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COMBINED SCIENCE

0653/52

Paper 5 Practical Test

May/June 2022

1 hour 15 minutes

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [].
- Notes for use in qualitative analysis are provided in the question paper.

For Examiner's Use	
1	
2	
3	
4	
Total	

This document has **16** pages. Any blank pages are indicated.



1 (a) Water moves into a cell by osmosis.

You are going to investigate the effect of temperature on the movement of water by osmosis.

You will use a dialysis tubing bag as a model cell.

You are provided with a glucose solution and two dialysis tubing bags. The dialysis tubing bags are provided in distilled water ready to use.

Procedure

Step 1 Label one boiling tube (large test-tube) **C** and a second boiling tube **H**.

Step 2 Use a syringe to put 10 cm^3 of glucose solution into one of the dialysis tubing bags.

Step 3 Tie a knot in the top of the dialysis tubing bag, as shown in Fig. 1.1.

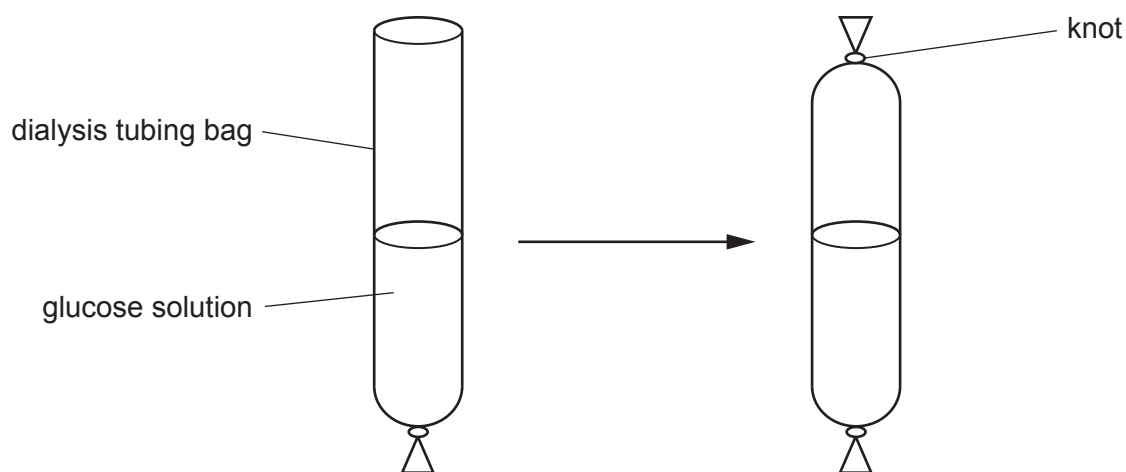


Fig. 1.1

Step 4 Place the filled dialysis tubing bag into boiling tube **C**.

Step 5 Repeat **Step 2** to **Step 4** with the second dialysis tubing bag, placing it into boiling tube **H**.

Step 6 Remove the dialysis tubing bag from boiling tube **C** and measure its **initial** mass. Then put the dialysis tubing bag back into boiling tube **C**.

Step 7 Remove the dialysis tubing bag from boiling tube **H** and measure its **initial** mass. Then put the dialysis tubing bag back into boiling tube **H**.

(i) Record in Table 1.1 the **initial** mass of each dialysis tubing bag.

[2]

Table 1.1

dialysis tubing bag in boiling tube	initial mass /g	final mass /g	change in mass /g
C			
H			

Step 8 Add enough distilled water to both boiling tubes so that the dialysis tubing bags are fully covered.

Step 9 Place boiling tube **C** into the beaker of cold water labelled **cold**.

Step 10 Place boiling tube **H** into the beaker of hot water labelled **hot**.

Step 11 Start a stop-clock and leave the beakers for 10 minutes.

While waiting you can start question **1(b)**.

Step 12 After the 10 minutes, remove the dialysis tubing bag from boiling tube **C** and dry it with a paper towel. Leave the dialysis tubing bag on the paper towel and label the towel **C**.

Step 13 Remove the dialysis tubing bag from boiling tube **H** and dry it with a paper towel. Leave the dialysis tubing bag on the paper towel and label the towel **H**.

Step 14 Measure the **final** mass of each dialysis tubing bag.

(ii) Record in Table 1.1 the **final** mass of each dialysis tubing bag. [2]

(iii) Calculate the **change in mass** for each dialysis tubing bag. Record your answers in Table 1.1. [1]

(iv) Describe the effect of temperature on the mass of water entering the dialysis tubing bags.

.....
 [1]

(v) Explain why the dialysis tubing bags are dried in **Step 12** and **Step 13**.

.....
 [1]

- (b) You are provided with a slice of citrus fruit. The slice of citrus fruit has an inner flesh part and an outer skin part.

- (i) Measure the diameter of the slice of fruit.

Record your answer in millimetres to the nearest millimetre.

diameter of slice of fruit = mm [1]

- (ii) In the box provided, make a large, clear pencil drawing of the slice of fruit.



[3]

- (iii) Measure the diameter of your drawing in (b)(ii).

Record your answer in millimetres to the nearest millimetre.

diameter of your drawing = mm [1]

- (iv) Calculate the magnification of your drawing.

Use the equation shown.

$$\text{magnification} = \frac{\text{diameter of your drawing}}{\text{diameter of slice of fruit}}$$

magnification = [1]

[Total: 13]

2 You are going to investigate the solubility in water of five substances, **L**, **M**, **N**, **P** and **Q**.

(a) (i) **Procedure**

- Half-fill a clean test-tube with distilled water.
- Add all of solid **L** to the water.
- Stir the mixture of **L** and water with a stirring rod for 30 seconds.
- Record in Table 2.1 your observations.

Repeat the procedure with solids **M** and **N**.

The observations for solid **P** are shown in Table 2.1.

Table 2.1

solid	observations
L	
M	
N	
P	green solid in a colourless liquid

[3]

(ii) State which solids, **L**, **M**, **N** or **P** are insoluble in water.

..... [1]

(b) **Procedure**

- Half-fill the beaker labelled **C** with cold tap water.
- Add 10.0 cm³ of distilled water to the boiling tube containing **Q**.
- Raise your hand and request a beaker labelled **H** containing very hot water.
- Use a test-tube holder to place the boiling tube of **Q** and water into the beaker labelled **H**.
- Stir the mixture of **Q** and water with a thermometer until it dissolves.
- Remove the boiling tube with the solution from the beaker **H**.
- Place the boiling tube with the solution into the beaker labelled **C**.
- Stir the solution with the thermometer and look carefully at the inside of the boiling tube.
- Record, to the nearest 0.5 °C, the temperature when the first crystals of **Q** appear in the boiling tube.

temperature when first crystals appear = °C [2]

- (c) A student repeats the procedure in (b) but cools the boiling tube with the solution in **air** instead of in cold water.

Suggest why cooling the solution in air will give a more accurate temperature for when the first crystals appear.

.....

..... [1]

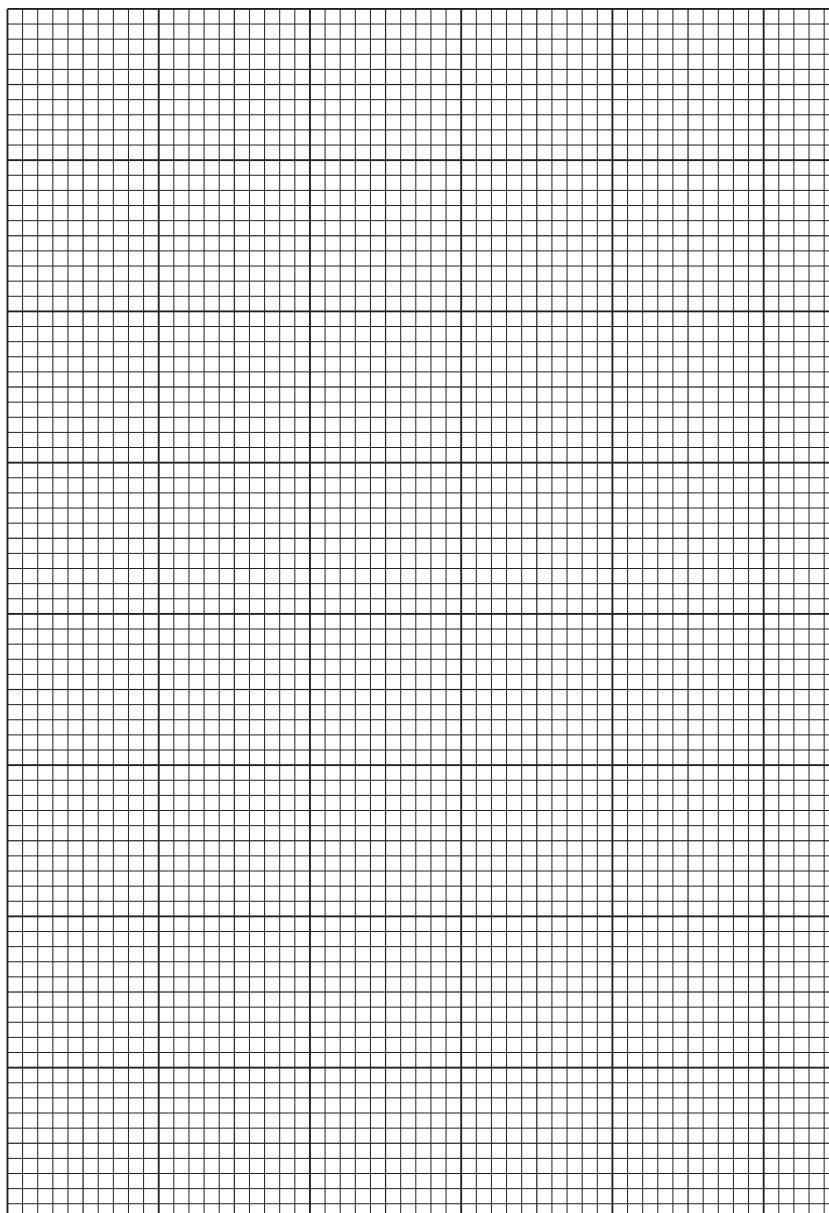
- (d) A student repeats the procedure in (b) using different masses of **Q**.

The results are shown in Table 2.2.

Table 2.2

mass of Q in solution /g	temperature when first crystals of Q appear /°C
5	8
10	30
15	50
20	65
25	75

- (i) On the grid, plot a graph of the temperature when first crystals of **Q** appear (vertical axis) against the mass of **Q** in solution.



[3]

(ii) Draw the curve of best-fit. [1]

(iii) Describe the relationship between the mass of **Q** in the solution and the temperature when the first crystals appear.

.....

..... [1]

(iv) Use the temperature you recorded in (b) and your graph to estimate the mass of **Q** used in the procedure in (b).

mass of **Q** = g [1]

3 You are going to investigate thermal energy changes in water.

(a) Procedure

- Add 150 cm³ of water at room temperature to the large beaker.
- Record in Table 3.1 the temperature of the water to the nearest 0.5 °C.
- Raise your hand to request 50 cm³ of very hot water.
- Record in Table 3.1 the temperature of the very hot water to the nearest 0.5 °C.
- Immediately pour the very hot water from the small beaker into the water in the large beaker.
- Stir the water.
- Record in Table 3.1 the final temperature of the mixture of water in the large beaker to the nearest 0.5 °C.

Table 3.1

	volume of water /cm ³	temperature /°C
water at room temperature	150	
very hot water	50	
mixture	200	

[3]

- (b) (i)** Calculate,
- the difference in temperature between the water at room temperature and the final mixture, ΔT_R
 - the difference in temperature between the very hot water and the final mixture, ΔT_H .
- Record your answers in Table 3.2.

Table 3.2

$\Delta T_R / ^\circ\text{C}$	$\Delta T_H / ^\circ\text{C}$

[1]

- (ii)** Calculate the increase in thermal energy ΔE_R of the water at room temperature.

Use the equation shown.

$$\Delta E_R = 630 \times \Delta T_R$$

$$\Delta E_R = \dots\dots\dots \text{ J [1]}$$

- (iii) Calculate the decrease in thermal energy ΔE_H of the very hot water.

Use the equation shown.

Give your answer to **two** significant figures.

$$\Delta E_H = 210 \times \Delta T_H$$

$$\Delta E_H = \dots\dots\dots \text{ J [1]}$$

- (c) A student suggests that the increase in thermal energy ΔE_R of the water at room temperature should be equal to the decrease in thermal energy ΔE_H of the very hot water.

Suggest **one** reason why your answers to (b)(ii) and (b)(iii) are **not** equal.

.....
 [1]

[Total: 7]

- 4 Fig. 4.1 shows a door, hinged at one side. The door can be pulled open by applying a force to the metal ring at any point along the bar **AB**.

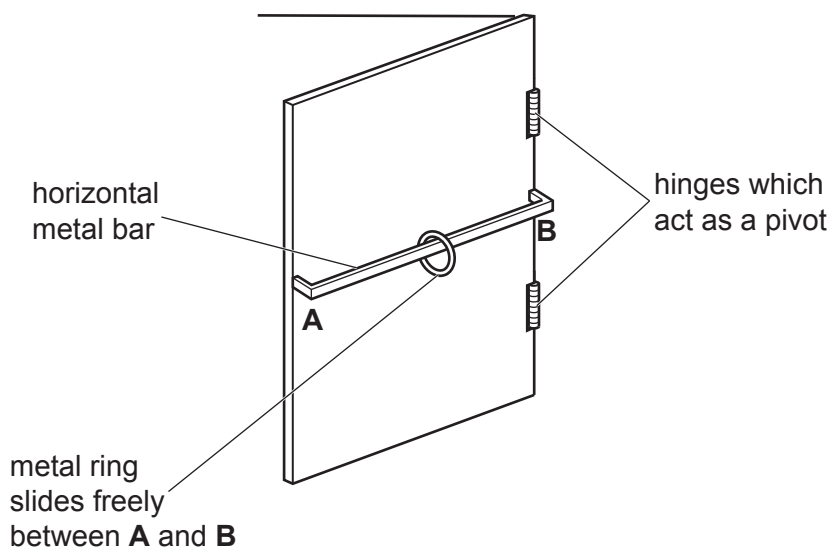


Fig. 4.1

Plan an investigation to find out how the size of the force needed to just open the door varies with the distance of the force away from **B**.

You are given the apparatus in Fig. 4.1 and you may use any common laboratory apparatus.

You are not required to do this investigation.

In your plan include:

- the apparatus needed
- a brief description of the method and an explanation of any safety precautions you will take
- what you will measure and the variables you will control
- a results table to record the measurements
- how you will process your results to draw a conclusion.

You are not required to include any results in your results table.

You may include a labelled diagram if you wish.

NOTES FOR USE IN QUALITATIVE ANALYSIS

Tests for anions

anion	test	test result
carbonate (CO_3^{2-})	add dilute acid	effervescence, carbon dioxide produced
chloride (Cl^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify, then add aqueous barium nitrate	white ppt.

Tests for aqueous cations

cation	effect of aqueous sodium hydroxide	effect of aqueous ammonia
ammonium (NH_4^+)	ammonia produced on warming	—
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt. or very slight white ppt.
copper(II) (Cu^{2+})	light blue ppt., insoluble in excess	light blue ppt., soluble in excess, giving a dark blue solution
iron(II) (Fe^{2+})	green ppt., insoluble in excess	green ppt., insoluble in excess
iron(III) (Fe^{3+})	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc (Zn^{2+})	white ppt., soluble in excess, giving a colourless solution	white ppt., soluble in excess, giving a colourless solution

Tests for gases

gas	test and test result
ammonia (NH_3)	turns damp red litmus paper blue
carbon dioxide (CO_2)	turns limewater milky
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	'pops' with a lighted splint
oxygen (O_2)	relights a glowing splint

Flame tests for metal ions

metal ion	flame colour
lithium (Li^+)	red
sodium (Na^+)	yellow
potassium (K^+)	lilac
copper(II) (Cu^{2+})	blue-green

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