

Hormonal Communication

Model Answers 2

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Communication, homeostasis and energy
Topic	Hormonal communication
Booklet	Model Answers 2

Time allowed: 43 minutes

Score: /32

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E
>69%	56%	50%	42%	34%	26%

Question 1

(a) A doctor arranged for a 59-year-old patient to have a series of blood tests. One of these tests was to determine the patient's 'fasting blood glucose' concentration.

- The result of this test indicates whether or not the patient's blood glucose concentration is being regulated within the normal range.
- The validity of the result relies on the patient not having eaten for at least eight hours before the test.
- The patient confirmed to the doctor that he had not eaten since the previous evening.

(i) What condition was being tested for in this 59-year-old patient? [1]

Diabetes

(ii) Why was it important that the patient had not eaten for at least eight hours before the test? [1]

Time is needed for blood glucose levels to be restored to normal

(iii) The result of the patient's fasting blood glucose test was 7.0 mmol dm^{-3} .

The upper limit for 'normal' blood glucose concentration is considered to be 5.9 mmol dm^{-3} .

Calculate the percentage by which this patient's blood glucose concentration is higher than the upper limit for normal concentration.

Show your working. Give your answer to one decimal place. [2]

$$7.0 - 5.9 = 1.1 \quad \text{this the increase in blood glucose}$$

$$\frac{1.1}{5.9} = 0.186 \quad \text{divided by the original}$$

$$\times 100 = 18.6\% \quad \text{x 100 to 1 dp}$$

(b) The patient was sent for a further blood test, known as the haemoglobin A1C (HbA1C) test.

- Glucose combines with haemoglobin in the bloodstream to form a 'glycosylated haemoglobin' molecule, HbA1C.
- The concentration of HbA1C is directly proportional to the mean concentration of glucose in the blood over an eight to twelve week period.

Suggest why a single HbA1C test cannot indicate accurately the mean blood glucose concentration for a period longer than twelve weeks.

[2]

- This blood test cannot be used accurately for periods longer than 12 weeks because red blood cells, otherwise known as erythrocytes, only have a limited lifespan of 8 to 12 weeks
- The glycosated haemoglobin is contained within the red blood cells, so it will not appear after eight weeks as the red blood cells will be dead

(c) The result of the patient's fasting blood glucose test showed a blood glucose concentration higher than the normal range even though the patient had not eaten food for at least eight hours before providing a blood sample.

The result of the patient's HbA1C test indicated that his mean blood glucose concentration had been within the normal range for the previous eight to twelve weeks.

Suggest an explanation for the patient's high value for the **fasting blood glucose test**. [1]

The high fasting blood glucose test may have been too high because the patient had had a drink containing sugar or, the patient was nervous and had started to secrete adrenaline, which increases blood glucose

(d) Another patient shows severe symptoms of unregulated blood glucose concentration. Under certain circumstances this condition may need to be treated with glucagon injections.

(i) Under what circumstances might this patient need to be given a glucagon injection?

[1]

- The patient might need to be given a glucagon injection if the blood glucose level falls dangerously low
- They could be given a glucagon injection if they cannot produce their own glucagon

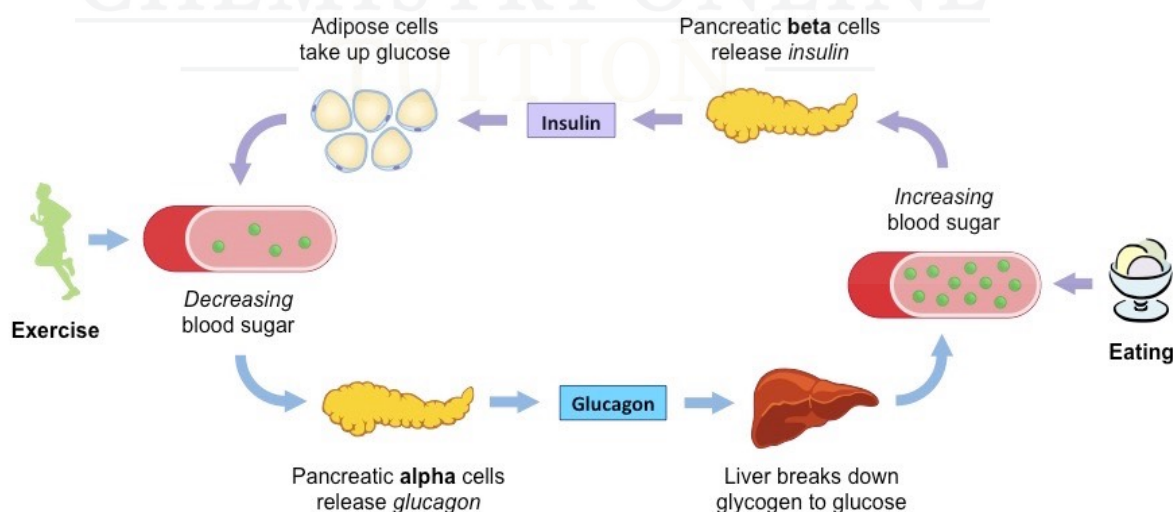
(ii) Describe how glucagon is involved in the regulation of blood glucose concentration in a person who is able to regulate their blood glucose concentration correctly.



In your answer, you should use appropriate technical terms, spelled correctly.

[5]

- Glucagon is released by the alpha cells in the islets of Langerhans in the pancreas
- Glucagon stimulates the liver to convert glycogen to glucose a process known as glycogenesis
- Glucagon also stimulates the liver to convert lipids to glucose or gluconeogenesis
- The respiration of fatty acids is stimulated
- Glucagon also inhibits the secretion of insulin



[Total: 13]

Question 2

Organisms respond to changes in their internal environment. These responses are controlled by nervous and hormonal mechanisms.

- (a) The concentration of blood glucose is regulated by hormones.

Complete the passage below, using the **most suitable** term in each case.

The pancreas releases hormones directly into the blood and these regulate the concentration of blood glucose. The pancreas, therefore, acts as an

..... **endocrine** gland.

When the blood glucose concentration increases, insulin is released from the beta cells in the regions of the pancreas known as the

..... **Islets of Langerhans**

A different hormone, glucagon, is released from the alpha cells of the pancreas and this hormone causes **glycogen** to be broken down into glucose,

in a process known as **glycogenolysis** [4]

- (b) The heart rate is controlled by both nervous and hormonal mechanisms.

- (i) Name **one** hormone which will **increase** the heart rate. [1]

- A hormone which will increase heart rate could be adrenaline or thyroxine

Adrenaline is also known as epinephrine (used in 'Epi pens')

- (ii) State **one** way in which the nervous system **decreases** the heart rate.

- Impulses from the parasympathetic or vagus nerve will decrease heart rate

A parachute (hopefully) slows you down when you jump out of a plane, so

parasympathetic stimulation slows down heart rate!

[1]

[Total: 6]

Question 3

(a) The pancreas is an unusual gland as it is both an endocrine and an exocrine gland.

Fig. 4.1, **on the insert**, shows a group of cells in the pancreas.

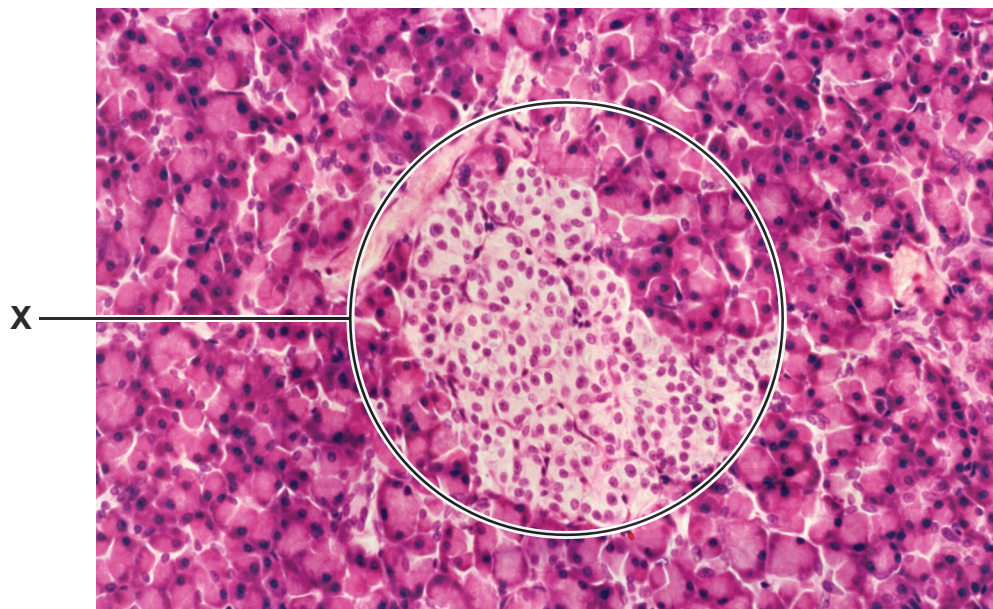


Fig. 4.1

(i) State the name given to the group of cells labelled X.

[1]

Islets of Langerhans

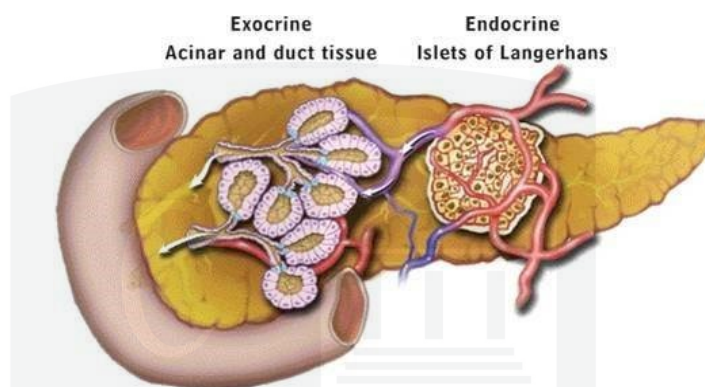
(ii) Describe the different ways in which the pancreas acts as both an endocrine and an exocrine gland.



In your answer, you should use appropriate technical terms, spelt correctly. [5]

- The pancreas act as an endocrine gland as it releases a hormone directly into the bloodstream
- Beta cells secrete insulin
- Alpha cells secrete glucagon
- The alpha and beta cells together detect and monitor the concentration of glucose in the blood stream

- As an exocrine gland the pancreas secretes enzymes into a duct
- This is triggered by both nervous and hormonal stimulation
- Secretions from the pancreas pass into the small intestine
- Enzymes such as lipase and amylase are both found in the secretions from the pancreas



(b) One particular type of cell in the pancreas is responsible for secreting insulin. The various events involved in the secretion of insulin are listed below.

A	Glucose is phosphorylated and metabolised to produce ATP
B	Potassium channels open, allowing potassium ions to diffuse out of the cell
C	The change in voltage across the membrane causes calcium channels to open
D	Glucose enters the cell
E	The movement of ions results in a potential difference across the cell surface membrane of -70 mV
F	Calcium ions diffuse into the cell
G	The presence of extra ATP causes the potassium channels to close
H	The membrane potential changes to -30 mV
J	The calcium ions cause the vesicles to fuse with the membrane and release insulin

Complete the following list by placing the events in the correct order.

B **E** **D** **A** **G** **H** **C** **F** **J**

[4]

- (c) (i) State **two** advantages of treating **Type 1** diabetes by using insulin that has been produced by genetically modified bacteria rather than insulin that has been extracted from pigs.

[2]

- Insulin produced by genetically modified bacteria provides a limitless supply
- It is cheaper
- It is more ethical and does not involve any cruelty to pigs
- Its quality is high and it is genetically identical to human insulin
- There is no allergic reaction

- (ii) A potential treatment for Type 1 diabetes is the use of stem cells.

State an advantage of this form of treatment compared to treatment using insulin. [1]

- Stem cells have the ability to cure the condition
- There would be no need for repeated treatments

[Total: 13]

CHEMISTRY ONLINE
— TUITION —