Chapter

1 Endocrine system

- the hypothalamus, pituitary, thyroid, parathyroid, pancreas, thymus, gonads, pineal and adrenal glands, are endocrine glands found in the human body
- hormones secreted from the hypothalamus, pituitary, thyroid, parathyroid, pancreas and adrenal glands are involved in homeostasis by affecting specific target organs
- the secretions of the pituitary gland are controlled by the hypothalamus through transport of hormones, either via nerve cells or the vascular link between them
- hormones can be lipid-soluble and able to cross cell membranes to bind with and activate intracellular receptors or, water-soluble and able to bind with and activate receptors on cell membranes, and require secondary messengers to affect cell functioning

MULTIPLE-CHOICE QUESTIONS

1. *(2013:1.07)*

The hormone that influences ovulation **most** directly is

(a) progesterone.

(b) follicle stimulating hormone.

(c) luteinising hormone.

(d) oestrogen.

2. *(2014:1.07)*

During the ovarian cycle, the ovum is released from a mature follicle. The hormone that directly stimulates the release of the ovum is

(a) follicle stimulating hormone.

(b) progesterone.

(c) luteinising hormone.

(d) oestrogen.

3. *(2014:1.11)*

Glucocorticoids are secreted by the adrenal cortex in response to ACTH from the pituitary gland. Which of the following is **not** an effect of glucocorticoids?

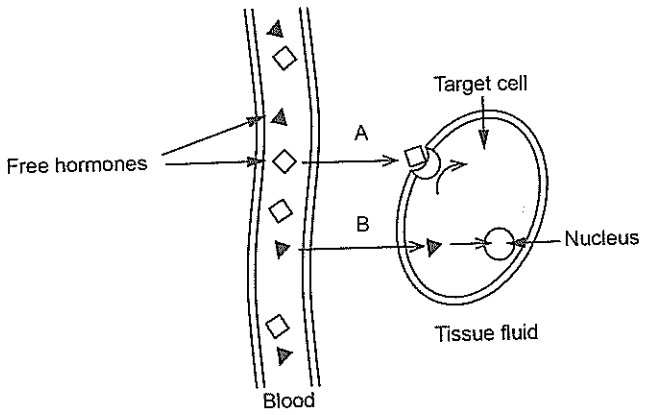
(a) stimulate fat breakdown

(b) produce glucose from amino acids

(c) stimulate the release of insulin

(d) increase blood glucose levels

The next two questions refer to the diagram below, which shows the mode of action of two different hormones.



(2015:1.04)

4.

A characteristic of hormones A and B illustrated by the diagram is that they

(a) are secreted by endocrine glands.

(b) travel in the bloodstream.

(c) can pass easily through a plasma membrane.

(d) can bind to many types of cells.

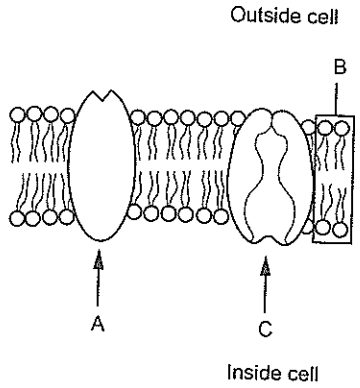
(2015:1.05)

5.

Which of the following links correctly the type of hormone with its mode of action as shown by pathway A in the diagram above?

	Type of hormone	Mode of action
(a)	amine	activates a secondary messenger
(b)	amine	activates a gene directly
(c)	steroid	activates a secondary messenger
(d)	steroid	activates a gene directly

The next question refers to the diagram shown below.



6. *(2015:1.29)*

Structure B consists of phospholipids. Lipid-soluble hormones are able to pass through this part of the membrane. This is due to structure B possessing

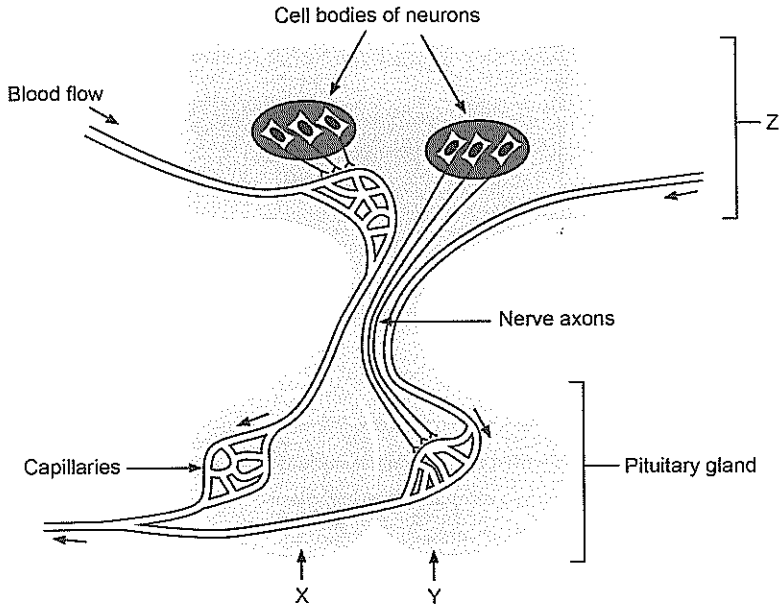
(a) hydrophilic lipid heads and hydrophobic phosphate tails.

(b) hydrophilic lipid tails and hydrophobic phosphate heads.

(c) hydrophobic lipid heads and hydrophilic phosphate tails.

(d) hydrophobic lipid tails and hydrophilic phosphate heads.

The next question refers to the diagram shown below.



7. *(2016:1.11)*

X and Y represent the two lobes of the pituitary gland. A target organ for hormones released from lobe Y is the

(a) thymus.

(b) thyroid gland.

(c) ovaries.

(d) uterus.

8. *(2017:1.03)*

The adrenal cortex is stimulated to produce aldosterone when

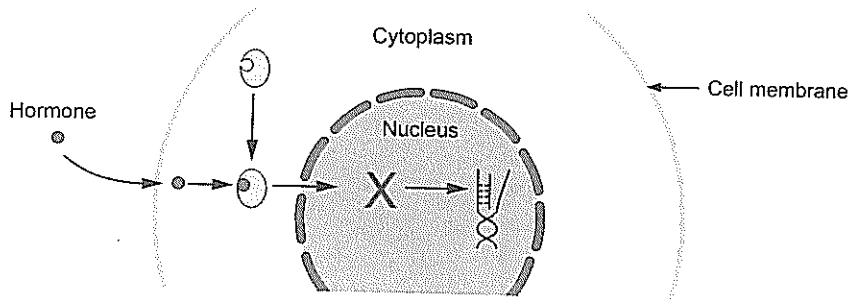
(a) there is an increase in water reabsorption from the collecting duct of the nephron.

(b) adrenocorticotropic hormone is released from the posterior pituitary gland.

(c) there is a high level of potassium ions present in the bloodstream.

(d) there is a high level of sodium ions in the distal tubule of the nephron.

The next two questions refer to the diagram shown below, which depicts how a hormone enters and affects a cell.



9. *(2017:1.08)*

The hormone represented in this diagram is

(a) lipid soluble and binds with a receptor on the cell membrane.

(b) water soluble and binds with a receptor in the nucleus.

(c) lipid soluble and binds with a receptor in the cytoplasm.

(d) water soluble and binds with an intracellular receptor.

10. *(2017:1.09)*

At point X in the diagram, a

(a) secondary messenger binds to DNA.

(b) hormone-receptor complex binds to RNA.

(c) secondary messenger binds to RNA.

(d) hormone-receptor complex binds to DNA.

11. *(2017:1.18)*

One hour after consuming a glucose drink, the blood glucose concentration of two people was determined. One of these people suffered from Type 1 diabetes. Person A had a blood glucose concentration of 11 mmol/litre and Person B had a blood glucose concentration of 6 mmol/litre. Just before consuming the drink both people had a blood glucose concentration of 5 mmol/litre.

The reason for the difference between A and B was that

(a) A was diabetic and therefore was unable to store glucose as glycogen in the liver.

(b) B was diabetic and therefore lost excess glucose through the kidneys.

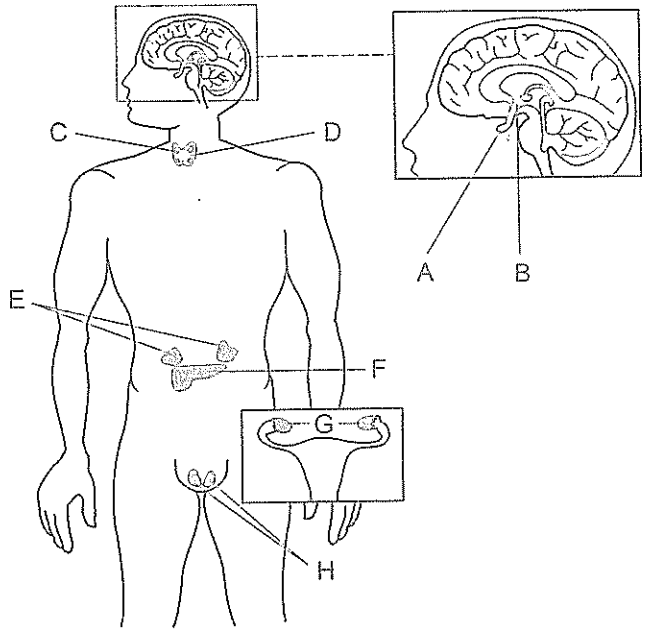
(c) A was diabetic and therefore required less glucose in cells for respiration.

(d) B was diabetic and therefore was unable to release sufficient glucose from muscle cells.

SHORT ANSWER QUESTIONS

12. [11 marks] *(2013:2.32)*

Parts (a) and (b) of the question refer to the diagram of endocrine glands below.



(a) Identify the endocrine gland that

(i) secretes the hormone aldosterone. [1]

_____

(ii) secretes a hormone that targets bone. [1]

_____

(b) Describe the role of each of the following structures in the regulation of body fluid composition. [2]

A: _____

_____

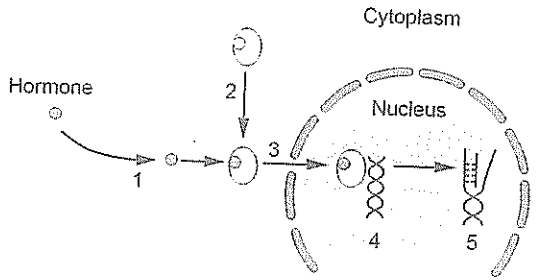
B: _____

_____

CONTINUED NEXT PAGE

Hormones can be grouped into two different categories based on their mode of action when they reach a target cell.

Parts (c), (d) and (e) of the question refer to the diagram below, which represents the mode of action of one of the categories of hormone.



(c) Using the diagram above, complete the following questions.

(i) Name the category of hormones this diagram represents. [1]

(ii) At Point 1, what feature of the cell membrane enables the hormone to cross into the cytoplasm? [1]

(d) Describe what is occurring at Points 2–5. [4]

2	
3	
4	
5	

(e) The mode of action of the other category of hormones differs from the mode of action shown in the diagram. Identify one characteristic of the other category of hormones that makes it unique. [1]

13. [4 marks] *(2014:2.39)*

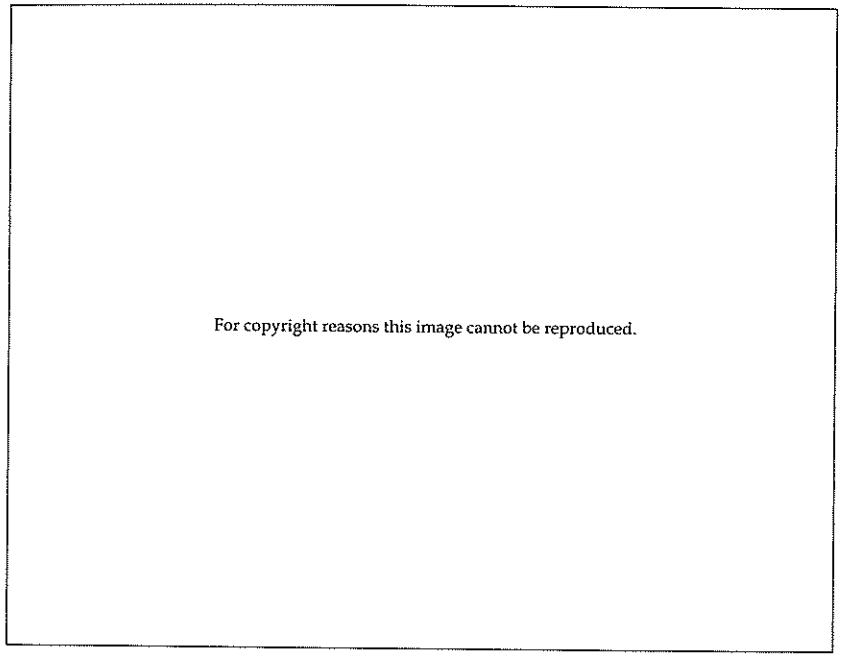
(d) Calcium plays an important role in the functioning of the nervous system. Explain how the thyroid and parathyroid glands ensure calcium supplies are balanced.

(i) Thyroid [2]

(ii) Parathyroid [2]

14. [13 marks] *(2015:2.37)*

Parts (a), (b) and (c) of the question refer to the diagram of the endocrine system shown below.



(a) Identify **one** hormone produced at D. [1]

(b) (i) Identify which letter in the diagram indicates the gonads. [1]

(ii) Several hormones are produced by the gonads. Name **one** of these hormones, state the target organ it influences and describe the main effect the hormone has on the body. [3]

(c) Structure B is divided into two lobes, called the 'anterior' and 'posterior'. The production and release of hormones from these lobes is different.

(i) Explain how the production and release of a hormone from the anterior lobe is controlled by structures A and B. [3]

(ii) Explain how the production and release of a hormone from the posterior lobe is controlled by structures A and B. [3]

(d) Hormones differ from nerves in their mode of action. In relation to the time taken to respond and the duration of a response, how is a hormonal response different from a nervous response? [2]

	Hormonal response compared to a nervous response
Time taken to respond	
Duration of response	

15. [5 marks] *(2016:2.33)*

A study has recently been carried out to find a way by which Type 1 diabetics may be able to eliminate daily insulin injections. Scientists have investigated the possibility of the use of a particular type of therapy to control blood glucose levels and regulate glucose metabolism.

A small sequence of DNA was injected into the veins of diabetic rats, creating cells that produce insulin. The scientists found that, for up to six weeks, a single injection enabled the diabetic rats to show the same control of glucose levels as that found in healthy rats.

(e) If the insulin-producing cells created by this DNA sequence were functioning in the same way as insulin that is normally produced in the body, what is the stimulus being received that ensures optimal levels of glucose are maintained? [1]

(h) Describe **two** processes controlled by insulin that ensure the maintenance of blood glucose levels. Include the locations in the body where each process occurs. [4]

16. [8 marks] *(2016:2.35)*

Cortisol is a steroid hormone produced and secreted by the adrenal gland.

(a) Is cortisol a water-soluble or lipid-soluble hormone? [1]

(b) Describe the mode of action of a steroid hormone such as cortisol when it reaches a target cell. Include in your answer how the hormone enters the cell and brings about an effect. [4]

Cushing's syndrome, otherwise known as hypercortisolism, is a disease caused by prolonged exposure to excessive levels of cortisol. It is often caused by a tumour growing on the pituitary gland that alters its normal hormonal secretions. Patients with Cushing's syndrome can have many different symptoms, including high blood pressure, weight gain, depression, memory dysfunction and bone and muscle weakness.

A patient with Cushing's syndrome had a large pituitary tumour.

(c) (i) Which lobe of the pituitary gland would the tumour have affected? [1]

(ii) Which pituitary hormone would have had its secretion altered by the tumour? [1]

(d) Treatment for Cushing's syndrome may require the removal of part of the pituitary gland or adrenal gland. Removing the affected endocrine gland may eliminate the high levels of cortisol; however, it can create other problems. Identify **one** such problem. [1]

17. [4 marks] *(2016:2.36)*

Use the table below to complete the following questions.

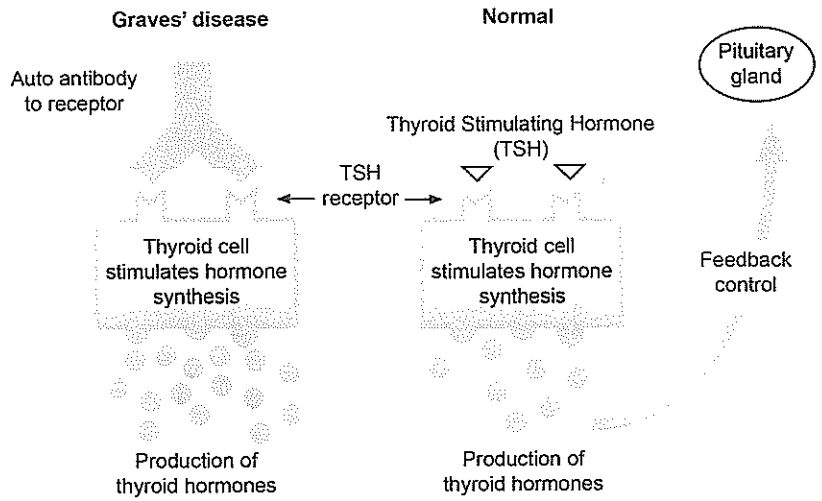
Time (mins)	Level of anti-diuretic hormone (ADH) in the bloodstream (arbitrary units)	Rate of urine production in the kidney (ml/min)
0	7.5	2.1
2	7.5	2.1
4	7.0	2.1
6	17.0	1.5
8	22.0	1.3
10	7.0	1.5
12	7.5	2.1
14	7.5	2.1

(c) (i) Does an increase in ADH levels in the bloodstream increase or decrease the rate of urine production? [1]

(ii) Describe the process that causes the change in the rate of urine production you have stated in part (c)(i). [3]

18. [7 marks] *(2017:2.36)*

Graves' disease is an autoimmune condition affecting the thyroid gland. The diagram below is a representation of how it alters thyroid function.



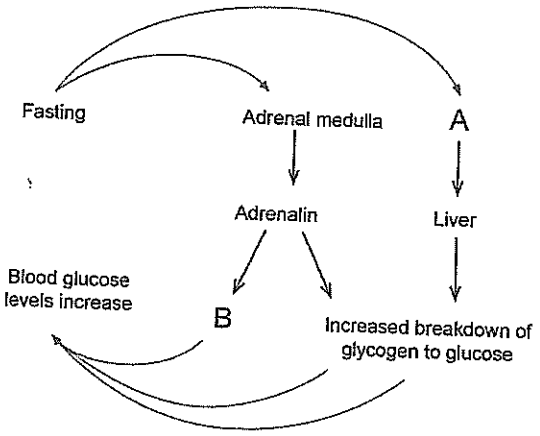
(b) Identify two symptoms you would expect someone with Graves' disease to display. [2]

(d) Describe the process that, under normal circumstances, stimulates the release of TSH from the pituitary gland. [5]

19. [12 marks] *(2018:2.35)*

Before any medical operation involving anaesthetics, individuals are asked to fast (not eat or drink) from at least midnight on the evening before the operation.

The diagram below shows some of the effects of fasting on blood sugar levels.



(a) (i) In the diagram above, what would structure A be? [1]

(ii) In this scenario, structure A releases a hormone that acts on the liver. What name is given to this hormone? [1]

(iii) Adrenalin acts on many structures to help increase blood sugar levels. What process is occurring at B that would contribute to the raising of blood sugar levels? [1]

(iv) What other endocrine gland not shown in the diagram above could possibly be involved in maintaining blood sugar levels? [1]

The dawn phenomenon is a normal, natural rise in blood sugar that occurs in the early morning hours, between roughly 4 am and 8 am. The rise in blood sugar is normally handled with hormones and a healthy person will feel no effects. People with diabetes, however, feel the effects of having high sugar levels in their blood.

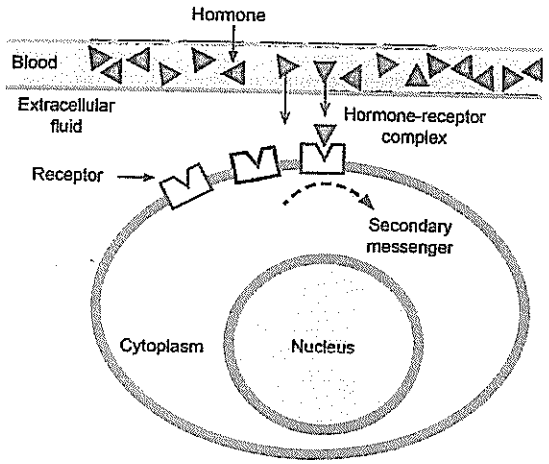
(b) To help lower blood sugar levels, a series of processes occurs in various effectors. Define each of the following terms and name the structures in which each process occurs. [4]

Process	Definition	Structure/s
Glycogenesis		
Lipogenesis		

(c) Explain why a person with diabetes would feel the effects of high blood sugar, such as tiredness and excessive thirst. [4]

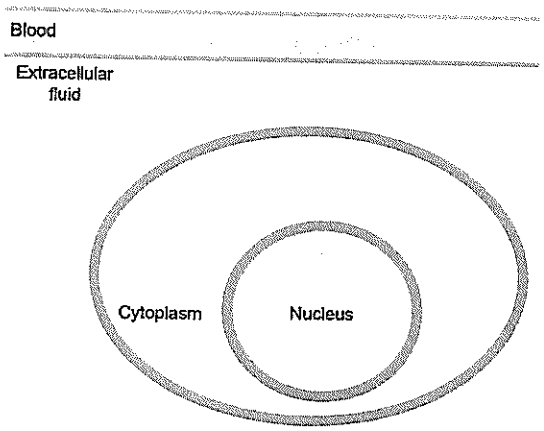
20. [13 marks] *(2018:2.37)*

The diagram below shows one type of hormonal mode of action.

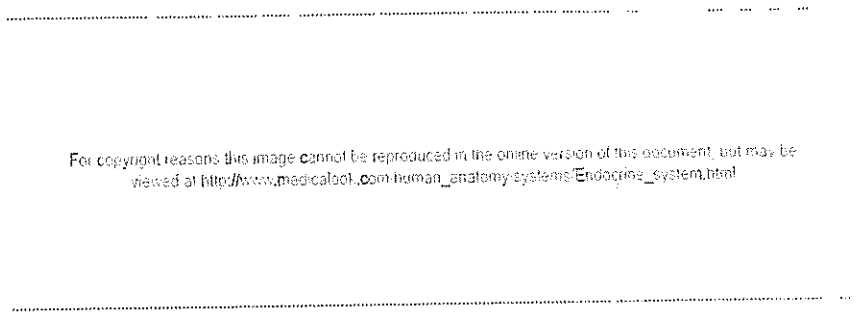


(a) (i) Is the diagram above a representation of the mode of action of a lipid-soluble or a water-soluble hormone? [1]

(ii) In the outline below, draw an annotated diagram of the mode of action of the other type of hormone not shown in the diagram above. [4]



The diagram below shows the glands of the endocrine system.



(b) Using the information in the diagram, identify the appropriate gland using letters 'A'–'I' in the table below. [3]

Description	Letter
the pineal gland is	
aldosterone is released from	
hormones released from this gland target the bones	

(c) (i) State the type and the location of the receptors that detect changes which stimulate the production and release of antidiuretic hormone (ADH). [2]

(ii) Explain how the structures labelled 'B' and 'C' in the diagram are involved in the production and release of ADH. [3]

EXTENDED ANSWER QUESTIONS

21. [20 marks] *(2014:3.42)*

(a) Describe the roles of the hypothalamus and pituitary gland and explain how they work together. [12]

(b) Contrast the modes of action of steroid and amine hormones. [8]

Nervous system

Chapter 2

- structure and function of the divisions of the nervous system can be observed and compared at different levels in detecting and responding to the changes in the internal and external environments including:
  - central-peripheral
  - afferent-efferent
  - autonomic-somatic
  - sympathetic-parasympathetic
- the parts of the central nervous system, including the brain (cerebrum, cerebellum, medulla oblongata, hypothalamus, corpus callosum) and spinal cord, have specific roles in the co-ordination of body functions and are protected by the meninges and cerebro-spinal fluid
- different receptors detect changes in the internal and external environments, including thermoreceptors, osmoreceptors, chemoreceptors and receptors for touch and pain
- the reflex arc comprises of specially structured neurons, including sensory, interneuron and motor neurons, to transmit information from the receptor to the effector to respond rapidly to stimuli
- transmission of nerve impulses is via electro-chemical changes that occur at the generation of the impulse, the propagation of the impulse along the nerve fibre, and the transfer of the impulse across the synapse
- the nervous and endocrine systems work together to co-ordinate functions of all body systems, but differ in terms of:
  - speed of action
  - duration of action
  - nature and transmission of the message
  - specificity of message

Unit 3 Homeostasis and disease

Chapter 1: Endocrine system

MULTIPLE-CHOICE QUESTIONS

1 (2013:07)	(c)	2 (2014:07)	(c)	3 (2014:11)	(c)	4 (2015:04)	(b)
5 (2015:05)	(a)	6 (2015:29)	(d)	7 (2016:11)	(d)	8 (2017:03)	(c)
9 (2017:08)	(c)	10 (2017:09)	(d)	11 (2017:18)	(a)		

SHORT ANSWER QUESTIONS

12 2013:32

(a) (i) E/adrenal gland/adrenal cortex/suprarenal gland **(11 marks)** (1)

(ii) Any one of: (1 mark each – max. 1) (1)
C/parathyroid gland
D/thyroid

(b) A – increases or decreases release of ADH/releases ADH (1)
B – receptor/detect changes/osmotic pressure/osmotic balance/produces ADH/stimulates A to release ADH/acts as modulator (1)

(c) (i) Steroid/lipid (soluble) (1)
(ii) Lipid/phospholipid (1)

(d) 1 mark each – max. 4 (1)
(4)

Description	Marks
2. Receptor attaches (binds) to hormone/hormone-receptor complex forms	1
3. Enters nucleus/ through nuclear pore	1
4. Complex binds to DNA/chromatin receptor sites/activation of genes/activation/ up regulation of genes	1
5. Transcription/production of mRNA/protein synthesis	1

(e) Any one of: (1 mark each – max. 1) (1)
- Protein/amine
- water soluble/hydrophilic/lipophobic/not fat soluble
- Hormone receptor complex forms on the cell membrane/surface (vs inside cytoplasm)
- Enzymes activated within the cytoplasm (vs in nucleus or other organelles)
- Secondary messenger within cytoplasm is activated (vs genes activated)

13 2014:39

(d) (i) Thyroid releases: **(14 marks)** (2 marks)
- Calcitonin into blood
- osteoclasts inhibited/osteoblasts stimulated increase uptake of calcium into the skeleton/ less Ca in the blood

(ii) Parathyroid releases: (2 marks)
- parathormone/parathyroid hormone
- osteoclasts stimulated to release calcium from skeleton/increases calcium absorption from gut (kidney)/increase activation of vitamin D/increase Ca in blood

14 2015:37

(b) (ii) Must NAME ONE hormone, state the target organ for that hormone and a main effect. **(5 marks)** (3)
Any one of:
- Oestrogen (1)
- Uterus/ovaries/breasts/anterior pituitary/hypothalamus (1)
- Repairs uterine lining/endometrium/inhibits FSH/promotes/stimulates LH secretion/ maintains female secondary sexual characteristics (1)

OR

- Progesterone (1)
- Uterus/breasts/anterior pituitary/hypothalamus (1)
- maintains uterine lining/endometrium/inhibits LH/prepares breasts/breast tissue for milk production (1)

OR

- testosterone/androgens (1)
- testes/brain/muscles/bones (1)
- promotes/maintains male secondary sexual characteristics/stimulates sperm production/growth of muscles and bones/musculoskeletal system (1)

(d) MUST be a difference in response (2)
- Time = slower/longer (nerves are faster/take less time to respond)
- Duration = longer lasting (nerve response last)

15 2016:33 **(5 marks)**

(e) Increase in blood glucose levels (1)

(h) 2 marks each for any 2 of the following examples (4)

e.g. 1
- Insulin produced by pancreas targets liver cells
- Liver cells convert glucose to glycogen (glycogenesis)

e.g. 2
- Insulin targets body cells
- Increases permeability of cell membranes to glucose/uptake of glucose

e.g. 3
- Insulin targets body cells generally
- Increases rate of metabolism of glucose

e.g. 4
- Insulin increases rate glucose is converted to lipids
- Lipids stored in adipose tissue

e.g. 5
- Insulin targets liver and muscle
- Increases rate glucose is converted to amino acids

16 2016:35 **(8 marks)**

(a) Lipid-soluble (1)

(b) 1 mark for each dot point (4)
- Being lipid-soluble it moves readily through the mainly lipid membrane by diffusion
- It enters cytoplasm and binds with a receptor protein
- The combined hormone and receptor move into the nucleus
- They activate genes controlling protein synthesis

(c) (i) Anterior (1)
(ii) Adrenocorticotrophic hormone/ACTH (1)

(d) any 1 of the following (1)
- Lower levels of cortisol may reduce ability to cope with long term stress
- Lower levels of cortisol may reduce ability to sufficiently increase blood glucose levels
- Lower levels of cortisol may reduce ability to repair damaged tissue
- Reduce production of other hormones from adrenal glands e.g. adrenaline, nor adrenaline and aldosterone
- Reduce production of other hormones from anterior pituitary e.g. FSH, LH, TSH

17 2016:36 **(4 marks)**

(c) (i) Decrease (1)

(ii) 1 mark for each dot point (3)
- ADH increases membrane permeability to water in the distal convoluted tubules and the collecting ducts of the kidney nephrons
- There is a higher concentration of dissolved solutes in the blood than in filtrate/higher osmotic pressure in blood
- Rate of water reabsorption from the filtrate back into the blood (in the peritubular capillary network) increases

18 2017:36 **(7 marks)**

(b) One mark each for any two points (2)
- Rapid heart beat
- Anxiety, restlessness
- Difficulty in sleeping/insomnia
- Increased sweating
- Raised temperature
- Sensitivity to heat
- Weight loss (unexplained)
- Fatigue
- Increased appetite
- Protruding eyeballs

(d) One mark for each point (5)
- Hypothalamus is stimulated by lower body temperature/lowered levels of thyroxine in blood
- Hypothalamus Produces TSHRF
- Carried by blood vessels to anterior lobe of pituitary (ALP)
- TSHRF stimulates ALP production and release of TSH into blood
- TSH targets the thyroids causing thyroids to produce and release thyroxine

19 2018:35 **(12 marks)**

(a) (i) Pancreas / islets of Langerhans (1)
(ii) Glucagon (1)
(iii) Glycogenolysis (1)
(iv) adrenal cortex (1)

(b) One mark for each dot point (4)

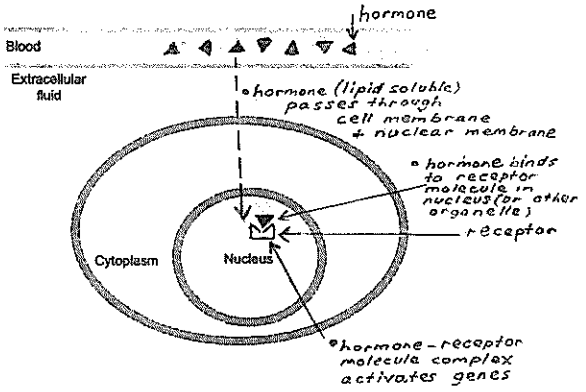
Process	Definition	Structure/s
Glycogenesis	• Metabolic process that converts glucose to glycogen	• Liver and muscles
Lipogenesis	• Production of fat (lipids) from glucose (and other carbohydrates) / formation of fatty acids (and triglycerides) from glucose	• Liver (and adipose tissue)

(c) One mark for each point (4)
- Diabetic is unable to produce enough insulin, or their cells do not respond to insulin.
- Diabetic is therefore unable to convert excess blood glucose to glycogen and store it for use when needed.
- Tiredness is due to insufficient stored glucose that provides energy between meals etc.
- Diabetic produces large volume of urine to remove excess glucose, thirst is due to the excretion of copious amounts of urine, which is largely water.

20 2018:37 **(13 marks)**

(a) (i) Water - soluble (1)

(ii) One mark for each point shown on the diagram (3)
Only one mark for labelling both hormone and receptor (1)



(b) One mark for each dot point in the table (3)

Description	Letter
the pineal gland is	• A
aldosterone is released from	• F
hormones from this gland target the bones	• D

(c) (i) One mark for each point (2)
- Type – osmoreceptors
- Location – hypothalamus

(ii) One mark for each point (3)
- Osmoreceptors in B (the hypothalamus) detect a rise in the osmotic pressure of the blood.
- Nerve impulses initiated by the hypothalamus pass along axons that extend into C (the posterior lobe of the pituitary).
- The nerve impulses cause ADH which is stored in axon terminals in C, to be released into the blood.

EXTENDED ANSWER QUESTIONS

21 2014:42 (20 marks)

(a) Any 12 points for 1 mark each. You must comment on the interaction of BOTH posterior and anterior pituitary glands with the hypothalamus for full marks. (12)
- Hypothalamus controls release of hormones from the pituitary (1)
- Pituitary releases hormones that control many other endocrine glands/ pituitary is the master gland/master endocrine gland (1)
- Hypothalamus regulates many basic bodily functions/regulates body temperature/ water balance/heart rate/named example of a hormone produced with function (eg ADH – water balance/control of osmotic pressure)
- Pituitary hormones regulate many bodily activities/regulates growth/regulate metabolism/ regulate reproductive cycles/named example of a hormone produced with function (eg TSH stimulates thyroid to secrete thyroxine)
- Infundibulum connects the hypothalamus to the pituitary gland
- Hypothalamus works differently for each pituitary lobe

Posterior lobe of pituitary:
- Hormones (ADH and oxytocin) are produced in cell bodies located in the hypothalamus/ not produced by pituitary/posterior lobe not true endocrine gland (does not produce its own hormones) (1)
- Hormones are transported down the axons (neurosecretory cells) of the cells to the posterior lobe (1)
- Hormones stored in posterior lobe (1)
- Hormones released via nervous stimulation (from hypothalamus) (1)

Anterior lobe of pituitary:
- Hormones (secreted by anterior lobe) produced in anterior lobe (1)
- Blood vessels (hypothalamic-hypophyseal portal system) connects hypothalamus with the anterior lobe (1)
- Released via chemical/hormonal stimulation (1)
- Inhibiting and releasing factors secreted by hypothalamus (1)

(b) One mark for each of any four points: (8)

Amine hormones:
- Receptor on the surface/cell membrane
- Stays outside of cell (not lipid soluble)
- Hormone receptor complex forms on the cell membrane/surface/hormone binds to surface receptor
- Enzymes activated within the cytoplasm
- Secondary messenger within cytoplasm is activated
- Faster acting/effects in seconds or minutes

One mark each for any four points:

Steroid hormones:
- Receptor inside cytoplasm
- Moves through cell membrane

- Hormone receptor complex forms inside cytoplasm
- Enzymes activated inside nucleus/organelles
- Genes activated to form a particular protein
- Slower acting/effects in hours or days

Chapter 2: Nervous system

MULTIPLE-CHOICE QUESTIONS

1 (2013:01)	(b)	2 (2013:14)	(c)	3 (2013:15)	(a)	4 (2013:18)	(a)
5 (2013:19)	(c)	6 (2013:29)	(d)	7 (2013:30)	(d)	8 (2014:02)	no solution available
9 (2014:03)	no solution available	10 (2014:04)	(c)	11 (2014:12)	(b)	12 (2014:18)	(b)
13 (2015:14)	(c)	14 (2015:15)	(a)	15 (2015:16)	(c)	16 (2015:25)	(c)
17 (2015:26)	(a)	18 (2016:01)	(b)	19 (2016:02)	(d)	20 (2016:10)	(a)
21 (2016:14)	(b)	22 (2016:15)	(a)	23 (2016:16)	(d)	24 (2016:26)	(a)
25 (2016:30)	(d)	26 (2017:01)	(d)	27 (2017:02)	(a)	28 (2017:13)	(a)
29 (2017:19)	(b)	30 (2017:20)	(b)	31 (2017:23)	(d)	32 (2017:30)	(d)
33 (2018:01)	(c)	34 (2018:06)	(c)	35 (2018:07)	(a)	36 (2018:08)	(b)
37 (2018:12)	(a)	38 (2018:14)	(c)	39 (2018:15)	(a)	40 (2018:17)	(d)
41 (2018:18)	(c)	42 (2018:26)	(d)				

SHORT ANSWER QUESTIONS

43 2013:39 (13 marks)

(a) (i) Motor/efferent/myelinated/effector (1)
(ii) White matter/ascending tracts/descending tracts (1)

(b) (i) Arrow must travel from the skin to the Muscle fibre. (1)
(ii) Any three of: (1 mark each – max. 3) (3)
- Rapid/involves only a small number of neurons
- Automatic/Involuntary/without conscious thought
- Requires a stimulus/not spontaneous
- Stereotyped/happens the same way every time

(iii) Protective/prevents (further) damage/allows removal of danger before being aware. (1)

(c) Skin (1)
Receptors for pain are at the ends of/in the sensory neuron (1)

(d) (i) Arrow head going away from CNS