Hormonal Communication Model Answers 1

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Communication, homeostasis and energy
Торіс	Hormonal communication
Booklet	Model Answers 1

Time allowed:	51 minutes
Score:	/38
Percentage:	/100 MISTRY ONLINE
Grade Boundaries:	

A*	А	В	С	D	E
>69%	56%	50%	42%	34%	26%

Banting and Best pioneered experiments into the functions of the pancreas.

In one experiment, they removed the pancreas of dogs. Shortly afterwards, the dogs developed the symptoms of diabetes.

- Banting ground up the removed pancreas to produce an extract.
- He called the extract "isletin".
- The isletin was then injected into dogs that had had their pancreas removed.
- He then tested the blood glucose concentration.

The graph below is a summary of the results.



but this experiment doesn't prove it

D

Only 1

The hormone ecdysone is synthesised in the prothoracic glands found in the upper thorax of some invertebrates and is released into haemolymph. It is then transported to cells near the surface of the body and causes the loss of the exoskeleton so that a new exoskeleton can form.

Which of the following statements explains how ecdysone is able to act on cells near the surface of the body?

- 1 Ecdysone is synthesised by specialised neurosecretory cells.
- 2 Ecdysone is soluble in haemolymph because it is a polar molecule.
- 3 Ecdysone is complementary to cell surface receptors on cells throughout the body of some invertebrates.
- A. 1, 2 and 3
- B. Only 1 and 2



[1]

Hormones are involved in cell signalling, they have a specific shape which is complementary

to a receptor (glycoprotein) on the surface membrane of the cell. To be soluble in

haemolymph it must be polar.

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Question 3

Which of the following is/are interventions in the control of blood glucose concentration?

- Statement 1: Insulin injection.
- Statement 2: Regular cardiovascular exercise.
- Statement 3: Glucagon injection.



- C Only 2 and 3
- **D** Only 1



1 - An insulin injection will cause cells to take up blood glucose and therefore will reduce blood glucose concentrations.

2 - Exercise is an intervention used by type 2 diabetics to reduce their blood glucose concentration. The reduction of blood glucose occurs through the uptake of glucose from the blood as it is required by cells to use in respiration to produce energy needed for exercise / muscle contraction.

3 - Glucagon injections are used in hypoglycemic emergencies when blood glucose concentrations are very low and the individual needs to convert its glycogen stores into glucose.

Question 4



(a) Fig. 1.1 is a diagram representing the mammalian pancreas and associated structures.

Fig. 1.1

The pancreas is an exocrine and an endocrine gland.

How does Fig. 1.1 indicate that the pancreas has an **exocrine** function?

[2]

- The pancreas can be regarded as an exocrine as it as duct
- The pancreas secretes enzymes into the duct
- It does not secrete them into the bloodstream

Endocrine glands do not have ducts, they secrete hormones into the bloodstream. The pancreas is an exception because it is both an exocrine gland and an endocrine gland, it secretes the hormones insulin and glucagon.



(b) Fig. 1.2 represents a cross-section of part of the pancreas.



Fig. 1.2

(i) Name the group of cells that include the cell labelled C.

The cells labelled C are the Islets of Langerhans

- (ii) Identify the structure labelled **D**.
 - Structure D is an erythrocyte or red blood cell

The biconcave shape creates a larger surface area, they are thin so that gases have less distance to diffuse and have no nucleus. Just full of haemoglobin and the enzyme carbonic anhydrase.



[1]

[1]

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Fig. 1.3

(i) After the meal, the concentrations of glucose and insulin in the blood increase.

Explain why there is a delay in the increase of insulin concentration following the increase in blood glucose concentration. [2]

- The rise in blood glucose has to be detected by the β cells
- The β cells then take time to depolarise
- Insulin secretion by exocytosis also takes time

(ii) The shaded parts of the graph in Fig. 1.3 are over-simplified representations of the blood glucose and insulin concentrations.

Describe **and** explain how these concentrations should be represented on the graph accurately.

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

- [4]
- The lines should not be straight on the graph, levels do not stay the same but fluctuate
- Both insulin and glucose levels should fluctuate
- Blood glucose levels should be maintained about a norm or set point
- Control of blood glucose is an example of negative feedback

Note the 'describe and explain' requirements of this question. Control of blood glucose is an example of homeostasis which is the regulation of a constant or **stable internal environment**, within **narrow limits**, **despite** external changes. It uses negative feedback as the control process. The rise or fall about the set point or norm stimulates receptors, which via cell signalling triggers a response in an effector, this reverses the change back to the norm. The published Glycaemic Index value (GI) of a carbohydrate-containing food, rates the food on a scale from 0 to 100 according to how much it raises blood glucose concentration after it is eaten.

To determine the GI value of a test food:

- 10 healthy people fast overnight
- the test food containing 50 g of carbohydrate is eaten
- blood samples are taken every 15 minutes for the next two hours and blood glucose concentrations are measured
- a value known as the iAUC is obtained from these measurements
- the GI value is calculated by dividing the iAUC for the test food by the iAUC for glucose and multiplying by 100
- the mean of the GI values from all 10 people is the published GI value for that food
 - (i) Why is it necessary for the people to fast overnight before the start of the test? [1]
 - It was necessary to fast so that a baseline was set for normal glucose levels
- (ii) The **iAUC for glucose** is used to calculate the GI value of the test food. For this calculation to be valid, a number of variables must be controlled when determining the iAUC for glucose.

Suggest two variables and how they may be controlled.

[2]

- The same ten people should be used
- The age ranges and gender balance should be the same
- Nothing else should be eaten or drunk during the test
- The temperature and activity levels should be the same

These are all control variables and make the investigation **valid**. If temperature changes

then the metabolic rate of individuals would be affected and consequently blood glucose,

more activity would lower blood glucose as it would be needed for aerobic respiration to

release energy for muscle contaction

- (iii) Why does the procedure use the mean of the GI values to obtain the published GI value for the food? [1]
 - The mean GI values were given as they vary from person to person
 - Giving the mean values reduces the effect of any anomalies or outliers



Question 5

Within the mammalian body, different systems of communication are used to coordinate and control activities.

- (a) Complete the following passage by using the most suitable term in each case.
 The pancreas and the adrenal glands are both examples of <u>endocrine</u>
 glands. Adrenaline is a <u>hormone</u> that is secreted by the adrenal
 glands. These glands also secrete steroids such as corticosteroids from cells in the
 <u>cortex</u> region. The chemicals secreted by these glands are
 transported by the blood to their <u>target</u> cells and tissues. [4]
- (b) Insulin is secreted from the beta cells of the pancreas in response to increased blood glucose concentration.

Fig. 2.1 is a diagram representing the sequence of events leading to the secretion of insulin from the beta cell.



Fig. 2.1

- (i) With reference to Fig. 2.1, describe the events occurring at the stages labelled 1 to 4. [4]
 - Glucose is respired in glycolysis to produce ATP
 - The ATP closes the potassium ion channels so the potassium ions build-up inside the cell (because they cannot leave)
 - This causes calcium ion channels to open, which then enter the cell by diffusion
 - Calcium ions result in the movement of vesicles to the membrane, which releases

insulin by exocytosis



(ii) After the initial release of insulin from the beta cell, insulin secretion continues even when there is no further glucose intake.

Suggest and explain why the cell continues to secrete insulin. [2]

Even though there is no further intake of glucose, the levels of glucose in the plasma are still high

Sufficient ATP is still present and so some potassium ion channels remain closed

Exocytosis is therefore still being triggered by the influx of calcium ions

[Total : 10]



The regulation of blood glucose concentration is important for homeostasis and involves hormonal control.

(a) (i) Name the endocrine tissue in the pancreas that is responsible for secretion of hormones.

The Islets of Langerhans is the endocrine tissue responsible for the secretion of

[1]

hormones in the pancreas

(ii) Identify the **specific** cell type in pancreatic tissue that secretes the hormone insulin. [1]

Insulin is secreted by the beta / β cells

(b) The incomplete flowchart below outlines the way in which the secretion of insulin from a pancreatic cell is controlled.

Complete the flowchart by inserting the most appropriate word(s) in the spaces provided. ^[5]

Insulin secretion is stimulated when the blood glucose concentration increases				
Glucose enters the pancreatic cell through channel proteins. The glucose				
enters the pathway and ATP				
is produced.				
The increase in ATP causes ATP-controlled potassium ion channels to close				
and the cell membrane becomes <u>depolarised</u>				
This results in the opening of voltage-gated				
ion channels and the concentration of this ion inside the cell increases.				
▼				
The increased concentration of these ions causes the secretion of insulin from				
exocytosis the cell by the process of				



(c) (i) Insulin is a polypeptide molecule.

State where in a pancreatic **cell** insulin molecules are synthesised. [1]

Insulin is made on the ribosomes or rough endoplasmic reticulum

Note that the question refers to insulin as a polypeptide, in other words where are proteins made in the cell

- (ii) Outline the events that occur after the synthesis of an insulin molecule until it is ready to be secreted from the pancreatic cell.
 [3]
 - Insulin is transported to the Golgi
 - It is modified in the Golgi by the addition of a carbohydrate group
 - It is packaged into Golgi vesicles
 - Vesicles move towards, then fuse with the cell surface membrane

Vesicles, and anything else that is moved around the cell, involves the use of the cytoskeleton.

[Total: 11]