epinephrine
(4) Corticosterone

25. Which of the following pair is incorrect?
(a) Oxytocin – Stimulates uterine contraction during child birth
(b) ACTH – stimulates release of adrenaline from adrenal medulla
(c) Insulin – Stimulates glycogen breakdown in the liver
(d) Thyroxine – Stimulates metabolic process
(1) c and d (2) b and c
(3) c only (3) a, c and d

26. Two hormone .....(a)..... and .....(b)..... synthesized in hypothalamus and transported in pituitary gland through .....(c).....and .....(d)..... respectively.
(1) a = oxytocin $\Rightarrow$ c = portal circulation
b = ADH $\Rightarrow$ d = direct release
(2) a = ADH $\Rightarrow$ c = axonal transport
b = GnRH $\Rightarrow$ d = portal circulation
(3) a = ACTH $\Rightarrow$ c = axonal transport
b = MSH $\Rightarrow$ d = portal circulation
(4) a=Somatostatin$\Rightarrow$c=axonal transport
b = ADH $\Rightarrow$ d = portal circulation

27. The thyroid and parathyroid glands both glands secrete hormones that control the concentration of .....ions in the blood, the amount of this ion is decreased by ..... and increased by ..... :
(1) Ca^{+2}, Thyrocalcitonin, Parathormone
(2) I^{-}, Thyrocalcitonin, Parathormone
(3) I^{-}, T_3, T_4
(4) Ca^{+2}, Parathormone, Thyrocalcitonin

28. Find out the incorrect statements:
(1) Hormone always produces their effect by binding with specific proteins located on cell membrane or inside the cell.
(2) Receptors are specific for a particular hormone molecule.
(3) Hormones act with membrane bound receptors and then enters into cell to bind with secondary messenger.
(4) Protein hormone produce secondary messengers inside the target cell.

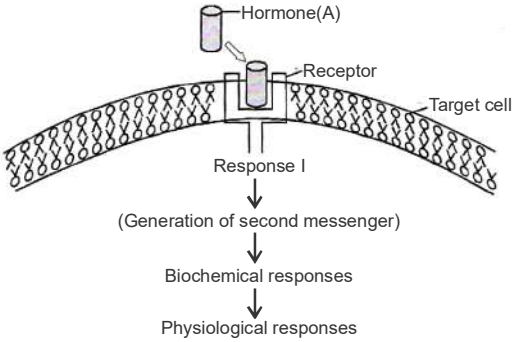
29. The hormone released by Adenohypophysis which is responsible for increased lipolysis and protein synthesis to support physical growth :
(1) Follicle stimulating hormone
(2) Growth hormone
(3) Melanocyte stimulating hormone
(4) ACTH

30. Which of the following hormone help's in response to infant suckling of milk by contracting myoepithelial cells of breast?
(1) Prolactin (2) FSH
(3) FSH & Prolactin (4) Oxytocin

31. Which of the following hormones interacts with intracellular receptors and alters the chromosome function and the way of expression of genes?
(1) GnRH and Somatostatin
(2) FSH and LH
(3) Cortisol and Estradiol
(4) ANF and Thymosin

32. Which one is correctly matched?
(a) Pineal gland – Metabolism, Mental retardation
(b) Thymus – Throne of immunity
(c) Thyroid – Anti inflammatory reaction
(d) Pancreas – blood sugar level
(1) a, c (2) b, c (3) c, d (4) b, d

33. In following hormonal mechanism hormone – A could be recognised as :



(1) Thymosin (2) Progesterone
(3) Thyroxine (4) Cortisol

34. The hormone that reduces the destruction of bones and also enhances deposition of Ca^{+2} in bones thus making them solid and strong. This hormone is :
(1) Collip hormone (2) Thyrocalcitonin
(3) Thyroxine (4) Vasopressin

35. When a normal man's heart is injected with physiological concentration of adrenaline it shows?
(1) Decreased heart beat
(2) First increased rate and then normal rate
(3) Sustained increased heart beat
(4) Person will die

36. Read the following characteristics and identify the particular hormone of your body:
(a) Blood pressure lowering hormone
(b) Source organ is not an organised endocrine gland
(c) Binds with membrane bound receptor on target cell
(d) secretion stimulated when BP is high
(1) Prostaglandin (2) ANF
(3) ADH (4) Nor-epinephrine

37. Read the following statements:
(A) Stimulates proteolysis and inhibits cellular uptake of amino acids.
(B) Provide relief when used in allergic disease.
(C) Can be used as immunosuppressive agent after kidney transplantation.
(D) Can be used in treatment of inflammatory disorders.
Which of the following hormone performs all the above functions?
(1) Thymosin (2) Thyroxin
(3) Cortisol (4) Adrenaline

38. Carbohydrate metabolism is influenced by:
(1) Thyroxine (2) Insulin
(3) Glucocorticoids (4) All

39. Consider the following statements:
(a) Binds with membrane bound receptor in the target cells
(b) Secondary messenger is required for their functioning
(c) Mainly acts on kidney
(d) Stimulates resorption of water and electrolytes in distal tubules
Keeping all the above characteristics in your brain, the hormone can be identified as :
(1) ADH (2) Aldosterone
(3) Cortisol (4) Both (1) and (2)

40. Mark the correct statement for Catechalomines of adrenal gland :
(1) Decrease the rate and force of heart contraction
(2) Conversion of liver glucose into glycogen.
(3) Contraction in pupil part of eye.
(4) Inhibits secretion of saliva and other digestive juices.

41. After ovulation, ruptured follicle secrete hormone that helps in:
(1) Libido
(2) Growth of facial hair
(3) High pitch voice
(4) Pregnancy support

42. The target cells of a hormone always have:
(1) Undifferentiated cytoplasm
(2) Special receptors to which hormone binds
(3) Special channels through which the hormone moves
(4) Large amount of the hormone stored within vesicles.

43. Find out suitable match for the following hormones and related organ:
(1) ANF– Heart
(2) Renin – Kidney
(3) Calcitonin – Kidney
(4) Oestrogen – Graafian follicle

44. Which of the following is an accumulation and release centre of Neurohormones?
(1) Anterior Pituitary lobe
(2) Neurohypophysis
(3) Pars intermedia
(4) Hypothalamus

45. BMR and Temperature of body is controlled by which endocrine gland ?
(1) Adrenal cortex (2) Thymus
(3) Thyroid (4) Pituitary

46. Location and secretion of leydig cells are?
(1) Pancreas - Glucagon
(2) Ovary - estrogen
(3) Ovary - Progesterone
(4) Testis - Testosterone

47. Which of the following hormones increase alertness, piloerection and sweating?
(1) TCT
(2) Catecholamines
(3) Cortisol
(4) Thymosins

48. Given below is a list of glands. Find out correct match for them:

	Hormone	**Function**
(1)	Adrenal medulla	Hormone induces constriction in pupil and reduces sweating during emergency
(2)	β-cell of pancreas	Hormone acts on liver and induces glycogenolysis and gluconeogenesis
(3)	Testis	Hormone induces catabolic effect of proteins
(4)	Thyroid follicles	Hormone induces BMR and temperature regulation and binds with intranuclear receptors.

49. Which of following is not a protein hormone?
(1) Relaxin (2) HCG
(3) Placental lactogen (4) Estradiol

50. Which of the following is a hormone ?
(1) Calcitriol (2) Thyroxine
(3) Adrenaline (4) All of these

51. Which one of the following pairs correctly matches a hormone with a disease resulting from its deficiency?
(1) Relaxin – Gigantism
(2) Prolactin – Cretinism
(3) Parathyroid hormone – Tetany
(4) Insulin – Diabetes insipidus

52. Why thyroxine is a hormone, not an enzyme?
(1) It is secreted in very large quantity
(2) It is not a polypeptide
(3) It has no special effect
(4) It get consumed as the reaction is over

53. Which one of the following pair's correctly matches a hormone with a disorder resulting from its deficiency?
(1) Insulin – Diabetes insipidus
(2) Thyroxine – Tetany
(3) Parathyroid hormone – Diabetes mellitus
(4) Luteinizing hormone – Failure of ovulation

54. In heart cells, which one serves as a second messenger, speedling up muscle cell contraction in response to adrenaline ?
(1) cAMP (2) cGMP (3) GTP (4) ATP

55. Which of the following is not paired correctly?
(1) Myxoedema – obesity
(2) Insulin – raises blood glucose
(3) Parathyroid – tetany
(4) Cretinism – mentally retarded

56. Which of the following statement are false/true?
(A) Calcitonin regulates the metabolism of calcium.
(B) Oxytocin stimulates contraction of uterine muscle during birth.
(C) Grave's disease is caused by malfunctioning of adrenal gland.
(D) ADH stimulates absorption of water and increase the urine production.
(1) A and C are true, B and D are false
(2) A and B are true, C and D are false
(3) A and D are true, B and C are false
(4) A, B and C are true, D only false

57. Which of the following is not a peptide hormone?
(1) Insulin (2) Antidiuretic
(3) Prostaglandins (4) Oxytocin

58. Hypersecretion in any glands take place due to :
(1) Tumour formation (2)Cancer formation
(3) Apoptosis (4) Both (1) & (2)

ANSWER-KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Ans.	3	3	3	1	4	2	4	2	2	2	4	1	2	3	2	4	3	2	4	2	2	2	2	2	2
Que.	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Ans.	2	1	3	2	4	3	4	1	2	2	2	3	4	1	4	4	2	3	2	3	4	2	4	4	4
Que.	51	52	53	54	55	56	57	58																	
Ans.	3	4	4	1	2	2	3	4																	

Exercise – III (Previous Year Question)

[AIPMT- 2006]

1. Which hormone causes dilation of blood vessels, increased oxygen consumption and glycogenolysis?
(1) Adrenaline (2) Glucagon
(3) ACTH (4) Insulin

2. A steroid hormone which regulates glucose metabolism is :
(1) 11-deoxycorticosterone
(2) Cortisone
(3) Cortisol
(4) Corticosterone

3. Which one of the following is not a second messenger in hormone action?
(1) Sodium (2) cAMP
(3) cGMP (4) Calcium

[AIIMS - 2006]

4. Tadpoles of frog can be made to grow as giant sized tadpoles, if they are :
(1) Administered antithyroid substance like thiourea.
(2) Administered large amounts of thyroxine
(3) Reared on a diet rich in egg yolk
(4) Reared on a diet rich in both egg yolk and glucose

[AIIMS - 2008]

5. Which one of the following pairs of organs includes exclusive endocrine glands?
(1) Thymus and Testes
(2) Adrenal and Ovary
(3) Parathyroid and Adrenal
(4) Pancreas and Parathyroid

6. The blood calcium level is lowered by the deficiency of :
(1) Both calcitonin and Parathormone
(2) Calcitonin
(3) Parathormone
(4) Thyroxine

7. In hult females oxytocin :
(1) Stimulates pituitary to secrete vasopressin
(2) Causes strong uterine contractions during parturition
(3) Is secreted by anterior pituitary
(4) Stimulates growth of mammary glands

[AIPMT - 2009]

8. A health disorder that results from the deficiency of thyroxine in adults and characterised by:
1. A low metabolic rate
2. Increase in body weight and
3. Tendency to retain water in tissue is
(1) Simple goitre (2) Myxoedema
(3) Cretinism (4)Hypothyroidism

[AIPMT-Pre – 2010]

9. Toxin agents present in food which interfere with thyroxine synthesis lead to the development of:
(1) simple goitre (2) thyrotoxicosis
(3) toxic goitre (4) cretinism

10. Injury to adrenal cortex is not likely to affect the secretion of which one of the following?
(1) Adrenaline
(2) Cortisol
(3) Aldosterone
(4) Both Androstenedione and Dehydroepiandrosterone

11. Which one of the following pairs is incorrectly matched?
(1) Corpus luteum – Progesterone (Secretion)
(2) Insulin – Diabetes mellitus (Disease)
(3) Glucagon – Beta cells (Source)
(4) Somatostatin – Delta cells (Source)

[AIPMT - Mains – 2010]

12. Which one of the following is now being commercially produced by biotechnological procedures?
(1) Morphine (2) Quinine
(3) Insulin (4) Nicotine

13. Select the corner matching of a hormone, its source and function.

	Hormone	Source	Function
(1)	Norepine Phrine	Adrenal medulla	Increases heart beat, rate of respiration and alertness
(2)	Glucagon	Beta-cells of Islets of langerhans	Stimulates glycogenolysis
(3)	Prolactin	Posterior pituitary	Regulates growth of mammary glands and milk formation in females
(4)	Vasopressin	Posterior pituitary	Increases loss of water through urine

14. Signals from fully developed foetus and placenta ultimately lead to parturition which requires the release of :
(1) Oxytocin from maternal pituitary
(2) Oxytocin from foetal pituitary
(3) Relaxin from placenta
(4) Estrogen from placenta

[AIPMT - Pre – 2012]

15. Which one of the following pairs of hormones are the examples of those that can easily pass through the cell membrane of the target cell and bind to a receptor inside it (mostly in the nucleus):
(1) Somatostatin, oxytocin
(2) Cortisol, testosterone
(3) Insulin, glucagon
(4) Thyroxin, Insulin

[NEET- UG – 2013]

16. A pregnant female delivers a baby who suffers from stunted growth, mental retardation, low intelligence quotient and abnormal skin.
This is the result of :
(1) Over secretion of pars distalis
(2) Deficiency of iodine in diet
(3) Low secretion of growth hormone
(4) Cancer of the thyroid gland

17. Which of the following statements is correct in relation to the endocrine system?
(1) Releasing and inhibitory hormones are produced by the pituitary gland.
(2) Adenohypophysis is under direct neural regulation of the hypothalamus.
(3) Organs in the body like gastrointestinal tract, heart, kidney and liver do not produce any hormones.
(4) Non-nutrient chemicals produced by the body in trace amount that act as intercellular messenger are known as hormones.

[AIIMS - 2013]

18. Which of the following hormone is correctly matched with it's source & function?
(1) Vasopressin – Anterior pituitary – Induces reabsorption of water in nephron.
(2) Oxytocin – Anterior pituitary – Contraction in uterine muscles during birth (parturition)
(3) Thymosin – Thymus-Helps in differentiation of T-Lymphocyte
(4) Glucagon – Pancreatic α-cells – Induces the uptake & utilization of glucose inside cells.

19. Which of the following is not a steroidal hormone?
(1) Progesterone (2) Insulin
(3) Testosterone (4) Cortisol

[AIPMT – 2014]

20. Which of the following causes an increase in sodium reabsorption in the distal convoluted tubule?
(1) Increase in aldosterone levels
(2) Increase in antidiuretic hormone levels
(3) Decrease in aldosterone levels
(4) Decrease in antidiuretic hormone levels

21. Identify the hormone with its **correct** matchings of source and function:
(1) Oxytocin–posterior pituitary, growth and maintenance of mammary glands.
(2) Melatonin-pineal gland, regulates the normal rhythm of sleep wake cycle.
(3) Progesterone – corpus-luteum, stimulation of growth and activities of female secondary sex organs.
(4) Atrial natriuretic factor – ventricular wall, increases the blood pressure.

22. Fight-or-flight reactions cause activation of :
(1) The parathyroid glands, leading to increased metabolic rate.
(2) The kidney, leading to suppression of renin angiotensin-aldosterone pathway.
(3) The adrenal medulla, leading to increased secretion of epinephrine and norepinephrine.
(4) The pancreas leading to a reduction in the blood sugar levels.

[AIIMS - 2014]

23. Hormone responsible for the secretion of milk after parturition is :-
(1) ACTH (2) LH
(3) ICSH (4) Prolactin

24. Which of the following is correct regarding hormones?
(1) Parathyroid is essential for absorption of potassium ions.
(2) Insulin and glucagon maintains blood glucose homeostasis.
(3) Old person is ageing person due to lack of progesterone.
(4) Thymus gland increases in size with age.

[Pre – AIIMS - 2015]

25. Which one of the following hormones is not involved in sugar metabolism?
(1) Glucagon (2) Cortisone
(3) Aldosterone (4) Insulin

26. Which one of the following hormones though synthesised elsewhere, is stored and released by the master gland?
(1) Melanocyte stimulating hormone
(2) Antidiuretic hormone
(3) Luteinizing hormone
(4) Prolactin

[AIIMS – 2015]

27. Which hormones causes Gluconeogenesis?
(1) Adrenalin
(2) Glucagon
(3) Insulin
(4) Adrenalin + Glucagon

28. Which of the following is not derived from cholesterol?
(1) Vitamin-D
(2) Insulin
(3) Bile juice
(4) Sex hormone

29. GnRH from hypothalamus reaches anterior pituitary through :
(1) Nuclei (2) Axon
(3) Blood vessels (4) Lymph vessels

[NEET - 2016]

30. The two polypeptides of human insulin are linked together by :
(1) Hydrogen bonds
(2) Phosphodiester bond
(3) Covalent bond
(4) Disulphide bridges

31. Which of the following pairs of hormones are not antagonistic (having opposite effects) to each other?
(1) Parathormone – Calcitonin
(2) Insulin – Glucagon
(3) Aldosterone – Atrial Natriuretic Factor
(4) Relaxin – Inhibin

32. Changes in GnRH pulse frequency in females is controlled by circulating levels of:
(1) Estrogen and progesterone
(2) Estrogen and inhibin
(3) Progesterone only
(4) Progesterone and inhibin

33. The amino acid Tryptophan is the precursor for the synthesis of:
(1) Melatonin and Serotonin
(2) Thyroxine and Triiodothyronine
(3) Estrogen and Progesterone
(4) Cortisol and Cortisone

[NEET - 2017]

34. A decrease in blood pressure/volume will not cause the release of :
(1) Atrial Natriuretic Factor
(2) Aldosterone
(3) ADH
(4) Renin

35. A temporary endocrine gland in the human body is :
(1) Corpus cardiacum (2) Corpus luteum
(3) Corpus allatum (4) Pineal gland

36. GnRH, a hypothalamic hormone, needed in reproduction, act on :
(1) Anterior pituitary gland and stimulates secretion of LH and FSH.
(2) Posterior pituitary gland and stimulates secretion of oxytocin and FSH.
(3) Posterior pituitary gland and stimulates secretion of LH and relaxin.
(4) Anterior pituitary gland and stimulates secretion of LH and oxytocin.

37. Hypersecretion of Growth Hormone in adults does not cause further increase in height, because :
(1) Epiphyseal plates close after adolescence.
(2) Bones loose their sensitivity to Growth Hormone in adults.
(3) Muscle fibres do not grow in size after birth.
(4) Growth Hormone becomes inactive in adults.

[NEET – 2018]

38. Which of the following hormones can play a significant role in osteoporosis?
(1) Parathyroid hormone and Prolactin
(2) Aldosterone and Prolactin
(3) Estrogen and Parathyroid hormone
(4) Progesterone and Aldosterone

39. Which of the following is an amino acid derived hormone?
(1) Estriol (2) Epinephrine
(3) Estradiol (4) Ecdysone

40. Loss of anterior lobe of pituitary gland causes:
(1) Addison's disease
(2) Cushing syndrome
(3) Simmond's disease
(4) Conn's disease

[NEET – 2019]

41. Match the following hormones with the respective disease:

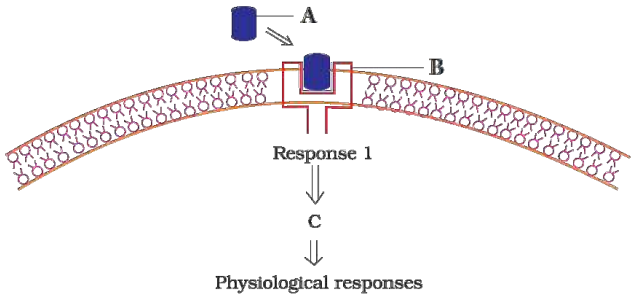
(a) Insulin	(i) Addison's disease
(b) Thyroxin	(ii) Diabetes insipidus
(c) Corticoids	(iii) Acromegaly
(d) Growth	(iv) Goitre Hormone
	(v) Diabetes mellitus

Select the **correct** option.

	(a)	**(b)**	**(c)**	**(d)**
(1)	(v)	(iv)	(i)	(iii)
(2)	(ii)	(iv)	(i)	(iii)
(3)	(v)	(i)	(ii)	(iii)
(4)	(ii)	(iv)	(iii)	(i)

[NEET – 2019 (Odisha)]

42. Identify A, B and C in the diagrammatic representation of the mechanism of hormone action.



Select the correct option from the following:

(1) A-Steroid Hormone; B-Hormone receptor Complex, C-Protein

(2) A-Protein Hormone; B-Receptor; C-Cyclic AMP

(3) A-Steroid Hormone; B-Receptor, C-Second Messenger

(4) A-Protein Hormone; B-Cyclic AMP, C-Hormone-receptor Complex

43. Which of the following hormones is responsible for both the milk ejection reflex and the foetal ejection reflex?

(1) Estrogen (2) Prolactin

(3) Oxytocin (4) Relaxin

44. Which of the following conditions will stimulate parathyroid gland to release parathyroid hormone?

(1) Fall in active Vitamin D levels

(2) Fall in blood Ca^{+2} levels

(3) Fall in bone Ca^{+2} levels

(4) Rise in blood Ca^{+2} levels

45. Artificial light, extended work-time and reduced sleep-time disrupt the activity of

(1) Thymus gland

(2) Pineal gland

(3) Adrenal gland

(4) Posterior pituitary gland

[NEET – 2020]

46. Select the correct statement.

(1) Insulin is associated with hyperglycemia

(2) Glucocorticoids stimulate gluconeogenesis

(3) Glucagon is associated with hypoglycemia.

(4) Insulin acts on pancreatic cells and adipocytes.

47. Presence of which of the following conditions in urine are indicative of Diabetes Mellitus?

(1) Renal calculi and Hyperglycaemia

(2) Uremia and Ketonuria

(3) Uremia and Renal Calculi

(4) Ketonuria and Glycosuria

48. Match the following columns and select the correct option:

	Column-I		**Column-II**
(a)	Pituitary gland	(i)	Grave's disease
(b)	Thyroid gland	(ii)	Diabetes mellitus
(c)	Adrenal gland	(iii)	Diabetes insipidus
(d)	Pancreas	(iv)	Addison's disease

	(a)	**(b)**	**(c)**	**(d)**
(1)	(ii)	(i)	(iv)	(iii)
(2)	(iv)	(iii)	(i)	(ii)
(3)	(iii)	(ii)	(i)	(iv)
(4)	(iii)	(i)	(iv)	(ii)

[NEET – 2020 (Covid - 19)]

49. Match the following columns and select the correct option:

	Column-I		**Column-II**
(a)	Pituitary hormone	(i)	Steroid
(b)	Epinephrine	(ii)	Neuropeptides
(c)	Endorphins	(iii)	Peptides, proteins
(d)	Cortisol	(iv)	Biogenic amines

(1) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

(2) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

(3) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)

(4) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

50. Hormones stored and released from neurohypophysis are:

(1) Thyroid stimulating hormone and Oxytocin
(2) Oxytocin and Vasopressin
(3) Follicle stimulating hormone and Luteinizing hormone
(4) Prolactin and Vasopressin

[NEET(UG) – 2021]

51. Erythropoietin hormone which stimulates R.B.C. formation is produced by :

(1) Alpha cells of pancreas
(2) The cells of rostral adenohypophysis
(3) The cells of bone marrow
(4) Juxtaglomerular cells of the kidney

[NEET(UG) – 2022]

52. Which of the following are **not** the effects of Parathyroid hormone?

(a) Stimulates the process of bone resorption
(b) Decrease Ca^{2+} level in blood
(c) Reabsorption of Ca^{2+} by renal tubule
(d) Decreases the absorption of Ca^{2+} from digested food
(e) Increases metabolism of carbohydrates

Choose the most appropriate answer from options given below:

(1) (a) and (c) only
(2) (b), (d) and (e) only
(3) (a) and (e) only
(4) (b) and (c) only

[Re-NEET(UG) – 2022]

53. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A) :

FSH which interacts with membrane bound receptors does not enter the target cell.

Reason (R) :

Binding of FSH to its receptors generates second messenger (cyclic AMP) for its biochemical and physiological responses.

In the light of the above statements, choose **the most appropriate answer** from the options given below:

(1) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A)**
(2) Both **(A)** and **(R)** are correct but **(R)** is not the correct explanation of **(A)**
(3) **(A)** is correct but **(R)** is not correct
(4) **(A)** is not correct but **(R)** is correct

ANSWER-KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Ans.	1	3	1	1	3	3	2	2	1	1	3	3	1	1	2	2	4	3	2	1	2	3	4	2	3
Que.	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Ans.	2	4	2	3	4	4	1	1	1	2	1	1	3	2	3	1	2	3	2	2	2	4	4	2	2
Que.	51	52	53																						
Ans.	4	2	2																						