Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4105113597

CO-ORDINATED SCIENCES **0654/63**

Paper 6 Alternative to Practical **May/June 2024**

1 hour 30 minutes

You must answer on the question paper.

No additional materials are needed.

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 [ ].

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

DC (DE/SW) 330090/4

1 A student investigates the effect of temperature on the movement of molecules through a cell membrane.

(a) Dialysis (Visking) tubing behaves like a cell membrane.

Procedure

The student:

- adds 4 cm^3 of iodine solution to each of two pieces of dialysis tubing which are tied at one end
- ties the open end of each piece of tubing with a knot to enclose the iodine solution and make a bag
- thoroughly rinses the outside of each bag with water
- assembles the apparatus as shown in Fig. 1.1

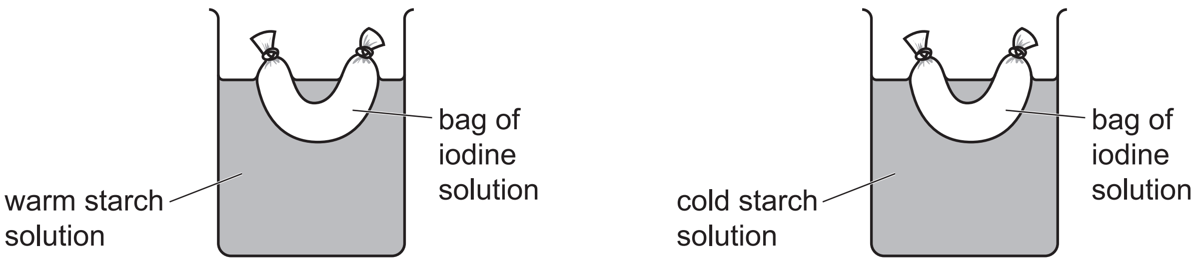

Fig. 1.1

- lifts the bags out of the beakers every minute for 5 minutes and records in Table 1.1 the colour of the solution in each bag and the colour of the solution in each beaker.

Table 1.1

time / minutes	colour observed			
	warm		cold	
	solution in bag	solution in beaker	solution in bag	solution in beaker
0	brown	colourless	brown	colourless
1	brown	colourless	brown	colourless
2	brown	blue-black	brown	colourless
3	brown	blue-black	brown	colourless
4	brown	blue-black	brown	colourless
5	brown	blue-black	brown	blue-black

(i) Iodine solution is a test for starch.

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

Explain the student's observations at 5 minutes for the solution in the **warm** beaker and the solution in the bag in the **warm** beaker.

Use the 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 the student's observations for the warm and cold solutions in the beakers during the 5 minutes.

....

.... [1]

(iii) Name a piece of apparatus suitable for measuring $4\,cm^3$ of iodine solution.

.... [1]

(iv) Suggest why it is important that the dialysis tubing bags are rinsed in the procedure.

....

.... [1]

(v) Suggest why the student lifts the bags out of the solutions to record the colours.

....

.... [1]

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

Explain your answer.

improvement ....

explanation ....

.... [1]

(b) **(i)** Starch is broken down into reducing sugar by the enzyme amylase.

Describe a test used to confirm the presence of reducing sugar.

Include the colour observed for a positive result.

test ....

....

observation ....
[3]

(ii) The enzyme amylase is a protein.

Describe a test to confirm the presence of protein.

Include the colour observed for a positive result.

test ....

....

observation ....
[2]

[Total: 13]

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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.

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 A student investigates the thermal energy released during a neutralisation reaction.

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

(a) Procedure

The student:

step **1** places a polystyrene cup into a beaker
step **2** uses a 25 cm^3 measuring cylinder to add 25 cm^3 of dilute hydrochloric acid to the polystyrene cup
step **3** places a thermometer into the polystyrene cup as shown in Fig. 3.1

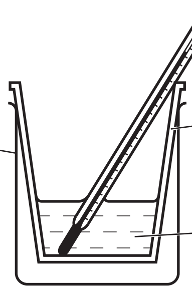

Fig. 3.1

step **4** records the initial temperature of the dilute hydrochloric acid

initial temperature = ...21.5...................... °C

step **5** adds 5 cm^3 of aqueous sodium hydroxide to the polystyrene cup
step **6** stirs the mixture and records the temperature in Table 3.1.

The student repeats steps **5** and **6** until a total volume of 40 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	24.5	3.0
10		
15	32.5	11.0
20	36.0	14.5
25	39.5	18.0
30	38.0	16.5
35		
40	34.0	12.5

Fig. 3.2 shows the thermometer readings for 10 cm^3 and 35 cm^3 of aqueous sodium hydroxide added.

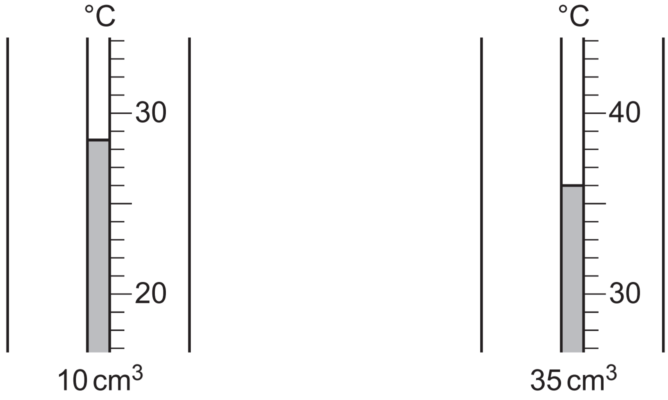

Fig. 3.2

Record in Table 3.1 these temperatures to the nearest 0.5 °C. [2]

(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]

(iv) Suggest why the mixture is stirred in step **6**.

....

.... [1]

(c) **(i)** Calculate the temperature increase ΔT for 10 cm^3 and 35 cm^3 of aqueous sodium hydroxide added.

Use step **4**, 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.

$$\text{thermal energy released} = 189 \times \Delta T$$

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]

(e) State the name of an indicator the student adds to the reaction mixture to find out if the mixture is an acid, an alkali or neutral.

State the colour of the indicator in acidic solution, in alkaline solution and in neutral solution.

indicator ....

colour in acidic solution ....

colour in alkaline solution ....

colour in neutral solution ....
[2]

[Total: 12]

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4 A student investigates the identity of a solution **H**.

The student does five different tests on solution **H**.

The student identifies solution **H** as aqueous copper(II) chloride.

(a) Complete Table 4.1 with the observations the student makes during the tests.

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 dilute nitric acid followed by a few drops of aqueous silver nitrate	
add dilute nitric acid followed by aqueous barium nitrate	
flame test	

[6]

(b) Solution **Y** contains sodium chloride.

State how the results for one of the tests for sodium chloride differs from those for copper(II) chloride in Table 4.1.

....

.... [1]

(c) Explain why a flame test uses a blue Bunsen burner flame rather than a yellow one.

....

.... [1]

[Total: 8]

5 A student investigates the stretching of a spring.

The student assembles the apparatus as shown in Fig. 5.1.

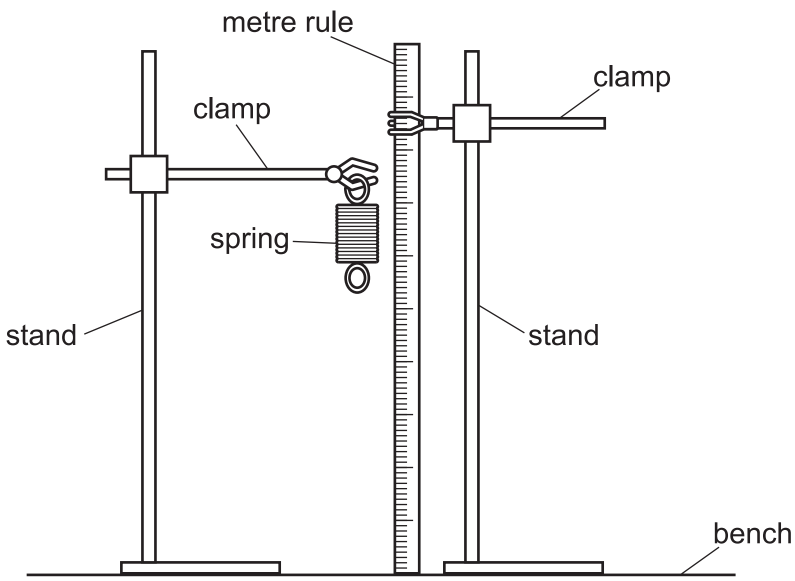

Fig. 5.1

(a) Fig. 5.2 shows a diagram of the unstretched spring and part of the rule.

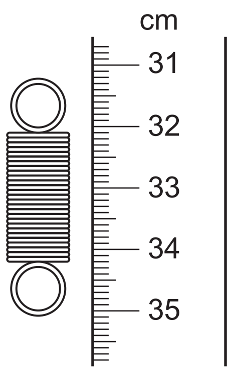

Fig. 5.2

(i) Take readings from the rule to the nearest 0.1 cm for the top and the bottom of the spring in Fig. 5.2.

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 the student avoids a line-of-sight (parallax) error when measuring the length of the spring.

....

.... [1]

(b) The student suspends a load L of 1.0 N on the spring.

(i) The stretched spring is shown full size in Fig. 5.3.

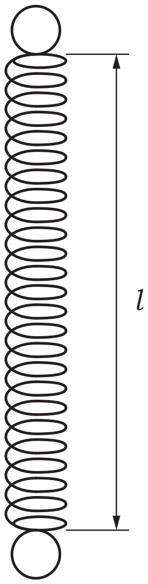

Fig. 5.3

Measure 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	8.2
3.0	12.0
4.0	16.4
5.0	20.5

[1]

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

The student's values are shown in Table 5.1.

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

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

[3]

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

(d) (i) 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]

(ii) The gradient of the graph measures the elastic stiffness of the spring.

The greater the elastic stiffness, the harder it is to stretch the spring.

On your graph, draw a line to show how the extension of another spring with a greater elastic stiffness changes as loads are added to it.

Label this line **E**. [1]

[Total: 12]

6 A student investigates the resistance of lamps.

The student assembles the circuit shown in Fig. 6.1.

This is circuit **1**.

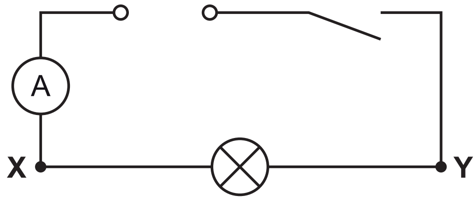

Fig. 6.1

(a) Procedure

The student:

- connects a voltmeter to measure the potential difference between **X** and **Y**
- closes the switch
- records in Table 6.1 the potential difference V and the current I for circuit **1**
- opens the switch
- disconnects the voltmeter.

(i) On Fig. 6.1, draw the symbol for a voltmeter connected to measure the potential difference between **X** and **Y**. [1]

(ii) The readings on the voltmeter and ammeter are shown in Fig. 6.2.

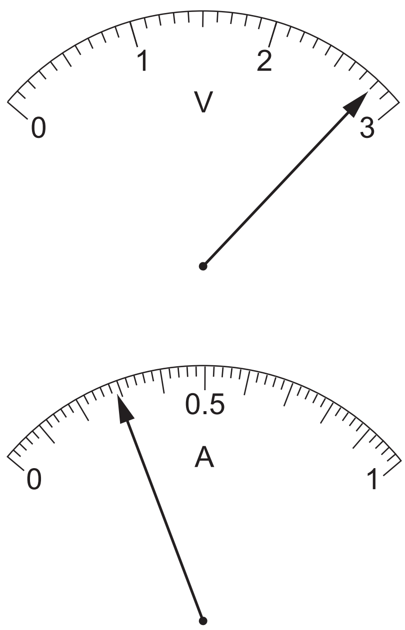

Fig. 6.2

Record in Table 6.1 the voltmeter and the ammeter readings.

Table 6.1

circuit	potential difference V /V	current I /A
1		
2	2.9	0.21

[2]

(b) Procedure

The student:

- connects another identical lamp in series with the first lamp, as shown in Fig. 6.3

This is circuit **2**.

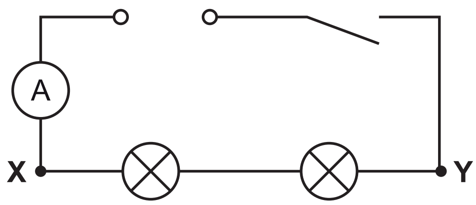

Fig. 6.3

- connects the voltmeter into circuit **2** to measure the potential difference between **X** and **Y**
- closes the switch
- records in Table 6.1 the potential difference V and the current I
- opens the switch.

The student's results are shown in Table 6.1.

Describe a difference in the observations of the lamp in circuit **1** compared to the lamps in circuit **2**.

....

.... [1]

(c) 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]

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

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

(e) 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 **(d)** 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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