

OCR A-LEVEL BIOLOGY B • H422

BIOLOGY



EXAM QUESTION PACK

5.3.2 THE HORMONAL CONTROL OF BLOOD GLUCOSE AND THE MANAGEMENT OF DIABETES

SCORE

/165

PERCENTAGE

%

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1 Fig. 3.1 is a scanning electron micrograph of receptor cells in the retina of the human eye.

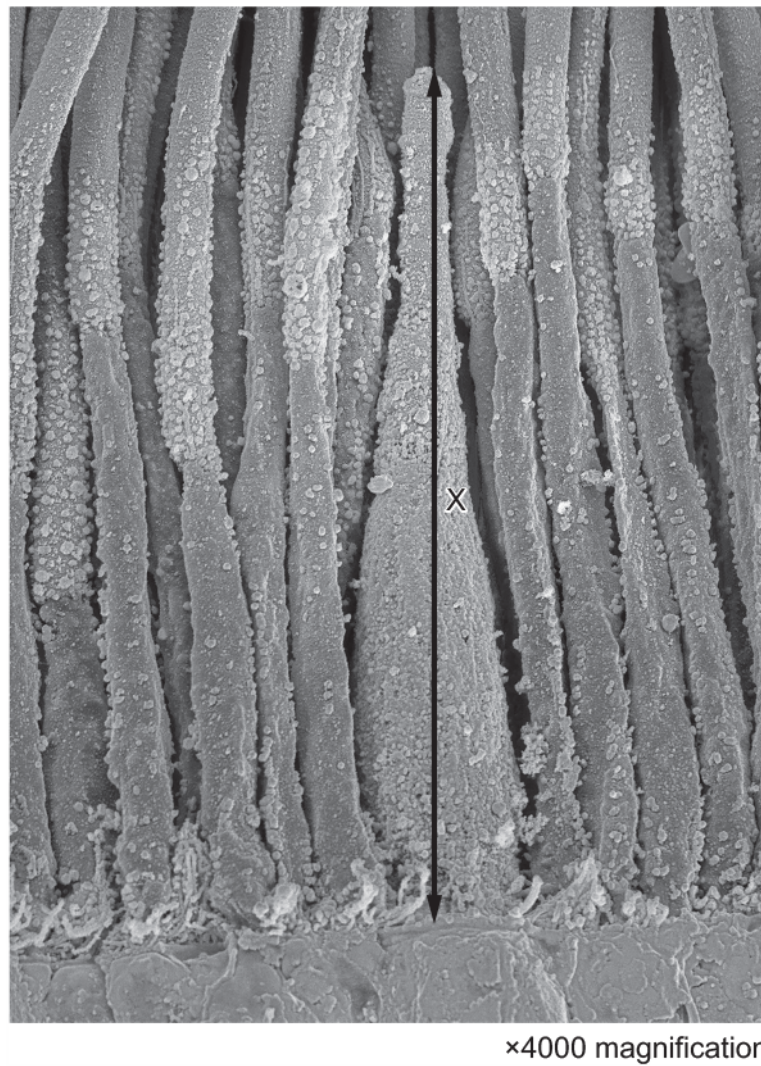


Fig. 3.1

Retinopathy is an eye condition which can be caused by diabetes.

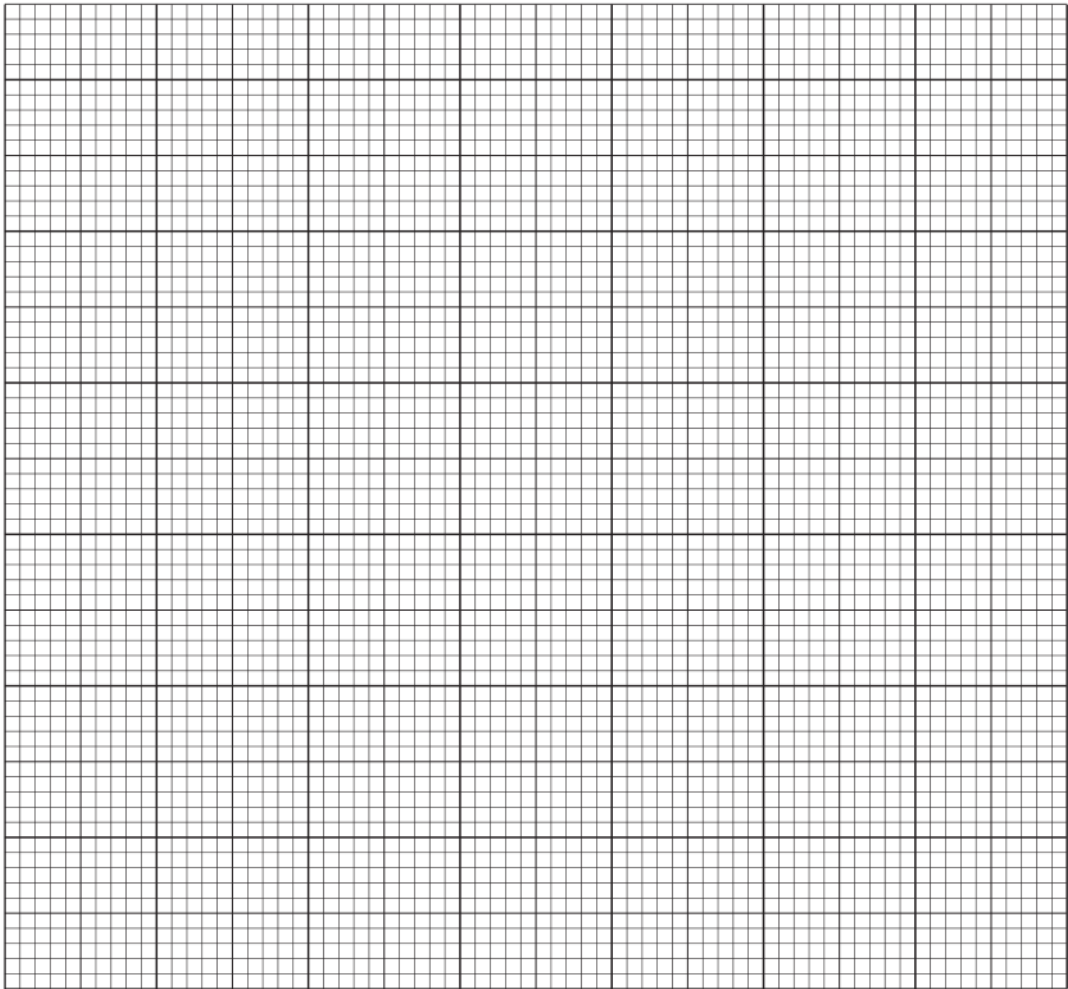
An investigation into the incidence of diabetic retinopathy in the UK was carried out.

Some of the data from the study are shown in the table below.

Age (years)	Frequency density
$35 \leq X < 46$	28
$46 \leq X < 63$	26
$63 \leq X < 69$	33

$69 \leq X < 81$	45
$81 \leq X < 95$	31

(i) Using the data in the table, plot a histogram on the grid provided.



[3]

(ii) Calculate how many cases of diabetic retinopathy were found between the ages of 63 and 81.

number of cases = ... [2]

(iii) Explain why it is an advantage to use large sample sizes.

[1]

(iv) A key finding of the study was large regional variation in the incidence of retinopathy, after accounting for age, gender, deprivation and ethnicity.

Suggest a reason for the large regional variation.

[2]

2(a) Type 1 and type 2 diabetes have different treatments.

(i) Compare the treatments for type 1 and type 2 diabetes.

[3]

(ii) Explain why measurement of the concentration of glycosylated haemoglobin is used to evaluate how well a patient's blood glucose concentration has been controlled.

[2]

(b) Diabetes can lead to the development of a disease called retinopathy, which involves damage to the retina.

Some doctors have suggested that hypertension increases the risk of retinopathy in patients with type 1 diabetes.

A clinical trial was carried out to investigate the effect of blood pressure on the risk of developing retinopathy.

Two groups of patients with type 1 diabetes were selected and treated as follows:

- the test group of 231 patients received lisinopril, a drug that reduces hypertension
- the control group of 228 patients received a placebo

Both groups were monitored for a period of 24 months. Their blood pressure and glycosylated haemoglobin concentrations were measured regularly.

The results of the trial are shown in the table.

	Number of patients who developed retinopathy or whose retinopathy worsened	Number of patients whose retinopathy improved	Mean blood pressure at start of trial	Mean blood pressure at end of trial
Test group (lisinopril)	21	33	$\frac{123}{81}$	$\frac{120}{80}$
Control group (placebo)	39	28	$\frac{123}{81}$	$\frac{123}{81}$

- (i) Name an instrument used to measure blood pressure.

----- [1]

- (ii) Calculate the percentage decrease in the systolic blood pressure in the test group over the course of the trial.

percentage decrease = ...% [2]

- (iii) * The doctors running the clinical trial concluded that lisinopril had beneficial effects on retinopathy caused by type 1 diabetes.

Evaluate this conclusion.

In your answer, suggest what additional information the doctors would need to be more confident in their conclusion.

Handwriting practice lines consisting of 20 sets of three horizontal dashed lines.

[6]

(c) A researcher collected data for the incidence of hypertension and type 2 diabetes in a population.

(i) Describe how the researcher could test for correlation between hypertension and type 2 diabetes.

[2]

(ii) The researcher found that there was a positive correlation between hypertension and type 2 diabetes.

As a result, they concluded that type 2 diabetes was caused by hypertension.

Explain why the researcher’s conclusion may not have been correct.

[2]

- 3 Renal glucosuria is a rare condition in which glucose is excreted in the urine despite normal or low blood glucose levels.

(i) Outline a test that could be used to detect glucose in a urine sample.

[2]

(ii) Draw the ring structure of a molecule of glucose in the space below.

- 4 Which of the options, **A** to **D**, describes an indirect role of glucagon? [2]

- A condensation
- B esterification
- C hydrolysis
- D oxidation

Your answer

[1]

5(a) The photomicrograph in Fig. 36 shows a section of pancreatic tissue.

An endocrine structure is labelled X.

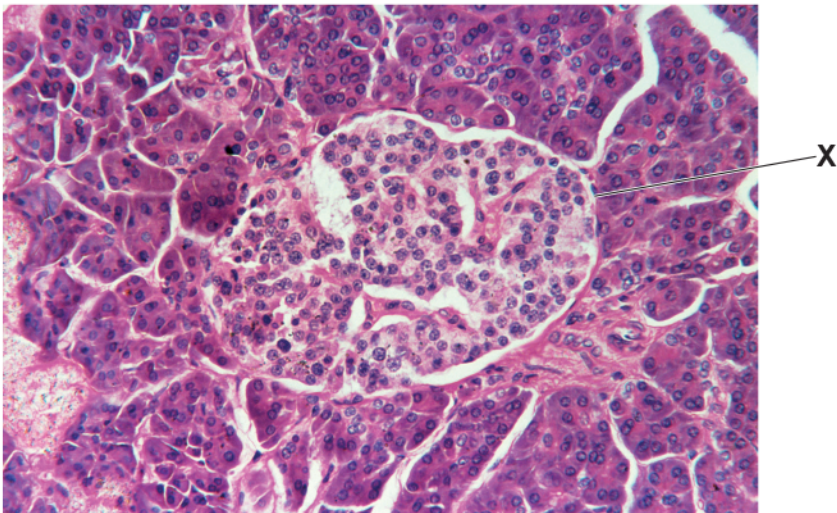


Fig. 36

(i) Identify structure X.

----- [1]

(ii) * In a healthy individual, the concentration of blood glucose is maintained at around 80 to 90 mg per 100 cm³.

Discuss the mechanisms that control blood glucose concentration.

Your answer should include **named** cell types and biochemical pathways.

[6]

- (b) Impaired regulation of blood glucose concentration is a feature of diabetes.

Scientists are investigating new treatments for diabetes using mouse models. Diabetes can be induced in healthy mice by administering a compound called streptozotocin (STZ) and feeding the mice with a normal or high-fat diet.

STZ is toxic to pancreatic islet cells.

- (i) Two strategies for inducing diabetes in healthy mice are described below. For each strategy, suggest which **type** of diabetes would be induced **and** provide an explanation.

High dose of STZ and a normal diet.

Low dose of STZ and a high-fat diet.

[2]

- (ii) Both strategies are carried out over a period of five weeks. After this time, the mice are tested for diabetes.

Name **one** test that can be used to confirm that the mice are diabetic.

[1]

6 A student was asked to find out the glucose concentration in mock body fluids. The student was provided with **three** samples. The student's plan contained the following apparatus list:

- test tubes
- 5 cm³ syringes
- water bath set at 100 °C
- colorimeter fitted with a red filter
- cuvettes
- balance measuring in grams – 2 decimal place display
- filter papers and funnels
- table of data showing absorbance of 1, 5, 10 and 20 mmol dm⁻³ glucose solutions when tested with quantitative Benedict's reagent.

The student was given the choice of two methods, shown in Table 3.1.

Method 1 Benedict's reagent	Method 2 quantitative Benedict's reagent
• Add 5 cm³ of Benedict's reagent to a small volume of sample in a test tube. • Stand the test tube in boiling water for a few minutes. • Observe the colour change. A colour change from green to yellow, then to brown and finally to red indicates the presence of reducing sugar.	• Add 2 cm³ of quantitative Benedict's reagent (QBR) to 4 cm³ of sample in a test tube. • Stand the test tube in boiling water for 5 minutes. • Allow the tube to stand until the precipitate settles or filter to remove the precipitate. • Measure the absorbance using red light.

Table 3.1

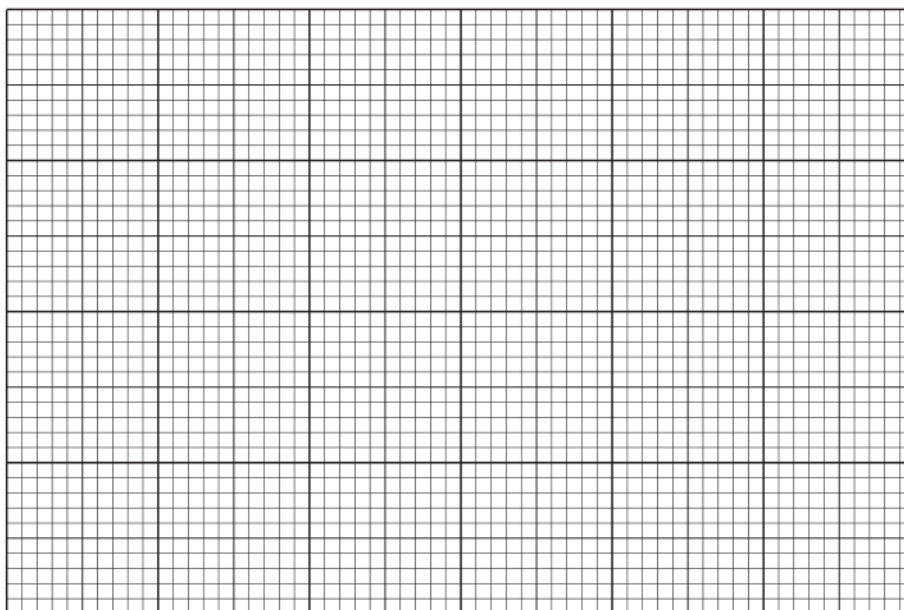
The student chose to use method 2.

The results of a similar investigation are shown in Table 3.2.

Location of body fluid sample	Mean concentration of glucose (mmol dm ⁻³)	Standard deviation
Bowman's capsule	15	2.0
Proximal convoluted tubule	4	0.7
Distal convoluted tubule	3	0.5

Table 3.2

(i) Use the grid provided to present these data in the most appropriate way.



[4]

(ii) A student concludes that these data came from a diabetic person.

Select **one** piece of evidence to support this conclusion.

[1]

7 Which of the options, **A** to **D**, is true of type 2 diabetes?

A caused by autoimmunity

B present from birth

C rapid onset

D slow onset

Your answer

☐

[1]

8(a) This question is about the hormonal control of blood glucose concentration in health and disease.

Complete the missing words in the paragraph below to explain the role of insulin in blood glucose homeostasis.

When the concentration of blood glucose rises above a set point, _____ cells in the _____ of the pancreas are stimulated to release insulin. Effector cells respond to insulin by increasing the expression of _____ proteins in the cell surface membrane. This increases the uptake of glucose. Liver cells store some excess glucose in a process known as _____. The concentration of blood glucose then falls.

[4]

(b) The oral glucose tolerance test (OGTT) is used to diagnose diabetes.

A result from an OGTT measuring blood glucose and insulin concentrations is shown in Fig. 32.

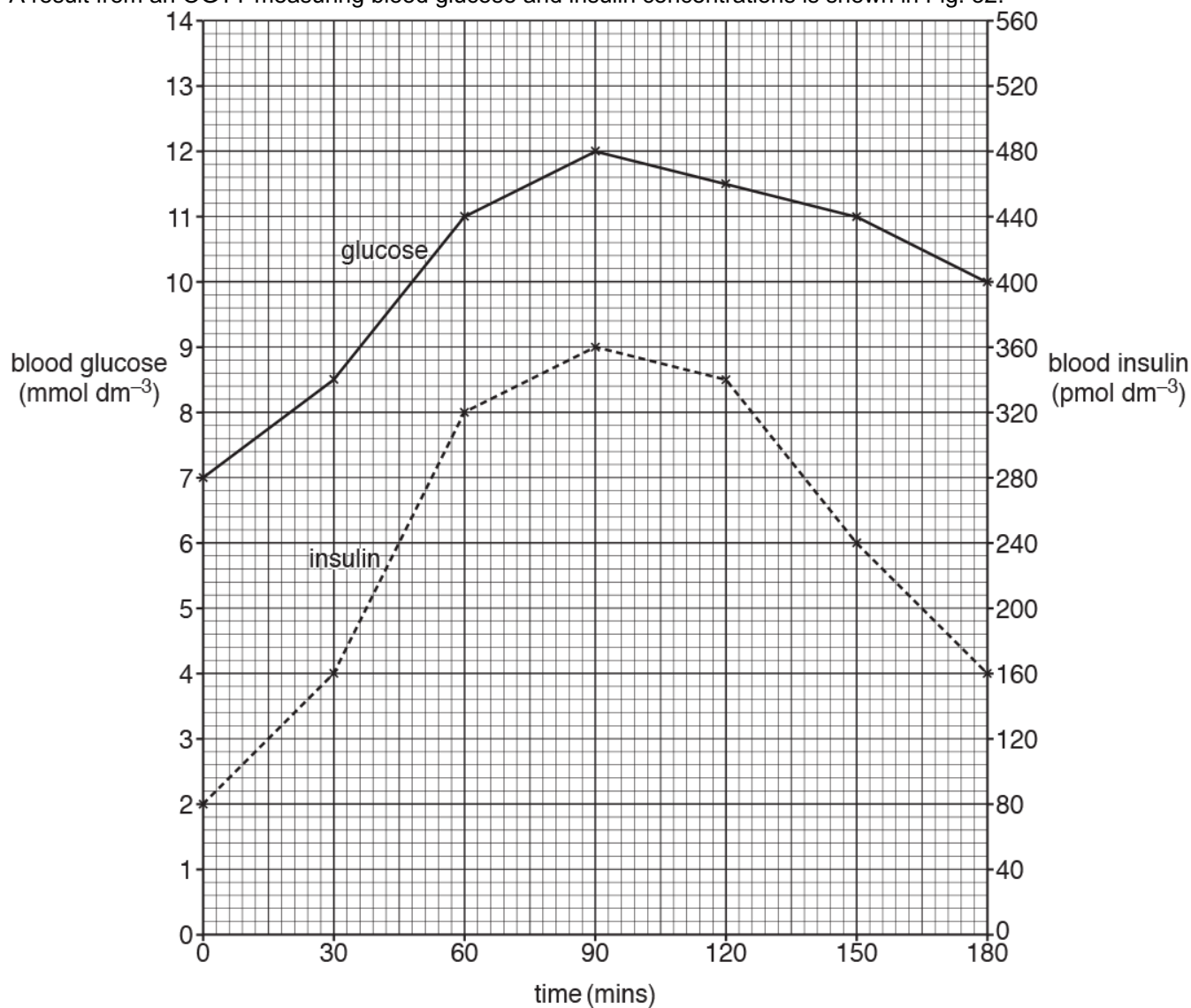


Fig. 32

(i) The OGTT result in Fig. 32 shows evidence of diabetes. State which type of diabetes the patient has and explain how this can be concluded.

type

explanation

.....[1]

- (ii) Calculate the percentage increase in blood glucose concentration after 90 minutes compared to time 0.
Give your answer to **two** significant figures.

Answer = ...% [2]

(i) Several different blood tests are used to diagnose and manage diabetes.

Explain how this test works.

[3]

1

2

[2]

Explain what you understand by the term *evidence-based practice*.

-----[1]-----

- (b) The graph in Fig. 31.1 shows the number of people newly diagnosed with type 2 diabetes each year in the USA between 2000 and 2010.

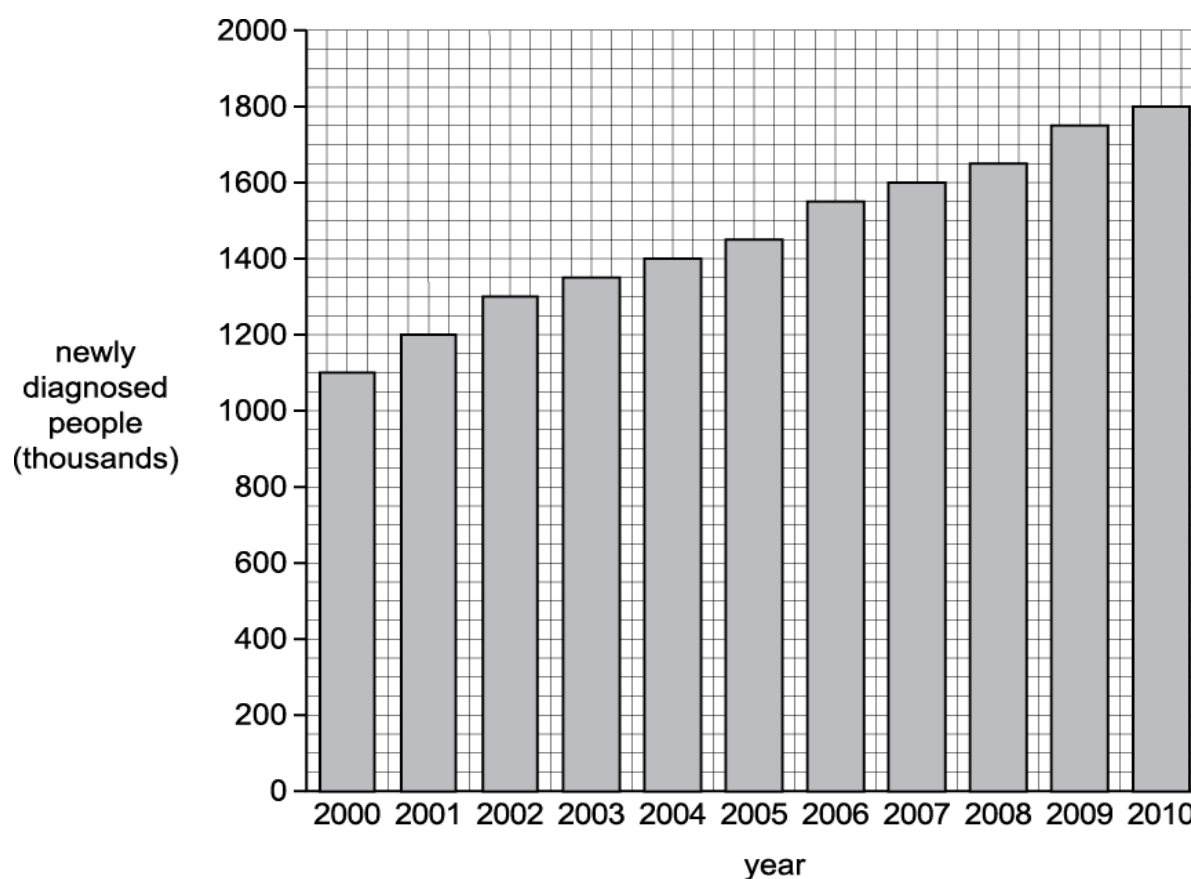


Fig. 31.1

- (i) Calculate the percentage increase in the number of people diagnosed with type 2 diabetes for the five-year period, 2002 to 2006.

Answer % [2]

- (ii) Give **one** reason why some people are concerned with increasing levels of type 2 diabetes.

.....
..... [1]

(iii) Suggest **two** reasons why the data in Fig. 31.1 do **not** provide direct evidence that levels of type 2 diabetes increased in the USA between 2000 and 2010.

1

2

[2]

10(a) Aerobic fitness can be measured using the lactate threshold. The lactate threshold is defined as the level of exercise intensity that can be maintained without lactate concentrations in the blood increasing continuously.

The following paragraph describes a method to detect lactate concentrations in blood. The method is similar to that which is used to detect blood glucose concentrations.

Complete the paragraph using the most appropriate terms.

Blood lactate can be detected and measured using a _____. The enzyme lactate dehydrogenase is _____ on a test strip. A drop of blood is added to the test strip and the strip is placed in a machine.

The enzyme converts lactate in the blood sample to pyruvate in the presence of NAD, which acts as a _____. NAD is _____ to NADH. An electrode converts NADH back to NAD, producing a small electrical current. A digital read out of lactate concentration in mmol dm^{-3} is obtained.

[4]

(b) An investigation was carried out to assess the effect of training on aerobic fitness. The dependent variable was blood lactate **concentration** measured after a 1000 m run at a speed of 4 m s^{-1} .

(i) Suggest one continuous independent variable other than exercise intensity that could be investigated.

-----[1]

(ii) Using the axes below, sketch and label the graph you would expect to produce if you increased the variable you identified in part (i).



Fig. 6

----- the answer to this question should be drawn on Fig. 6 -----

[2]

11(a) The control of blood glucose is essential because changes in blood glucose concentration will change the water potential of blood.

Water potential changes are detected by the osmoregulatory centre and adjustments are then made to the secretion of ADH.

- (i) State **one** reason, other than the effect that it has on water potential, why blood glucose concentrations must be controlled.

----- [1]

- (ii) State the location in the brain of the osmoregulatory centre and the source of ADH secretion.

osmoregulatory centre

source of ADH secretion

[1]

- (b) If people with type 1 diabetes do not administer the appropriate medication, the concentration of glucose in the blood can remain higher than the normal range for relatively long periods of time.

- (i) Name the medication that is required to treat type 1 diabetes.

Describe how and when this medication is administered **and** how it acts to reduce the blood glucose concentration.

[5]

- (ii) **Predict** the effect of high blood glucose concentration on ADH release and urine volume. You should assume that no glucose is lost from the blood and that glucose levels remain high. Justify your prediction.

effect on ADH release

effect on urine volume

justification

[3]

12 A phlebotomist said that a blood sample can be taken to test for diabetes.

In an oral glucose tolerance test for diabetes, a blood sample is taken after a period of fasting. Then, further blood samples are taken at regular intervals after the glucose drink has been consumed.

(i) Explain why sampling before and after the consumption of the glucose drink helps to determine whether a person has diabetes.

[2]

(ii) Suggest why a high glucose level in the final blood sample of the glucose tolerance test might not necessarily confirm that a person has diabetes.

[1]

13 People with diabetes can use biosensors to monitor their blood glucose concentration.

(i) Explain why it is important for diabetics to monitor their blood glucose concentration.

----- [2]

(ii) Complete the following passage by inserting the **most appropriate word** into each gap to explain how a biosensor works.

A person's blood is placed on a test strip on the biosensor. The test strip contains a molecule called glucose . This molecule is an that converts glucose in the blood into .

An electrode detects the small electric current generated by this chemical reaction. The current is converted by a into a digital reading of the person's blood glucose concentration.

[4]

14 Symptoms of the menopause such as hot flushes can be treated by hormone replacement therapy (HRT).

Some forms of HRT are provided as implants.

Explain why cyclical HRT treatments are not available as implants.

----- [1]

15(a) Recent studies, such as those carried out by the World Health Organisation, have noted an increase in the global incidence of **Type 1** diabetes.

Type 1 diabetes occurs due to changes in pancreatic tissue. Fig. 2.1 shows a photomicrograph taken of a section through pancreatic tissue.

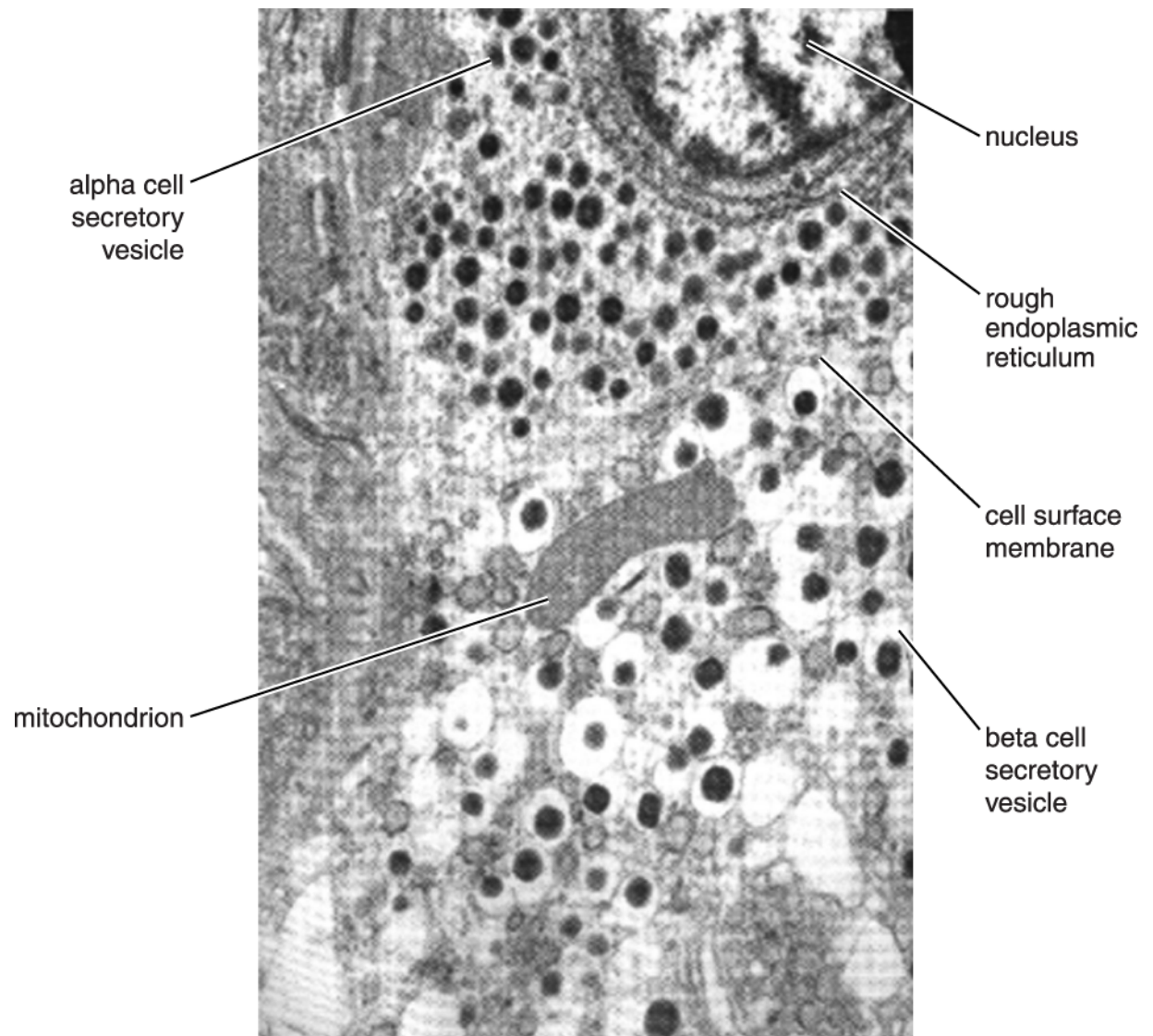


Fig. 2.1

(i) State the region of the pancreas from which this tissue section has been taken.

-----[1]

(ii) Which of the secretory vesicles contains the hormone that lowers blood glucose?

-----[1]

(b) The hormones produced by the region of the pancreas shown in Fig. 2.1 are both polypeptides.

Explain how these hormones are:

- produced by the secretory cells
- released from the secretory cells
- transported to their target organs.



In your answer you should refer to the organelles shown in the diagram and identify the target organs.

[8]

16(a) Describe **two** precautions that a person should take when using a blood glucose meter.

[2]

(b)

- (i) Explain what happens to the glucose in the blood sample when it comes into contact with the chemicals on the test strip.

[2]

- (ii) Several factors may affect the results when taking a series of readings using a blood glucose meter.

State **two** factors that could affect the results.

[2]

17(a) The Diabetes Specialist Nurse (DSN) is just one healthcare professional who will be involved in the treatment of patients with type 1 and type 2 diabetes.

A DSN must be able to provide and give advice on **injectable** therapies for **hyperglycaemia**. One of the injectable therapies used to treat **type 2** diabetes uses **GLP-1**.

GLP-1 is a small peptide produced naturally by the gut.

GLP-1 has several effects including:

- decreasing glucose release from the liver
- decreasing gastric (stomach) emptying
- increasing insulin release from the pancreas
- decreasing glucagon release from the pancreas.

(i) Suggest why GLP-1 is injected rather than taken orally.

----- [1]

(ii) In what form is glucose normally stored in the liver?

----- [1]

(iii) Suggest how a delay in the emptying of the stomach could improve the management of type 2 diabetes.

----- [1]

(iv) Name the cells in the pancreas where GLP-1 acts.

----- [2]

(b) A DSN also be able to provide and give advice on **oral** therapies for hyperglycaemia and hypoglycaemia.

- (i) One of the drugs used in oral therapies for **hyperglycaemia** in **type 2** diabetes targets the enzyme that normally breaks down GLP-1.

Suggest how the action of this drug on the enzyme lowers hyperglycaemia.

----- [1]

- (ii) Explain why this drug is **not** used in the treatment of hyperglycaemia in **type 1** diabetes.

----- [1]

- (iii) State how **hypoglycaemia** would be treated orally in type 1 diabetes.

----- [1]

- (c) In addition to monitoring injectable and oral therapies, and interpreting blood and urine test results, a Diabetes Specialist Nurse (DSN) will also be involved in other aspects of the longterm care of people with diabetes.

Discuss the role of the DSN in the long-term care of people with diabetes **other than** in monitoring different therapies and interpreting blood and urine test results.

----- [3]

Suggest the type of diabetes that is likely to develop in adults as a result of fetal under-nutrition.

Explain your choice.

[3]

(b) Table 2.1 shows the prevalence of type 2 diabetes among **children** in the USA in 2001 and in 2009.

	2001 type 2 diabetes prevalence (per 1000)	2009 type 2 diabetes prevalence (per 1000)
Female	0.42	0.58
Male	0.26	0.35
Caucasian	0.14	0.17
Asian Pacific Islanders	0.35	0.34
Hispanic	0.45	0.79
Native American Indian	1.22	1.20

Table 2.1

Using the information in Table 2.1, compare the changes in the prevalence of type 2 diabetes among children of different genders and ethnic backgrounds in the USA.

[illegible]

19(a) Fig. 3.1 is a colour enhanced light micrograph of mammalian pancreatic tissue.

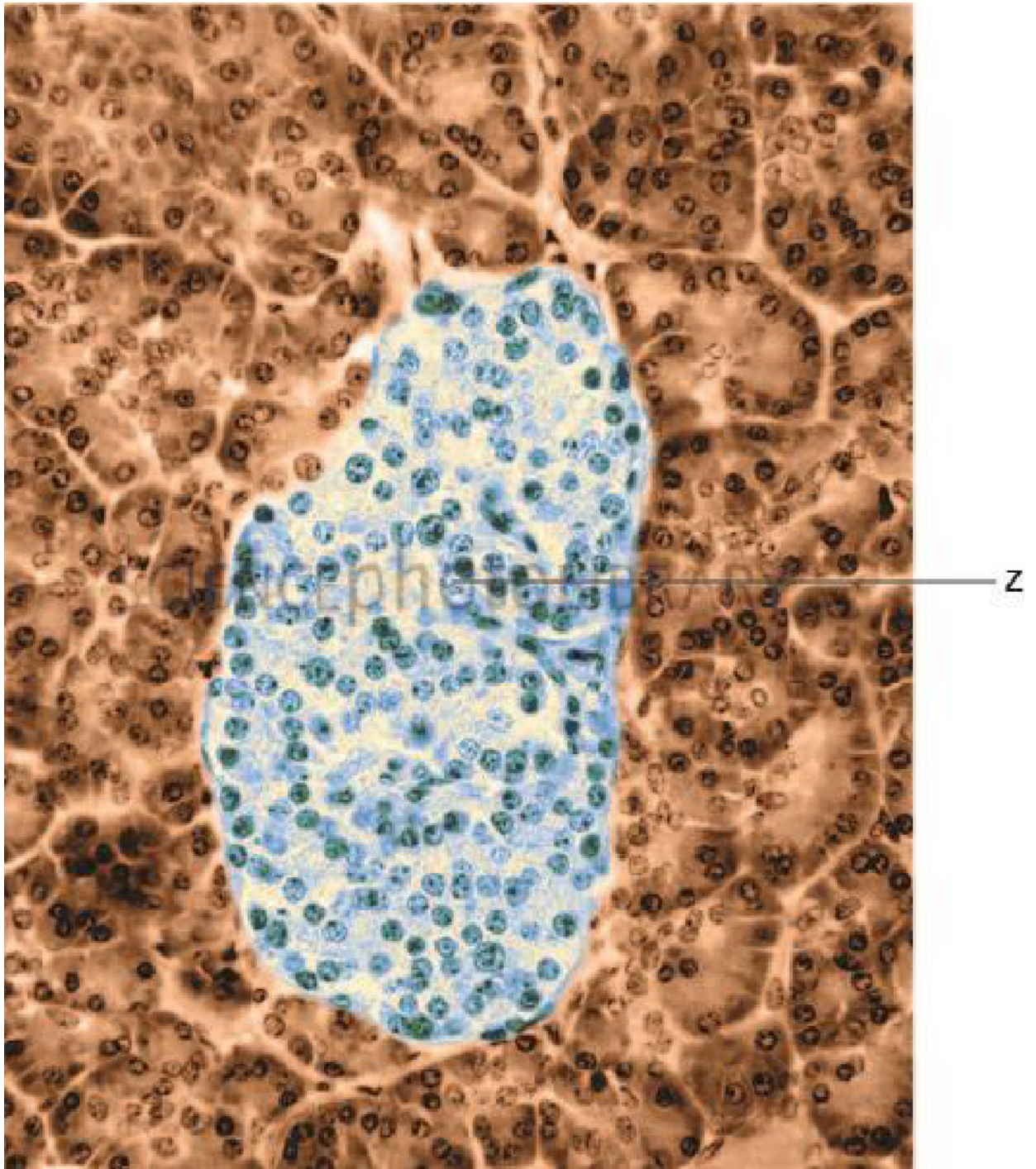


Fig. 3.1

- (i) Name the structure labelled Z in Fig 3.1.

-----[1]

- (ii) In the space below draw a labelled and annotated plan of the pancreatic tissue shown in Fig. 3.1.

[3]

- (b) A student is asked to analyse some blood plasma from a Type 1 diabetic person for the presence of glucose.

The analysis is carried out by heating a plasma sample with Benedict's solution in a boiling water bath and observing any colour change.

A colorimeter is then used to obtain quantitative results.

Table 3.1 shows the blood glucose concentrations recorded by the student over five days.

Time when blood glucose tested	Day 1	Day 2	Day 3	Day 4	Day 5
07:00	4.5	4.7	4.7	4.8	4.6
09:00	7.5	6.9	7.4	4.7	7.3
11:00	6.4	6.0	6.1	4.5	6.0
13:00	7.9	7.4	7.6	7.8	7.5
15:00	6.8	6.3	6.3	6.8	6.2
17:00	5.8	5.7	5.7	5.8	5.8
19:00	7.9	7.5	7.6	7.8	7.5
21:00	5.8	5.7	5.7	5.8	5.8
23:00	5.2	5.2	5.3	5.1	5.4
Mean	6.42	6.16	6.27		6.23

Table 3.1

- (i) Complete Table 3.1, by calculating the mean for Day 4.

[1]

- (ii) Calculating a mean blood glucose concentration to plan the correct doses of insulin for each day is inappropriate. Explain why.

----- [2]

- (iii) The data for the morning of **Day 4** appear to be different from the other days. Suggest **two** possible reasons why.

1

2

[1]

- 20 Hormones such as luteinising hormone (LH) and human chorionic gonadotrophin (hCG) play a key role in the control of the menstrual cycle and in the establishment of a pregnancy.

Name the **type** of organ responsible for secreting LH and hCG directly into the blood stream.

----- [1]

- 21 Alzheimer's is a neurological disorder. A potential new drug treatment for Alzheimer's has entered clinical trials.
The drug has passed the phase 2 trial in which it was tested on 50 patients.

A brief summary of the plan for phase 3 of the trial is as follows:

- The new drug is compared to the best treatment currently available.
- 70 patients receive the new drug in total, 35 from hospital A and 35 from hospital B.
- A placebo is not used.
- Blind trials are used.

- (i) Discuss aspects of the planned phase 3 clinical trial and explain how each aspect is likely to affect the validity of the results.

[3]

- (ii) State **two** possible causes of Alzheimer's.

1

2

[2]

22(a) This question is based on the Advanced Notice article **MYOKINES**, which is an insert.

IL-6 is produced by muscle cells in response to physical exercise.

(i) Using the data in **Table 1.1**, determine the mode and mean IL-6 increase after a 1.5 hour cycle ride.

Determine the mode to **one** significant figure and the mean to **three** significant figures.

mode _____ mean _____

[3]

(ii) Based on the data in **Table 1.1**, how valid are the following conclusions?

The duration of exercise affects IL-6 concentration in blood.

Running has a greater influence than cycling on IL-6 concentrations.

[4]

(b)

- (i) Suggest how IL-6 increases the uptake of glucose from the blood plasma to muscle cells **and** how it increases glucose production in the liver.

----- [3]

- (ii) * *"IL-6 increases the risk of type 2 diabetes."*

Evaluate the evidence that supports or contradicts the above statement.

Use information from the article **MYOKINES**.

----- [6]

(c) Studies F and H in **Table 1.2** both used knockout mice.

(i) Outline **one** way in which a gene can be inactivated in the knockout procedure.

----- [1]

(ii) Suggest **one** reason why mice are used as the model organism in the knockout procedure.

----- [1]

(d) Cytokines produced in muscles are called myokines. IL-6 is an example of a myokine.

Cytokines can act as chemical signals between immune cells.

Describe **one** specific role of cytokines in the immune system.

----- [2]

23 The image below in **Fig. 25.1** shows a section of pancreatic tissue as seen under a microscope.

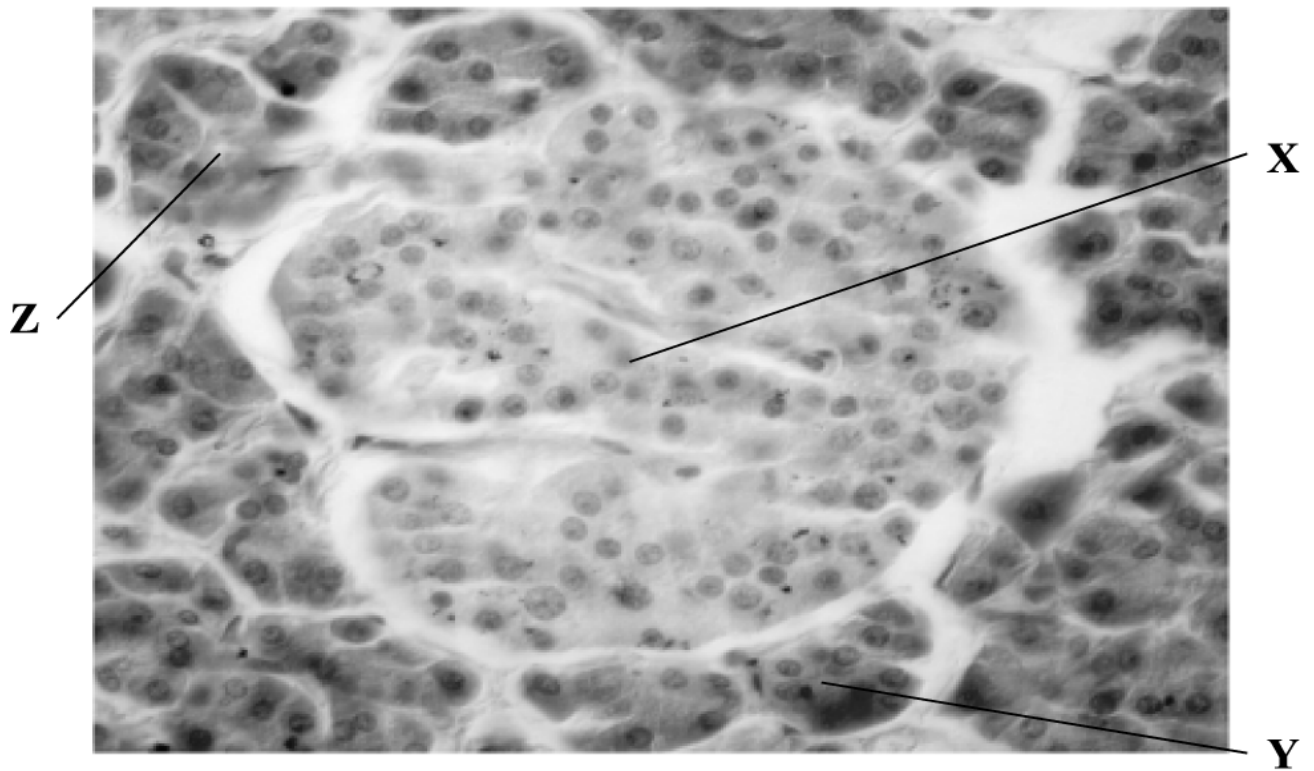


Fig. 25.1

A student identifies X as endocrine cells, Y as alpha cells and Z as Islets of Langerhans.

Is the student correct?

- A X, Y and Z are correct
- B only X and Y are correct
- C only Y and Z are correct
- D only X is correct

Your answer ☐

[1]

Outline how the organelles in pancreatic cells work together to produce and release these protein molecules from the cells.



[5]

END OF QUESTION PAPER

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1		i	histogram drawn (with bars touching), with appropriate bar widths for each age category ✓ X axis labelled as "age / years " AND Y axis labelled as 'Frequency Density' AND plot area covers 50% of the available space ✓ all data plotted correctly ✓	3 AO 2.8	Do not award mp1 if there is a line of best fit also plotted through histogram ALLOW +/- 0.5 small square
		ii	(total = 198 + 540 =) 738 ✓✓	2	69-63 = 6 x 33 = 198 81-69 = 12 x 45 = 540 View of 198 or 540 gains 1 mark
		iii	<i>large sample size:</i> is more representative of the (actual) population OR gives a more accurate mean / is more likely to lie close to the true mean OR reduces the impact of anomalous results (on the mean) ✓	1	
		iv	regional differences in incidence may relate to regional differences, in the organisation / delivery, of screening programmes ✓ uptake of screening and (as a result) opportunities for diagnosis, may be lower in rural versus urban areas (due to decreased accessibility of screening services) ✓ challenges in identifying diabetic retinopathy, including communication with screening services / communication with patients ✓	2 max AO 3.4	
			Total	8	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
2	a	i	<i>type 1 diabetes:</i> insulin (injection) ✓ <i>type 2 diabetes any two from:</i> controlled diet / reduced intake of refined sugars ✓ weight loss ✓ more / increased , exercise ✓ (named) drug treatment ✓	3 AO1.1	needs insulin for full marks DO NOT ALLOW 'healthy diet' DO NOT ALLOW 'regular exercise' ALLOW medication
		ii	concentration of , glycosylated haemoglobin / HbA1c , increases with blood glucose concentration ✓ (gives indication of) average blood glucose concentration over several weeks ✓	2 AO1.1	ALLOW Hb_{A1c} / glycosylated haemoglobin concentration is proportional to glucose concentration
	b	i	sphygmomanometer ✓	1 AO1.1	ALLOW any non-ambiguous phonetic spelling.
		ii	FIRST CHECK ON ANSWER LINE if answer = 2.4 % award 2 marks $(123 - 120) / 123$ ✓ = 2.4 % ✓	2 AO 2.2	ALLOW 0.024 for 1 mark ALLOW calculator value 2.4390243 correctly rounded

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	Summary of instructions to markers: <i>Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)</i> <i>Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.</i> <i>Then, award the higher or lower mark within the level, according to the Communication Statement (shown in italics):</i> ◦ <i>award the higher mark where the Communication Statement has been met.</i> ◦ <i>award the lower mark where aspects of the Communication Statement have been missed.</i> • The science content determines the level. • The Communication Statement determines the mark within a level. Level 3 (5–6 marks) An evaluation including pieces of evidence supporting and pieces of evidence not supporting the conclusions. There is more than one idea for additional information required. <i>There is a well-developed line of reasoning which is clear and logically structured and uses scientific terminology at an appropriate level. All the information presented is relevant and forms a continuous narrative.</i> Level 2 (3–4 marks) An evaluation including a piece of evidence supporting and a piece of evidence not supporting the conclusions. An idea for additional information is included.	6 AO 3.2	Indicative scientific points may include Evidence supporting conclusions • Retinopathy developed or got worse in fewer patients in test group • Retinopathy improved in more patients in test group • Blood pressure decreased in test group • calculation of % Evidence not supporting conclusions • No information provided about Hb_{A1c} • Small difference between the test and control groups in number of improvements • Numbers/sample size relatively small • Only small decrease in blood pressure • Blood pressure was in the normal range in both groups / no hypertension • 21 patients developed / worsened Additional information needed • Larger trial required • Statistical analysis • Information about severity of diabetes in two groups • Whether groups were age / sex matched • Need to correlate HB_{A1c} / control of diabetes with retinopathy • Other medication / pre-existing conditions

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			<i>There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.</i> Level 1 (1–2 marks) An evaluation including pieces of evidence either supporting or not supporting the conclusions. <i>The information is communicated with only a little structure. Communication is hampered by the inappropriate use of technical terms.</i> 0 marks No response or no response worthy of credit.		
	c	i	any two from: plot a scattergraph ✓ calculate (Spearman's rank) correlation coefficient ✓ look up / AW , p values (in a table) ✓	2 AO 2.8	
		ii	any two from: correlation does not imply causation ✓ both diseases are , caused by / AW , obesity ✓ both diseases may be , caused by / linked to , another factor ✓	2 AO 2.3 3.1	
			Total	18	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
3		i	Benedict's, reagent / test / solution ✓ any 1 from: ref to heating reagent ✓ (positive result is) blue / green, to, yellow / orange / brown / brick red ✓ reduction of copper (II) / Cu ²⁺ to copper (I) / Cu ⁺ ✓	max 2 AO1.2	ALLOW Clinistrip / clinistix ALLOW (clinistrip) colour change compared to chart
		ii	correct structure in alpha or beta form ✓✓	2 AO1.1	ring structure with one oxygen atom between carbon 1 and carbon 5 = 1 mark
			Total	4	
4			C	1 AO1.1	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
5	a	i	islet(s) of Langerhans ✓	1 AO2.3	<u>Examiner's Comments</u> Many candidates did not recognise the Islets of Langerhans, although the question stated that this was a section of pancreatic tissue.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	Summary of instructions to markers: <i>Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)</i> <i>Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.</i> <i>Then, award the higher or lower mark within the level, according to the Communication Statement (shown in <i>italics</i>):</i> ◦ <i>award the higher mark where the Communication Statement has been met.</i> ◦ <i>award the lower mark where aspects of the Communication Statement have been missed.</i> • The science content determines the level. • The Communication Statement determines the mark within a level. Level 3 (5 – 6 marks) A detailed discussion of the homeostatic mechanisms that control blood glucose levels, including named biochemical pathways that increase and decrease blood glucose. The hormones and hormone-producing cells are correctly identified. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3 – 4 marks) A good discussion of the effect of hormones that regulate glucose levels, including some biochemical pathways that increase or decrease blood glucose. The hormones and hormone-producing cells	6 AO1.1 1.2	Indicative scientific points may include: homeostatic mechanisms • ref to significant change from set-point • detected by receptor cells of pancreas • increased blood glucose concentration detected by beta cells • decreased blood glucose concentration detected by alpha cells • negative feedback loop hormones • beta / β cells secrete insulin • alpha / α cells secrete glucagon • hormones travel in blood to target tissues / effector cells effect of hormones • insulin stimulates liver and/or muscle cells to increase glucose uptake • by upregulating glucose transporters on cell surface • increased rate of glycogenesis / more glucose for cellular respiration / conversion of glucose to fat • reduction in blood glucose <u>concentration</u> • glucagon stimulates glycogenolysis and gluconeogenesis/increases fat metabolism • increase in blood glucose <u>concentration</u> <u>Examiner's Comments</u> This question was answered well by many candidates. Most candidates correctly identified the hormones and cell types as well as some biochemical pathways. For full marks candidates needed to refer to the mechanism of control i.e. deviations from the set point being detected, hormones released which produce effects to reverse the change in a negative feedback pathway.

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
	are identified correctly. <i>There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.</i> Level 1 (1 – 2 marks) A limited discussion that may name the hormones and cell types. Some biochemical pathways that increase or decrease blood glucose are discussed. <i>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.</i> 0 marks No response or no response worthy of credit.		Exemplar 6 The mechanism of negative feedback is used to control blood glucose concentration, when the level of glucose is maintained around a set point (80 to 90 mg per 100 ml). When glucose concentration becomes too high, beta cells in the islet of Langerhans secrete insulin, resulting in the conversion of glucose to glycogen in liver and muscle cells. This process is called glycogenesis, and results in a decrease in blood glucose concentration to the set point. When blood glucose concentration gets too low, alpha cells produce glucagon. This causes the liver cells to convert glycogen into glucose in the process of glycogenolysis. Amino acids and lipids are also converted into glucose by the process of gluconeogenesis. This increases the blood glucose concentration back up to the set point. [6] Exemplar 6 illustrates a script awarded full marks. Exemplar 7 In the islet of Langerhans, it consists of alpha and beta cells. Beta cells secrete insulin. So when glucose conc. is high, beta cells stop secreting glucagon and alpha cells secrete insulin. Insulin causes uptake of glucose in cells, also causes glycogenesis to occur where liver + muscle cells convert glucose to glycogen. And lipogenesis to occur where adipose cells convert glucose to fatty acids/lipids. If glucose concentration is too low, alpha cells secrete glucagon and beta cells stop secreting insulin. This causes glycogen to be broken down to glucose in liver + muscle cells called glycogenolysis. Also causes adipose tissue to convert fatty acids into glucose, gluconeogenesis. Uptake of glucose by cells is decreased. Insulin causes an increase in glucose transporter protein on cell surface membrane of cells. Glucagon prevents translocation of glucose transporter proteins. Exemplar 7 is a good answer that accurately describes the hormones and their effects but without any detail of how the system is controlled by negative feedback.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b	i	<i>strategy A</i> type: 1 AND explanation: destruction of pancreatic cells so insulin not produced ✓ <i>strategy B</i> type: 2 AND explanation: insulin is produced, cells less responsive because of (high fat) diet ✓	2 AO2.3	<u>Examiner's Comments</u> Several elements are needed for each correct answer here. Firstly correct reference to the type i.e. Type 1 or 2. Secondly a link between the treatment and the effect. So, for type 1 diabetes a high dose of STZ would destroy the pancreatic/beta cells so no insulin would be produced. For type 2 diabetes, a high fat diet would make the (target) cells less responsive to insulin.
		ii	(oral) glucose tolerance test ✓ fasting (blood) glucose test ✓	max 1 AO2.3	ALLOW OGTT <u>Examiner's Comments</u> The glycosylated haemoglobin test is not appropriate for diagnosis of diabetes in mice.
			Total	10	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance												
6		i	3 <u>separate</u> bars AND y-axis scale is equidistant AND use of appropriate scale so plot area (bars) occupies more than 50% of paper ✓ y-axis labelled 'mean concentration of glucose mmol dm⁻³' AND x-axis labelled 'location of sample' AND each bar with a suitable label ✓ (separate) bars correctly plotted ✓ standard deviation bars correctly plotted ✓	4 (AO 2.8)	<table><tr><th>Location of sample</th><th>Mean concentration of glucose (mmol dm⁻³)</th><th>Error bars plotted at....</th></tr><tr><td>BC</td><td>15</td><td>13.0 and 17.0</td></tr><tr><td>PCT</td><td>4</td><td>3.3 and 4.7</td></tr><tr><td>DCT</td><td>3</td><td>2.5 and 3.5</td></tr></table> ALLOW tolerance of plots +/- half a small square <u>Examiner's Comments</u> Many candidates gained 3 marks and often lost the final mark due to either drawing a histogram or a line graph rather than a bar chart. In some cases it appeared candidate were not used to using SD values to construct error bars. For example, some candidates incorrectly plotted the SD values on the x-axis and the mean glucose concentration on the y-axis. Centres should encourage candidates to use data to plot range bars and error bars and also to understand the difference between the two, where and why they should be used. Likewise the importance of using 'sensible' scales should be encouraged: some candidates used scales of 0.6 mmol dm⁻³ glucose for each small square on the y-axis which led, in some cases, to plotting errors.  OCR support Math for Biology website contains a tutorial on how to select the appropriate graphical format: https://www.ocr.org.uk/subjects/biology/maths-for-biology/graphs/	Location of sample	Mean concentration of glucose (mmol dm ⁻³)	Error bars plotted at....	BC	15	13.0 and 17.0	PCT	4	3.3 and 4.7	DCT	3	2.5 and 3.5
Location of sample	Mean concentration of glucose (mmol dm ⁻³)	Error bars plotted at....															
BC	15	13.0 and 17.0															
PCT	4	3.3 and 4.7															
DCT	3	2.5 and 3.5															

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	Mark first answer. One from: <u>mean</u> glucose concentration in Bowman's capsule is higher than normal value / AW ✓ presence of glucose in dct OR glucose levels in the PCT and DCT are very similar (so little glucose has been selectively reabsorbed) ✓	1 (AO 3.2)	IGNORE presence of glucose in PCT unqualified (as glucose will be present in PCT as this is the site of selective reabsorption) <u>Examiner's Comments</u> Examination technique for this question was similar to Q1(a), whereas only the first reason suggested by the candidate was considered. Some answers were vague such as "the glucose levels are high in the Bowman's capsule" which is unqualified and therefore was not credited. Some candidates referred to the mean glucose level in the Bowman's capsule being above the expected normal range and quoted values for the normal range to support this point. Many candidates suggested that if selective reabsorption was efficient the mean glucose level in the distal convoluted tubule would be significantly less than that of the proximal convoluted tubule.
			Total	0	
7			D	1	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
8	a		beta / β ✓ islets of Langerhans ✓ (glucose) transport(er) ✓ glycogenesis ✓	4	ALLOW wrong use of upper and lower cases ALLOW GLUT (1-4) OR carrier DO NOT ALLOW receptor / co-transport ALLOW glycogen synthesis Examiner's Comments (a) addressed AO1 criteria, part (b)(i) was focused on AO3, part b(ii) was focused on AO2 and the Level of Response question, part (c), addressed both AO1 and AO2. (a) was done well although candidates need to be careful when writing β cells so not to confuse it with B cells (remembering that B cells are very different to β cells). The most common incorrect responses were channel / receptor proteins and there was still some evidence of candidates confusing glycogenesis with glycogenolysis and occasionally gluconeogenesis.
	b	i	Type: 2 AND Explanation: production / release of insulin ✓	1	ORA ALLOW any reference to graph showing insulin resistance / insulin not having effect on glucose / blood glucose remaining high Examiner's Comments In (b)(i) most candidates correctly identified type 2 diabetes although fewer used evidence from the figure to explain their conclusion and simply stated that type 1 diabetes produced no insulin.
		ii	71% ✓ ✓	2	ALLOW 71.4 or unrounded answer (71.4285...) for 1 mark Examiner's Comments The calculation in (b)(ii) was done well by many candidates although a few did not notice the reference to 2 significant figures.
			Total	7	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
9	a	i	measurement of, glycosylated / glycated, haemoglobin ✓ glycosylated / glycated, haemoglobin proportional to blood glucose ✓ average measurement over several, weeks / months ✓	3	ALLOW Hb for haemoglobin
		ii	reduce sugar intake / controlled diet ✓ lose weight ✓ increase exercise participation ✓	max 2	IGNORE refs to drug treatment
		iii	evidence from (scientific) research used to inform clinical decisions ✓	1	
	b	i	19 ✓ ✓	2	19.2 = 1 mark ref to 250 = 1 mark
		ii	strain on health service ✓ ref to complications of the disease ✓	max 1	ALLOW strain on NHS DO NOT ALLOW complications alone
		iii	does not account for population increase ✓ number of undiagnosed cases unknown ✓ need to know, prevalence / number of cases per 100 000 ✓	max 2	
			Total	11	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
10	a		biosensor ✓ immobilised ✓ coenzyme ✓ reduced ✓	4	ALLOW a term which describes immobilisation e.g. covalently bonded
	b	i	frequency of exercise OR time / duration of exercise ✓	1	
		ii	X axis to be labelled with variable in part (i) AND appropriate units ✓ Y axis to be labelled lactate concentration (following run) AND appropriate units ✓ Slope downwards from left to right / negative correlation ✓	max 2	
			Total	7	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
11	a	i	<i>idea that</i> glucose is a respiratory substrate OR (plasma) glucose is the only respiratory substrate for neurones OR if blood glucose too low neurones lose function / AW;	1	IGNORE ref to preventing hyper or hypo glycaemia without further qualification CREDIT idea of preventing a coma Examiner's Comments In (i) the question required applying knowledge of the role of blood glucose other than its effect on water potential. High blood pressure and damage to cells are due to the osmotic effect of glucose. A number of candidates also think that high blood glucose causes diabetes rather than being a symptom of it. Many candidates did answer in terms of the role of glucose as a respiratory substrate.
		ii	hypothalamus AND (posterior) pituitary;	1	Mark the first answer on each line. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks BOTH answers required for 1 mark DO NOT CREDIT anterior pituitary Examiner's Comments In (ii) many candidates lost marks by stating the anterior pituitary gland as the source of ADH secretion.
	b	i	insulin; injections / pump / insulin pen; <i>idea that</i> injected prior to a meal OR blood glucose measured to determine how much insulin is needed; binds to receptors on,(cell surface membrane(s) of,) liver / fat / muscle (cells);	5	IGNORE epipen ACCEPT 3 or 4 times a day

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			<i>idea that it, <u>promotes</u> / <u>increases</u> uptake of glucose;</i> <i>idea that it promotes / triggers, the conversion of glucose to glycogen / <u>glycogenesis</u>;</i> idea that use of glucose in respiration, is increased OR glucose is respired preferentially to, fats/fatty acids;		CREDIT '<u>more</u> glucose is taken up' DO NOT CREDIT a description if an incorrect term or incorrectly spelled term is then used as this is a contradiction e.g. 'stimulates glycogenolysis which is the conversion of glucose to glycogen' = 0 MARK DO NOT CREDIT 'insulin converts glucose to glycogen' DO NOT CREDIT 'increase in respiration of glucose' Examiner's Comments Part (i) was answered well although one common misconception was that insulin is administered after meals. Some candidates lost marks by describing the conversion of glucose to glycogen but then using an incorrect term. This was treated as a 'contradiction'. Most candidates expressed themselves well but some phrase their answer in terms of insulin converting glucose to glycogen or insulin opening glucose channels in the membrane rather than insulin being the cell signalling molecule which triggers these events.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	more / AW,(ADH) AND decrease (in urine volume); <i>justification</i> (high blood glucose) lowers water potential, (stimulating /AW, release of ADH); (ADH triggers) more water reabsorption (so a lower urine volume);	3	Examiner's Comments Many candidates gained full marks on (ii) although some candidates linked the presence of ADH to glucose uptake.
			Total	10	
12		i	<i>idea that</i> first sample, sets baseline / for comparison; <i>idea of</i> later samples show if glucose, returns to baseline / stays high;	2	IGNORE reference to control Examiner's Comments Only more able candidates demonstrated an understanding of the need for a baseline reading for comparison. Most candidates explained why glucose levels could be high but failed to appreciate the need to see if the readings remained high for a period of time, or failed to fall to the baseline level.
		ii	(might indicate) another medical condition; idea of patient might be using drugs that interfere with results;	1 max	e.g. pre-eclampsia IGNORE false positive without qualification IGNORE references to eating/drinking/cheating Examiner's Comments Many candidates made comments about dietary glucose or rate of metabolism, but failed to recognise the role that other diseases or medication could play in the result of the test.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
13		i	<i>idea that</i> you can, check / see / know, if glucose concentrations are too, high / low; (if untreated) high blood glucose may cause named condition; (if untreated) low blood glucose may cause, faint / coma / death; so the person can adjust their insulin dose / carbohydrate intake (if necessary);	2	ACCEPT to check levels are within limits DO NOT CREDIT 'to ensure' ACCEPT to detect hypoglycemia / hyperglycemia e.g. blindness / foot amputation / nerve damage / kidney failure / high blood pressure / heart disease / strokes / chronic infections / shortening of life Examiner's Comments This question also mainly addressed AO3 but had some elements of AO1 and AO2 Candidates failed to appreciate the difference between checking to see if blood glucose was too high or too low (which was what was required), and ensuring it didn't get too high or too low(which is what they were saying, implying a control mechanism) . Some candidates were not specific about the direction of blood glucose concentration (too high / too low) and the correct consequence. A good analogy would be that a thermometer tells you what the temperature is so you know if it is changing, but the water bath keeps it constant. There were too many 'water bath' answers, and not enough 'thermometer' answers.
		ii	oxidase / dehydrogenase; enzyme; <u>gluconolactone</u>; transducer;	4	Examiner's Comments This question also mainly addressed AO3 but had some elements of AO1 and AO2 Most candidates gained a mark for 'enzyme, and several for 'oxidase' or 'dehydrogenase'. Gluconolactone was often incorrectly spelled. Very few candidates identified the transducer.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
14			<i>idea that</i> in cyclical HRT progesterone is not given every day;	1	CREDIT explanations using reverse argument e.g. an implant would release hormones continuously <u>Examiner's Comments</u> While many candidates answered this well, some other responses were imprecisely worded in terms of how progestin and oestrogen were taken. The fact that implants release hormones continuously was the most common answer given.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
15	a	i	Islet(s) of Langerhans;	1	ACCEPT upper or lower case, phonetic spelling Examiner's Comments This question was almost entirely AO1 but did contain marks which were synoptic with F221 (cell structure) and F224 (protein synthesis). Most candidates correctly identified the Islets of Langerhans in (a)(i) from the photomicrograph. A failure to gain credit usually resulted from either an imprecise answer ('endocrine tissue') or confusion with the glomerulus despite the question clearly being about the pancreas.
		ii	beta / β (cells);	1	Examiner's Comments This question was almost entirely AO1 but did contain marks which were synoptic with F221 (cell structure) and F224 (protein synthesis). In (a)(ii) again most candidates correctly stated beta cells.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b		1 (gene(s) for hormones) transcribed / AW, in nucleus; 2 hormones / polypeptide / protein / synthesised, on ribosomes ; 3 (ribosomes / proteins synthesised / translation) on RER; 4 hormones / polypeptides / proteins, transfer to Golgi (apparatus); 5 (golgi) packages / AW, hormones into vesicles; 6 vesicles, fuse with / AW, cell surface membrane / hormones released by exocytosis; 7 mitochondria provide, energy / ATP, for (named) process; 8 (hormones) soluble in blood / transported in, blood / plasma; 9 (targets) muscle / liver; 10 ref to (hormone binding to) receptors on cell surface / plasma, membrane (of cells in target tissues);	7	ACCEPT hormone / named hormone / polypeptide for mps 1.2.3. and 4 1 ACCEPT a description of transcription such as 'mRNA (for hormones) being synthesised' 2. ACCEPT mRNA translated on ribosomes or a description DO NOT CREDIT if exocytosis is given as part of a list 7 CREDIT this mark if linked to any process from mp 1,2.,4, 5 DO NOT CREDIT 'produce energy' DO NOT CREDIT as part of a list with other non-target organs

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			QWC;	1	Award if: mp 8 and 9 have been awarded plus any two from mps 1,3,5,6,7 Examiner's Comments In part 2(b), several candidates answered the question in terms of homeostasis and wrote excellent answers to a question which had not been asked. In terms of homeostasis, a surprising number of candidates still believe that the alpha and beta cells are regulated by the hypothalamus and the pituitary. For those candidates who did attempt to address the question recurring errors included using the terms 'transcription' and 'translation' as if they were interchangeable, describing exocytosis as the release of vesicles into the blood stream and using the term 'active transport' to describe exocytosis. Examiners were happy to credit the link between mitochondria and use of ATP for exocytosis as ATP would be required, for example, to move vesicles to the cell surface membrane. However, the term 'active transport' is reserved for transmembrane transport which requires a specific ATP- driven protein 'pump' - a different form of transport to exocytosis. As stated in the introduction, too many candidates wrote about the release of glycogen or glucogen from alpha cells.
			Total	10	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
16	a		reference to sterile conditions; <i>idea that</i> the meter should be calibrated; safe disposal of test strip;	2 max	CREDIT description e.g. swab skin with alcohol use of sterile lancet CREDIT description of meter function ACCEPT safe disposal of e.g. lancet Examiner's Comments This question incorporated a range of assessment objectives (AOs 1, 2 and 3) with a biochemical thread running throughout. Some questions were in the context of the procedure for testing for blood glucose. This part was in the context of testing for blood glucose and many candidates were able to gain credit in this part for referring to sterile conditions as a safety precaution; few candidates referred to precautions relating to the functioning of the blood glucose meter itself.
	b	i	glucose is converted to gluconolactone; by glucose oxidase;	2	CREDIT glucose dehydrogenase
		ii	time of day the blood sample is taken; exercise before testing; food / drink, before testing; insulin has been used before testing;	2 max	IGNORE ref. to glucagon administration Examiner's Comments This part was well-answered across the ability range and in (i) there were some good responses from stronger candidates with both marking points being awarded. However, some candidates referred to a <i>reaction</i> occurring between the enzyme on the test strip and glucose. Candidates at AS level would be expected to understand that enzymes are catalysts in reactions and do not react with their substrates.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
17	a	i	<i>Idea that</i> peptide / GLP–1 would be denatured (by stomach acid);	1	CREDIT peptide / GLP–1, would be, digested / hydrolysed / broken down
		ii	glycogen;	1	
		iii	<i>idea that</i> person feels full for longer; <i>idea that</i> prevents rapid, digestion (of carbohydrate) / absorption (of glucose); <i>idea that</i> person will eat less / less risk of obesity / AW;	1	Mp2 CREDIT ref to preventing a sudden increase in blood glucose DO NOT CREDIT less breakdown of glucose
		iv	alpha (cells); beta (cells);	1	Examiner's Comments This was answered well although in (iv) a failure to read the stem of the question led to candidates answering in terms of a tissue rather than the cells.
	b	i	<i>idea that</i> GLP–1 circulates for longer / half life prolonged / stays active in the blood for longer;	1	CREDIT <i>idea that</i> drug is an enzyme inhibitor; ACCEPT idea that GLP-1 isn't broken down
		ii	<i>idea that</i> Type 1 due to, lack of / AW, insulin (secretion);	1	CREDIT (type 1 diabetes) treated with insulin injections
		iii	using / AW, glucose, tablets / drink / gel;	1	ACCEPT reference to a named sweet foodstuff Examiner's Comments Good candidates were able to apply their knowledge of enzyme action. It was disappointing to see that some candidates were unaware of how to treat hypoglycaemia. Reference to insulin injections suggests that some of them had misread the term.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c		advise / AW, related to retinal examinations; advise / AW, related to foot care; advise / AW, related to diet; advise / AW, related to BMI / weight; advise / AW blood pressure; advise / AW, kidney function tests; AVP;	3	CREDIT ref to retinopathy or eye checks CREDIT ref to neuropathy e.g. advise on exercise, ref to crisis management, information on support groups / involving family members Examiner's Comments The most common answers on the role of the DSN included general support, dietary advice and exercise. References to checking eyes, feet, blood pressure and kidney function were rarely seen.
			Total	11	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
18	a		type 2 / late onset (diabetes); <i>idea that</i> type 2 diabetes results from, changes in metabolism / obesity; <i>idea of</i> genetic influence; (type 2) is not an autoimmune condition;	3 max	2 max for explanation <u>Examiner's Comments</u> Very few candidates understood that poor foetal nutrition would causes changes to metabolism, which is stated in the pre-release material. This question proved challenging and whilst the majority correctly suggested Type 2 diabetes, few went on to explain their choice correctly. Candidates described the reasons for Type 2 diabetes and their explanation referred to the fact that it was late onset. Candidates did not appear to relate this question to any information provided in the pre-release material. A few candidates described Type 2 diabetes as a lack of insulin production.
	b		<i>gender:</i> females show a greater increase (in prevalence) than males; <i>ethnicity:</i> decrease in Asian Pacific Islanders AND Native American Indian OR increase in Hispanic AND Caucasian OR Hispanic show the largest increase (of any group); correct use of figures;	3	Look for comparative figures per 1000 between 2001 and 2009 for either gender or ethnicity linked to mp1 or 2 <u>Examiner's Comments</u> This was generally well answered with most candidates achieving at least one-mark point however many candidates analysed or stated the trends <u>at</u> 2001 and 2009 rather than comparing changes <u>from</u> 2001 to 2009 as required by the question.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
19	a	i	Islet of Langerhans	1	ALLOW Islets of Langerhans
		ii	<i>LP plan must only show regions of tissues with no cell detail</i> <i>In addition there should not be any shading or other detail within the plan</i> sharp pencil AND straight label lines AND lines touch structures (1) ratios approx correct (islet should occupy approx 40–50% of width & 60–70% of height) AND shape of islet (1) Islet of Langerhans labelled and annotated AND non-endocrine tissue labelled and annotated (1)	3	DO NOT ALLOW if cells have been drawn (ONLY areas of tissue to be drawn) ALLOW Islets – though only one is visible, candidates may not appreciate that the word is a plural Examples of annotations may include: e.g. blue, many distinct circular nuclei e.g. brown, regions of non-cellular material, ducts visible
	b	i	5.90	1	IGNORE 5.9 All other means in the table are given to 2 d.p. and candidates should be aware of this guidance (maths skills and practical skills handbooks)
		ii	<i>idea of mean</i> shows the central tendency of a data set (1) <i>idea of blood glucose concentrations vary constantly</i> (1)	2	ALLOW data needs to show variation ALLOW full range of figures needs to be shown IGNORE mean is an average ALLOW the purpose of insulin is to reduce variation rather than lower a mean
		iii	missed meal AND excessive exercise	1	ALLOW <i>an idea of</i> excessive exercise, e.g. very long run, prolonged vigorous activity IGNORE exercise unqualified
			Total	8	
20			(an) endocrine gland (1)	1	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
21		i	Any 3 from: <i>idea that</i> 70 people is too low for a phase 3 trial (therefore reducing validity) / phase 3 trial should involve, hundreds / thousands, of people <i>idea that</i> (sample size of 70 people is) unlikely to differentiate new drug's performance from current drug (therefore reducing validity) blind trials (improve validity by), reducing / removing, bias (of patients) double blind trials (would be), improvement / AW, by removing bias of scientists <i>idea that</i> placebo cannot be used because it would be unethical in a phase 3 trial	3	
		ii	Any 2 from: genetics head injuries age smoking	2	
			Total	5	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
22	a	i	mode = 2 mean = 3.11	3	$(2 \times 9) + (2 \times 8) + (3 \times 11) + (6 \times 7) / 35 = 3.11$ Award one mark if a candidate has clearly taken the number of participants into account but has made an error in the calculation
		ii	<i>General points</i> <i>Idea of valid conclusions</i> would require information about the intensity of exercise <i>Idea that</i> (named) statistical test would confirm conclusion <i>Duration (up to a maximum of 2 marks)</i> positive correlation (suggests the conclusion is valid) many studies / repeats / AW, improves validity <i>idea of relationship / correlation</i> , clearer for cycling (than running) <i>Running vs cycling (up to a maximum of 2 marks)</i> <i>idea that</i> (conclusion is valid because) for a given duration, IL-6 increases more with running (than cycling) the number of participants varies, which makes comparison difficult	4	The general point marks can be scored for either section, but can only be scored once ALLOW 'meta-analysis' for 'many studies' ALLOW calculated example
	b	i	Any 3 from: <i>Glucose uptake</i> (IL-6) increases / AW, insulin production (IL-6) increases / AW, insulin receptor sensitivity (on muscle cells) <i>Glucose production</i> (IL-6) increases / AW, glucagon production glycogen converted to glucose (in liver cells)	3	ALLOW acts like a hormone ALLOW glycogenolysis
		ii	* Level 3 (5–6 marks) Candidate's evaluation demonstrates excellent judgement of the data, providing conclusions that address all the significant issues. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i>	6	Examples of relevant scientific points at L3 (in addition to points at L1 and L2) <i>experimental & epidemiological evidence</i> - discussion of <i>in vitro</i> v <i>in vivo</i> experiments (e.g. the conflicting results in A and B; <i>in vitro</i> experiments might lack important factors, for example, found in <i>in vivo</i>) - discussion of the link between TNF and IL-6 (e.g. G and H. IL-6 could, for

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			Level 2 (3–4 marks) Judgement is made on a range of aspects of the data, but conclusions are not comprehensive. <i>There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.</i> Level 1 (1–2 marks) Simple conclusions are made, drawing on limited aspects of the data. <i>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.</i> 0 marks No response or no response worthy of credit.		example, be high in certain cases because it has a defensive role against TNF) i.e. detailed links made between studies in Table 1.2 and impact on diabetes risk - in depth discussion of correlation v causation (e.g. C and D show correlation but not causation). <i>biological knowledge</i> - detailed understanding of the causes and symptoms of type 2 diabetes. Examples of relevant scientific points at L2 (in addition to points at L1) <i>experimental & epidemiological evidence</i> - discussion of correlation v causation - linking exercise, low baseline IL-6 and possible effects on diabetes risk - quite detailed links made, some in detail, between studies in Table 1.2 and the impact on diabetes risk. <i>biological knowledge</i> - good understanding of the causes and symptoms of type 2 diabetes. Examples of relevant scientific points at L1 <i>experimental & epidemiological evidence</i> - basic links made between studies in Table 1.2 and the impact on diabetes risk. <i>biological knowledge</i> - some understanding of the causes and symptoms of type 2 diabetes.
	c	i	<i>idea that</i> (gene is) replaced / disrupted / AW, with, artificial / synthetic / AW, DNA	1	

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		ii	Any 1 from: (mice have) similar, genome / DNA sequences, to humans (mice have) similar, metabolism / physiology, to humans (mice are) easy / cheap, to, house / manipulate / breed	1	
	d		chemotaxis attraction of neutrophils (to site of infection) OR cause / stimulate, B cells / T cells, to, differentiate / proliferate cause / stimulate, B cells to release antibodies OR inhibit virus replication activation / AW, of T killer cells	2	ALLOW (undergo) clonal expansion
			Total	20	
23			D	1	
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
24			1 nucleus, contains gene (for protein) / site of transcription / produces mRNA ; 2 ribosomes / rough endoplasmic reticulum / RER, site of, protein synthesis / translation ; 3 vesicles for transport (of protein) ; 4 Golgi (apparatus / body), processes / modifies / (re)packages, proteins ; 5 (vesicles) fuse to, cell surface / plasma, membrane ;	4 max	Max 4 marks for content Look for name of organelle and its function / role ACCEPT enzyme / protease for protein MAX 3 if answer refers to insulin or incorrect protein ACCEPT DNA / genetic material / genetic information for 'gene' IGNORE 'mRNA leaves nucleus' ACCEPT description of assembling a <i>chain</i> of amino acids mp3 can be awarded either for transport between ER and Golgi or between Golgi and Plasma membrane E.G. tertiary folding / quaternary structure / carbohydrate added / converted to glycoprotein / placed in vesicles IGNORE ref to RER IGNORE binds / attach / joins IGNORE exocytosis IGNORE ref to vesicles leaving cell ACCEPT merges with / becomes part of

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			QWC ;	1	Any two technical terms from the list below used appropriately and spelled correctly : ribosomes rough endoplasmic reticulum (NOT RER for QWC) transcription (and derivatives) translation (and derivatives) golgi vesicles plasma membrane / cell surface membrane Examiner's Comments Candidates were asked to outline how organelles work together to secrete a specific protein. Most candidates gave excellent responses that were well organised and clearly worded. The QWC mark was usually awarded. In certain areas candidates need to be more specific with their wording of responses. For example, they should describe the secretory vesicle as 'fusing to the cell surface membrane' rather than 'binding to the membrane'. Binding does not necessarily suggest that the vesicle membrane becomes a part of the cell surface membrane and that the contents of the vesicle are released through the membrane.
			Total	5	