InkBiology

ANSWER BOOK

Blood glucose: two hormones, one liver, and two different diabetes

Hormonal communication, plant responses and homeostasis · Unit B15

AQA 3.6.4.2 · OCR A 5.1.4 · Edexcel A Topic 7 (homeostasis) · CAIE 14.1

6 questions · 24 marks

NAVY EDITION

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SECTION B · Standard, 3 to 5 marks

B1 **B1** more glucose enters the beta cell through its transporter protein and is phosphorylated and respired. **B1** the concentration of ATP in the cytoplasm therefore rises, in proportion to how much glucose the cell is respiring. **B1** ATP binds to the potassium channels in the cell surface membrane and closes them, so potassium ions can no longer diffuse out. **B1** positive charge builds up inside and the membrane depolarises, which opens voltage-gated calcium channels and calcium ions diffuse in. **A1** the calcium causes vesicles of insulin to fuse with the cell surface membrane and release their contents by exocytosis. [5]

B2 **B1** insulin binds to receptors on liver, muscle and adipose cells; it is a signal and never touches a glucose molecule, and the conversions are done by enzymes inside those cells. **B1** vesicles carrying glucose transporter proteins fuse with the cell surface membrane, so more glucose enters by facilitated diffusion. **B1** insulin activates the enzymes of glycogenesis, so glucose entering liver and muscle cells is stored as glycogen, and it also raises the rate of respiration of glucose and promotes its conversion into fat. **A1** it inhibits the alpha cells at the same time, so the opposing glucagon signal is switched off and less glucose is released from the liver. [4]

B3 **B1** in type 1 the beta cells have been destroyed by the person's own immune system, whereas in type 2 the target cells respond poorly to insulin and secretion may fall later. **B1** in type 1 little or no insulin is produced, whereas in type 2 insulin is produced, sometimes in excess, but the receptors respond weakly to it. **B1** type 1 must be managed with insulin injections matched to meals and exercise, whereas type 2 is usually managed first by diet, weight loss and exercise, with drugs and sometimes insulin later. **B1** the two are separated by cause and not by age: type 2 is regularly diagnosed in teenagers and type 1 can begin at fifty. [4]

B4 **M1** the increase is 9.8 − 5.6 = 4.2 mmol per dm3. **M1** percentage increase is the increase divided by the starting value and multiplied by 100, so 4.2 ÷ 5.6 × 100. **A1** 75 per cent. **A1** the fall of 4.2 mmol per dm3 takes 90 minutes, so the mean rate is 4.2 ÷ 90 = 0.047 mmol per dm3 per minute. [4]

B5 **B1** insulin is a protein, and a protein that is swallowed is hydrolysed by proteases in the stomach and small intestine. **B1** it would be broken down into amino acids, which are absorbed but have none of the effects of the hormone, so it must enter the blood without passing through the gut. **B1** in type 2 diabetes the beta cells still secrete insulin, so reducing the glucose load of meals and losing weight can improve how well the target cells respond and let the person's own insulin cope. **A1** in type 1 the beta cells have been destroyed, so there is no insulin to improve the response to, and the hormone itself has to be replaced. [4]

B6 **B1** beta cells secrete insulin. **B1** alpha cells secrete glucagon. **B1** both are found in the islets of Langerhans, the endocrine tissue scattered through the pancreas. [3]