Mark scheme

Question			Answer/Indicative content	Marks	Guidance
1			D	1	**Examiner's Comments** Options **A** and **B** were the most often seen incorrect responses, highlighting the need for candidates to be secure in their knowledge regarding the mechanisms of hormone action and the associated terminology.
			Total	**1**	
2	a		**Level 3 (5-6 marks)** An answer that includes appropriate conclusions **and** an accompanying explanation *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3-4 marks)** An answer that includes an appropriate conclusion **and** an accompanying explanation. *There is a line of reasoning with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1-2 marks)** An answer that includes an appropriate conclusion. *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 marks** No response or no response worthy of credit.	6	***Examples of when the mark for the communication statement would be lost*** ***- the need to link different parts of the answer together to award a conclusion point or explanation point*** ***- if the answer contains lots of irrelevant information*** **Indicative scientific points may include (but are not limited to):** • **C both types of diabetes are affected by the environment and genetics** • **E** because genetic influence alone would cause 100% of identical twin pairs to have diabetes • **E** because genetic influence alone would cause (approximately) 50% of non-identical twin pairs to have diabetes • **C environment appears to have more influence than genetics for both types** • **E** because (all four) percentages are low • **E** because if genetics and environment exerted a similar influence, we would expect 50% for identical twins / 25% for non-identical, and the

					percentages are all lower than these values • **C genetic component of type 2 might be higher than that of type 1** • **E** because percentages are higher for, both types of / non-identical / identical, twins with type 2 diabetes • **C conclusions drawn are limited / AW** • **E** different numbers of pairs of twins in each group / many more pairs of twins with type 2 diabetes looked at compared to type 1 diabetes / small overall sample size / no statistical analysis/ are both non identical twins the same gender/ are all pairs of twins the same age • **E** assumption that twins both grew up in same environment / all pairs of twins were in similar environments / had similar diets or exercise **<u>Examiner's Comments</u>** This question included a strong element of stretch and challenge. The data presented to candidates was unusual and from a study that had some limitations. Importantly, the data contradicted some of the understanding many candidates may have about the relative influence of genetics and the environment on the risk of developing diabetes. Therefore, this question was a data analysis and evaluation question rather than requiring prior knowledge of diabetes causes. Candidates that interpreted the data correctly were able to score full marks. However, many candidates attempted to fit their understanding of the causes of diabetes to the data, rather than allowing the data to lead them to conclusions. Candidates had to state clearly that the data showed that both type 1 and type 2 diabetes were influenced by

					both genetics and the environment. More successful candidates recognised that if the only influence was genetic, then all the identical twins would have type 1 or type 2 diabetes. As the percentage concordance for each type of diabetes was less than 100 but more than 0 for identical twins, there must be an environmental and a genetic influence on each type of diabetes Some more successful candidates noted that the percentage concordance for identical twins was less than 50 for both types of diabetes, so the dominant influence in both type 1 and type 2 diabetes was environmental. Others noted that both types of twins had a higher percentage for type 2, concluding that the genetic influence on type 2 was greater than for type 1. Few candidates identified that the study was unreliable, or conclusions were limited due to flaws in the design. Less successful candidates who attempted to make this point referred to a lack of a control group which did not apply in this study. **Misconception** Many candidates attempted to use the data to support the misapprehension that type 1 diabetes was only influenced by genetics and type 2 only by the environment. In fact, both types of diabetes are influenced by both genetics and the environment. Exemplar 2

					Both types of diabetes are influenced by environmental factors. Type 1 diabetes is much more likely to occur in identical twins who share all their DNA than in non-identical twins who only share half their DNA (33% in identical vs 5% in non-identical). Type 1 diabetes is very likely to be influenced by genetic factors. However, environmental factors still influence to some degree, as not all identical twins both have type 1 diabetes. Type 2 diabetes is also likely to have a genetic factor as more identical twins (28% both) both have it than non-identical twins (16% both). However, environmental factors play a larger role because more non-identical [8] twins both have type 2 diabetes than type 1 diabetes (16% vs 5%). Non-identical twins are more likely to share lifestyles than genes, as they were likely brought up similarly. This answer has stated that both types of diabetes have potential genetic and environmental components. These points are scattered throughout the answer, as was often the case with this first conclusion (other conclusions are much more likely to be found as a single statement).The idea that the environment has some influence on type 1 diabetes as not all identical twin pairs have type 1 diabetes is the explanation for this conclusion (i.e. there must be environmental influence as well as genetic as less than 100% of identical twins both have type 1 diabetes) So this answer has both a conclusion and explanation – gains Level 2, 3 marks. The communication mark was not credited because the conclusion was not stated clearly. Exemplar 3 From the data in the table, it can be concluded that both type 1 and type 2 diabetes have a genetic link as the % probability of both identical twins having the disease is higher in identical twins for both type one and type 2. It may be suggested that type 2 diabetes has a stronger genetic link as there is also a higher probability in non-identical twins for any type 2 than type one. However, the sample size for the twins with type 2 was much greater than that of type 1 (i.e. 505 pairs vs 109 pairs respectively) This means that a causal relationship (direct cause and effect) may not be able to be found due to the difference in sample size. However despite this, it cannot be [8] said that either type 1 or 2 is more genetic as if it was, the probability of identical twins both having the disease will also be more as they share more DNA. This means that there must be environmental factors having an effect on the development of diabetes This answer has stated that both types of diabetes have potential genetic and environmental links, but these points are scattered throughout the answer. They go on to state that the diabetes is not entirely genetic as

					identical twins should be 100% and so has the explanation for this conclusion. They also conclude that genetics has a greater effect on type 2 diabetes as there is a higher probability of both non - identical twins having type 2 diabetes than type 1. Finally, they mention that any conclusions drawn are limited due to the relevant sample sizes of twins with type 1 and 2 diabetes. This is a clear Level 3 answer worth 6 marks.
	b		A = islet of Langerhans B = (branch of pancreatic) duct C = (named) blood vessel	3	**ALLOW** α-cell / β-cell **ALLOW** (intralobular) duct **ALLOW** artery / arteriole / vein / venule **ALLOW** red blood cell / erythrocyte **DO NOT ALLOW** capillary (contains too many erythrocytes) / incorrectly named blood vessel (e.g. hepatic artery) **Examiner's Comments** Most candidates correctly identified A as an islet of Langerhans. Credit was also given if A was identified as an α–cell or a β-cell. More successful answers recognised B as a (pancreatic) duct and C as a blood vessel, or a red blood cell inside the blood vessel. Marks were not gained due to references to the blood vessels being hepatic rather than pancreatic, or for thinking that C was a capillary which was not allowed as it contains too many erythrocytes.
	c		all 5 data points plotted correctly (± half a square) ✓ (smooth) line of best fit ✓	2	Smooth continuous curve starting at point 1 and finishing at point 5 going through all 5 points **ALLOW** if goes between points 3 and 4 or misses either point 3 or point 4 **DO NOT ALLOW** ruled lines between points **Examiner's Comments** Candidates were required to plot five points and draw a line of best fit. The majority of candidates plotted the points correctly, but the line of best fit was less successful. The line mark was not credited for drawing a straight

					line instead of a curved one or for sketching the line, so that in places there were two lines. Successful candidates drew a smooth curve which passed through points 1, 2 and 5, and either passed between points 3 and 4 or only touched one or both of them.
	d	i	(they can) differentiate into, specialised / specific, cells / AW✓	1	**IGNORE** 'they are, undifferentiated / unspecialised unqualified **ALLOW** develop / change / divide / form, for differentiate **ALLOW** pluripotent / multipotent **IGNORE** totipotent e.g. 'they can specialise into, many / any, different types of cell' e.g. 'they can differentiate into, pancreatic / β, cells' **IGNORE** 'grow into / turn into, specialised cells' **Examiner's Comments** Nearly all candidates recognised that stem cells are undifferentiated, with most continuing to say that they could differentiate to form many types of cells, to gain credit.
		ii	*idea that* type 1 diabetes is an autoimmune disease (so response against (any) β-cells would still occur) ✓	1	e.g. mistake **their own** new β-cells as foreign and attack them' **IGNORE** 'to stop the immune system attacking the cells' alone **Examiner's Comments** This proved to be a demanding question. Very few candidates seemed to notice that the new cells were from the patient, and more candidates referred to autoimmune disease in Question 5 (a) than in this question. Candidates were required to recognise that although the new cells came from the patient, the autoimmune response would need to be suppressed, as their own beta cells were regarded as foreign and therefore were being attacked.
			Total	**13**	

3	a	i	(a group of cells that) secretes / releases / produces, hormones ✓ (directly) into the blood (stream) ✓	2 (AO1.2)	**DO NOT ALLOW** excretes **ALLOW** doesn't have ducts / ductless **Examiner's Comments** Most candidates knew that hormones were produced by endocrine glands to gain one mark. Good responses were seen where candidates extended their response to include information about hormones directly entering the bloodstream or glands being 'ductless'. There were some less successful responses that mentioned excretion, or release of hormones inside the cell.
		ii	(because digestive enzymes) are released into ducts ✓	1 (AO2.1)	**ALLOW** (because digestive enzymes) are not released (directly) into the blood **Examiner's Comments** Some candidates knew that enzymes were secreted into ducts, but a number described that digestive enzymes were secreted from cells or become active outside them.
	b		inside cells / in cytoplasm / in the nucleus ✓ because steroids can cross the, cell surface / plasma, membrane ✓	2 (AO2.1)	**ALLOW** can cross phospholipid bilayer **Examiner's Comments** This question was generally well answered. Some candidates suggested that the receptor would be on the membrane despite also describing those steroid hormones could pass through. Other candidates incorrectly concluded that being lipid soluble meant they would not be able to pass through and stated the receptors would be on the surface of the plasma membrane. Some just referred to the 'cell membrane' or 'bilayer' instead of the plasma membrane, cell surface membrane or phospholipid bilayer.
	c	i	cortisol / glucocorticoids, regulate carbohydrate metabolism ✓ lack of, aldosterone /	2 (AO2.1)	**ALLOW** helps regulate availability of glucose **or** ref to gluconeogenesis **or** glycogenolysis

			mineralocorticoids, cause, low blood pressure / salt craving, as regulate ion concentration ✓		**IGNORE** aldosterone **ALLOW** for ions either sodium ions **or** Na^+ **or** potassium ions **or** K^+ **DO NOT ALLOW** cortisol **Examiner's Comments** Most candidates found this question challenging. Some candidates did link cortisol to the regulation of metabolism but omitted to say that it is specifically 'carbohydrate' metabolism. Other candidates correctly attributed low blood pressure to the absence of aldosterone but did not develop their answer to link this to regulation of ion concentration, or just talked about salts rather than ions. Less successful responses confused the effects of each hormone, or attributed them both to each symptom or effect, e.g. cortisol and aldosterone are responsible for low blood pressure.
		ii	**any three from**: ACTH only affects (adrenal) cortex ✓ adrenaline is produced by the (adrenal) medulla ✓ adrenaline is responsible for, response to danger / flight or fight response ✓ response to danger / fight or flight response, is also, mediated by / AW, (autonomic/sympathetic) nervous system ✓	3 (AO2.1)	**ALLOW** ACTH does not affect medulla **DO NOT ALLOW** parasympathetic **Examiner's Comments** This question was generally answered well, and most candidates were able to gain 1 or 2 marks. Many responses included the idea that adrenaline was produced by the adrenal medulla, and linked the fact that adrenaline was responsible for the fight or flight response. Several candidates made reference to the sympathetic nervous system but did not develop their answer to include that it is also responsible for the flight or fight response.
			Total	**10**	