

Homeostasis

Section One: Multiple-choice

1. The role of the modulator is to
 - a) send information to the receptors.
 - b) receive information and integrate this information into a response.
 - c) detect a change in the body's homeostasis.
 - d) counteract or amplify the initial stimulus.

2. When swimming, how does one lose heat?
 - a) conduction
 - b) convection.
 - c) evaporation.
 - d) radiation.

3. When there is a high osmotic pressure, which of the following **does not** occur?
 - a) the permeability of water at the collecting duct increases.
 - b) water content in the body is high and ADH stops being released.
 - c) the hypothalamus informs the cerebral cortex, and a conscious feeling of thirst occurs.
 - d) the permeability of water at the distal convoluted tubule increases.

4. When blood glucose falls below normal levels, which of the following **does not** occur?
 - a) gluconeogenesis at the liver.
 - b) glycogenolysis at the liver and muscle release glucose into the blood.
 - c) cortisol and glucagon are released.
 - d) metabolism of fat into free fatty acids and glycerol.

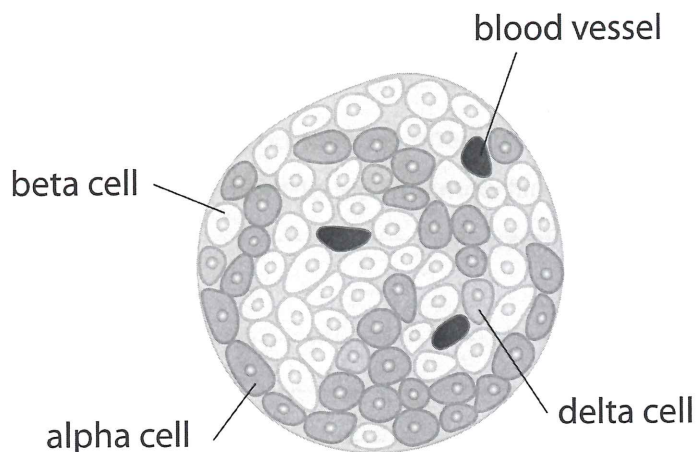
5. Sodium reabsorption at the nephron is directly stimulated by
 - a) cortisol.
 - b) antidiuretic hormone.
 - c) aldosterone.
 - d) vasopressin.

6. Vasoconstriction of skin blood vessels occurs when body temperature falls below 37°C. What is the effect of this?
- a) less heat will be lost via radiation.
 - b) being the largest organ, less blood flow to the skin will mean heat loss is prevented by way of preventing conduction.
 - c) the skin is better insulated, so heat loss is reduced.
 - d) increased convection currents.
7. Hyperthyroidism can be treated by
- a) iodine supplements.
 - b) synthetic thyroid hormones.
 - c) beta blockers.
 - d) none of the above.
8. Positive feedback
- a) involves the body counteracting an original stimulus.
 - b) is the most common form of feedback in the body.
 - c) involves an amplification of the original stimulus.
 - d) is illustrated by the regulation of body temperature.
9. Which of the following is **incorrect** concerning *diabetes mellitus*?
- a) in type I diabetes, the alpha cells in the islets of Langerhans are destroyed.
 - b) in type II diabetes, the body can produce insulin but the cells cannot respond to the insulin.
 - c) following the consumption of a meal by a type I diabetic, the cells remain "starved" of glucose as insulin is not present to allow the cells to receive glucose.
 - d) type I diabetes can be treated via the synthetic hormone insulin, which is injected prior to the consumption of food.
10. Beta blockers
- a) are also known as anti-thyroid drugs, which act by blocking iodine from being used by the thyroid.
 - b) block the symptoms of hyperthyroidism like high heart rate, but do not change the amount of hormone produced.
 - c) block the symptoms of hyperthyroidism like high heart rate, by reducing the amount of thyroid hormone produced.
 - d) are administered to sufferers of hypothyroidism.

11. ADH secretion is increased by all of the following **except**
- decreased extracellular volume.
 - increased fluid loss.
 - increased fluid intake.
 - increased fluid osmolarity.
12. When body temperature increases, what three mechanisms are employed to regain normal body temperature?
- secretion of adrenaline and noradrenaline, sweating and behavioural mechanisms.
 - secretion of thyroxine, vasodilation of skin blood vessels, and behavioural mechanisms.
 - shivering, vasoconstriction of skin blood vessels and behavioural mechanisms.
 - sweating, vasodilation of skin blood vessels and behavioural mechanisms.
13. Hypothyroidism alters the function of many organ systems. Which of these effects is absent in individuals with hypothyroidism?
- Review Page 20 of the Coursebook.*
- lack of energy (fatigue).
 - increased appetite.
 - slow heart rate.
 - goitre.
14. Chemoreceptors will primarily detect which of the following in response to a decrease in blood pH?
- carbonic acid.
 - oxygen.
 - hydrogen ions.
 - carbon dioxide.
15. When carbon dioxide levels increase above the normal range, what will directly counteract this change? The
- diaphragm and intercostal muscles will increase the rate of inspiration and expiration only.
 - diaphragm and intercostal muscles will increase the rate and depth of inspiration and expiration.
 - diaphragm and intercostal muscles will decrease the rate of inspiration and expiration only.
 - kidneys will rapidly reverse the reduced pH by buffering the blood.

16. What is insulin's effect on adipose tissue?
- a) fat stores become more active and store glucose as triglycerides (fat).
 - b) fat stores are released into the blood as free fatty acids and glycerol.
 - c) fat stores are unaffected by insulin. They are only affected by glucagon.
 - d) Statements a) and b) are correct.
17. Glucagon targets the liver. Which of the following explains its effect(s) on the liver?
- a) amino acids and fats are converted to new glucose molecules (gluconeogenesis) and subsequently released into the blood.
 - b) the production of glycogen occurs via glycogenesis.
 - c) glycogen is converted to glucose (glycogenolysis) and subsequently released into the blood.
 - d) amino acids and fats are converted to new glucose molecules (gluconeogenesis) and subsequently released into the blood AND glycogen is converted to glucose (glycogenolysis) and subsequently released into the blood.
18. Aldosterone indirectly causes water reabsorption. What is its primary effect on the nephron?
- a) aldosterone causes sodium and potassium reabsorption at the nephron.
 - b) aldosterone causes sodium excretion and potassium reabsorption at the nephron.
 - c) aldosterone causes sodium and potassium excretion at the nephron.
 - d) aldosterone causes sodium reabsorption and potassium excretion at the nephron.
19. The respiratory centre controlling breathing is
- a) located in the cerebral cortex.
 - b) located in the medulla.
 - c) sensitive to changes in oxygen.
 - d) the main location of peripheral chemoreceptors.
20. Which of the following is **not** an example of a negative feedback control system?
- a) stretch reflex.
 - b) blood clotting.
 - c) blood glucose control.
 - d) body temperature control.

21. How does sweating cool the body?
- a) sweating moves excess body heat to the body's surface in water droplets. Because the skin is in contact with atmospheric gas, heat is lost via conduction.
 - b) sweating moves excess body heat to the body's surface in water droplets. When the water droplets evaporate, the heat dissipates and produces a cooling effect on the body.
 - c) once excess heat is moved to the body's surface trapped in water droplets, the water boils and the heat dissipates.
 - d) sweating cools the body by dilating blood vessels in the skin.
22. When blood glucose falls below normal levels, which of the following **does not** occur?
- a) gluconeogenesis at the liver.
 - b) glycogenolysis at the liver and muscle.
 - c) cortisol and glucagon are released.
 - d) glycogenesis at the muscle.
23. Hypothyroidism can be caused by
- a) radioactive iodine therapy.
 - b) Graves' disease.
 - c) an over-production of thyroid hormones from the thyroid gland.
 - d) excessive iodine consumption.
24. The endocrine structure pictured below is a section of the



- a) adrenal gland.
- b) pancreatic islet.
- c) pancreatic islet with type I diabetes.
- d) thyroid gland.

Section Two: Short Answer

Question 25.

(20 marks)

Endocrine hormones are released from the cells of an endocrine gland into the bloodstream to induce a specific effect on cells of the target organ. Thyroid hormones are kept under tight homeostatic control.

a) What are **two stimuli** that would result in the release of thyroid hormones? (2 marks)

b) What are **two differences** between the thyroid hormones, T3 and T4? (2 marks)

c) The thyroid is regulated by the hypothalamic-pituitary-thyroid axis. Explain the relationship between these **three endocrine glands**. (5 marks)

d) Explain whether or not the thyroid gland is under positive or negative feedback. Ensure your answer indicates the exact components of the hypothalamic axis that are under negative or positive mechanisms. (2 marks)

When dysregulation of the thyroid occurs, disease can result. Thirty-three-year-old Karen consumes soy milk daily. The brand of soy milk she uses is later found to have toxically high levels of a sea vegetable known as Kombu. Sea vegetables like Kombu have high iodine concentrations. Karen visits her GP, and a blood test is carried out.

e)

i) What condition is Karen likely to be diagnosed with? (1 mark)

ii) Explain **two observations** in Karen's blood results that you expect to see, along with the cause of these findings. (3 marks)

iii) A physical exam is also carried out. Explain whether you would expect to find goitre. (2 marks)

iv) What would be **three treatment options** that you would recommend to Karen? (3 marks)

Question 26.

(23 marks)

a) How is digested energy stored after eating?

(2 marks)

b) How are stores of energy mobilised following a period of fasting?

(2 marks)

Blood glucose levels are tightly regulated.

c)

i) What is the normal range for blood glucose?

(1 mark)

ii) Why is a tight control of blood glucose levels necessary?

(1 mark)

d) Pancreatic hormones are the major chemical messengers that regulate blood glucose. Adrenal hormones also regulate blood glucose. Complete the table below. (6 marks)

Hormone	Stimulus	Main effect
Adrenaline		
Cortisol		
Insulin		

e) Type I and type II diabetes are distinctly different conditions. Yet, there exists an overlap in the presenting symptoms. Explain the following shared symptoms.

i) Polyuria (1 mark)

ii) Polydipsia (1 mark)

iii) Polyphagia (1 mark)

f) Complete the table below. (8 marks)

Effect produced	Definition of effect	Hormone causing this effect	Organ where the effect is produced
	The lysis or breakdown of glycogen into glucose that does not result in an increase in blood glucose		
Lipogenesis			
	Increased synthesis of glucose from fats	Cortisol	

Question 27.

(20 marks)

James plays the first game of his Summer Soccer League in forty-degree heat. As a result, his body temperature increases above 37°C.

- a) Which structure in the body detects the increase in body temperature? (1 mark)

- b) Where are the structures that detect this increase in body temperature located? (1 mark)

- c) The humidity is low on the day that James exercises. Explain the primary method of heat loss his body would use. (3 marks)

- d) By the end of the soccer game, James is thirsty. Explain the homeostatic mechanisms involved in the thirst reflex. (5 marks)

*Review Page 17-18
of the Coursebook.*

20 marks)

result, his

e) Two hormones that affect James' osmolarity would circulate within his bloodstream. Identify the two hormones, and complete the table below. (10 marks)

	Hormone One	Hormone Two
Name of hormone		
Site of release		
Target organ		
Function		
Effect on osmotic pressure		

(1 mark)

d?

(1 mark)

od of heat

(3 marks)

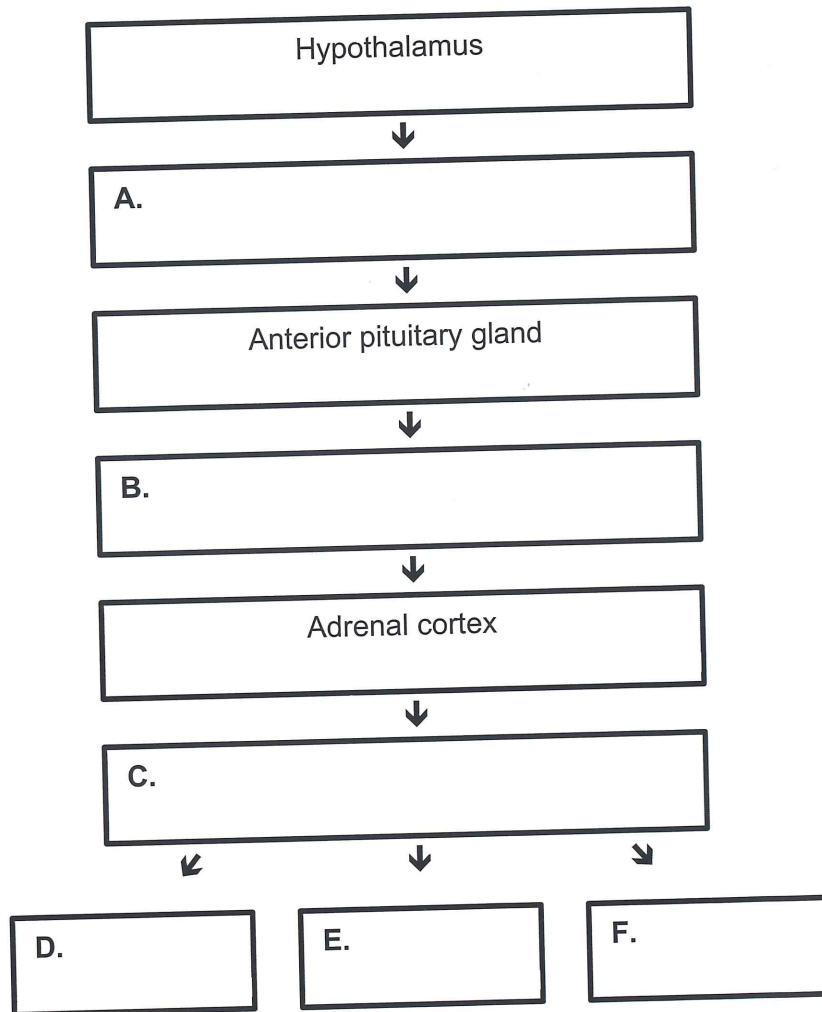
chanisms

(5 marks)

Question 28.

(10 marks)

The following flow chart indicates the hypothalamic-pituitary-adrenal axis.



- a) 'A', 'B' and 'C' are hormones. Label the hormones in the chart. (3 marks)
- b) The final hormone 'C' produces three physiological effects (D, E, and F) that result in changes in glucose metabolism. Label the effects in the chart. (3 marks)
- c) On the chart, annotate the feedback that Hormone 'C' has on Hormone 'B'. (1 mark)
- d) On the chart, annotate the effect that Hormone 'C' has on Hormone 'A'. (1 mark)

The pancreas, like the adrenal gland, is an endocrine gland that releases hormones. The pancreas releases glucagon and insulin that also result in changes to glucose metabolism.

e) What lifestyle conventions mean we require a rigid control of blood glucose? (2 marks)

Question 29.

(14 marks)

A healthy person donates blood.

- a) Explain what this fall in blood volume will do to blood pressure. (2 marks)

- b) Which reflex will be activated by the fall in blood pressure? Include in your answer how the change in blood pressure will be detected. (2 marks)

- c) Explain the effect that the reflex will have on the heart and blood vessels. (4 marks)

- d) Will blood flow to the brain be affected? (1 mark)

- e) A second person runs a marathon and loses water through sweating. What physiological mechanism beginning in the pituitary gland will lead to a rapid change in kidney function to counteract dehydration? Describe this mechanism. (5 marks)

Section Three: Extended Answer

Question 30.

(20 marks)

A fourteen-year-old female is required to take an oral glucose tolerance test in order to determine if she has diabetes. As part of the test, she is required to fast overnight for at least eight hours. In this time, she cannot consume any food or caffeinated drinks but can consume water.

- a) Explain the homeostatic mechanism that operates in response to her fasting. (10 marks)

The blood sample is analysed, and the patient is then given a diagnosis of hyperglycaemia. The diabetes nurse is required to educate the patient on type I and type II diabetes.

- b) Compare and contrast type I and type II *diabetes mellitus* in terms of:

- Symptoms
- Causes
- Risk factors
- Treatment options
- Side effects/complications of the condition
- Ethical issues of the treatment options

(10 marks)

Question 31.

(20 marks)

Homeostatic mechanisms function to return body systems to their 'optimal level.' Many homeostatic responses often require the input of a brain structure to analyse incoming information and determine a response.

a) Describe the location and role of the

- Pneumotaxic centre in the control of respiration.
- Cerebral cortex in the regulation of thirst.
- Vasomotor centre when blood pressure is low.

(6 marks)

Blood glucose is under homeostatic control since physical activity varies throughout the day, and, as humans, we have an intermittent supply of food. As such, blood glucose is controlled via endocrine glands and their chemical secretions, known as hormones.

b) Describe how the endocrine pancreas and adrenal glands function to regulate blood glucose levels.

(14 marks)

*Review Page 13 of the
Coursebook.*