1. The adrenaline receptor is one of a class of receptors known as GPCRs. The glucagon receptor on liver cells is another type of GPCR.

Glucagon stimulates conversion of glycogen to glucose in liver cells.

What is the action of glucagon?

A Cyclic AMP catalyses the conversion of glycogen to glucose.
B Glucagon is a second messenger.
C The glucagon receptor is located in the cytoplasm of liver cells.
D When glucagon binds to its receptor it stimulates the conversion of ATP to cyclic AMP.

Your answer ☐ **[1]**

2(a). Scientists analysed the occurrence of diabetes in identical and non-identical twins.

Identical twins have the same DNA. Non-identical twins share approximately 50% of each other's DNA.

The scientists selected 614 pairs of twins in which at least one of the individuals had diabetes: 109 pairs had type 1 diabetes; 505 pairs had type 2 diabetes.

The scientists calculated the percentage probability of an individual having diabetes when their twin has the disease.

The table shows the percentage probability of both individuals in a pair of twins developing either type 1 or type 2 diabetes.

	Percentage probability of both individuals in a pair of twins having the disease	
	Type 1 diabetes	**Type 2 diabetes**
Identical twins	23	34
Non-identical twins	5	16

Explain what conclusions can be drawn from the data in the table about the influence of the environment and genetics on the probability of developing diabetes.

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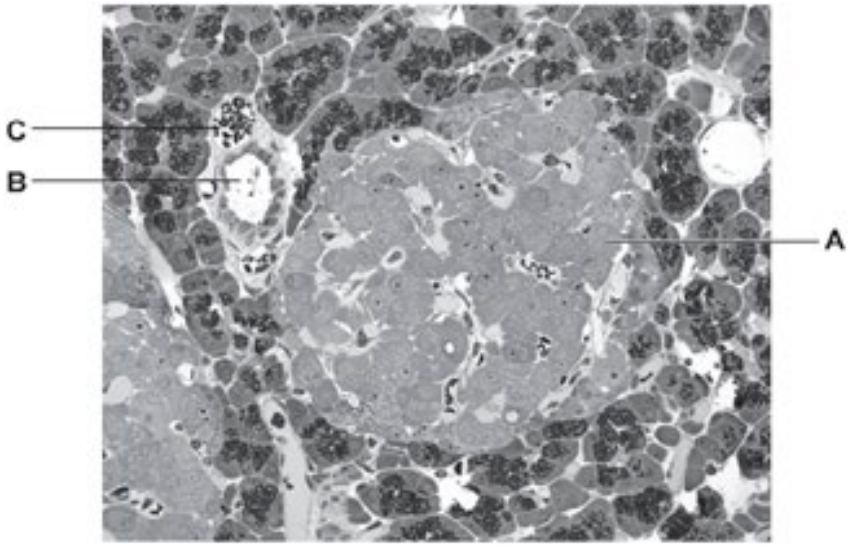
_____ **[6]**

(b). Insulin is secreted from cells in the pancreas.

This is a photomicrograph of pancreatic tissue.



Identify the structures labelled **A**, **B** and **C**.

A

_____

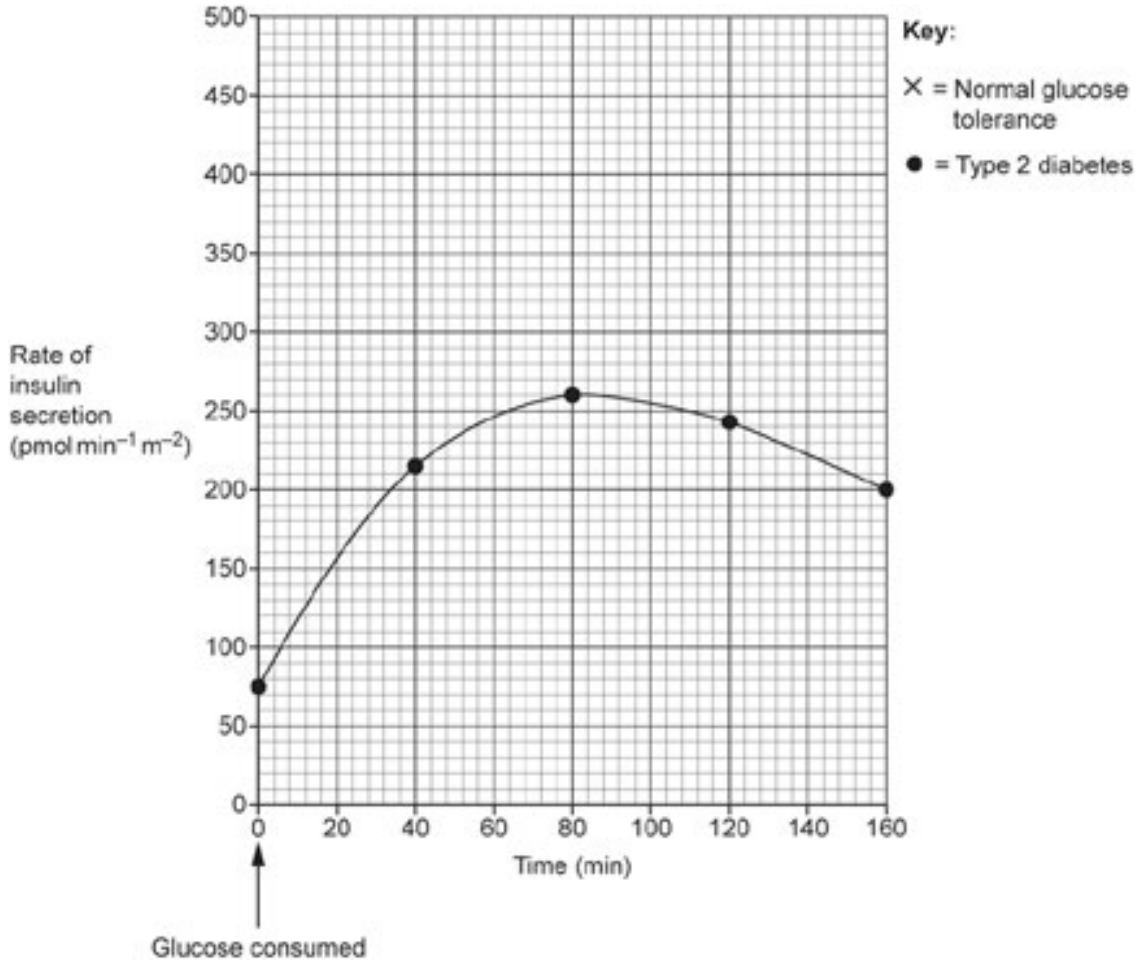
B

_____

C

_____ **[3]**

(c). The graph shows the changes in the rate of insulin secretion in a person with type 2 diabetes after consuming glucose.



The table shows the changes in the rate of insulin secretion in a person with normal glucose tolerance after consuming glucose.

Time (min)	Rate of insulin secretion (pmol min^{-1} m^{-2})
0	60
40	460
80	365
120	299
160	190

Plot the data from the table **on the graph and** draw a line of best fit.

[2]

(d). In the future, type 1 diabetes could be treated by giving patients new pancreatic β-cells that have been produced in a laboratory from stem cells.

i. State a feature of stem cells that allows them to be used to produce pancreatic β-cells.

---**[1]**

ii. Future treatments for type 1 diabetes may be able to use stem cells from a patient's body to produce new β-cells.

Explain why patients receiving these new β-cells would still need to be given immunosuppressant drugs.

---**[1]**

3(a). Glands can be either endocrine or exocrine.

i. Describe what is meant by an endocrine gland.

---**[2]**

ii. The pancreas contains endocrine glands such as the Islets of Langerhans. It also contains cells that produce digestive enzymes.

Suggest why the cells that produce digestive enzymes are described as exocrine rather than endocrine.

---**[1]**

(b). Hormones can be classed as either steroid or non-steroid. Steroids are lipid soluble.

Suggest the location of the receptors for steroid hormones and state a reason for your suggestion.

---**[2]**

(c). The Society for Endocrinology has produced a booklet about adrenal failure to help patients understand their illness.

The following statements are adapted from this booklet.

- Adrenal failure is caused by inability of the adrenal glands to produce sufficient amounts of cortisol and aldosterone.
- In healthy people, the hormone ACTH is produced by the pituitary gland and causes the adrenal cortex to release more cortisol and aldosterone.
- A pituitary tumour can stop ACTH production by the pituitary. This leads to adrenal failure.
- Symptoms of adrenal failure include severe fatigue and weakness, weight loss, low blood pressure and salt craving.

i. Explain the symptoms of adrenal failure.

[2]

ii. Explain why patients with a pituitary tumour have adrenal failure but still respond normally to situations of danger or excitement.

[3]

END OF QUESTION PAPER