

OCR A-LEVEL BIOLOGY B • H422

BIOLOGY



EXAM QUESTION PACK

2.1.2 WATER AND ITS IMPORTANCE IN PLANTS AND ANIMALS

SCORE

/99

PERCENTAGE

%

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- 1 The table shows the results from an analysis of some of the organic compounds found in a human urine sample.

	Concentration (g dm ⁻³)				
	Carbon (C)	Nitrogen (N)	Oxygen (O)	Hydrogen (H)	Sulfur (S)
Organic compounds	5.15	7.46	4.78	1.24	0.13

Which of the molecules, A to D, would contain the sulfur shown in the analysis?

- A amino acids
- B nucleic acids
- C pyruvate
- D urea

Your answer

[1]

- 2 Which of the biofluids, A to D, is **not** an extracellular fluid?

- A cell sap
- B lymph
- C plasma
- D urine

Your answer

[1]

- 3 Portable haemoglobinometers can be used by patients at home to measure the haemoglobin concentration in their blood.

A haemoglobinometer works as follows:

- The patient drinks a litre of water to ensure they are well-hydrated.
- A small sample of blood is taken by a finger prick technique.
- The blood is put into a container and mixed with a chemical that releases haemoglobin from the red blood cells.
- The container is put into the haemoglobinometer to measure the colour intensity of the solution.
- The results are displayed on the screen of the haemoglobinometer.

- (i) State **one** advantage to the patient of using a portable haemoglobinometer.

----- [1]

- (ii) Suggest **one** reason for measuring haemoglobin concentration in the blood.

----- [1]

- (iii) The patient drinks a litre of water before the test to ensure that they are well-hydrated.

Suggest how hydration levels could affect the validity of the results.

----- [1]

4(a) Energy drinks are sports supplements used by some athletes.

A sports scientist wanted to investigate the reducing sugar content of one of the drinks.

They used the following method:

1. Take a 5% glucose solution and add it to a labelled test tube.
2. Add excess Benedict's reagent.
3. Boil the sample in a water bath.
4. Filter the solution using filter paper.
5. Dry the filter paper and measure the mass of precipitate.
6. Repeat steps 1–5 for glucose concentrations of 4%, 3%, 2% and 1%.
7. Plot a graph of concentration of glucose against the mass of precipitate.
8. Repeat steps 1–5 for the energy drink.

State **three** improvements that the scientist could make to the method.

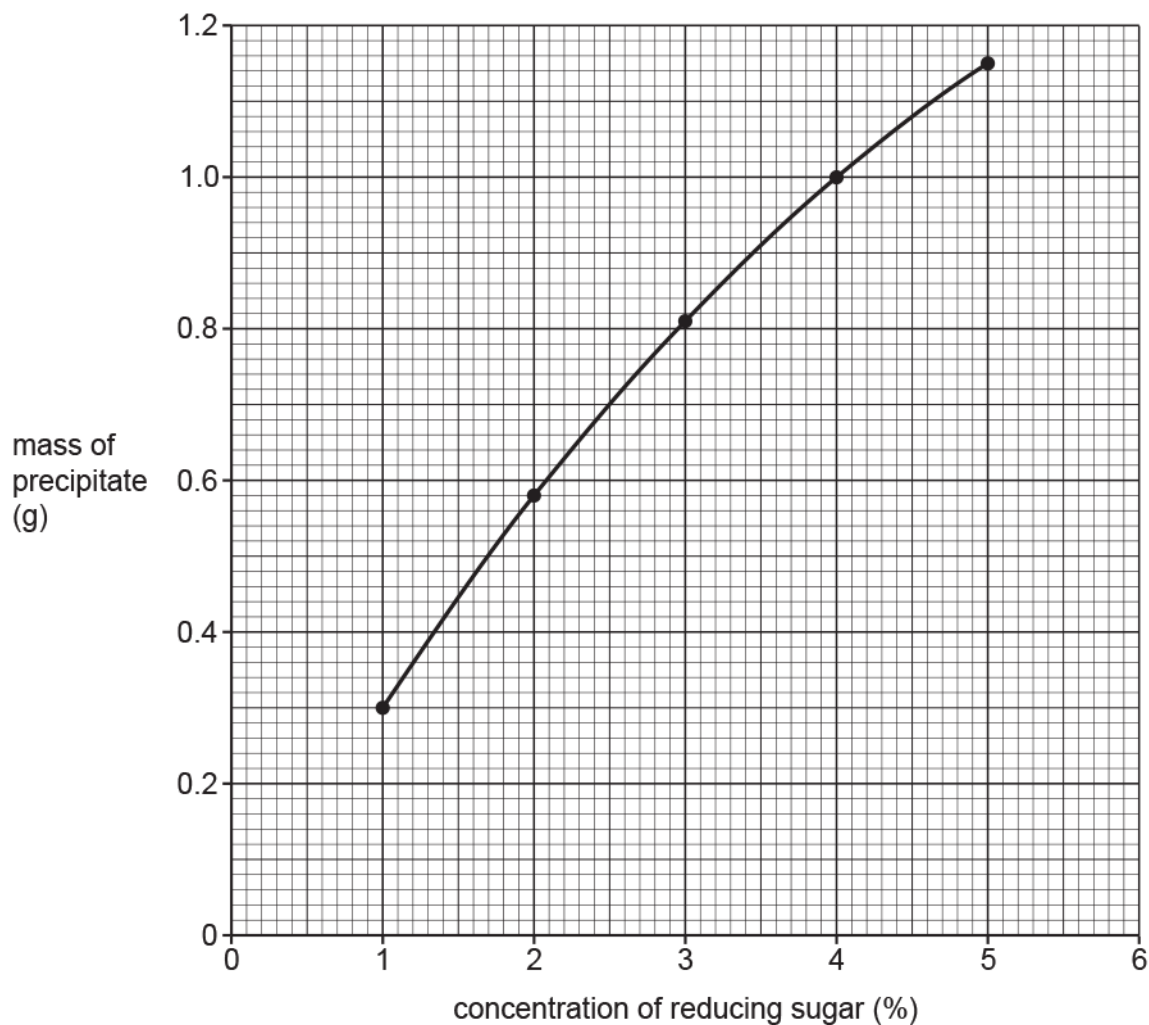
1 _____

2 _____

3 _____

[3]

(b) The results of the investigation are shown in the graph.



The mass of the precipitate produced by the energy drink was 0.66 g.

Use the graph to calculate the concentration of reducing sugar in the energy drink.

Concentration of reducing sugar = ... (%) [1]

(c) The concentration of sugar in the energy drink was 5.5% as it also contained non-reducing sugars.

State **two** additional steps that could be added to the method to allow the total concentration of sugar to be measured. Explain why each of these additional steps is carried out.

Additional step 1 -----

Explanation -----

Additional step 2 -----

Explanation -----

[4]

- 5 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.

[2]

- 6 Water flows continuously through xylem vessels due to cohesion.

Which of the options, A to D, is responsible for the cohesive properties of water?

- A covalent bonds
- B hydrogen bonds
- C hydrophobic interactions
- D ionic bonds

Your answer

[1]

7 An experiment was carried out to investigate osmosis in potato cells.

Six beakers were filled with distilled water and dissolved sucrose to produce six solutions ranging from 0.0 to 1.0 mol dm⁻³ sucrose concentration.

A potato was peeled and cut into slices of exactly 2.50 g mass. Five slices were soaked in each sucrose solution for 30 minutes. The slices were then removed, briefly dried with tissue and weighed.

The final mass of each potato slice is shown in Table 33.

Sucrose concentration / mol dm ⁻³	Final mass of potato slice / g						
	1	2	3	4	5	Mean	Standard deviation
0.0	2.78	2.74	2.79	2.80	2.89	2.80	0.06
0.2	2.66	2.58	2.61	2.64	2.66	2.63	0.03
0.4	2.44	2.47	2.45	2.50	2.43	2.46	0.03
0.6	2.38	2.29	2.36	2.34	2.29	2.33	
0.8	2.32	2.31	2.20	2.26	2.28	2.27	0.05
1.0	2.25	2.23	2.19	2.19	2.26	2.22	0.04

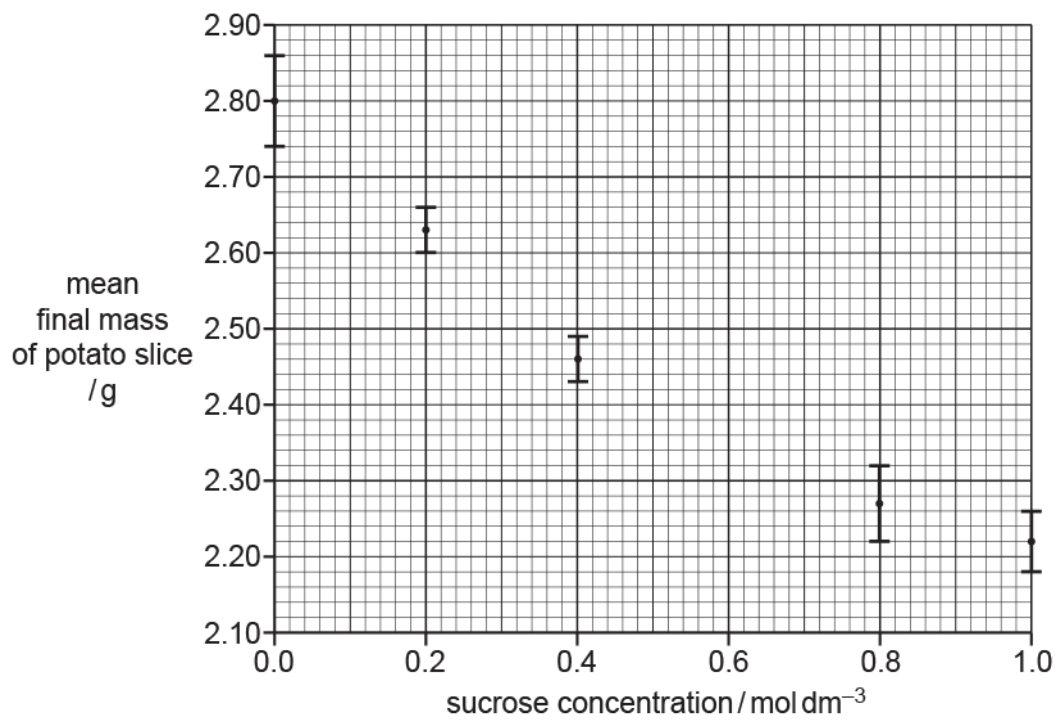
Table 33

- (i) Calculate the standard deviation for the final mass of potato slices soaked in 0.6 mol dm⁻³ sucrose concentration.

Use the formula: $s = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}}$

standard deviation = ... [2]

- (ii) The graph below represents the data in Table 33.



Complete the graph by plotting the data for the potato slices soaked in 0.6 mol dm^{-3} sucrose using the data in Table 33 **and** the standard deviation calculated in (i). [2]

(iii) With reference to the data in Table 33, explain how the sucrose concentration of the solution determines the final mass of potato.

[3]

(iv) Suggest **two** factors in the method that could have contributed error to the data, as shown by the error bars in the graph in (ii).

1 _____

2 _____

[2]

8(a) 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.

Give **one** reason why the student chose method 2.

----- [1]

- (b) * Outline how the student could have used method 2 and the apparatus provided, to find out the glucose concentration in the samples of mock body fluids.

Blank lined paper for writing.

- (c) A teacher was asked to comment on the method and results collected.

Complete the paragraph by choosing the most appropriate word from the list below.

anomaly accuracy error limitation precision

 repeatability reproducibility resolution

The teacher suggested using a balance measuring in grams with a three decimal place display to improve After examining the results, the teacher concluded that the colorimeter had a zeroing error, limiting the of the results. The teacher stated that one of the investigation was that temperature was not controlled.

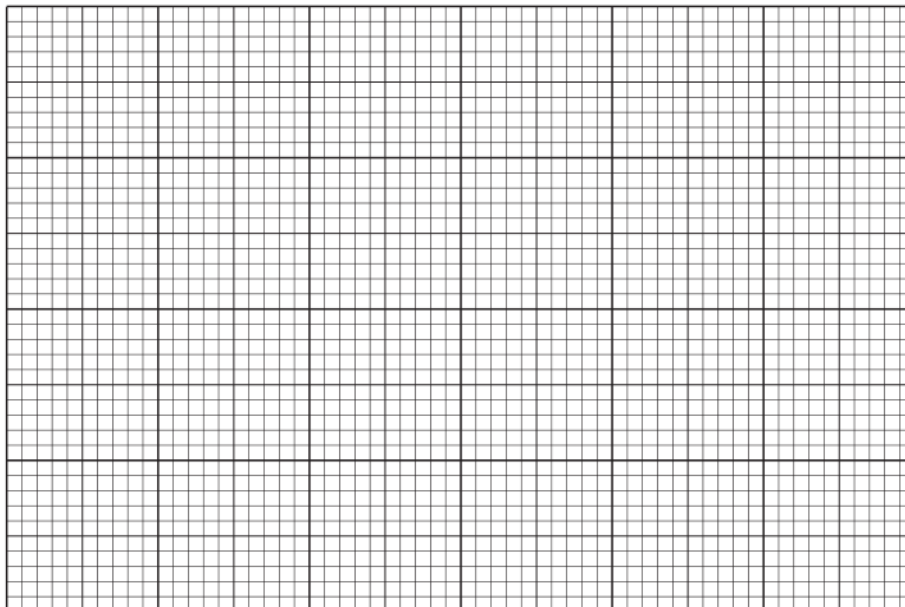
[3]

- (d) 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]

- 9 The extracellular matrix (ECM) can be thought of as the 'glue' that holds together the cells in a tissue. The ECM consists of water, proteins and polysaccharides.

Matrix metalloproteinases (MMPs) are a group of proteases that hydrolyse proteins in the ECM.

Each MMP consists of a single polypeptide chain.

Marimastat is an MMP inhibitor that was used in clinical trials as a potential treatment for cancer.

Suggest how marimastat could inhibit MMPs to reduce the hydrolysis of proteins in the ECM.

[2]

10(a) Water is a polar molecule. Molecules of water are attracted to each other.

Fig. 36.1 shows the structure of a water molecule.

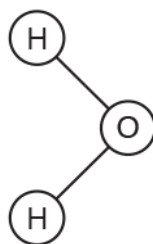


Fig. 36.1

Draw a **second** water molecule on Fig. 36.1, in the position it might take up beside the first water molecule.

Your drawing should show:

- the bond(s) between the two molecules
- the name of each bond
- the charges on each atom.

[Answer on Fig. 36.1]

[3]

- (b) Water is required for many metabolic reactions, such as the hydrolysis of starch.

The enzyme that catalyses this reaction, amylase, is commonly used in the food industry. It is produced in large-scale bacterial cultures.

A group of students investigated the amylase activity of five bacterial species.

The bacterial species were treated using the following method:

1. Prepare three nutrient agar plates containing 1% potato starch.
2. Soak five paper discs with cultures of five bacterial species, A to E.
3. Allow excess liquid to drain from the paper discs and then place onto an agar plate.
4. Repeat steps 1–3 for the other two agar plates.
5. Incubate the agar plates at 25 °C for 3 days.
6. After 3 days, flood the agar plates with reagent X.
7. Measure the diameter of any clear zones around the paper discs using a ruler.

Fig. 36.2 shows an agar plate at the end of the investigation.

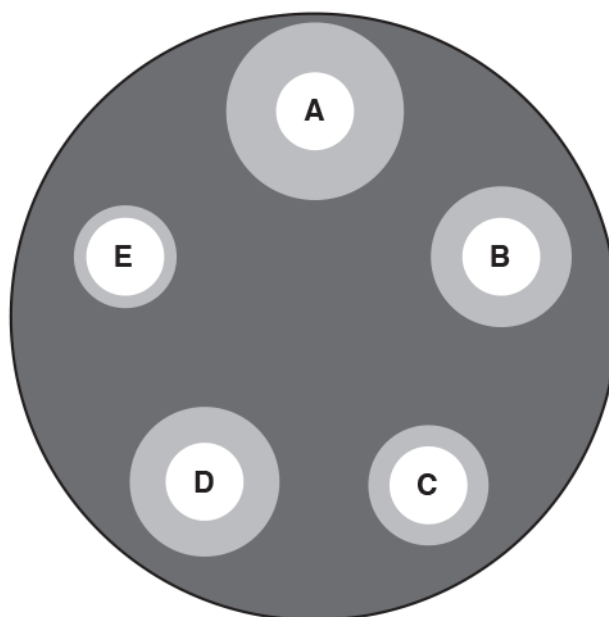


Fig. 36.2

- (i) State the **precise** name of the chemical bond in starch that is hydrolysed by amylase.

-----[1]

(ii) Reagent X was used to indicate the presence or absence of starch in the agar plates.

State the name of this reagent **and** its colour in the presence of starch.

Name -----

Colour -----

[1]

(iii) The table below shows the results of the investigation.

Bacterial species	Diameter of clear zone (mm)				
	Plate 1	Plate 2	Plate 3	Mean	Standard deviation
A	23	22	22	22.3	0.6
B	17	20	19	18.7	1.5
C	15	15	14	14.7	0.6
D	19	18	20	19.0	1.0
E	9	12	12	1.0	

Calculate the standard deviation for the data for bacterial species E.

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

Standard deviation = ----- [2]

(iv) The investigation did not include any control experiment.

Suggest **one** control experiment that could have been included in this investigation and explain its importance.

----- [2]

(v) Suggest **one** other way in which the method could be changed to improve the validity of the conclusions.

----- [1]

- 11 Haemoglobin is contained in erythrocytes. While studying oxygen transport, a student investigated the water potential of erythrocytes. They wrote the following description in their laboratory notebook:

I placed a drop of blood on a microscope slide and covered it with a coverslip, then added a drop of distilled water on one side of the coverslip. I immediately observed the slide under high power. I repeated the procedure with sodium chloride solutions of two different concentrations to find the one that caused plasmolysis to occur.

- (i) Explain why the term 'plasmolysis' is used incorrectly in this student's description.

----- [1]

- (ii) State **two** ways in which the experimental procedure described by the student could be improved.

improvement 1 -----

improvement 2 -----

----- [2]

12 Three diagnostic tests were performed on a solution containing a biological molecule.

The results of the tests are shown in the table below.

	Colour of test reagent	
	Before	After
Benedict's test (with hydrolysis)	blue	green
Biuret test	blue	purple
Iodine test	yellow-brown	yellow-brown

Which of the options, **A** to **D**, is the biological molecule that was tested?

- A** glucose
- B** glycoprotein
- C** glycolipid
- D** starch

Your answer

[1]

1. Grind spinach leaves in ice-cold isolation medium.
2. Centrifuge the sample to obtain a pellet and a supernatant.
3. Suspend the pellet in a further 2 cm^3 of ice-cold isolation medium.
4. Store the samples in an ice-cold water bath while setting up the test tubes as shown in the table.
5. Illuminate all the test tubes except test tube C and time how long it takes for the DCPIP to change from blue to colourless.

Test tube	Leaf extract from pellet (cm^3)	Supernatant (cm^3)	Isolation medium (cm^3)	Distilled water (cm^3)	DCPIP solution (cm^3)
A	0.5				5
B			0.5		5
C	0.5				5
D	0.5			5	
E		0.5			5

(i) Which stage of photosynthesis was being investigated?

(ii) In this experiment DCPIP was used as an indicator.

[1]

Suggest why.

- (b) As an alternative to step 5 in the method described, the colour of the DCPIP was monitored using a colorimeter. Table 3.1 shows some of the readings taken with the colorimeter.

Time from illumination (min)	Absorbance	
	Test tube A	Test tube E
2	5.0	5.0
3	4.6	4.6
4	4.3	4.0
5	4.0	3.7
6	3.8	3.4
7	3.4	3.0
8	3.0	2.7
9	2.6	2.6
10	2.2	2.3
11	1.9	2.0
12	1.4	1.7
13	0.9	1.6
14	0.6	1.3
15	0.5	1.0
16	0.5	0.8
17	0.4	0.5
18	0.5	0.3
19	0.4	0.3
20	0.3	0.3

Table 3.1

- (i) The progress of the reaction was monitored with the use of a colorimeter.

What colour filter should have been used?

(ii) Suggest why no further readings were taken after 20 minutes.

----- [1]

(iii) Both test tubes showed photosynthetic activity and changed the colour of DCPIP equally.

Test tube A contained chloroplasts. Test tube E contained no chloroplasts.

Suggest how test tube E produced the same results as test tube A.

----- [2]

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

One test measures how well a patient's blood glucose levels are being controlled. The patient is **not** required to fast beforehand.

Explain how this test works.

[3]

- (ii) Describe **two** pieces of lifestyle advice that a doctor may give to a patient with type 2 diabetes.

1

2

[2]

- (iii) The management of diabetes is an example of evidence-based practice.

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

[1]

15 A disc of potato was cut from a tuber and dried to remove excess moisture.

It was weighed and the mass recorded as **mass 1**.

The disc was then placed in pure water for an hour, removed, dried and re-weighed as **mass 2**.

Finally, it was placed in a concentrated sucrose solution for an hour, removed, dried and re-weighed as **mass 3**.

Which of the rows, **A** to **D**, from the table below gives the expected results of the experiment?

	Mass 1 (g)	Mass 2 (g)	Mass 3 (g)
A	4.8	4.3	5.2
B	4.8	4.5	4.3
C	4.8	5.0	4.8
D	4.8	5.2	4.3

Your answer

[1]

Fig. 1.2 summarises the glyoxylate cycle in peroxisomes. This cycle converts fatty acids to carbohydrates. The glyoxylate cycle is a modification of the Krebs cycle.

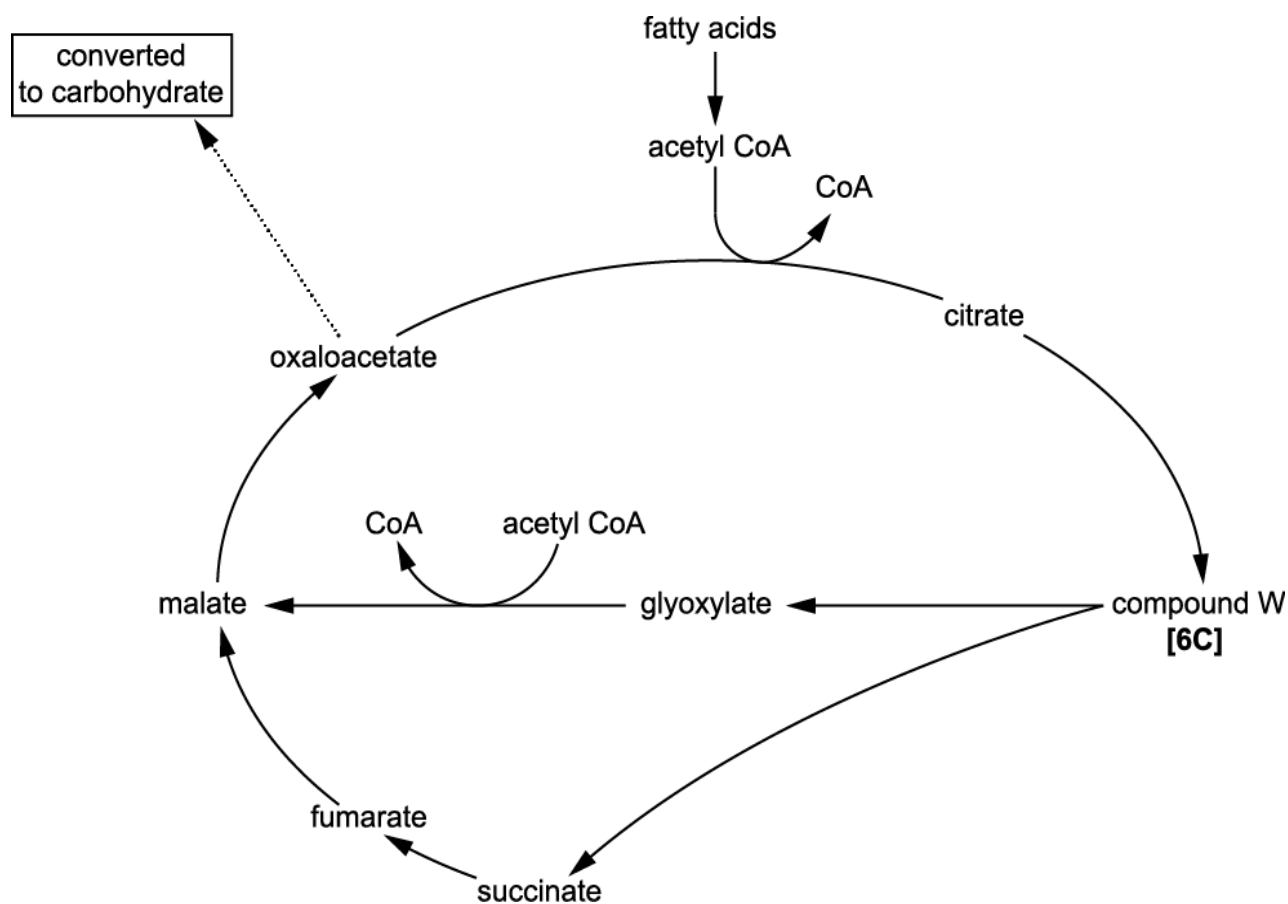


Fig. 1.2

Identify the following from the information given in Fig. 1.2:

- (i) a 6-carbon compound other than compound W

-----[1]

- (ii) the number of carbons present in glyoxylate

 [1]

- (iii) a 4-carbon compound other than oxaloacetate

-----[1]

- (iv) In the **Krebs cycle**, the conversion of compound **W** to succinate results in the production of an excretory product.

Give the name of this product.

-----[1]

- 17 Apart from using Benedict's solution and a colorimeter, suggest **two** alternative quantitative methods for measuring the concentration of glucose in blood plasma.

1

2

[2]

- 18 * Aspirin (2-*O*-acetylsalicylic acid) is a drug commonly used in medicine.

Ingestion of more than 500 mg kg^{-1} of aspirin causes severe and possibly fatal toxicity.

Once in the body aspirin is gradually broken down in the liver into salicylic acid.

Salicylic acid is excreted through the kidney and leaves the body in the urine.

Estimates of the amount of aspirin remaining in the body can be made by determining the amount of salicylic acid in the urine. Salicylic acid reacts with a solution of iron(III) chloride to give a purple-coloured substance.

Write a method to determine the concentration of salicylic acid in a sample of urine.

Your method must be based on the assumption that you are provided with the following:

- a solution of 100 mg dm^{-3} salicylic acid
- a 1% solution of iron(III) chloride
- a colorimeter
- school or college laboratory resources.

[illegible]

- 19 Benedict's solution can be used to detect reducing sugars in urine.

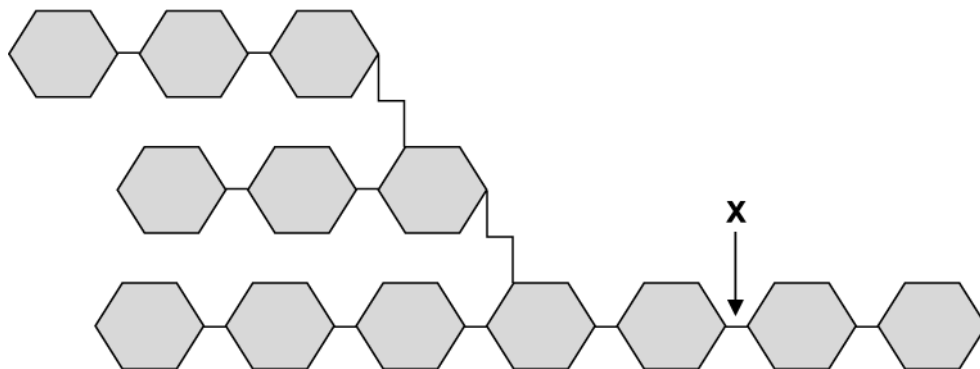
Which of the options, **A** to **D**, is the colour that you would expect to see after testing the urine of a diabetic person?

- A blue
B blue-black
C brick-red
D purple

Your answer

[1]

20 The diagram below represents the structure of a glucose polymer.



Which of the options, **A** to **D**, correctly describes the bond labelled **X**?

- A 1,4-glycosidic bond, formed during a condensation reaction
- B 1,4-glycosidic bond, formed during a hydrolysis reaction
- C 1,6-glycosidic bond, formed during a condensation reaction
- D 1,6-glycosidic bond, formed during a hydrolysis reaction

Your answer

[1]

- 21 One mechanism for controlling gene expression in cells uses small, double stranded pieces of RNA known as siRNA.

- 1 siRNA molecules are introduced into the cell.
- 2 The siRNA molecules are combined with a protein complex called the RNA induced silencing complex (RISC) and one of the siRNA strands is destroyed.
- 3 The other strand remains bound to RISC and acts as a guide. RISC is now said to be activated.
- 4 This strand binds to complementary sequences on messenger RNA molecules in the cytoplasm causing them to be destroyed.

Fig. 36.1 shows the sequence of events for this mechanism.

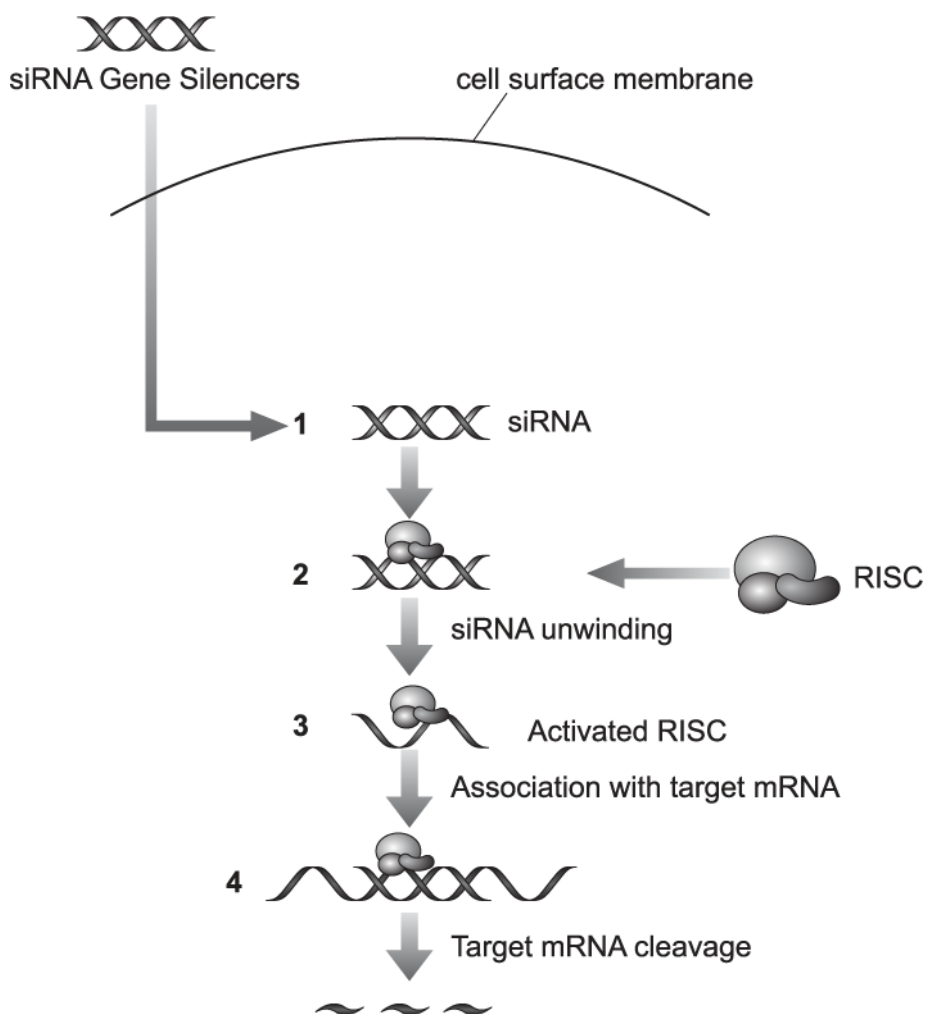


Fig. 36.1

- (i) An RNA strand on an activated RISC has the following sequence.

On the line above, write out the sequence that activated **RISC** would bind to on the mRNA molecule.

[1]

- (ii) What type of reaction is carried out by activated **RISC** on the bonds in the mRNA molecule?

[1]

- (iii) Clinical trialling is being carried out on the use of siRNA as an anti-viral therapy for the treatment of Hepatitis C infections.

Suggest how siRNA could prevent the spread of a virus within a person infected by the Hepatitis C virus.

----- [3]

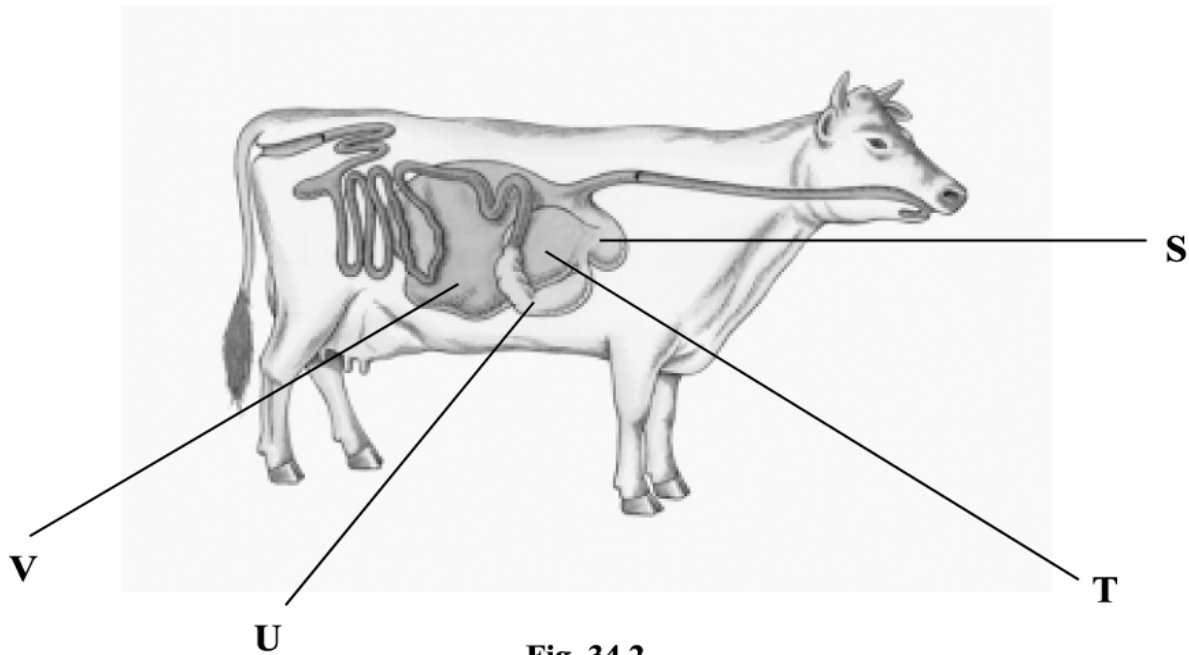


Fig. 34.2

(i) Complete the following table about the parts of the cow's digestive system labelled in Fig. 34.2.

Description	Name	Letter
Secretes hydrochloric acid and protease enzymes.		
Allows the cow to regurgitate material back up to the mouth for further chewing.		

[2]

- (ii) Both cows and humans need a range of amino acids to make their own proteins.
- Amino acids which have to be present in the diet are called essential amino acids.
 - Unlike humans, essential amino acids do **not** need to be present in the diet of cows.

Explain how cows obtain their essential amino acids.

[2]

- (iii) Amino acids which have been absorbed but which are **not** required for protein synthesis cannot be stored.

State what happens in liver cells to the amino acids which are not required for protein synthesis.

END OF QUESTION PAPER

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1			A	1(AO1.2)	
			Total	1	
2			A	1(AO1.1)	
			Total	1	
3		i	minimal disruption to lifestyle / AW ✓ fast results ✓ small volume of blood for sample ✓	1max(AO 3.2)	IGNORE can be 'carried out at home' or 'used by patient themselves' or 'easy to carry' (as given in the question)
		ii	monitor / AW, blood disorder / named blood disorder ✓ determine the severity of, blood disorder / named blood disorder ✓ monitor / AW, response to treatment ✓ monitor suitability / AW, to become a blood donor ✓	1max(AO 1.2)	e.g. 'monitor anaemia'
		iii	low hydration levels increases concentration of solutes in plasma, leading to artificially high results / AW ✓	1(AO3.2)	
			Total	3	
4	a		set volume of glucose solution ✓ boil for suitable time ✓ measure / subtract, the mass of filter paper ✓ dry to constant mass ✓	max 3(AO3.4)	ACCEPT a stated volume e.g. 2 cm ³ ACCEPT stated time e.g. 2 minutes ACCEPT description of drying to constant mass
	b		2.3 – 2.4% ✓	1(AO2.8)	
	c		add (dilute) HCl and boil ✓ hydrolyses the glycosidic bonds ✓ add sodium hydrogen carbonate ✓ neutralises the acid ✓	4(AO 3.3)	ACCEPT add alkali
			Total	8	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
5		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	
6			B	1 AO1.1	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
7		i	0.04 ✓✓	2 AO2.4	correct use of numbers in formula = 1 mark max unrounded answer (0.0409...) = 1 mark max
		ii	error bars equal in height, above and below mean ✓ correctly plotted error bars (4 mini-squares above and below 2.33) ✓	2 AO2.4	ALLOW ECF

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	mass of potato influenced by <u>osmosis</u> ✓ a 0.35 mol dm⁻³ sucrose, decrease in mass t because water potential of potato greater > than that of sucrose solution ✓ a 0.35 mol dm⁻³ sucrose, increase in mass t because water potential of sucrose < solution greater than that of the potato ✓ a 0.35 mol dm⁻³ sucrose, no change in t mass because, no net movement of ~ water / water potential of potato and sucrose solution equal ✓	3 AO2.3 3.1	ALLOW Ψ for water potential or vice versa or vice versa DO NOT ALLOW statements relating change in mass to gain/loss of water without explanation <u>Examiner's Comments</u> Most candidates did not read this question carefully and did not appreciate that the potato slices in pure water/low sucrose concentrations were gaining mass (starting mass was 2.5g). This classic practical exercise allows the precise water potential of the cells to be obtained by determining the sucrose concentration at which there is no change in mass. Very few candidates referred to specific values when explaining the data. Exemplar 3 As the sucrose concentration increases the mean final mass of potato decreases, with the mean mass being 2.80g in 1.0 mol dm⁻³ sucrose, to being 2.22g in 1.0 mol dm⁻³. This is because there is a lower water potential outside the potato cells, compared to inside, resulting in water to move out of the cell by osmosis, down a water potential gradient. As water leaves the potato, the mass will decrease, so the lower the water potential due to the sucrose concentration, the more water is lost and the more the mass decreases. [3] This script was typical of many that gained just one mark for understanding that the change in mass of the potato was due to osmosis. To obtain more than this reference needed to be made to specific data points where the potato was gaining mass and where it was losing mass, along with an explanation as to why this was the case.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iv	Inconsistent / uneven, drying (of potato slices) ✓ ref to stacking/contact between potato slices ✓ different regions of potato sampled ✓ different, shapes / surface area, of slices ✓	max 2 AO3.4	ALLOW SA:V or SA/V
			Total	9	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
8	a		Mark first answer. One from the following: absolute value ✓ not / less, subjective ORA ✓ removes doubt over end point / colour of sample / AW ✓ <i>idea that method</i> gives different options for measuring DV (absorbance of filtrate, transmission of light and /or mass of residue) ✓	1 (AO 3.2)	IGNORE “quantitative” or “quantitative method” as this is given in the Q ALLOW numerical value DO NOT ALLOW ‘how much’ / precise <u>Examiner’s Comments</u> This question was similar to Q1(a), whereas only the first reason suggested by the candidate was considered.. Many candidates referred to the fact that method 2 provided quantitative results. This was not credited as this information is provided to the candidates in the stem of the question. Only a few candidates were able to provide good answers such as method 2 being more objective/less subjective.

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
	b	Summary of instructions to markers: <i>Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.) 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) Further details of a workable method to produce accurate and repeatable quantitative data are provided to include the calibration of the colorimeter. Details of safety are included. Some details of interpretation of glucose concentration are included. <i>There is a well-developed line of reasoning which is clear and logically structured and uses scientific terminology at an appropriate level. The information presented is relevant and substantiated.</i> Level 2 (3-4 marks) Some further details of a workable method to produce repeatable quantitative data are provided. There is an outline of the use of the colorimeter. Details of safety are included. Details of interpretation of glucose concentration may or may not be	6 (AO 1.2) (AO 2.8)	Indicative scientific points could include: Method (further detail to that already given in the question) • use of (graduated) syringe(s) to measure volumes • use of filtrate in cuvette to obtain absorbance or transmission readings • all steps carried out for three mock body fluid samples Accuracy • colorimeter recalibrated for each sample • precipitate weighted to constant mass • top pan balance zeroed Reliability • repeats (min. three replicates for each of the mock body fluid samples AND each of the diluted glucose solutions) Interpretation • data table plotted on a calibration graph • values for 3 samples interpolated from calibration curve Risk assessment: • potential hazards associated with Benedict's reagent • potential hazards associated with boiling water • general good practice in laboratory e.g. goggles, glassware Examiner's Comments Many candidates were able to achieve at least Level 1. There was evidence that some candidates may not have had experience using or observing how to use a colorimeter. As a consequence these candidates referred to placing the

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	included. <i>There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented in the most part relevant and supported by some evidence.</i> Level 1 (1–2 marks) Limited further details of a workable method suggested to provide some results but some information may be missing. Safety is not included. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks No response or no response worthy of credit.		precipitate into the colorimeter and/or using test tubes, rather than cuvettes, into the colorimeter. In these cases the method was not deemed workable. Most candidates included details of a risk assessment and the importance of collecting replicates to make sure repeatability. Some candidates described a method to produce a serial dilution of glucose solutions but then did not go on to say how the colorimeter would be used, and/or did not include details to show the intention of carrying out the same QBR on all 3 mock samples so in effect did not actually generate any meaningful results. High scoring answers demonstrated safe, repeatable and accurate methodology for example referring the zeroing of the colorimeter with distilled water, carrying out 3 replicates for each of the 3 mock body fluid samples and how to construct a calibration curve from the data table provided (see apparatus list final bullet point on page 8).  OCR support Practical work should be an integral part of the study of Biology. The practicals provided by OCR to support the practical endorsement include Practical Activity Group (PAG) 5 in which there is practical activity on determining glucose concentration using colorimeter. PAG activities are available on OCR interchange: https://interchange.ocr.org.uk/Downloads/PAG5.zip It is acknowledged that not all centres will have access to colorimeters but there are several good video clips available online that can be used in these cases so candidates understand how and where this

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					apparatus can be used.												
	c		resolution ✓ accuracy ✓ limitation ✓	3 (AO 3.4)	DNA precision <u>Examiner's Comments</u> Most candidates scored at least one mark on this question with the most common correct answer being limitation. A common mistake was to use the term precision in the first gap which required the term resolution. For the purpose of this clarity in this question, precision is the '<i>closeness of agreement between (consistency, low variability of) measured values obtained by repeated measurements</i>', which is not appropriate in this first gap.  OCR support Centres are strongly recommended to use the definitions of these key terms as per the specification which are based on the "Language of measurement" document published by the ASE and Nuffield Foundation used by all awarding bodies at both GCSE and GCE Level. Appendix 4 in the Practical Skills Handbook contains a list of definition of the most common key terms: https://www.ocr.org.uk/Images/294468-biology-practical-skills-handbook.pdf												
	d	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'	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>	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....															
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			AND each bar with a suitable label ✓ (separate) bars correctly plotted ✓ standard deviation bars correctly plotted ✓		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/

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		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	
9			<i>Competitive inhibitor</i> (Marimastat) binds to / blocks , the <u>active site</u> of, MMPs / proteases / enzyme ✓ (this) prevents / competes with, binding of, substrate / proteins ✓ OR <i>Non-competitive inhibitor</i> Marimastat binds to allosteric site of, MMPs / proteases / enzyme ✓ (therefore) changes (3D) <u>shape of active site</u> ✓	2 AO2.1	<u>Examiner's Comments</u> Most candidates recognised that it would inhibit in a competitive or non-competitive manner. Marks were lost for lack of clarity when describing these types of inhibition. Candidates should be very clear about naming each stage, especially when lots of acronyms are being used.
			Total	0	

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Question			Answer/Indicative content	Marks	Guidance
10	a		bond between any H and any O on separate molecules ✓ labelled hydrogen bond / H bond ✓ (delta/δ) + charges on H atoms AND (delta/δ) – charges on O atoms ✓	3	ALLOW charges on a single water molecule <u>Examiner's Comments</u> Many candidates were able to gain full marks in this question although it was noted that many drawings showed more than one extra water molecule. This was not penalised on this occasion, but candidates should read instructions carefully, particularly when in bold type.
	b	i	α-1,4-glycosidic ✓	1	DO NOT ALLOW 1,4-glycosidic <u>Examiner's Comments</u> Very few candidates identified the precise name of the chemical bond which is the alpha 1-4 glycosidic bond.
		ii	reagent: (potassium) iodide / KI colour: blue-black / blue ✓	1	DO NOT ALLOW 'iodine' unless specific 'in potassium iodide' <u>Examiner's Comments</u> Very few candidates correctly identified iodine-KI reagent.
		iii	1.7 ✓✓	2	1.73 = 1 mark
		iv	disc soaked in pure amylase ✓ to show amylase is responsible for colour change ✓ OR disc soaked in water only ✓ to show colour change is, due to amylase / not due to moisture of the disc ✓	2	<u>Examiner's Comments</u> Many candidates correctly identified a control – most commonly this was soaking the paper discs in water. However, few candidates developed the answer to explain how this would show the colour change was caused by the amylase rather than the moisture on the disc.

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Question			Answer/Indicative content	Marks	Guidance
		v	measure the concentration of bacteria in the cultures before soaking the discs ✓ extract the amylase before testing ✓	max 1	<u>Examiner's Comments</u> There was confusion between validity and reliability here and many candidates suggested repeating the experiment. An experiment is valid if it measures what it is supposed to be measuring. In this case the experiment is comparing the amylase activity of different bacterial species by soaking paper discs in bacterial cultures. Having specific concentrations of bacteria in each culture would make it more valid.
			Total	10	
11		i	(plasmolysis) occurs in plant cells / erythrocyte is not a plant cell ✓	1	<u>Examiner's Comments</u> Approximately 40% of candidates achieved the mark for (b)(i). A lot of candidates stated the correct term but did not state the relevance of the actual term used.
		ii	allow time for equilibration before observation OR observe immediately and after 10 – 15 min ✓ use more concentrations ✓ count cells using, haemocytometer measure (diameter of) cells using, scale / graticule ✓	2	ALLOW other valid improvements <u>Examiner's Comments</u> For (b)(ii) the majority of candidates achieved mp2. Many candidates discussed slowly increasing the magnification or a better method for spreading the blood across the slide. Candidates did not appreciate that the improvement should be pertinent to observing osmotic effects. Candidates should focus on the relevance of the procedure, i.e. the student is trying to compare the solutions to 'find the one that caused' an osmotic effect, thus counting or measuring cells is the focus not how to apply the sample in the first place. A few candidates referred to adding a dye to visualise again without appreciating the osmotic relevance and thus the leakage of any dye from the cell.
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
12			B ✓	1	Examiner's Comments This was a straightforward question interpreting knowledge of biochemical tests and the majority of candidates chose the correct response.
			Total	1	
13	a	i	light dependent (reactions) ✓	1	ALLOW Hill reaction
		ii	(it acts as an) electron acceptor ✓	1	ALLOW reduced
		iii	maintains (chemical) activity of chloroplasts ✓	1	ALLOW references to maintaining pH in context of (chemical) activity of chloroplasts
	b	i	red ✓	1	
		ii	3 consecutive readings of same value (in test tube E) ✓	1	ALLOW the reaction had stopped in (test tube) E
		iii	chloroplasts physically damaged during preparation of leaf extract ✓ photosystems / chlorophyll present in supernatant ✓ other reducing agents / AW present in supernatant ✓	max 2	DO NOT ALLOW any suggestion of chemical damage
			Total	7	
14		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	
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
15			D ✓	1	
			Total	1	
16		i	citrate ✓	1	
		ii	2 ✓	1	
		iii	malate / fumarate / succinate ✓	1	
		iv	carbon dioxide ✓	1	ALLOW CO ₂
			Total	4	
17			biosensor (1) reagent strips (1)	2	ALLOW blood glucose meter / glucometer ALLOW clinistrips / Clinistix / Diastix IGNORE references to glycosylated or glycolated haemoglobin / HbA1c
			Total	2	

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18			* Level 3 (7–9 marks) Details of apparatus and a method to produce reliable data are provided to include the use of a dilution series to construct a standard curve. Most variables are identified, and the method states how most variables are controlled. <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 (4–6 marks) The apparatus and a method to provide reliable results are provided although some details may be missing. There is an outline of standard curve construction. Some variables are identified and the method states how some variables are controlled. <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 (1–3 marks) Apparatus and an outline method are suggested to provide some results but information, such as standard curve construction, may be missing. Some variables are omitted. <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.	9	Indicative scientific points could include: Apparatus & method: • cuvettes, test tubes • apparatus for volume measurement (pipettes, syringes) • distilled / deionised water • selection of appropriate filter (on colorimeter) • reference to zero or blank • details of quantitative preparation of dilution series (for salicylic acid) to include volumes and final concentration • standard curve construction • method of testing urine and obtaining a reading. Variables: • (curve) independent variable = dilution • dependent variable = colorimeter reading • correct units included • control variables e.g. filters (colorimeter), volumes, time, temperature. Reliability: • repeats (for dilutions and urine reading) • reference to quantitative processing of data e.g. calculation of means • reference to use of error bars on standard curve. Risk Assessment: • potential chemical hazards & control • potential electrical hazards & control • potential microbial hazards (urine) & control.
			Total	9	
19			C	1	
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance									
20			A	1										
			Total	1										
21		i	ACGGGAAGGGCCCGAGCACGGA UGCCCUUCCCGGGCUCGUGCCU	1										
		ii	hydrolysis	1	IGNORE 'cleavage'									
		iii	Any 3 from: (activated) RISC, cleaves / AW, viral mRNA no viral proteins made no, viral particles / AW, assembled <i>idea that</i> no new cells are infected	3	IGNORE 'virus cannot spread' as this is given in the question									
			Total	5										
22		i	<table border="1"><thead><tr><th>Description</th><th>Name</th><th>Letter</th></tr></thead><tbody><tr><td></td><td>Abomasum</td><td>U</td></tr><tr><td></td><td>Reticulum</td><td>S</td></tr></tbody></table>	Description	Name	Letter		Abomasum	U		Reticulum	S	2	One mark for each correct row ALLOW rumen and V
Description	Name	Letter												
	Abomasum	U												
	Reticulum	S												
		ii	<i>idea that</i> microbes in rumen are a protein source (microbial protein) hydrolysed into amino acids by protease enzymes	2										
		iii	(amino acids are) deaminated / AW	1										
			Total	5										