

Past-paper walk-through

Testing for biological molecules ■ 2.1

eXercise

Questions in this set

- 9700/11 N25 Q6 ■ 1 mark
- 9700/12 N25 Q6 ■ 1 mark
- 9700/13 N25 Q8 ■ 1 mark
- 9700/14 N25 Q6 ■ 1 mark
- 9700/33 N25 Q1 ■ 20 marks

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- **//** separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = “or words to that effect” – the wording need not match.

Question 6

9700/11 N25 ■ Q6 ■ 1 mark

- 6 Solution X was tested for the presence of non-reducing sugars. It did **not** contain reducing sugars.

Some steps that can be used to test for the presence of biological molecules are listed.

- 1 Add Benedict's solution to the test-tube.
- 2 Add dilute hydrochloric acid to the test-tube.
- 3 Add sodium hydrogencarbonate to the test-tube.
- 4 Heat the test-tube in a water-bath.

Which order of steps to identify the presence of non-reducing sugars in solution X is correct?

A 1 → 4

B 2 → 3 → 1 → 4

Question 6

C $2 \rightarrow 4 \rightarrow 3 \rightarrow 1 \rightarrow 4$

D $3 \rightarrow 2 \rightarrow 4 \rightarrow 1$

Solution 6

Answer: **C**

Why

- A non-reducing sugar must first be broken into its reducing monosaccharides.
- So hydrolyse with dilute hydrochloric acid, then neutralise with sodium hydroxide.
- Only then does Benedict's solution give a positive result – neutralising *before* Benedict's is essential.

Question 6

9700/12 N25 ■ Q6 ■ 1 mark

- 6 A student carried out four tests for biological molecules. The observations are shown in the table.

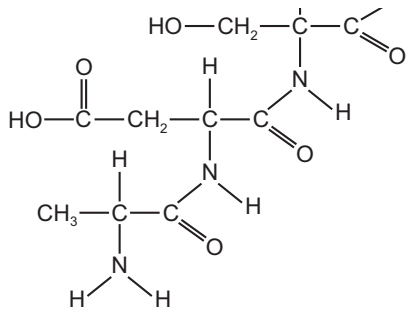
test	observations
iodine	orange
biuret	purple
Benedict's	orange
emulsion	clear

The diagrams show molecules or parts of molecules.

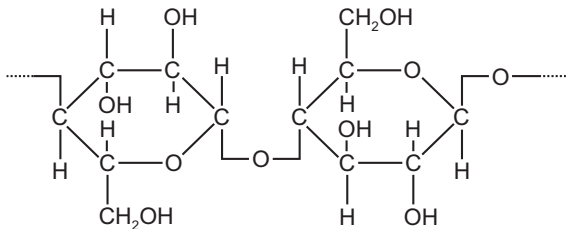
Which pair is present in the solution?



Question 6

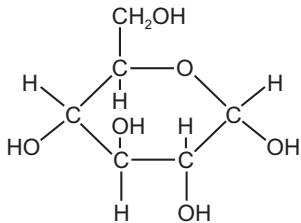


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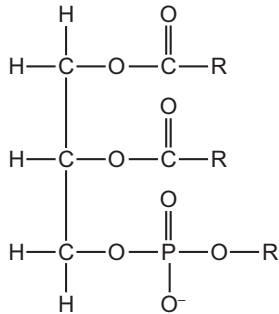


2

Question 6



3



4

A 1 and 2

B 1 and 3

C 2 and 3

D 3 and 4

Solution 6

Answer: **B**

Why

- Iodine orange means no starch; Benedict's orange means a reducing sugar is present.
- Biuret purple means protein is present; a clear emulsion test means no lipid.
- So look for the pair that is a reducing sugar plus a protein fragment.

Question 8

9700/13 N25 ■ Q8 ■ 1 mark

- 8 The diagram shows some steps in a laboratory method used to identify the presence of non-reducing sugars in a food sample.

Some terms are missing.



Which terms are correct for the expected result for a very low concentration of non-reducing sugar?

	X	Y	Z
A	acid hydrolysis	Benedict's test	orange
B	Benedict's test	acid hydrolysis	orange
C	acid hydrolysis	Benedict's test	green

Question 8

D	Benedict's test	acid hydrolysis	green
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Solution 8

Answer: **C**

Why

- A non-reducing sugar gives nothing with Benedict's until it is hydrolysed.
- So step X is acid hydrolysis and step Y is neutralisation with alkali.
- At a *very low* concentration the final Benedict's colour only just changes – green rather than red.

Question 6

9700/14 N25 ■ Q6 ■ 1 mark

- 6** Trehalose is a non-reducing disaccharide.

Separate samples of a mixture of fructose and trehalose were tested with Benedict's solution before and after acid hydrolysis.

What will be the results of these Benedict's tests?

	before acid hydrolysis	after acid hydrolysis
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = positive result with Benedict's test

✗ = negative result with Benedict's test

Question 6

Solution 6

Answer: **A**

Why

- Fructose is a reducing sugar, so Benedict's is positive even before hydrolysis.
- Trehalose is non-reducing, so it contributes nothing until it is hydrolysed.
- After hydrolysis both sugars give a positive result, so the test is positive both times.

Question 1

9700/33 N25 ■ Q1 ■ 20 marks

- 1 Dialysis tubing is a partially permeable membrane. Glucose molecules can diffuse through the dialysis tubing.

You are required to investigate the diffusion of glucose across dialysis tubing.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm ³
G	20.0% glucose solution	low	50
W	distilled water	low	200
Benedict's	Benedict's solution	harmful irritant	40
D	length of dialysis tubing in distilled water	low	–

Question 1

If any solution comes into contact with your skin, wash off immediately with cold water. It is recommended that you wear suitable eye protection.

You will need to:

- put glucose solution into dialysis tubing surrounded by water
- take samples of the water surrounding the dialysis tubing
- test for the presence of glucose in each sample of water.

Carry out step 1 to step 11.

step 1 Draw a mark 8 cm from the top of a large test-tube, as shown in Fig. 1.1.



Question 1

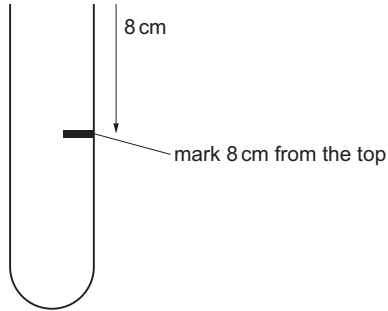
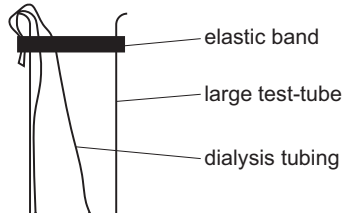


Fig. 1.1

- step 2 Remove the dialysis tubing from beaker **D**. Tie a knot in the dialysis tubing as close as possible to one end, so that the end is sealed.
- step 3 The whole length of the dialysis tubing needs to be separated to allow the tubing to

Question 1

- step 3 The whole length of the dialysis tubing needs to be separated to allow the tubing to be filled with solution. To do this, rub the whole length gently between your finger and thumb.
- step 4 Put 10 cm^3 of 20.0% glucose solution, **G**, into the open end of the dialysis tubing.
- step 5 Rinse the outside of the dialysis tubing by dipping it in the water in beaker **D**.
- step 6 Put the dialysis tubing containing **G** into the large test-tube and keep it in position using an elastic band as shown in Fig. 1.2.



Question 1

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Question 1

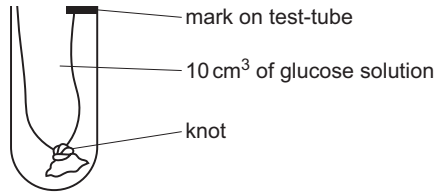


Fig. 1.2

step 7 Put distilled water into the large test-tube so that the top of the water is above the level of the glucose solution in the dialysis tubing.

step 8 Start timing.

You are required to take samples of the water surrounding the dialysis tubing every 5 minutes for 15 minutes. You will collect three samples.

Question 1

step 9 Label three test-tubes with the times the samples of water will be taken (**5**, **10** and **15**).

Question 1

step 10 After 5 minutes (step 8), put a 1 cm^3 syringe into the water surrounding the dialysis tubing so that the end of the syringe is level with the mark on the test-tube. Remove 1 cm^3 from the water surrounding the dialysis tubing and put this into the test-tube labelled **5**. Repeat this action to remove another 1 cm^3 from the water surrounding the dialysis tubing and put this into the test-tube labelled **5**. The test-tube labelled **5** will now contain a 2 cm^3 sample. Do **not** stop timing.

step 11 Repeat step 10 at 10 minutes and at 15 minutes using the appropriately labelled test-tubes.

You need to carry out a dilution of the 20.0% glucose solution, **G**, to make a 1.0% glucose solution. You will need 20 cm^3 of this 1.0% glucose solution.

(a) (i) Complete Table 1.2 to show the volume of distilled water, **W**, you will use to make 20 cm^3 of a 1.0% glucose solution.

Table 1.2

Question 1

Question 1

volume of 20.0% glucose solution, G /cm ³	volume of distilled water, W /cm ³
1	

[1]

step 12 Prepare the 1.0% glucose solution as shown in Table 1.2.

You will need to carry out a **serial** dilution of the 1.0% glucose solution you have prepared in step 12 as shown in Fig. 1.3. You must reduce the concentration by **half** between each successive dilution.

You will need to prepare **four** concentrations of glucose solution in addition to the 1.0% glucose solution from step 12.

Question 1

After the serial dilution is completed, you will need to have 10 cm^3 of each concentration available

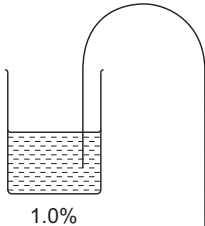
Question 1

After the serial dilution is completed, you will need to have 100 ml of each concentration available to use.

(ii) Complete Fig. 1.3 to show how you will prepare your serial dilution.

Each beaker should have:

- a labelled arrow to show the volume of glucose solution transferred
- a labelled arrow to show the volume of distilled water, **W**, added.



Question 1

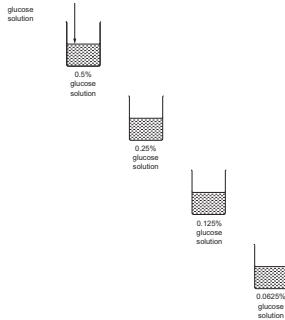


Fig. 1.3

[2]

step 13 Set up a boiling water-bath ready for step 18 and step 22.

step 14 Prepare the concentrations of glucose solution as shown in Fig. 1.3.

step 15 Label 5 test-tubes with the concentrations of glucose solution shown in Fig. 1.3.

step 16 Put 2 cm^3 of the 1.0% glucose solution into the appropriately labelled test-tube.

(iii) You are required to carry out the Benedict's test on the glucose solutions that you have prepared in step 14.

State the volume of Benedict's solution you will use for each reducing sugar test. Explain why you have selected this volume.

Question 1

Question 1

Question 1

[1]

step 17 Put the volume of Benedict's solution stated in **(a)(iii)** into the test-tube labelled 1.0%. Shake gently to mix.

step 18 Put this test-tube into the boiling water-bath and record in Table 1.3 the time to the first colour change.

If there is no colour change after 120 seconds, stop timing and record the time as 'more than 120'.

step 19 Remove the test-tube from the boiling water-bath.

step 20 Repeat step 16 to step 19 using 2 cm^3 of each of the other concentrations of glucose solution.

(iv) Complete Table 1.3 to record your results.

Table 1.3

Question 1

percentage concentration of glucose	
1.0	
0.5	
0.25	
0.125	
0.0625	

[1]

You are required to carry out the Benedict's test on the three samples collected from the water surrounding the dialysis tubing (**5**, **10** and **15**).

step 21 Put the volume of Benedict's solution stated in **(a)(iii)** into the test-tube labelled **5**.
Shake gently to mix.

Question 1

step 22 Put this test-tube into the boiling water-bath and record in **(a)(v)** the time to the first colour change.

If there is no colour change after 120 seconds, stop timing and record the time as 'more than 120'.

step 23 Remove the test-tube from the boiling water-bath.

step 24 Repeat step 21 to step 23 for the other samples (**10** and **15**).

(v) Record your results in an appropriate table.

Question 1

[4]

(vi) State **one** source of error when carrying out the Benedict's test.

Question 1

- (vii) Use your results in **(a)(iv)** and **(a)(v)** to estimate the percentage concentration of glucose in the samples taken at **5**, **10** and **15** minutes.

Question 1

Question 1

Question 1

[1]

(viii) Suggest a reason for the percentage concentrations of glucose estimated in (a)(vii).

Question 1

Question 1

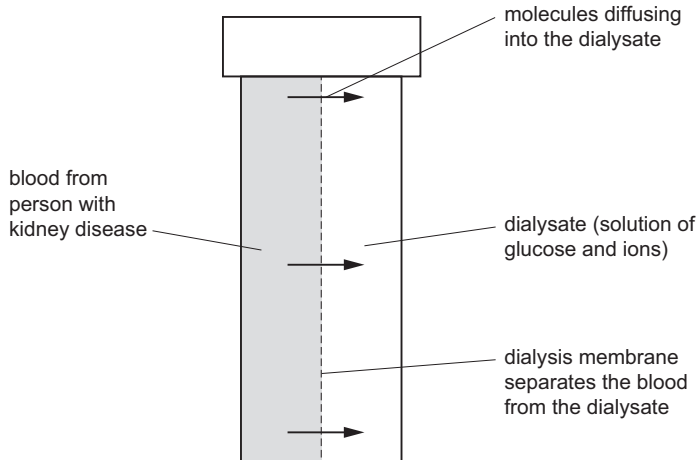
Question 1 continues on page 10.

- (b)** A dialysis membrane, similar to dialysis tubing, is used in the treatment of kidney disease.

During this treatment, the blood of a person with kidney disease is passed through a dialysis machine to remove unwanted waste products from the blood.

The machine contains dialysate which is a solution of glucose and ions. Blood flows through the dialysis machine and is separated from the dialysate by a membrane. Some molecules diffuse from the blood into the dialysate. This is shown in Fig. 1.4.

Question 1



Question 1



Fig. 1.4

Scientists studied the movement of two molecules, **P** and **Q**, found in the blood of a person with kidney disease. They wanted to see if these two molecules would remain in the blood or move out of the blood across the dialysis membrane into the dialysate.

The scientists took samples of blood from a person using a dialysis machine every 5 minutes for 20 minutes and recorded the concentration of **P** and **Q** in these samples. The results are shown in Table 1.4.

Table 1.4

time sample was taken	concentration of P in the	concentration of Q in the
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Question 1

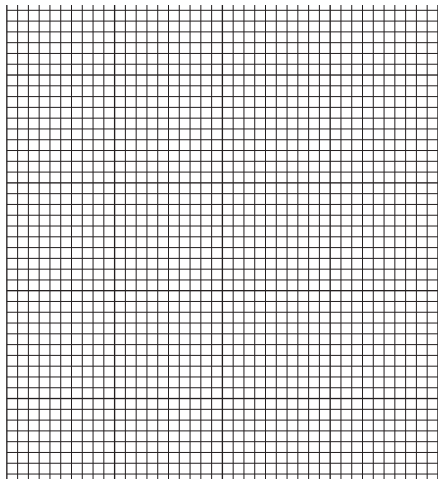
from the blood/min	blood/arbitrary units	blood/arbitrary units
0	200	400
5	205	280
10	200	150
15	195	90
20	200	75

(i) Plot a line graph of the data in Table 1.4 on the grid in Fig. 1.5.

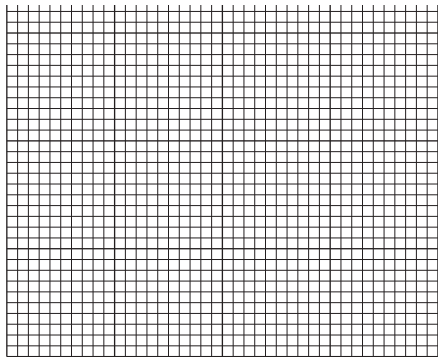
Use a sharp pencil.



Question 1



Question 1



Question 1

Fig. 1.5

[4]

- (ii) Calculate the percentage decrease in concentration of **Q** between 5 minutes and 20 minutes.

Show your working and give your answer to **two** significant figures.

Question 1

[2]

- (iii) Suggest a reason for the rate of decrease in the concentration of **Q** from 0 to 10 minutes and from 10 to 20 minutes.

Question 1

Question 1

[2]

[Total: 20]

Question 1

Question 2 starts on page 14.

Solution 1

(a)(i)

Mark scheme

- states 19 cm³ as the volume of distilled water, W to use ;
- 1

Solution 1

(a)(ii)

Mark scheme

- 1
- shows transfer of 10cm^3 to each beaker from the previous beaker ;
- 2
- shows 10 cm^3 of W added to each beaker ;
- 2

Solution 1

(a)(iii)

Mark scheme

- states the volume of Benedict's to add as 2 cm³ or a volume greater than 2 cm³ and explains that this is because equal or
- excess volume of Benedict's solution is needed ;
- 1

Solution 1

(a)(iv)

Mark scheme

- results show the correct trend for times of known concentrations, the higher the percentage concentration of glucose the
- shorter the time to first colour change ;
- 1

Solution 1

(a)(v) Mark scheme

- 1
- (heading for independent variable)
- sample time and minutes and to the left of the dependent variable ;
- 2
- (heading for dependent variable)
- time to first appearance of a colour change and s and no units in the body of the table ;
- 3

Solution 1

- results for each sampling time ;
- 4
- results recorded to nearest whole second ;
- 4

Solution 1

(a)(vi)

Mark scheme

- states source of error as the time to first colour change is subjective ;
- 1

(a)(vii)

Mark scheme

- results used correctly to estimate the concentration of glucose in the samples taken at 5, 10 and 15 minutes ;
- 1

Solution 1

(a)(viii)

Mark scheme

- (concentration higher at 15 minutes) glucose had more time to diffuse out of the dialysis tubing into the water ;
- 1

Solution 1

(b)(i) Mark scheme

- 1
- x-axis: time sample was taken from the blood / min
- and
- y-axis: concentration in the blood / arbitrary units ;
- 2
- scale on x-axis: 5 to 2 cm, labelled at least every 2 cm
- and
- y-axis: 50 to 2 cm, labelled at least every 2 cm ;

Solution 1

- 3
- correct plotting of points using small dots in circles or crosses ;
- 4
- plots joined with thin line passing through all points ;
- 4
- 9700/33
- October/November 2025

Solution 1

(b)(ii)

Mark scheme

- 1
- shows $(280 - 75) / 280 \times 100$;
- 2
- correct answer to 2 significant figures ;
- 2

Solution 1

(b)(iii)

Mark scheme

- 1
- (0 to 10 minutes) reference to a steep concentration gradient (between the blood and dialysate) ;
- 2
- (10 to 20 minutes) reference to a less steep concentration gradient (between the blood and dialysate) ;
- 2