Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME	

CENTRE NUMBER							CANDIDATE NUMBER					

3604641298

CO-ORDINATED SCIENCES **0654/53**

Paper 5 Practical Test **May/June 2024**

2 hours

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 60.
- 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	
5	
6	
Total	

This document has **20** pages. Any blank pages are indicated.

DC (SL/SG) 330087/4

1 You are going to investigate the effect of temperature on the movement of molecules through a cell membrane.

Dialysis (Visking) tubing behaves like a cell membrane.

You are provided with two pieces of dialysis tubing and two beakers of starch solution, in water-baths, labelled warm and cold. The beakers need to remain in the water-baths for the duration of the procedure.

(a) Procedure

- Take **one** piece of dialysis tubing. It is closed at one end with a knot.
- Rub gently at the end without the knot to open the tubing.
- Use a syringe to add 4 cm^3 of iodine solution carefully into the dialysis tubing.
- Tie the open end with a knot to enclose the iodine solution and make a bag.
- Very **thoroughly** rinse the outside of the bag with water, especially around the knots.
- Place the bag on a paper towel.

Repeat the procedure with the second piece of dialysis tubing.

(i) The colour of the solution in each bag will be the same. Record in Table 1.1 this colour for each **bag** at time t = 0.

The colour of the solution in each beaker will be the same. Record in Table 1.1 this colour for each **beaker** at time t = 0.

Table 1.1

time t / minutes	colour observed			
	warm		cold	
	solution in bag	solution in beaker	solution in bag	solution in beaker
0				
1				
2				
3				
4				
5				

[1]

(ii) • Place the bags of iodine solution into the apparatus as shown in Fig. 1.1.

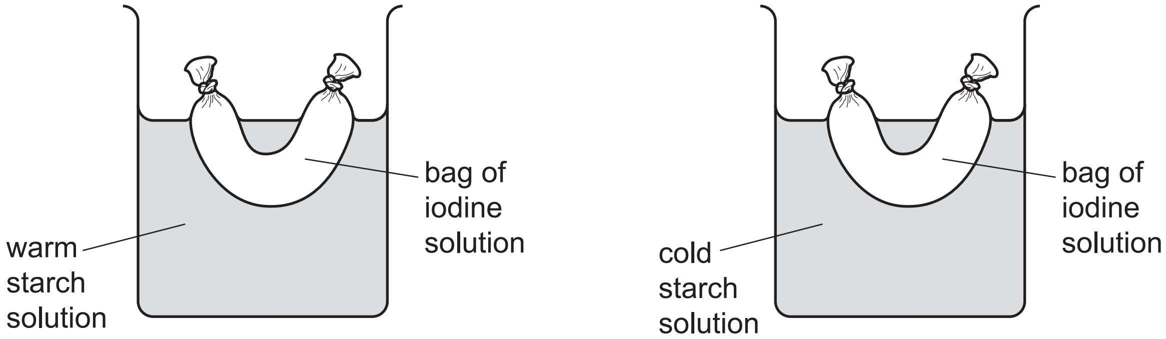

Fig. 1.1

- Start the stop-clock.
- Every minute for 5 minutes, carefully lift each bag above each solution and record in Table 1.1 the colour of the solution in each bag and the colour of the solution in each beaker.
- Immediately return the bags to the solutions in the beakers.

[4]

(b) **(i)** Iodine solution is a test for starch.

Dialysis tubing allows small molecules to pass through it but not large molecules.

Explain your observations at 5 minutes for the solution in the **warm** beaker and the solution in the bag in the **warm** beaker.

Use your results in Table 1.1.

Include ideas about the size of molecules in your answer.

....

....

....

....

....

.... [3]

(ii) Suggest the effect of increasing temperature on the rate of movement of molecules.

Use your observations for the warm and cold solutions in the beakers during the 5 minutes.

....

.... [1]

(iii) A student replaces the dialysis tubing with tubing that allows large and small molecules to pass through it.

Predict the final colours observed in each bag and each beaker.

....

.... [1]

(c) Suggest why a syringe is used to measure the $4\,cm^3$ of iodine solution instead of using a measuring cylinder.

....

.... [1]

(d) Suggest why it is important that the dialysis tubing bag is rinsed in the procedure.

....

.... [1]

(e) Suggest **one** improvement to the procedure to increase confidence in the results.

Explain your answer.

improvement ....

explanation ....

.... [1]

[Total: 13]

2 Plant seedlings need light to grow.

Plan an investigation to determine if the **colour** of the light affects the rate of growth of plant seedlings.

You are provided with plant seedlings.

You may use any common laboratory apparatus.

You are not required to do this investigation.

Include in your plan:

- the apparatus needed
- a brief description of the method
- what you will measure
- the variables you will control
- how you will process your results to draw a conclusion.

You may include a labelled diagram if you wish.

You may include a results table if you wish. You are **not** required to include any results.

....

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.... [7]

3 You are going to investigate the thermal energy released during a neutralisation reaction.

When aqueous sodium hydroxide neutralises dilute hydrochloric acid, the temperature of the mixture increases.

(a) Procedure

(i) step **1** Place a polystyrene cup into a beaker.
step **2** Using a 25 cm^3 measuring cylinder, add 25 cm^3 of dilute hydrochloric acid to the polystyrene cup.
step **3** Record the initial temperature of the dilute hydrochloric acid to the nearest 0.5 °C.

initial temperature = ... °C [1]

(ii) step **4** Using a 10 cm^3 measuring cylinder, add 5 cm^3 of aqueous sodium hydroxide to the polystyrene cup.
step **5** Stir the mixture for approximately 10 seconds.
step **6** Record in Table 3.1 the temperature of the mixture in the polystyrene cup.

Repeat steps **4**, **5** and **6** until a total volume of 35 cm^3 of aqueous sodium hydroxide is added.

Table 3.1

total volume of sodium hydroxide added / cm^3	temperature of mixture / °C	temperature increase ΔT / °C
5		
10		
15		
20		
25		
30		
35		

[4]

(b) **(i)** Suggest a piece of apparatus suitable for measuring the 25 cm^3 of dilute hydrochloric acid more accurately.

.... [1]

(ii) Suggest why the polystyrene cup is placed in a beaker.

....

.... [1]

(iii) Suggest a change to the **apparatus** which gives more confidence in the temperature measured.

....

.... [1]

(c) **(i)** Calculate each temperature increase ΔT in Table 3.1.

Use **(a)(i)**, Table 3.1 and the equation shown.

ΔT = temperature of mixture – initial temperature of dilute hydrochloric acid

Record your values in Table 3.1. [1]

(ii) Calculate the thermal energy released when $20\,cm^3$ of aqueous sodium hydroxide is added.

Use Table 3.1 and the equation shown.

thermal energy released = $189 \times \Delta T$

Record your answer to **three** significant figures.

thermal energy released = ... J [2]

(d) Estimate the volume of aqueous sodium hydroxide which exactly neutralises the dilute hydrochloric acid.

Explain your answer using the results in Table 3.1.

volume ....

explanation ....

....
[1]

[Total: 12]

4 You are going to investigate the ions present in solution **H**.

(a) Procedure

- Add approximately 1 cm depth of solution **H** into each of five test-tubes.
- Soak a wooden splint in one of these test-tubes and leave it for the last test in Table 4.1.
- Do the tests in Table 4.1.

Table 4.1

test	observation
add a few drops of aqueous sodium hydroxide add excess aqueous sodium hydroxide	
add a few drops of aqueous ammonia add excess aqueous ammonia	
add approximately 1 cm depth of dilute nitric acid followed by a few drops of aqueous silver nitrate	
add approximately 1 cm depth of dilute nitric acid followed by approximately 1 cm depth of aqueous barium nitrate	
place the wooden splint into the top of a blue Bunsen burner flame note the initial colour if you do not see a colour, repeat the test	

[6]

(b) Identify the ions present in solution **H**.

.... and .... [2]

[Total: 8]

5 You are going to investigate the stretching of a spring.

The apparatus is assembled as shown in Fig. 5.1.

Do **not** remove the spring from the clamp. Do **not** adjust the height of either clamp.

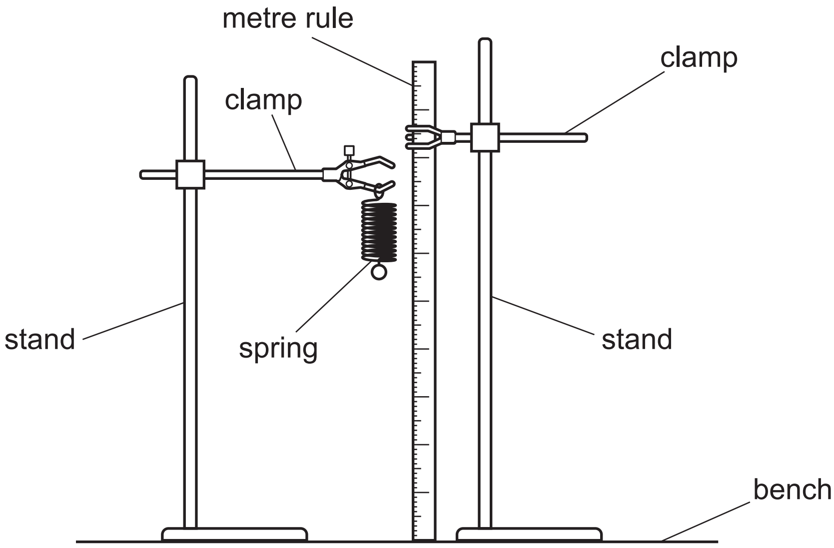


Fig. 5.1

(a) **(i)** Take readings from the rule to the nearest 0.1 cm at the top and the bottom of the unstretched spring.

Do **not** include the loops at the top and the bottom of the spring in your measurements.

reading on rule at top of spring = ... cm

reading on rule at bottom of spring = ... cm [1]

(ii) Use your readings from **(a)(i)** to determine the length l_0 of the unstretched spring to the nearest 0.1 cm.

l_0 = ... cm [1]

(iii) Describe how you avoid a line-of-sight (parallax) error when measuring the length of the spring.

....

.... [1]

(b) **(i)** Suspend a load L of 1.0 N on the spring.

Determine the length l of the spring to the nearest 0.1 cm.

l = ... cm [1]

(ii) Calculate the extension e of the spring.

Use the equation shown.

$$e = l - l_0$$

Record your answer in Table 5.1.

Table 5.1

load L / N	extension e / cm
0.0	0.0
1.0	
2.0	
3.0	
4.0	
5.0	

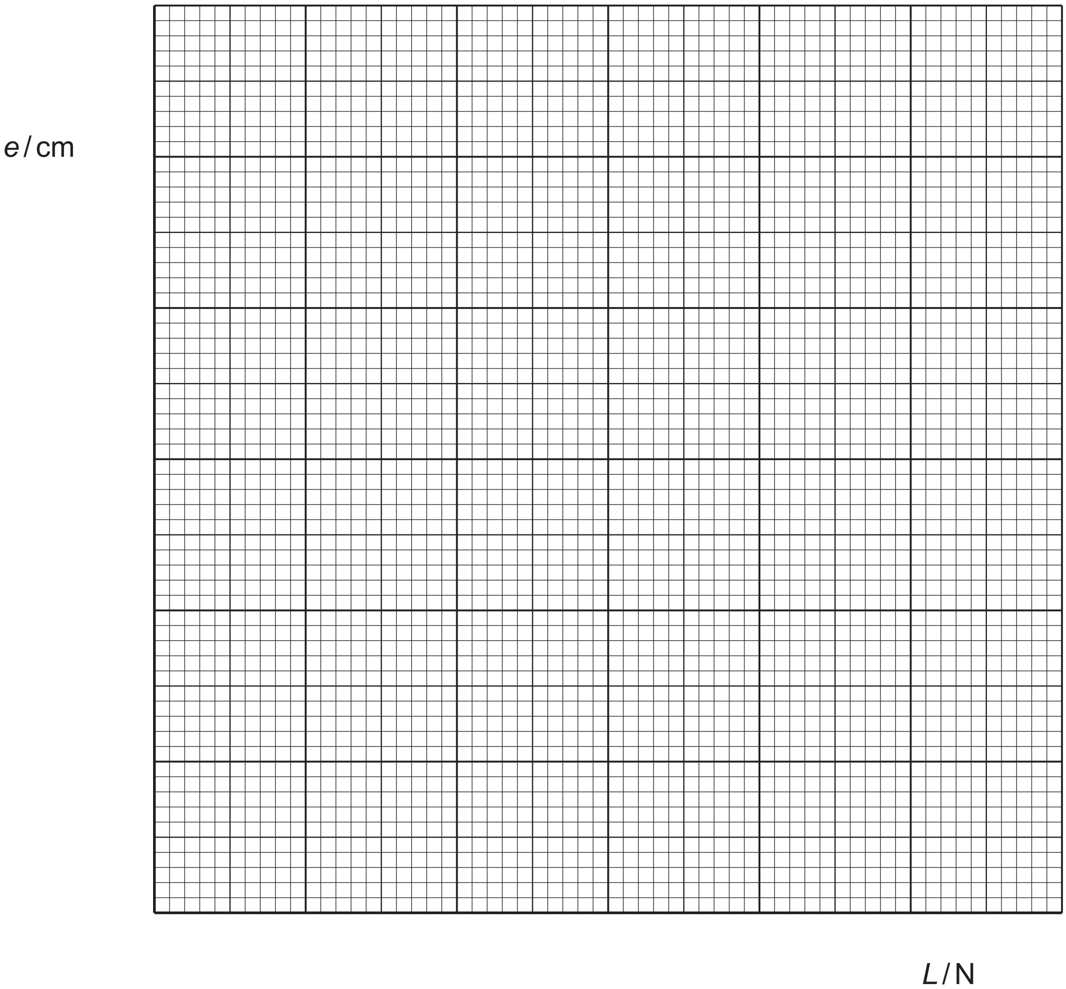
[1]

(c) Repeat **(b)** for loads of 2.0 N, 3.0 N, 4.0 N and 5.0 N.

Record in Table 5.1 all your values of extension e. [2]

(d) **(i)** On the grid, plot a graph of *e* (vertical axis) against *L*.

Start both axes from the origin (0,0).



[2]

(ii) Draw the best-fit straight line. [1]

(e) Calculate the gradient *G* of your line.

Show all working and indicate on your graph the values you choose to enable the gradient to be calculated.

G = ... [2]

[Total: 12]

6 You are going to investigate the resistance of lamps.

The circuit is assembled as shown in Fig. 6.1.

This is circuit **1**.

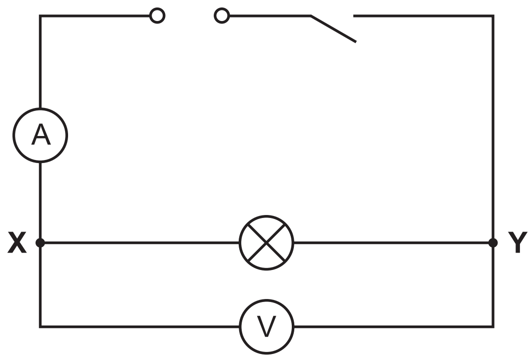


Fig. 6.1

(a) Procedure

- Close the switch.
- Record in Table 6.1 the potential difference *V* and the current *I* for circuit **1**.
- Open the switch.
- Disconnect the voltmeter.

Table 6.1

circuit	potential difference *V* /V	current *I* /A
1		
2		

[2]

(b) **Procedure**

- Connect another identical lamp in series with the first lamp, as shown in Fig. 6.2.

  This is circuit **2**.

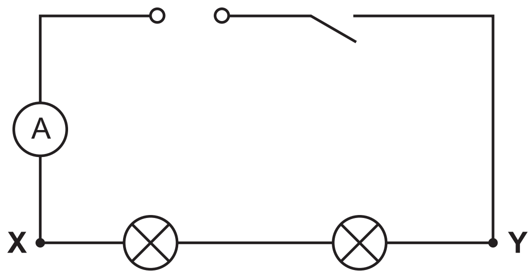


Fig. 6.2

- Connect the voltmeter into circuit **2** to measure the potential difference between **X** and **Y**.
- Close the switch.
- Record in Table 6.1 the potential difference *V* and the current *I* for circuit **2**.
- Open the switch. [1]

(c) The lamps in both circuits transfer power.

State **one** observation to determine which lamp transfers the most power.

....

.... [1]

(d) Calculate the total resistance R_1 measured between points **X** and **Y** for circuit **1**.

Use the equation shown.

$$R = \frac{V}{I}$$

R_1 = ... Ω

Calculate the total resistance R_2 measured between points **X** and **Y** for circuit **2**.

R_2 = ... Ω
[1]

(e) Calculate the ratio $\frac{R_2}{R_1}$.

$\frac{R_2}{R_1}$ = ... [1]

(f) A teacher makes the following statement.

'If each lamp has the same resistance, the ratio $\frac{R_2}{R_1}$ equals 2.0.'

Two values are considered to be equal within the limits of experimental accuracy if they are within 10% of each other.

State if your answer to **(e)** agrees with the teacher's statement, within the limits of experimental accuracy.

Justify your statement with a calculation.

statement ....

justification ....

....

[2]

[Total: 8]

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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.
bromide (Br^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	cream 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