OCR A-LEVEL BIOLOGY A · H420

BIOLOGY



EXAM QUESTION PACK

5.1.4 HORMONAL COMMUNICATION

SCORE	PERCENTAGE
/92	%

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Answer **all** the questions.

1. 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.

A 1, 2 and 3
B Only 1 and 2
C Only 2 and 3
D Only 1

Your answer ☐

[1]

2. The following are statements about the liver:

1 stores bile in the gall bladder
2 contains sinusoids
3 receives blood from the gut and heart

Which of these statements relate to the exocrine function of the liver?

A 1, 2 and 3
B Only 1 and 2
C Only 2 and 3
D Only 1

Your answer ☐

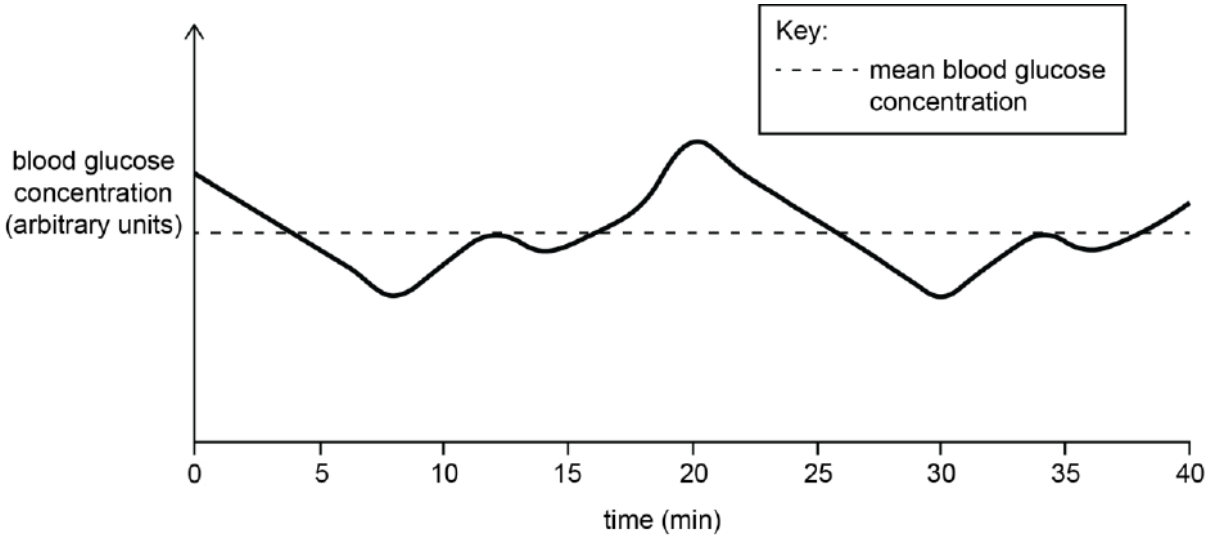
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3. The graph below shows the change in glucose concentration in a rat's bloodstream over a short period of time.



Which of the statements, **A** to **D**, is correct?

A blood glucose concentration at 15 min > blood glucose concentration at 20 min

B blood glucose concentration at 9 min << blood glucose concentration at 20 min

C blood glucose concentration at 0 min < blood glucose concentration at 40 min

D blood glucose concentration at 5 min >> blood glucose concentration at 28 min

Your answer ☐

[1]

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4. The following terms relate to the metabolism of carbohydrates in the human body:

1 gluconeogenesis
2 glycogenesis
3 glycolysis

Which of these processes will be stimulated when glucagon is released into the bloodstream?

A 1, 2 and 3
B Only 1 and 2
C Only 2 and 3
D Only 1

Your answer ☐

[1]

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5(a). During pregnancy, the hormone human chorionic gonadotrophin (hCG) is produced by the placenta. Fig. 16.1 shows how levels of hCG change throughout pregnancy.

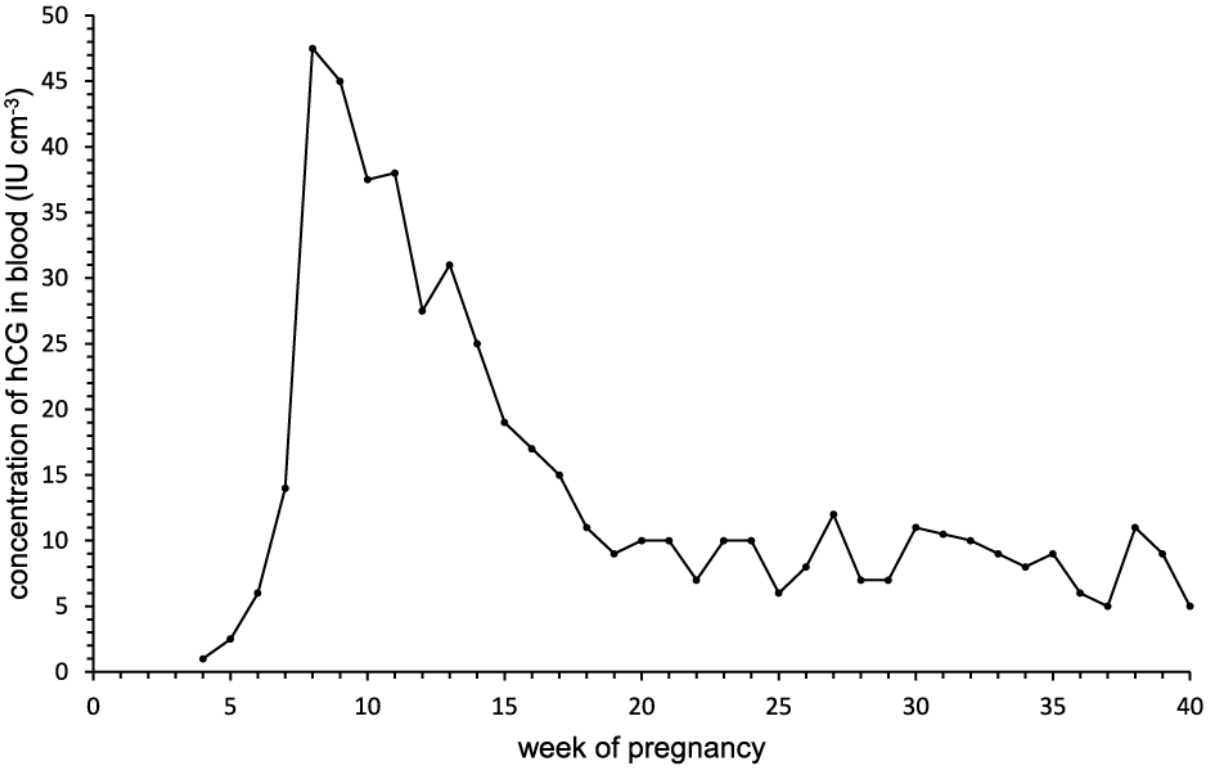


Fig. 16.1

Describe the trends shown in Fig. 16.1.

---

[4]

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(b). At birth, the production of another hormone, oxytocin, increases. Oxytocin causes rapid contractions of the uterus. These contractions cause more oxytocin to be released.

What term is used to describe this kind of interaction?

[1]

(c). Studies on the effects of hCG in humans have revealed the following information:

- Many different tissues are affected by hCG.
- Susceptible cells have glycoprotein receptors on their cell surface.
- These receptors are complementary to the shape of hCG molecules.

(i) What can be concluded from this information?

[3]

(ii) Another hormone produced during pregnancy is oestrogen. Oestrogen is lipid soluble.

Which molecule does oestrogen interact with when it changes cell activity?

[1]

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(d). A hydatidiform mole is a rare complication of pregnancy that can occur after implantation of the fertilised egg in the uterus. It results in excessive production of hCG and damage to the lining of the womb, leading to miscarriage.

Suggest how a hydatidiform mole could increase hCG above normal levels.

---

[3]

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6(a). Birds and humans have similar pancreas tissues, with the same cell types contributing to exocrine and endocrine roles.

(i) Fig. 21.1 shows a transverse section of pancreas tissue from a bird.

Select which letter identifies the following structures:

islet of Langerhans

[1]

acinus

[1]

(ii) Fig 21.2 shows a high-power image of cells from the pancreas.

In the space provided below draw **five adjacent** cells, annotating them to show visible features.

[5]

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Fig 21.1

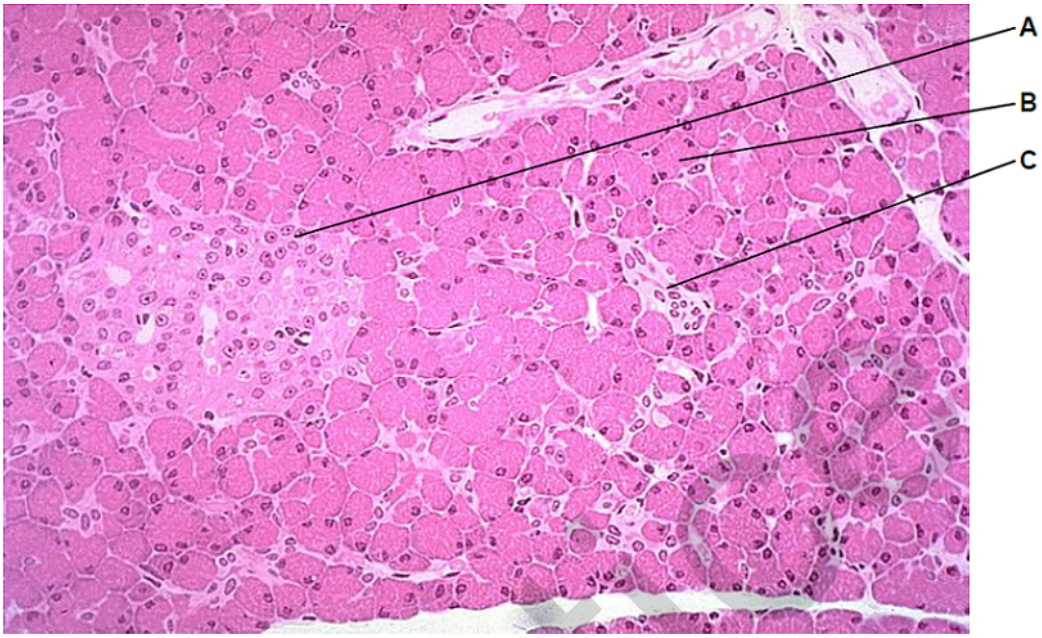
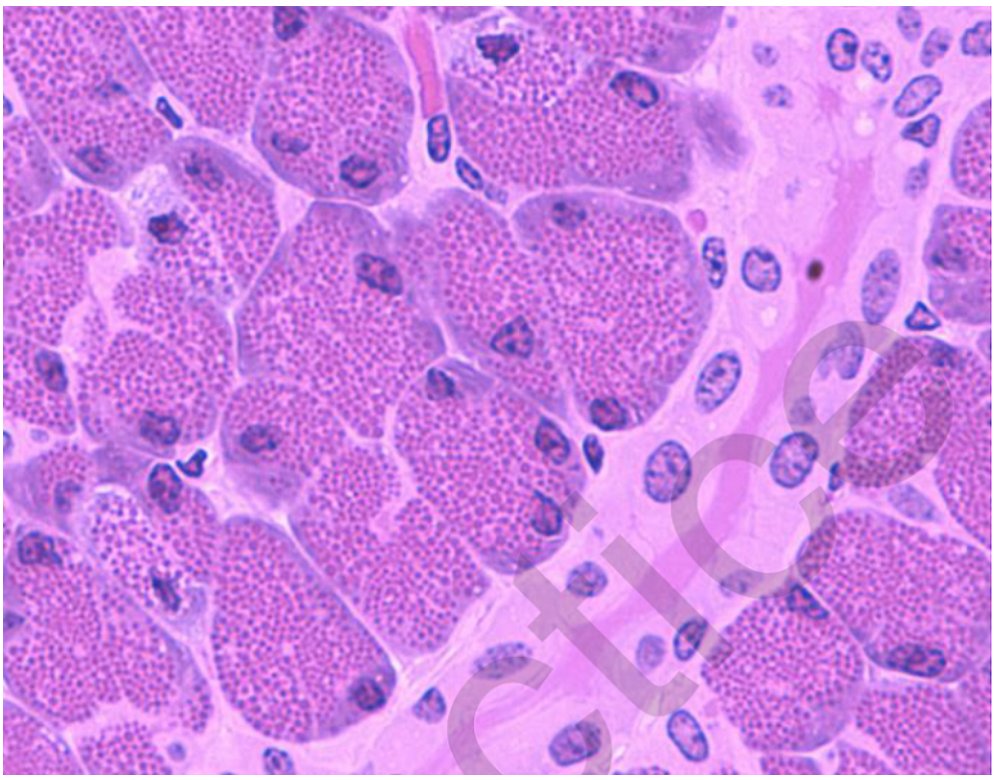


Fig 21.2



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(b). Table 21.1 gives some information about the hormones produced by the different regions of the adrenal gland.

Complete the table to include the correct region, hormone and role.

Region of adrenal gland	Hormone produced	Role of hormone in body
_____	aldosterone	_____ _____
medulla	_____	Increases heart rate. Stimulates glycogenolysis.

Table 21.1

[2]

(c). * Growth hormone (GH) is a peptide hormone that stimulates cell reproduction and regeneration in humans and other animals. It is produced during development to increase muscle mass and increase bone size and density.

GH can also be used in farming to enhance yields from different animals.

Design an experiment to investigate the following hypothesis:

"Varying the concentration of GH injected affects the yield of meat from farmed chickens"

You must explain how you would obtain valid data.

---

[9]

7(a). The rhythm and rate at which a human's heart beats can be determined by several factors.

Fig. 5.1 shows electrocardiogram traces (ECGs) from two different individuals, **X** and **Y**.



Fig. 5.1

Draw an ECG trace **on Fig. 5.1** (next to **Z**) to represent a recording from a patient with an ectopic heartbeat.

Show at least three cardiac cycles.

[2]

(b). Heart rate can be increased by the hormone adrenaline, which binds to cardiac cells.

Describe how adrenaline binds to cardiac cells.

---

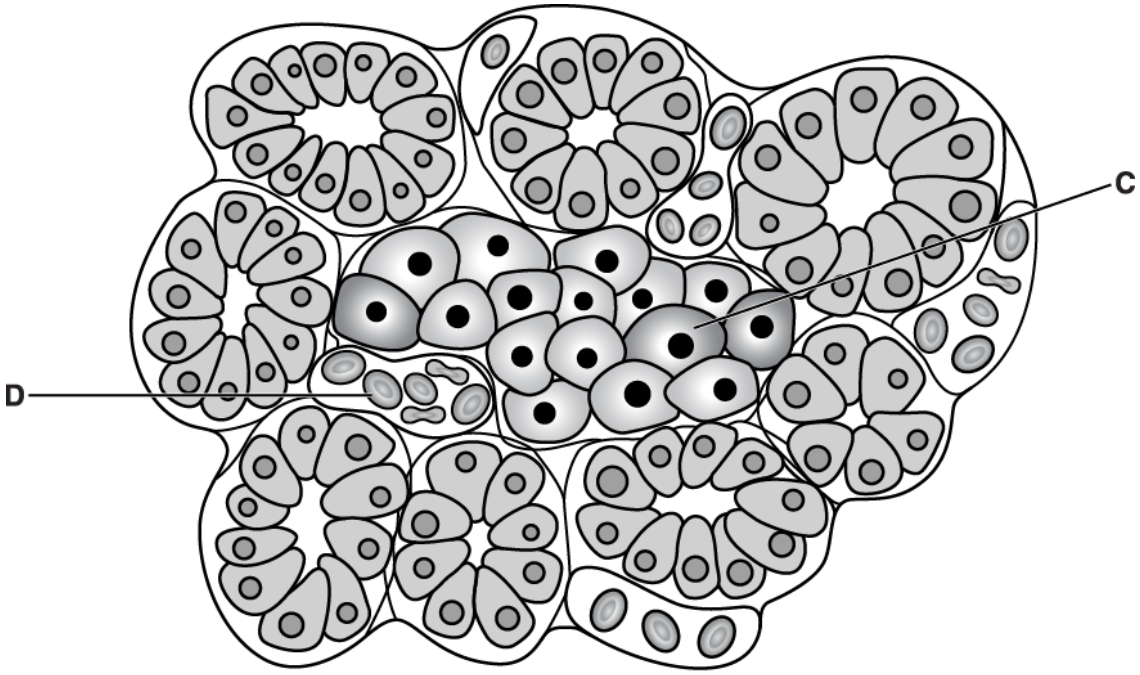
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8(a). The figure represents a cross-section of part of the pancreas.



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

---

[1]

(ii) Identify the structure labelled **D**.

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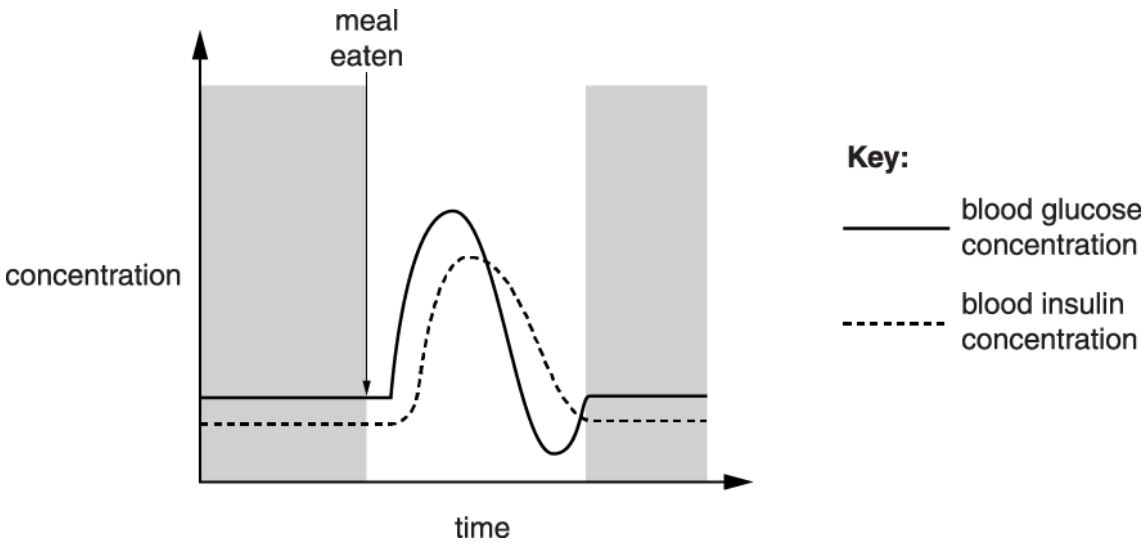
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(b). The figure shows the concentrations of glucose and insulin in the blood of an individual before and after a meal.



(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]

(ii) The shaded parts of the graph 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.

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[4]

(c). 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]

(ii) The **iAUC for glucose** is used to calculate the GI value of the test food. For this calculation to be valid, a

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number of variables must be controlled when determining the iAUC for glucose.

Suggest **two** variables and **how** they may be controlled.

1

2

---

[2]

(iii) Why does the procedure use the mean of the GI values to obtain the published GI value for the food?

---

[1]

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9. Heart rate is controlled by nervous and hormonal mechanisms.

(i) For each of the following statements, indicate whether the statement is true or false.

Statement	True or False
Heart rate is accelerated by stimulation from the vagus nerve.	
Stimulation by the sympathetic and parasympathetic nerves have opposite effects on the heart rate.	
The vagus nerve releases acetylcholine.	

[2]

(ii) Hormonal control of heart rate is achieved by hormones acting on the sino-atrial node (SAN).

Using your knowledge of the way in which heart action is coordinated, suggest why it can be deduced that hormones act on the SAN rather than on individual cardiac muscle cells.

---

[2]

(iii) Suggest how adrenaline brings about a response inside the cells of the SAN.

---

[2]

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10(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]**

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

____

____

____ **[1]**

(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**.

Answer = ______________________ % **[2]**

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(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]**

(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]**

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(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]**

(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]**

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

Complete the following passage by using the **most suitable** term in each case.

The pancreas and the adrenal glands are both examples of _____ glands. Adrenaline is a _____ that is secreted by the adrenal glands. These glands also secrete steroids such as corticosteroids from cells in the _____ region. The chemicals secreted by these glands are transported by the blood to their _____ 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.

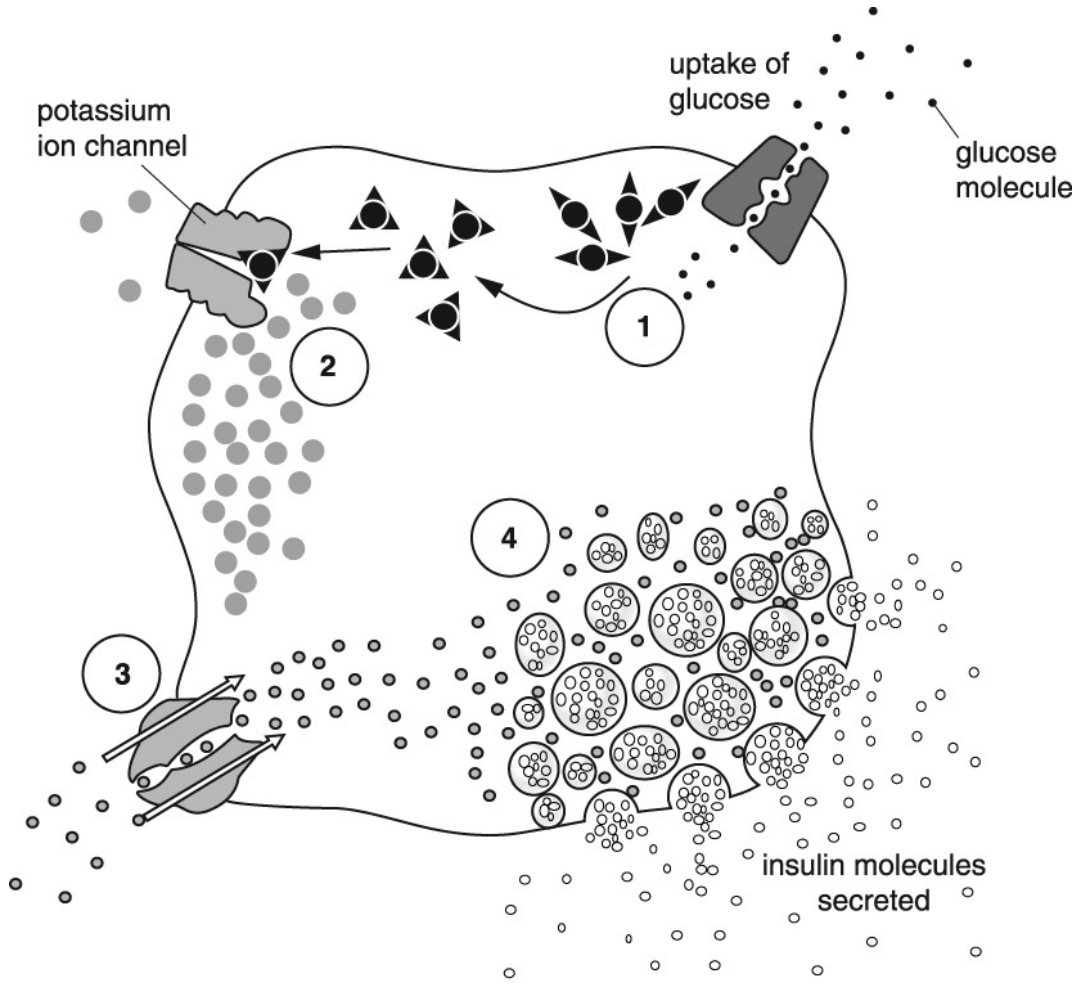


Fig. 2.1

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(i) With reference to Fig. 2.1, describe the events occurring at the stages labelled **1** to **4**.

1

2

3

4

---

[4]

(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]

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12(a). Stem cell therapy is a potential future treatment for diabetes mellitus.

Stem cells were extracted from the bone marrow of 131 patients with diabetes mellitus. Each patient received an implantation of their own stem cells.

Following the stem cell treatment:

- 53 patients showed no change
- 78 patients showed an improvement in their condition.

Suggest three additional pieces of information that would be needed to assess the effectiveness of the stem cell therapy.

1

2

3

---

[3]

(b). In the future, it might be possible to differentiate stem cells in a laboratory (*in vitro*) before they are implanted into the pancreas of a patient with diabetes.

(i) Name the type of differentiated cell that scientists would produce from stem cells in order to treat diabetes mellitus.

---

[1]

(ii) Which type of diabetes mellitus is most likely to be improved by stem cell therapy?

Explain your answer.

---

[2]

(c). The blood glucose concentration of a diabetes patient was measured on five separate occasions.

The five measured values (in mmol dm^{-3}) were 8.7, 8.7, 9.0, 9.0 and 10.9.

(i) Using the formula below, calculate the standard deviation of the patient's blood glucose concentration.

$$s = \sqrt{\frac{\sum(x-\bar{x})^2}{n-1}}$$

n = number of samples

x = each value in the data set

$\bar{x}$ = mean

Answer _____ **[3]**

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(ii) Explain why standard deviation is better than range for measuring the dispersion of these data.

---

[2]

(iii) Scientists compared the blood glucose concentrations of two diabetes patients:

- a patient who had received stem cell therapy
- a patient who had received no stem cell therapy.

Describe **two** aspects of the experimental design that the scientists would need to consider in order to produce a valid comparison of the two patients.

---

[2]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1			D	1	
			Total	**1**	
2			D	1	
			Total	**1**	
3			B	1	
			Total	**1**	
4			D	1	
			Total	**1**	
5	a		**any 4 from:** no production of hCG, until 4 weeks / AW (1) rapid increase / high gradient, until 8 weeks (1) *idea that* rate of decline, is less than increase after 8 weeks (1) levels peak at 8 weeks (1) levels fluctuate / not constant, after 19 weeks (1) *idea that* levels remain similar after 19 weeks (1) use of comparative figures to illustrate any point **with units** (1)	4	All points with dates underlined must have exact wording to achieve mark **ALLOW** hCG production starts at 4 weeks / is undetectable until 4 weeks **ALLOW** 'fluctuation' / AW **DO NOT ALLOW** 'plateau'
	b		positive feedback	1	
	c	i	(hCG is a) peptide hormone / hCG is not a lipid-based hormone (1) (hCG) binds to cell surface receptor (1) *idea that* cell signalling is involved in action of hCG (1) (hCG) uses cAMP / second messenger, to bring about response in cell (1)	3	
		ii	DNA / deoxyribonucleic acid	1	**ALLOW** transcription(al) factor / repressor protein **DO NOT ALLOW** RNA / histone / DNA polymerase

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Question			Answer/Indicative content	Marks	Guidance
	d		*idea that* (hydatidiform mole) cells produce more hCG than normal (1) (due to) expression / up regulation, of genes (1) synthesising more, hCG / protein(s) (1) *idea that* other tissues could be stimulated to produce more hCG than normal (1)	3	Cannot be inferred from other mark points **ALLOW** stimulates, mitosis in / proliferation of, cells that secrete hCG **ALLOW** *idea that* hydatidiform mole inhibits / competes with another molecule that would otherwise regulate the production of hCG
			Total	**12**	

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<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>6</td><td>a</td><td>i</td><td>A
B</td><td>2</td><td></td></tr>
<tr><td></td><td></td><td>ii</td><td>five cells drawn adjacent to each other
AND
clear continuous lines (1)

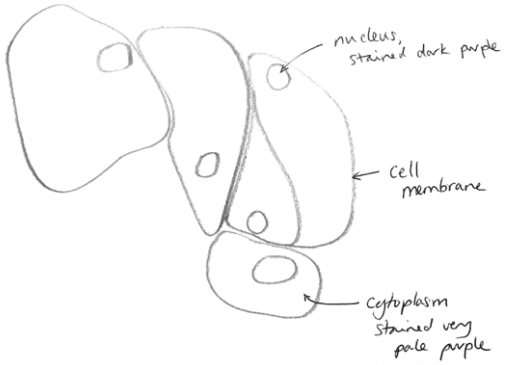
correct proportions (1)
uses ≥50% of area provided (1)

annotations:
label lines drawn with a ruler to correct feature (1)
cell membrane
AND
nucleus
AND
cytoplasm labelled (1)
comparative colour of any of above mentioned (1)</td><td>5</td><td>DO NOT ALLOW cells separated by gaps
DO NOT ALLOW more than five cells
DO NOT ALLOW ragged lines / any shading

ALLOW if it is clear which cells the candidate has attempted to draw

IGNORE any annotations not mentioned here
DO NOT ALLOW arrow heads

ALLOW implied comparison from different colours

NOTE:
 

= 3 marks (MP2, 3 and 6)</td></tr>
<tr><td></td><td>b</td><td></td><td>One mark per correct row

<table><tr><th>Region of adrenal gland</th><th>Hormone produced</th><th>Role of hormone in body</th></tr><tr><td>cortex</td><td></td><td>Na^+ / K^+ / ion , reabsorption in kidneys / concentration in blood
OR
water reabsorption
OR
control of blood pressure</td></tr><tr><td></td><td>adrenaline</td><td></td></tr></table></td><td>2</td><td>ALLOW epinephrine / noradrenaline / norepinephrine</td></tr>
</table>

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Question			Answer/Indicative content	Marks	Guidance
	c		* Read through the whole answer from start to finish, concentrating on features that make it a stronger or weaker answer using the indicative scientific content as guidance. The indicative scientific content indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the science content of the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme. Once the level is located, award the higher, middle or lower mark. **The higher mark** should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met. **The middle mark** should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing. **The lower mark** should be awarded where the level descriptor has been evidenced but the communication statement (in italics) has not been met. **In summary:** • **The science content determines the level.** • **The communication statement determines the mark within a level.** **Level 3 (7–9 marks)** A full and detailed method is provided which would allow valid comparisons and data to be collected. There is a detailed	9	**Indicative scientific points may include…** • Independent variable – concentration of GH injected • Dependent variable – rate of growth • Control variables – animal species, foodstuff, (named) conditions • Trial populations over several months • Control group to ensure validity of conclusions • Method for assessing growth – e.g. % mass change or growth rate to allow comparability • Different species of chickens should be investigated • Ensure food is consistent across all trial groups • Sample size needs to be large enough to reduce effect of anomalies • Ethical concerns – chickens should be reared in humane conditions • Consideration of potential negative effects on chickens, e.g. larger muscle mass, so may be unable to move as easily

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Question			Answer/Indicative content	Marks	Guidance
			explanation of the variables to be changed and measured, and how this could realistically be attempted in the scenario provided, along with detailed information about which variables need to be controlled. There is an appreciation of ethical concerns involved OR an appreciation of the sample size required to obtain repeatable data and to rule out anomalies. *There is a well-developed line of reasoning which is clear and logically structured. The method is detailed and clearly argued.* **Level 2 (4–6 marks)** A detailed method is provided which would allow valid comparisons and data to be collected. There is an explanation of the variables to be changed and measured, and how this could be attempted in the scenario provided, along with information about which variables need to be controlled. There is mention of the sample size required to obtain representative data. *There is a line of reasoning presented with some structure. The method has some detail.* **Level 1 (1–3 marks)** A limited method is provided which may allow valid comparisons and data to be collected. There is some explanation of the variables to be changed and measured, and how this could be attempted, along with limited information about which variables need to be controlled. Possible consideration of the sample size required for representative data is included. *There is a logical structure to the answer. The explanation, though basic, is clear.* **0 marks** No response or no response worthy of credit.		
			Total	**9**	

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Question			Answer/Indicative content	Marks	Guidance
7	a		three cardiac cycles drawn (1) second cardiac cycle closer to the first cycle than the third cycle (1) abnormal QRS in second cycle (e.g. extended peak or lack of T phase) (1)	2	e.g. 2 marks for 
	b		(binds to) receptor in, cell surface / plasma, membrane (1) glycoprotein (1)	2	
			Total	**4**	

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Question			Answer/Indicative content	Marks	Guidance
8	a	i	islet(s) of Langerhan(s);	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** α and β / alpha and beta, cells **DO NOT CREDIT** a / b / A / B **,** cells **DO NOT CREDIT** acinar cells **Examiner's Comments** Most candidates correctly identified the islets of Langerhans. Some candidates, however, mentioned only alpha or beta cells (although had both been mentioned the mark would have been awarded).
		ii	erythrocyte / red blood cell;	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** RBC **IGNORE** ref to blood vessel **Examiner's Comments** Erythrocytes were commonly seen, although some candidates identified a blood vessel instead.

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Question			Answer/Indicative content	Marks	Guidance
	b	i	1 increase (in blood sugar) is detected (by α cells); 2 *idea that takes time for* depolarisation (in α cells); 3 *time needed for* αcells to, produce / release, insulin;	2 max	**DO NOT CREDIT** 'B' or 'b' cell on first occasion then apply ecf A description of a *sequence* of events provides a timeline 2 *time for* making sure that there is enough ATP / ion channels open / to pump out K^+ / for Ca^{2+} to enter 3 **DO NOT CREDIT** ref to α cell(s) **Examiner's Comments** Poor communicators were not able to convey the idea of a timeline as the account was muddled. Some excellent accounts were seen, however, although many went into excessive descriptions about the mechanism of secretion of insulin that the mark tariff did not warrant. Some otherwise good answers failed to mention that insulin was secreted by the beta cells or that they were also responsible for detecting the increased glucose levels.
		ii	1 there should be no straight line(s) (on the graph) **or** line(s) (should), rise and fall / fluctuate; 2 glucose and insulin levels fluctuate; 3 insulin levels (should) rise (and fall) after those of glucose; 4 (glucose) level, maintained around / returned to, the **norm**(al) / a **set** point / a **set** value; 5 ref to **negative feedback** / **homeosta**sis;	3 max	**DO NOT CREDIT** in the context of eating a meal 2 Must be a statement that implies both levels change 4 **CREDIT** 'within narrow limits' / 'relatively constant' **IGNORE** optimum **CREDIT** maintained at, 80 – 120 mg $100cm^{-3}$ / 4 – 6 mmol dm^{-3} for the glucose value

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Question			Answer/Indicative content	Marks	Guidance
		ii	QWC;	1	Award if **3** of the following terms have been used in a correct context with correct spelling: **set** (point / value) **norm**(al) **negative feedback homeosta**sis **Examiner's Comments** This was challenging for many candidates. Some just referred to axis labels and scales but others attempted to describe the way in which the lines should have been portrayed. It was all too tempting for many candidates to refer to what was happening before, during and after a meal and they then launched into details of insulin and glucagon and their effects on the cells. Few conveyed the idea that the fluctuation of the blood glucose and insulin concentrations were out of phase. The Quality of Written Communication mark (QWC) was rarely awarded.
	c	i	to ensure that the (blood) glucose, is at its, base (level) / low (level) / normal (level);	1	**ACCEPT** 'sugar' instead of 'glucose' **ACCEPT** to make sure that the glucose (level) is not, raised / high **ACCEPT** to make sure that the rise in blood glucose is only due to the (tested) food eaten **DO NOT CREDIT** ref to ***no***, sugar / carbohydrate **Examiner's Comments** Most candidates appreciated that a base blood glucose concentration was required. Some did not get the mark as they referred to glucose being broken down, the need to remove all the glucose from the blood or that the participants needed the same blood glucose concentration at the beginning of the test.

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Question			Answer/Indicative content	Marks	Guidance
		ii	1 50 g of glucose must be used; 2 the data for glucose should be obtained for the same (ten) people (to eliminate differences between individuals); 3 same age / same age range (as people in original test); 4 same gender balance (as in original test); 5 have the same level of activity (during the test); 6 be at the same temperature; 7 don't eat or drink anything else (during the test); 8 same, body mass / BMI;	2 max	**IGNORE** ref to volume of blood taken or where in the body it is taken from **IGNORE** same number of people 1 **CREDIT** ref to same mass as test carbohydrate **IGNORE** amount 7 **CREDIT** 'only drinks water' (during the test) 8 **ACCEPT** same weight **IGNORE** same build **Examiner's Comments** This question referred to finding the iAUC for glucose but many candidates interpreted it as referring to the different foodstuffs. The question also asked them to indicate how the variables could be controlled but a significant number just stated the variables. Some felt that the blood samples should have the same volume or be taken from the same part of the body. Consequently, this question proved to be quite a good discriminator.

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Question			Answer/Indicative content	Marks	Guidance
		iii	1 (absorption / effect on blood glucose), variable from person to person; 2 it reduces the effect of, outliers / anomalous values;	1 max	**IGNORE** ref to accuracy / precision / reliability / validity **Examiner's Comments** A common misapprehension was that by calculating a mean it would identify or eliminate any anomalous results rather than reducing the effect of an atypical result or the risk of using a single unrepresentative result. Some vague answers and those quoting reliable, accurate or precise did not score without a more specific answer that related to the question.
			Total	**12**	

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Question			Answer/Indicative content	Marks	Guidance
9		i	False / F True / T True / T;;	2	**All 3 answers correct = 2 marks** **Any 2 answers correct = 1 mark** **1 or 0 answers correct = 0 marks** **Mark incorrect cells first** **1 □ = 1 max** **2 □ = 0 marks** **Examiner's Comments** Candidates frequently scored 1 mark for this question. The most common error was to decide that the final statement was false.
		ii	1 *idea that* (hormonal) stimulation of individual muscle cells would result in uncoordinated response **or** (hormonal) stimulation of SAN results in coordinated action of the cardiac muscle; 2 *idea that* (hormonal) stimulation of individual muscle cells will not result in a change in heart rate **or** (hormonal) stimulation of SAN results in a change in heart rate; 3 (as) (hormone) receptors only present on the SAN / individual cells do not have (hormone) receptors;	2 max	hormone binds to / hormone acts on = stimulation e.g. coordinated action = both atria contract together **Examiner's Comments** Candidates who simply described the role of the SAN in coordinating and regulating the rate of heart beat did not score as this did not answer the question. Answers needed to link this to the effect that hormones would have on either the SAN or individual cardiac muscle cells.

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Question			Answer/Indicative content	Marks	Guidance
		iii	1 adrenaline / first messenger / it, binds to receptor(s) on cell **surface** membrane (of SAN cell(s)); 2 activates adenyl(yl) cyclase; 3 ATP converted to, cyclic AMP / cAMP **or** cyclic AMP / cAMP / second messenger, synthesised; 4 results in depolarisation (of SAN cell membrane);	2 max	**IGNORE** ref to synthesis of glucose 1 **CREDIT** 'plasma membrane' or 'plasmalemma' for 'cell surface membrane' 2 **CREDIT** ref to adenylate cyclase 3 **DO NOT CREDIT** in context of 'wave of depolarisation' **Examiner's Comments** Many knew this well, but a lack of precision in expression meant that marks were not awarded. They were expected to refer to receptors on the cell surface membrane, activation of adenylyl cyclase and the formation of cAMP. The terms 'activation', 'production' and 'synthesis' seemed to be used interchangeably, so not always appropriately.
			Total	**6**	

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Question			Answer/Indicative content	Marks	Guidance
10	a	i		1	**Mark the first answer**. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**
		i	diabetes (mellitus);	1	**ACCEPT** hyperglycaemia **IGNORE** Type 1 or Type 2 **DO NOT CREDIT** hypoglycaemia **Examiner's Comments** Almost all candidates recognised that the condition being tested for was diabetes (mellitus).
		ii	*idea that* time needed, to restore normal (blood) glucose concentration / for insulin to act (fully);	1	**Examiner's Comments** Few candidates were awarded this mark as most were unable to grasp the idea that time would be needed to for insulin to act and reduce the concentration back to normal levels. Most candidates stated that a meal eaten within this time period would affect the blood glucose concentration and give an invalid result, which did not really indicate why it was important to leave an eight hour period before performing the test.

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Question			Answer/Indicative content	Marks	Guidance
		iii	18.6;	2	**Correct answer = 2 marks**, even if no working shown. **If answer is incorrect**, then **ALLOW** 1 mark for seeing: 1.1 ÷ 5.9 **or** (7.0 – 5.9) ÷ 5.9 **or** 118.6 **or** 118.64 **If the answer is not correctly rounded to 1dp**, then **ALLOW** 1 mark for seeing a correct unrounded answer e.g. 18.64 **Examiner's Comments** Most candidates were able to calculate the percentage by which the patient's blood glucose concentration was higher than the upper limit for normal concentration, achieving both marks. However, some rounded up incorrectly, or gave an incomplete answer of 118.6%. The common error was to divide 1.1 by 7.0 instead of 5.9.

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Question			Answer/Indicative content	Marks	Guidance
	b		**1** HbA1C / glycosylated Hb, contained within, red blood cell(s) / erythrocyte(s); red blood cells / erythrocyte(s), have limited life span / live for 8 to 12 weeks **or** red blood cells / erythrocyte(s), break down after, 12 weeks / 3 months; **3** HbA1C / glycosylated Hb, broken down, in liver / by hepatocytes / by Kupffer cells;	2 max	**CREDIT** RBC / rbc for 'red blood cell' throughout **3 IGNORE** ref to recycling **Examiner's Comments** Some candidates were able to gain a mark for understanding that red blood cells would only last for a maximum of 12 weeks after which they would be replaced. Candidates failed to gain credit for being too vague, for example stating 'blood cells' rather than RBC's, and several referred to 'haemoglobin' rather than glycosylated haemoglobin. Those candidates who did mention HBA1C being broken down failed to state that it was broken down in the liver. Many candidates commented that eating habits would vary during this period, with different amounts of glucose being consumed on different days, or varying amounts of exercise, which might cause the mean concentration to alter. Others stated that a single test would not allow a mean to be calculated or anomalous results to be identified.

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Question			Answer/Indicative content	Marks	Guidance
	c		patient might have had a drink containing sugar; AVP;	1 max	**DO NOT CREDIT** ref to having eaten (as patient had confirmed that he had not eaten) **CREDIT** ref to a specific sugar-containing drink e.g. • patient was nervous and secreted adrenaline • other medication interferes with glucose levels • patient's haemoglobin does not bind effectively with glucose (e.g. anaemia / sickle cell) **Examiner's Comments** Few candidates made reference to the patient having consumed a sugary drink, although some mentioned that the patient may have been nervous before the test so secreted adrenaline. Many attempted to answer the question by suggesting that the body would carry out a physiological response to a low blood glucose concentration by stimulating the secretion of glucagon which would then increase the blood glucose level. Others suggested that insulin may not have been able to reduce the concentration following a meal, although they had been told in the stem of the question that the patient's mean blood glucose concentration had been within the normal range for the previous 8 to 12 weeks.

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Question			Answer/Indicative content	Marks	Guidance
	d	i	**1** if blood glucose falls, extremely / dangerously / too / very, low; **2** if patient, cannot produce (enough) glucagon / produces little glucagon; **3** *idea that* glucose source cannot be taken by mouth;	1 max	**1 CREDIT** hypoglycaemic / hypoglycaemia **IGNORE** 'below normal' alone **2 CREDIT** ref to dysfunctional, α cells / glucagon receptors **3 CREDIT** a suitable reason (e.g. fitting or in a coma) **Examiner's Comments** Most candidates gained a mark in this section for stating that the circumstance under which the patient would need to be given a glucagon injection would be a very low blood glucose level. Some also commented that the alpha cells may not be functioning properly, resulting in an inadequate secretion of glucagon. It was insufficient to refer to 'low blood glucose' or 'below normal blood glucose concentration'.

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Question			Answer/Indicative content	Marks	Guidance
		ii	*when blood glucose concentration decreases* **1** (glucagon) released by the, **alpha** / α, cells in, **islet**s of Langerhans / **pancreas**; **2** promotes / AW, conversion of **glycogen** to glucose / **glycogenolysis**, in, liver / muscle / **effector**, cells; **3** ref **gluconeogenesis** / described; **4** ref conversion of triglycerides to (free) fatty acids / lipolysis / increased use of fatty acids in respiration; **5 negative feedback**, reduces / inhibits, the secretion of glucagon; **6** glucagon, reduces / inhibits, insulin secretion;	4 max	**IGNORE** ref to insulin or events following an increase in blood glucose concentration **1 DO NOT CREDIT** 'alpha cells are produced' **2 Any description must** correspond correctly to term **DO NOT CREDIT** if glucagon *converts* glycogen directly **3 Any description must** correspond correctly to term **IGNORE** imprecise ref to glucagon *doing the conversion* **4 Any description must** correspond correctly to term **IGNORE** imprecise ref to glucagon *doing the conversion* **5 DO NOT CREDIT** stopping glucagon secretion **6 DO NOT CREDIT** stopping insulin secretion

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Question			Answer/Indicative content	Marks	Guidance
		ii	**QWC** – technical terms used appropriately and spelled correctly;	1	Use of **three** terms from: **alpha, islet,** **pancreas, glycogen,** **glycogenolysis, effector,** **gluconeogenesis, negative feedback** **Please insert a QWC symbol next to the pencil icon, followed by** **a tick (□) if QWC has been awarded** **or a cross (×) if QWC has not been awarded You should use the green dot to identify the QWC terms that you are crediting.** **Examiner's Comments** The role of glucagon in the regulation of blood glucose concentration produced variable responses. Better candidates achieved all marks available for a good description of the secretion of glucagon from the alpha cells of the islets of Langerhans in the pancreas and its subsequent effects on liver or muscle cells. Most appreciated that glucagon would stimulate glycogenolysis and gluconeogenesis, or described the processes, although some failed to gain the second marking point for either failing to identify the effector cells or stating that glucagon itself would convert glycogen into glucose. Some contradicted their answers by referring to the breakdown of glycogen to glucose as glycolysis. While many also recognised that more fatty acids would be used in respiration, some simply that fats or lipids would be used. There were comparatively few references to glucagon reducing insulin secretion (most stated that insulin secretion was stopped) and hardly any to negative feedback reducing glucagon secretion once blood glucose levels had been restored to normal. Most candidates were awarded the QWC mark for three technical terms spelled correctly and used in an appropriate context.

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Question			Answer/Indicative content	Marks	Guidance
			Total	**13**	

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Question			Answer/Indicative content	Marks	Guidance
11	a		endocrine; hormone; cortex / cortical; target / effector;	4	**Mark the first answer on each prompt line**. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **Examiner's Comments** Many candidates were able to complete the passage using suitable terms. Common errors were to confuse endocrine with exocrine and cortex with medulla. Very occasionally, neutrotransmitter was used in place of hormone.
	b	i	1 glucose, respired / phosphorylated / metabolised, to produce ATP; 2 ATP, blocks / closes, potassium ion channel(s) **and** potassium ions / K^+, build up (inside cell) / cannot leave; 3 (voltage-gated) calcium ion / Ca^{2+}, channels open **and** calcium ions / Ca^{2+}, enter (cell by diffusion); 4 (more) calcium ions / Ca^{2+}, resulting in, movement of vesicles to membrane / exocytosis / described;	4	**IGNORE** the numbered prompt lines, but the events **must** be in the correct sequence. 1 **IGNORE** 'glucose is broken down to form ATP' 2 ion must be indicated at least once If symbol used, must have correct charge **IGNORE** ref to 'depolarisation' (as not indicated on fig.) 3 ion must be indicated at least once If symbol used, must have correct charge **IGNORE** ref to polarisation 4 if ion had been mentioned in stage 3, then allow 'calcium' alone for this mp **ACCEPT** ecf ***for this mp*** if mp 3 not awarded because Na^+ stated instead of Ca^{2+} **IGNORE** 'secretion' as given in question **Examiner's Comments** Well prepared candidates were able to interpret the stimulus material in Figure 2.1 and provide good accounts of the events taking place at the various stages leading to the secretion of insulin from the beta

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Question			Answer/Indicative content	Marks	Guidance
					cell. Most recognized that glucose would be respired to produce ATP, although some stated that glucose would be converted to ATP which was not credited. While many went on to describe how ATP would block the potassium ion channels, a significant number neglected to add that this would cause an accumulation of potassium ions within the beta cell as they were no longer able to leave. Most understood that the depolarisation of the cell would cause the calcium ion channels to open, leading to an influx of calcium ions and then linked this influx to the movement of vesicles containing neurotransmitter towards the cell surface membrane and subsequent fusion to it. However, some made the mistake of stating that the vesicles, rather than insulin, would leave the cell by exocytosis. Candidates who did not fully express the mark points tended to be repeating a learned sequence rather than interpreting the information in the diagram.

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Question			Answer/Indicative content	Marks	Guidance
		ii	1 (continues to be secreted) as long as <u>blood</u> / <u>plasma</u>, glucose (concentration), remains high / is higher than normal; 2 (sufficient) ATP is still present and so K^+ channels remain closed; 3 (exocytosis) still being triggered by, calcium ions / Ca^{2+};	2 max	**IGNORE** ref to what happens once the glucose level returns to normal and secretion stops (as Q asks about the continued secretion of insulin) 3 **CREDIT** Ca^{2+}, still present / remain high **CREDIT** exocytosis continues until Ca^{2+} can be removed from cell **Examiner's Comments** This question proved challenging. Candidates who did gain marks usually recognised that calcium ions were still present in the cell (triggering secretion of insulin). Several candidates knew that the calcium ion channels remained open but did not develop the idea further. Many mentioned that ATP was still present, others stated that potassium ion channels were closed, but few mentioned both conditions. Many of those who mentioned high glucose levels referred to levels in the cell rather than in the blood or to trying to reduce the glucose to zero. Some candidates answered in terms of the time taken for insulin to reach the target cells, rather than in terms of the levels of blood glucose and its effect on the cells. Many candidates did not note the reference to continuing insulin secretion, and referred to what would happen when glucose levels returned to normal (when little or no insulin secretion would take place) and negative feedback.
			Total	**10**	

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Question			Answer/Indicative content	Marks	Guidance
12	a		the type of diabetes (being treated) □ age (of patients) □ gender (of patients)□ *idea of* how the improvement was measured □ *idea of* when the improvement was measured □		**ACCEPT** extent of improvement / AW
	b	i	(pancreatic) beta / B, cells □	1	
		ii	*type I because:* *(*type I) results from a shortage of beta cells (in the pancreas)□ *idea that* stem cell therapy might increase insulin production □ *idea that* type II diabetes usually results from insulin resistance (rather than a lack of insulin)□	2 max	
	c	i	0.93 □□□	3	**ACCEPT** calculator value of 0.928977933 and any correct rounding Apply **ECF** throughout Max 2 if answer is incorrect **AWARD 1 mark** for calculating the mean (9.26) **AWARD 1 mark** for 5 correct subtractions (0.56, 0.56, 0.26, 0.26, 1.64) **AWARD 1 mark** for summation (Σ = 3.452) **AWARD 1 mark** for dividing by 4 (/n-1)
		ii	*standard deviation is:* less affected by the, 10.9 value / outlier / anomaly □ *idea of* takes into account every value in the data □	2	**ora throughout**

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Question			Answer/Indicative content	Marks	Guidance
		iii	*idea of* blood glucose measured using the same method ☐ blood glucose measured the same number of times of day / after eating ☐ idea of taking into account the patients' medical history / age / sex ☐ idea of correct use of statistical test ☐	2 max	**ALLOW** blood glucose measured the same number of times **ACCEPT** measurement of baseline blood glucose levels (prior to therapy) e.g. unpaired t–test
			Total	**13**	

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