

Unit 3 Biology

Revision Booklet 4

Topics

Endocrine System

Cell Signalling

Hormones

&

Homeostasis

Name:

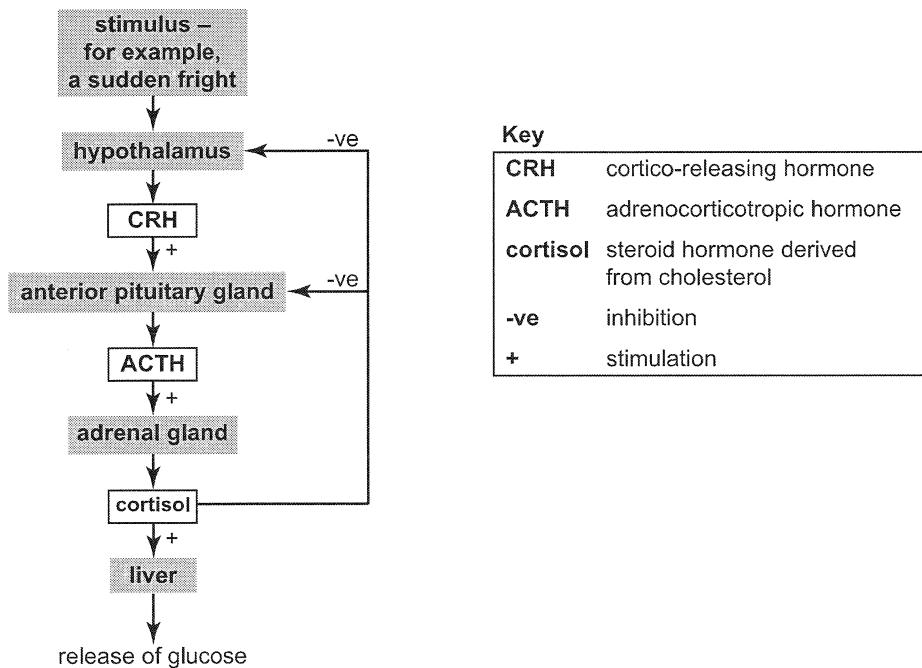
Question 6 2011

The hypothalamus, located within the brain, consists of neurons that produce hormones. The hormones are transported along the neural axon eventually being emptied into blood vessels at the far end of the neural axon.

a. Explain how this form of transport compares with that shown by a typical neuron.

2 marks

The anterior pituitary gland, also located in the brain, absorbs the hormones delivered by these blood vessels. The anterior pituitary gland itself secretes a hormone that targets the adrenal glands that are located on top of the kidneys. A pathway is shown below.



Key	
CRH	cortico-releasing hormone
ACTH	adrenocorticotrophic hormone
cortisol	steroid hormone derived from cholesterol
-ve	inhibition
+	stimulation

b. Explain in what ways the anterior pituitary gland acts as both receptor and effector in this pathway.

Receptor _____

Effector _____

2 marks

The adrenal glands produce the 'stress' hormone, cortisol. Short periods of stress lead to a burst of cortisol production. Elevated levels of cortisol are detected by the hypothalamus and anterior pituitary gland.

- c. Explain how the actions of cortisol regulate levels of blood glucose.

3 marks

Total 7 marks

Question 3 20/1

Herbivores can cause damage to the leaves, flowers and fruits of plants. In response, a plant may drop the affected part. This process of 'dropping off' parts by a plant is called abscission.

- a. Name the plant hormone responsible for plant abscission.

1 mark

Some *Physalis* plants abscise fruit containing larvae of a moth predator, *Heliothis subflexa*. To complete development, *H. subflexa* larvae need to feed off more than one fruit. For this to occur, larvae from dropped fruit must relocate and climb onto a new host plant.

An experiment was performed to determine the effectiveness of the abscission strategy for plants.

Two different species of *Physalis* were used.

Species 1: *P. pubescens* – a low shrub with drooping, spreading branches

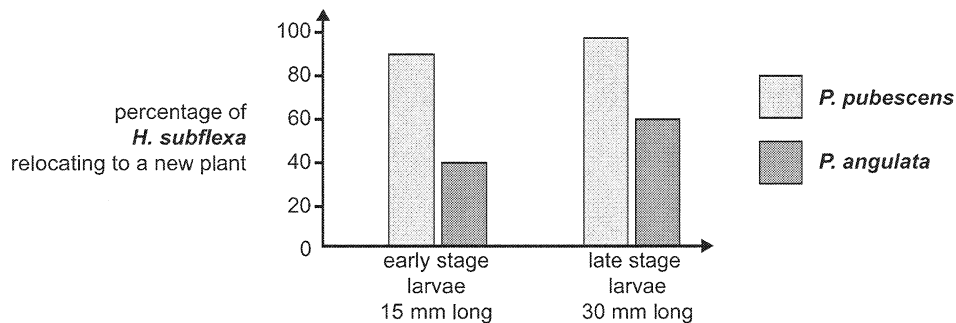
Species 2: *P. angulata* – a tall shrub with upright stem and branches

Different sized larvae were used.

- larvae at early stage development – 15 mm long
- larvae at late stage development – 30 mm long

Each species of plant was tested with two different sized larvae.

The results obtained are summarised in the following graph.



- b. i. Which species of *Physalis* is more susceptible to relocation by *H. subflexa* larvae?

- ii. From the information given suggest a reason why.

1 + 1 = 2 marks

A farmer decided she would reduce the number of *H. subflexa* in her cotton crop by installing a pheromone trap in the corner of the field.

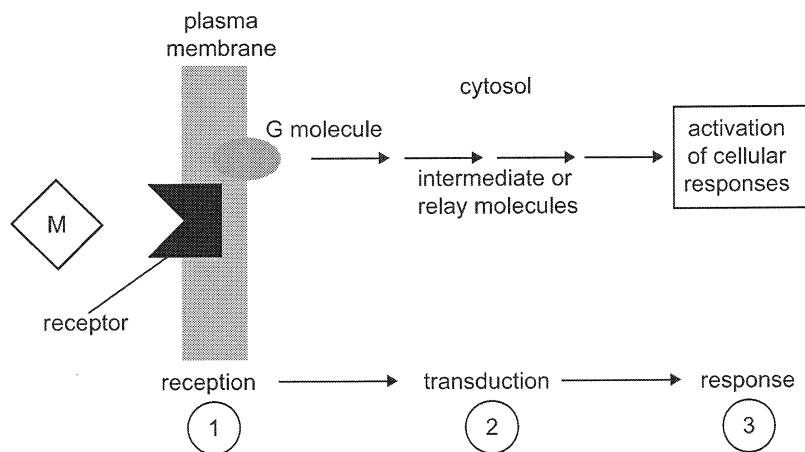
c. i. What is a pheromone?

ii. How would the presence of the trap reduce the *H. subflexa* infestation in the crop?

1 + 1 = 2 marks

Question 2 2006

A general signal transduction pathway is shown in the following figure. Some of the parts of the pathway are labelled.



a. **M** represents a compound which could initiate signal transduction. Give an example of compound **M**.

1 mark

b. The initiation of signal transduction in a cell is controlled and specific. Explain what feature ensures this specificity.

1 mark

c. What type of molecules generally act as intermediate or relay molecules?

1 mark

d. Name a response in the cell which may occur after signal transduction initiated by the compound **M** you have named in **part a**.

1 mark

Total 4 marks

SECTION B – continued
TURN OVER

SECTION B – Short answer questions

Instructions for Section B

Answer this section in **pen**.
 Answer **all** questions in the spaces provided.

Question 1

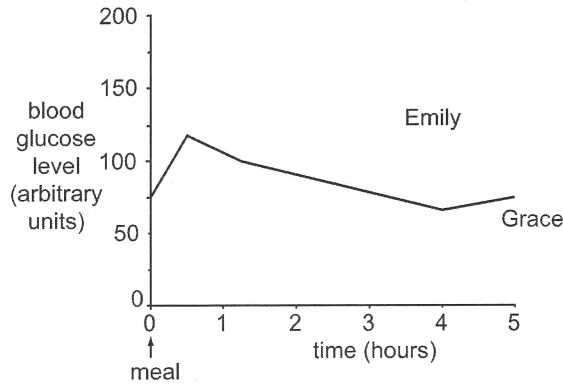
(2010)

a. What is the general function of a hormone?

1 mark

Blood glucose levels are controlled by a homeostatic mechanism.

Two females of the same age and similar body structure were each given an identical meal. The following graph shows the level of blood glucose in each female for the five-hour period after eating the meal.



b. i. Explain whether Emily or Grace had a defect in the blood-glucose homeostatic mechanism. Refer to at least two parts of the graph to support your answer.

Name of female _____

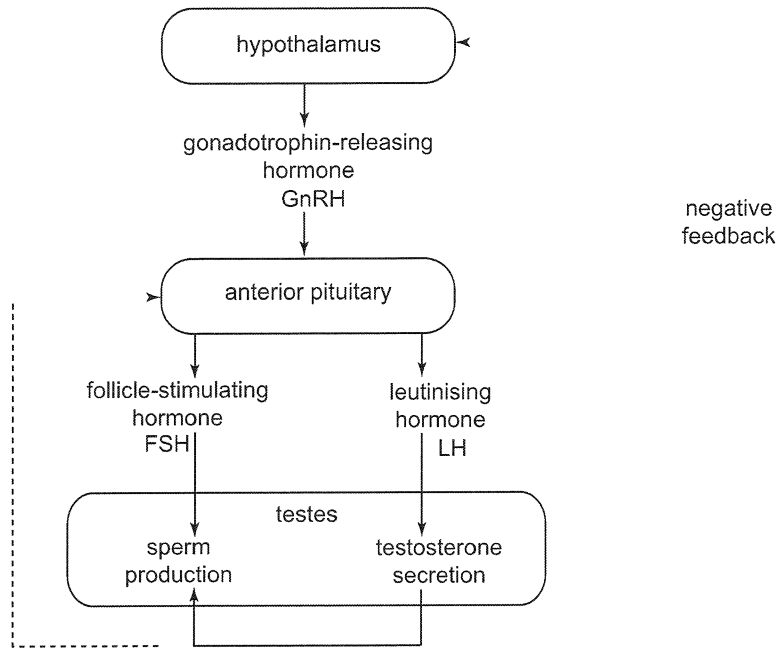
Explanation _____

Consider Grace.

ii. Explain the small rise in her level of glucose between four and five hours after the meal.

2 + 1 = 3 marks

The following diagram outlines the hormonal control of the testes.



If a tumour develops in the anterior pituitary of a male, normal production of follicle-stimulating hormone (FSH) and leutinising hormone (LH) is inhibited.

c. i. What effect would this have on the fertility of the person concerned?

ii. Explain what effect the presence of the tumour in the anterior pituitary would have on the production of gonadotrophin-releasing hormone (GnRH) by the hypothalamus.

Circle your choice and explain your answer.

fall in production

rise in production

Explanation

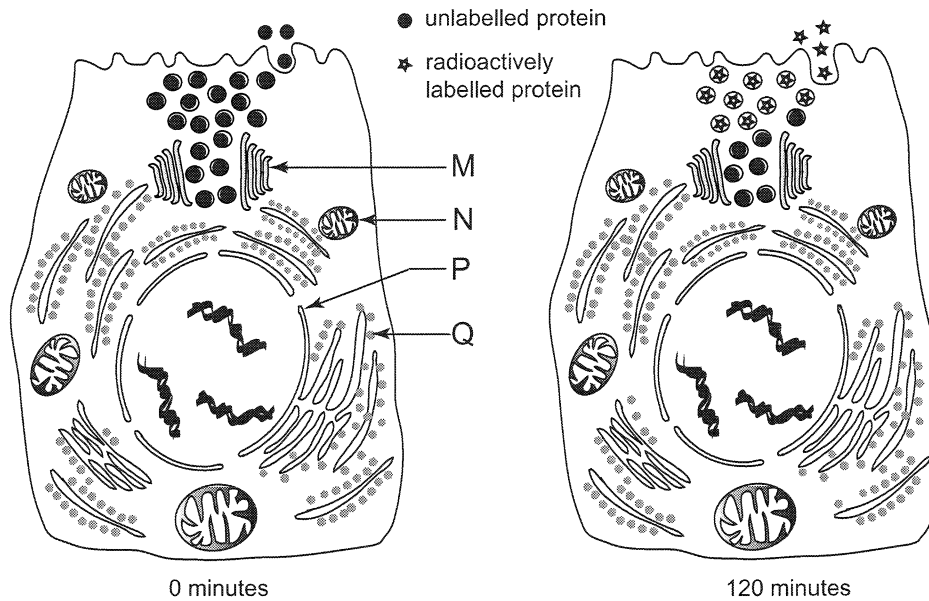
1 + 2 = 3 marks

Total 7 marks

Question 5 (2010)

Human pancreatic cells produce proteases that act on the contents of the small intestine. An experiment was performed to track the pathway of protease synthesis and release. This involved feeding pancreatic cells for a brief period with amino acids that had been radioactively labelled. These amino acids can be tracked over time. Images were taken immediately (0 minutes) after feeding the cells, then 3, 20 and 120 minutes later.

The results at 0 and 120 minutes are shown below.



At the 3 and 20 minute intervals the radioactive amino acids were observed to be at organelles.

a. Name and describe the functions of organelles **M** and **N**.

i. Organelle **M** _____

Function _____

ii. Organelle **N** _____

Function _____

2 + 2 = 4 marks

- b. Which of the letters, **M**, **N**, **P** and **Q**, indicates an organelle where the radioactive amino acids would be expected to be detected after three minutes?

1 mark

A hormone (hormone Y) travels from its site of production to a cell (cell X) elsewhere in the body.

- c. Explain how the characteristics of hormone Y will influence the way in which it initiates signal transduction with cell X.

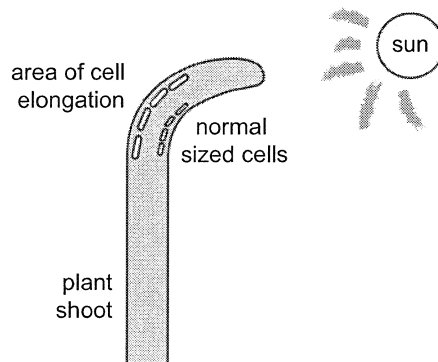
2 marks

Total 7 marks

Question 7

2006

The diagram below shows a young plant growing with a sufficient supply of nutrients in normal light.



- a. What type of growth response is being shown by the plant?

1 mark

Some VCE students were asked to perform an experiment to test the effect of lack of sunlight on the growth of a sample of seeds of the same plant.

- b. i. Name one controlled (fixed) variable that students should keep constant.

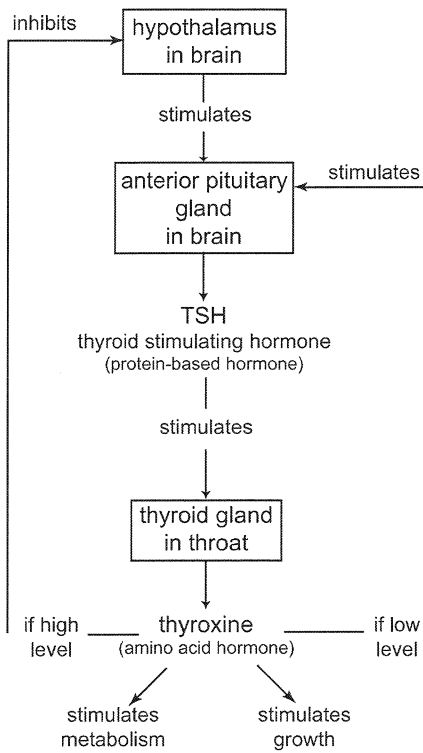
- ii. Name the one experimental (independent) variable that students should change.

1 + 1 = 2 marks

**SECTION B – continued
TURN OVER**

Question 5 2009

Thyroid hormone, thyroxine, is produced by the thyroid gland, a gland in the throat region. The following diagram summarises the production and action of thyroxine in the body.



- a. How does TSH travel to the thyroid gland?

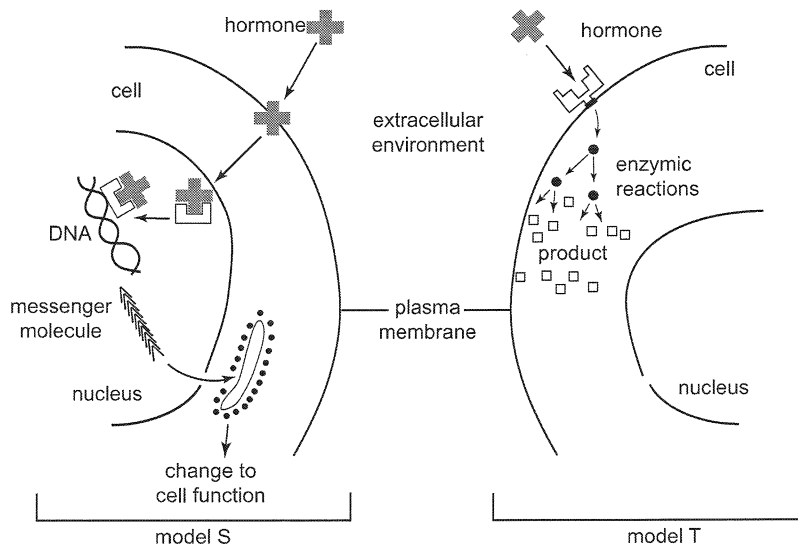
1 mark

The system shown in the diagram above is called a negative feedback system.

- b. Write a general statement that outlines the principle of a negative feedback system.

1 mark

The two diagrams shown below are general models for signal reception and transduction.



c. i. Which model, model S or model T, best corresponds to the mechanism of TSH?

ii. Explain your choice.

1 + 1 = 2 marks

Testes and brain tissue do not respond to thyroxine.

d. What is the most likely explanation for this condition?

1 mark

Question 8

2008

- a. Name a homeostatic system you have studied this year. Draw a labelled diagram outlining how the system operates.

3 marks

Copper is an essential trace element for most organisms. Over time, organisms have developed complex homeostatic mechanisms to regulate the uptake, distribution and removal of copper. These mechanisms, coordinated by the nucleus, involve the metal transcription factor (MTF-1).

In the fruit fly, *Drosophila*, MTF-1 acts as an activator under both high and low copper concentrations. Under high copper concentrations, MTF-1 activates metallothioneins that prevent additional copper entering the cell. Under low copper concentrations within a cell, MTF-1 activates the copper importer Ctr1B which enables more copper to enter the cell from the surroundings.

- b. What is the stimulus for homeostasis of copper?

1 mark

- c. Suggest why the level of copper in the cells of an organism is controlled.

1 mark

Total 5 marks

SECTION B – Extended response questions**Instructions for Section B**

Answer this section in **pen**.

Answer all questions in the spaces provided.

Question 1 2007

- a. What is the general name for the chemicals that act as sex attractants in many insects?

1 mark

A hormone was produced in one cell, entered the blood stream and travelled to two groups of cells adjacent to each other. One group of cells responded to the hormone but the neighbouring group did not.

- b. What is the most likely reason for this difference in response by cells to the same hormone?

1 mark

Consider one hormone you have studied this year that is transported through the blood to one or more types of cells.

- c. i. Name the hormone.

- ii. Name the tissue or gland that produces the hormone.

- iii. Explain what the term signal transduction refers to.

- iv. What is the outcome as a result of signal transduction in the cells that were targets for the hormone you chose in **part c.i.** of this question?

1 + 1 + 1 + 1 = 4 marks

Total 6 marks

Question 5 2006

Examine the following table.

Summary carbon dioxide and oxygen levels in air and water

Chemical	Solubility in water	Concentration in air
Oxygen	poor	~20.0%
Carbon dioxide	high	0.03%

The respiratory gases, oxygen and carbon dioxide, are under homeostatic control. The gas in shorter supply is normally regulated because it is the limiting factor. For instance, aquatic organisms, like fish, regulate levels of oxygen. Terrestrial organisms, like mammals, regulate levels of carbon dioxide.

A build-up of carbon dioxide in the blood can cause the pH of the blood to become acidic. Mammals are more susceptible to this build-up of carbon dioxide than fish. Receptors in the brain and arteries detect such changes in carbon dioxide and pH and stimulate ongoing breathing.

- a. Why are mammals more susceptible to a build-up of carbon dioxide than fish?

1 mark

- b. Consider a mammal that experiences an increase in its blood pH. Name one effector and suggest what its response would be?

2 marks

Hyperventilation is the practice of breathing deeply and rapidly to remove carbon dioxide from the lungs. This results in a significant lowering of the amount of carbon dioxide in the blood. It is extremely dangerous and can cause a person to become unconscious.

- c. Explain why underwater pearl divers, who use no special diving apparatus, would hyperventilate.

1 mark

- d. Why does hyperventilating cause a person to become unconscious?

1 mark

Total 5 marks