

Q1.

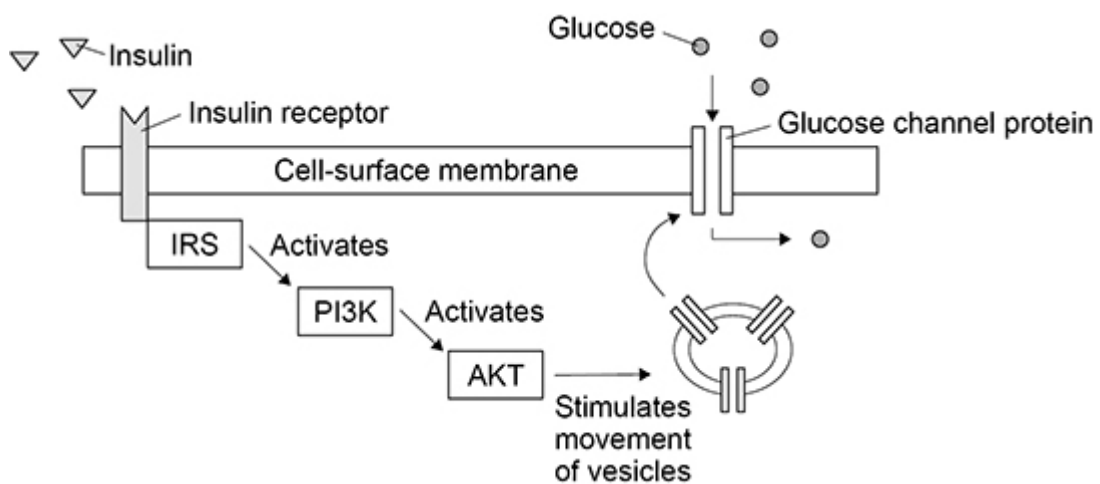
- (a) Neonatal diabetes is a disease that affects newly born children. The disease is caused by a change in the amino acid sequence of insulin.

This change prevents insulin binding to its receptor. Explain why this change prevents insulin binding to its receptor.

(2)

Phosphoinositide 3-kinase (PI3K) is an enzyme in several metabolic processes.

The figure below shows the role of PI3K in the control of blood glucose concentration.



- (b) A decrease in the activity of PI3K can cause type II diabetes.

Use the figure above to explain why.

(3)

- (c) Using your knowledge of the kidney, explain why glucose is found in the urine of a person with untreated diabetes.

(3)

(Total 8 marks)

Q2.

- (a) Describe the role of glucagon in gluconeogenesis.

Do **not** include in your answer details on the second messenger model of glucagon action.

(2)

- (b) The gene that codes for glucagon is 9.531 kilobases in length. The DNA helix makes one complete turn every 10 base pairs. Every complete turn is 3.4 nm in length.

Use this information to calculate the length in micrometres (μm) of the gene for glucagon. Give your answer to 3 significant figures.

Answer = _____ μm

(2)

Metformin is a drug commonly used to treat type II diabetes. Metformin's ability to lower the blood glucose concentration involves a number of mechanisms including:

- increasing a cell's sensitivity to insulin
- inhibiting adenylate cyclase.

- (c) Explain how increasing a cell's sensitivity to insulin will lower the blood glucose concentration.

(2)

- (d) Explain how inhibiting adenylate cyclase may help to lower the blood glucose concentration.

(3)

(Total 9 marks)

Q3.

- (a) Each year, a few people with type I diabetes are given a pancreas transplant. Pancreas transplants are not used to treat people with type II diabetes.

Give **two** reasons why pancreas transplants are not used for the treatment of type II diabetes.

1. _____

2. _____

(2)

- (b) The pancreas produces the hormone insulin.

Put a tick (✓) in the box next to the statement which describes **incorrectly** the action of insulin.

Activates enzymes involved in the conversion of glucose to glycogen.

Controls the uptake of glucose by regulating the inclusion of channel proteins in the surface membranes of target cells.

Attaches to receptors on the surfaces of target cells.

Activates enzymes involved in the conversion of glycerol to glucose.

(1)

Q4.

- (a) Give **two** ways in which people with type 1 diabetes control their blood glucose concentration.

1. _____

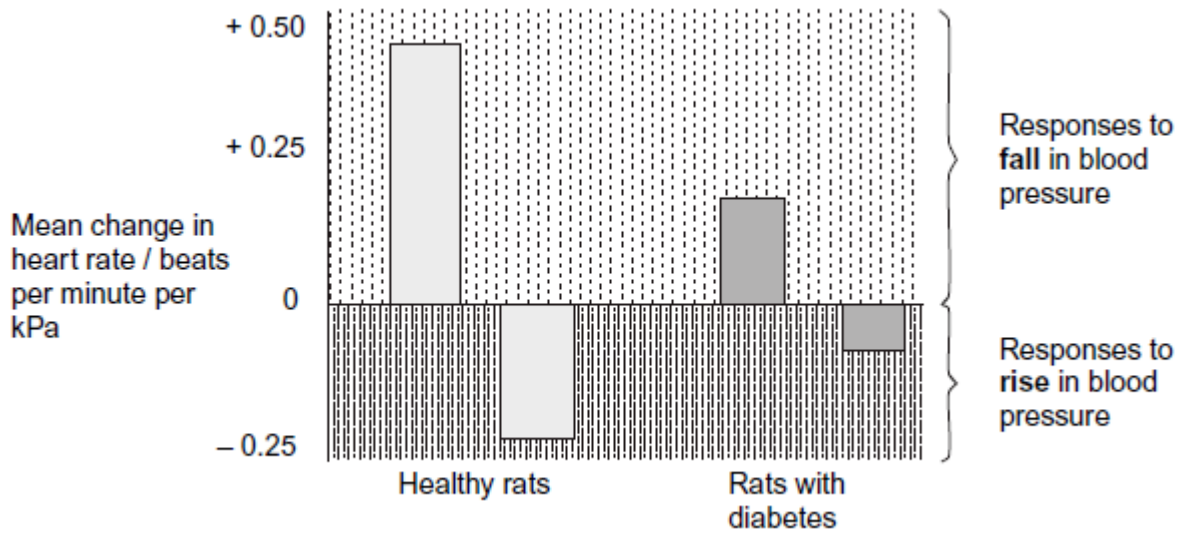
2. _____

(2)

- (b) Scientists investigated the effect of diabetes on the control of heart rate in response to changes in blood pressure in rats.

The scientists found the mean changes in heart rates of healthy rats and rats with diabetes in response to rises or falls in blood pressure.

The diagram shows their results in the form they were presented.



Diabetes can damage the nervous system. The response of the rats with diabetes is different from the response of the healthy rats. Use your knowledge of the control of heart rate by the nervous system to suggest an explanation for these results.

(4)
(Total 6 marks)