Cambridge IGCSE™

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	

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CO-ORDINATED SCIENCES **0654/61**

Paper 6 Alternative to Practical **October/November 2023**

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 (PQ/CGW) 320856/4

1 A student tests milk and rice for their nutrient content.

In order to test the rice, 'rice water' needs to be made. To make rice water the student:

- adds water to rice in a beaker
- leaves the mixture for 5 minutes
- stirs the mixture
- carefully pours off some of the rice water into each of two clean test-tubes.

(a) Procedure

The student:

- adds biuret solution to one test-tube of rice water
- adds a few drops of iodine solution to the other test-tube of rice water.

Repeats the procedure with milk instead of rice water.

The student's results show that:

- the rice water tests negative with biuret solution and positive with iodine solution
- the milk tests positive with biuret solution and negative with iodine solution.

(i) Draw a results table for the experiment.

[2]

(ii) Record in your results table in **(a)(i)** the final colours observed by the student in each test-tube. [3]

(iii) State the nutrients that these samples of rice water and milk contain.

rice water contains ....

milk contains ....

[2]

(b) (i) Suggest why it is important to soak the rice in water to make rice water before testing for the nutrients.

....

.... [1]

(ii) Suggest why iodine solution is used to determine the presence of the nutrient but **not** the concentration of the nutrient in the investigation.

....

.... [1]

(iii) Suggest why it is **not** possible to confirm the presence of fat in milk using the ethanol and water test.

....

.... [1]

[Total: 10]

2 Fig. 2.1 shows a photomicrograph of a single-celled organism called *Euglena*.

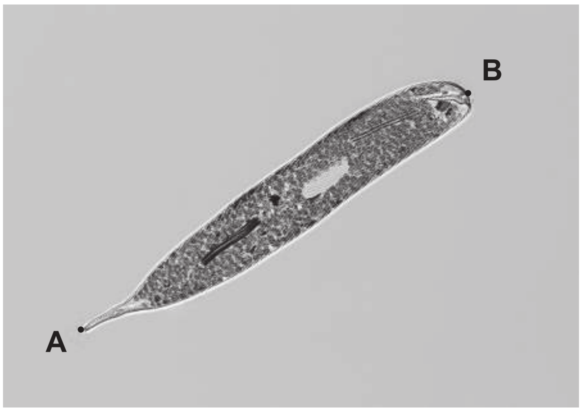


Fig. 2.1

(a) In the box below, make a large, detailed pencil drawing of the *Euglena* cell in Fig. 2.1.

[3]

(b) **(i)** Measure the length **AB** of the *Euglena* cell in Fig. 2.1 in millimetres to the nearest millimetre.

length of *Euglena* cell in Fig. 2.1 = ... mm [1]

(ii) Draw a line to show this length on your drawing in **(a)**.

Measure the length of this line in millimetres to the nearest millimetre.

length of *Euglena* cell on your drawing = ... mm [1]

(iii) Use your measurements in **(b)(i)** and **(b)(ii)** to calculate the magnification *m* of your drawing.

Use the equation shown.

$$m = \frac{\text{length of } \textit{Euglena} \text{ cell on your drawing}}{\text{length of } \textit{Euglena} \text{ cell in Fig. 2.1}}$$

Record your value to **two** significant figures.

magnification = ... [2]

(c) Fig. 2.2 shows a photomicrograph of a single-celled organism called *Chlamydomonas*.

Fig. 2.1 and Fig. 2.2 are shown at the same magnification.

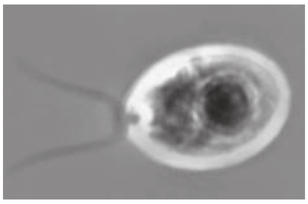


Fig. 2.2

Describe **two** visible differences and **one** visible similarity between the *Euglena* cell and the *Chlamydomonas* cell.

difference 1

....

....

....

difference 2

....

....

....

similarity

....

....

....

[3]

[Total: 10]

3 A student investigates the neutralisation of dilute hydrochloric acid with aqueous sodium hydroxide.

The reaction between dilute hydrochloric acid and aqueous sodium hydroxide is exothermic. Thermal (heat) energy is given out and the temperature of the mixture increases.

When the reaction is finished, no more thermal energy is given out.

When just enough alkali is added to neutralise the acid, a neutral substance is formed.

(a) (i) Procedure

The student:

- uses a measuring cylinder to put 25 cm^3 of dilute hydrochloric acid into a plastic beaker
- measures the initial temperature of the dilute hydrochloric acid and immediately starts a stop-watch
- records in Table 3.1 the temperature *T* to the nearest 0.5 °C
- records the temperature of the dilute hydrochloric acid every 0.5 minutes for 1.5 minutes
- at time *t* = 2.0 minutes adds 25 cm^3 of aqueous sodium hydroxide to the plastic beaker but does **not** measure the temperature
- stirs the mixture and records in Table 3.1 the temperature of the mixture every 0.5 minutes for a further 5.0 minutes.

Table 3.1

time *t* / min	temperature *T* / °C
0.0	20.0
0.5	20.5
1.0	20.5
1.5	21.0
2.0	
2.5	37.0
3.0	36.0
3.5	35.0
4.0	
4.5	32.0
5.0	31.5
5.5	31.0
6.0	29.5
6.5	
7.0	27.5

Fig. 3.1 shows the thermometer readings for 4.0 minutes and 6.5 minutes.

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

time t = 4.0 minutes

time t = 6.5 minutes

Fig. 3.1

[2]

(ii) Suggest a piece of apparatus suitable for measuring the volume of dilute hydrochloric acid more accurately than the measuring cylinder.

.... [1]

(b) **(i)** On the grid, plot temperature on the vertical axis against time.

Do **not** start the temperature axis at 0 °C.

The highest temperature on the vertical axis needs to be at least 6 °C above the highest temperature recorded in Table 3.1.

[3]

(ii) Draw the best-fit straight line through the temperatures for times $t = 0$ to $t = 1.5$ minutes. Extend the line as far as $t = 2.0$ minutes.

Draw the best-fit straight line through the temperatures for times $t = 2.5$ minutes to $t = 7.0$ minutes. Extend the line back to $t = 2.0$ minutes.

[2]

(iii) Draw a vertical line at 2.0 minutes.

Record the **two** temperatures where this vertical line crosses the two lines of best fit you have drawn.

highest temperature T_H = ... °C

lowest temperature T_L = ... °C

(If you have not drawn a graph, use the highest and lowest temperatures from Table 3.1. These values are **not** the correct values.) [2]

(iv) Measure the change in temperature ΔT for the reaction.

Use the equation shown.

$$\Delta T = T_H - T_L$$

ΔT = ... °C [1]

(c) Calculate the thermal energy Q given out during the reaction.

Use the equation shown.

$$Q = 210 \times \Delta T$$

Q = ... J [1]

(d) Thermal energy is lost to the air during the experiment.

Suggest **one** change to the apparatus that reduces the amount of thermal energy lost.

....

.... [1]

(e) The experiment is left on the bench for two hours.

Suggest the temperature of the mixture after two hours. Explain your answer.

....

.... [1]

[Total: 14]

4 A student investigates the formation of silver chloride in the test for chloride ions.

When aqueous silver nitrate is added to aqueous sodium chloride, a white precipitate forms.

If the white precipitate of silver chloride is left in light for a few minutes, it decomposes and silver solid and chlorine gas are formed.

silver chloride $\rightarrow$ silver + chlorine

(a) Procedure

The student:

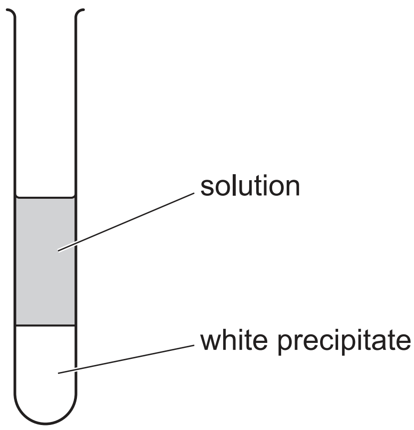
- puts 4 cm^3 of aqueous sodium chloride into a test-tube
- adds 2 cm^3 of aqueous silver nitrate to the test-tube
- leaves the test-tube for 5 minutes to let the precipitate settle at the bottom of the test-tube
- records the height of the precipitate in Table 4.1.

The student repeats the procedure, decreasing the concentration of aqueous sodium chloride by adding water to it, as shown in Table 4.1.

Table 4.1

	height of precipitate / mm
4 cm^3 of aqueous sodium chloride	24
2 cm^3 of aqueous sodium chloride mixed with 2 cm^3 of water	
1 cm^3 of aqueous sodium chloride mixed with 3 cm^3 of water	6

Fig. 4.1 shows the height of the precipitate formed with the 2 cm^3 of aqueous sodium chloride mixed with 2 cm^3 of water.



actual size

2 cm^3 of aqueous sodium chloride
and 2 cm^3 of water

Fig. 4.1

(i) Record in Table 4.1 the height of this precipitate in millimetres to the nearest millimetre. [1]

(ii) State the relationship between the concentration of aqueous sodium chloride and the height of precipitate formed.

....

.... [1]

(iii) Suggest why keeping the total volume in the test-tube the same each time makes the test fair.

....

.... [1]

(b) The contents of the test-tubes can be separated by filtration.

Draw a labelled diagram of the assembled apparatus used for this filtration.

Label the residue and the filtrate.

[2]

(c) The white precipitate is left in the light for 10 minutes.

Describe the appearance of the precipitate after 10 minutes.

Explain your answer.

appearance ....

explanation ....
[1]

[Total: 6]

5 A student investigates the resistance of different lamp combinations.

The student sets up the circuit shown in Fig. 5.1. This is circuit **1**.

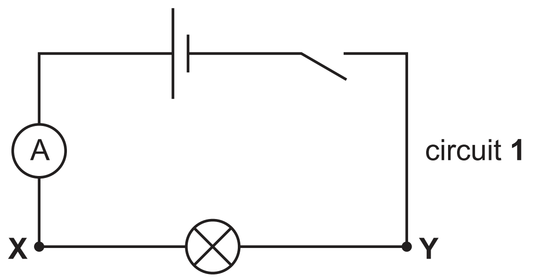


Fig. 5.1

(a) On Fig. 5.1, draw the symbol for a voltmeter connected to measure the potential difference between point **X** and point **Y**. [1]

(b) Procedure

The student:

- connects the voltmeter into circuit **1** to measure the potential difference between **X** and **Y**
- closes the switch
- measures the potential difference V, the current I and also if the lamp is bright or dim and records the results in Table 5.1
- opens the switch.

Table 5.1

circuit	V/V	I/A	R/................	brightness of lamp(s)
1				bright
2	2.9	0.21	14	dim
3	2.7	0.55	4.9	bright

Fig. 5.2 shows the readings on the voltmeter and the ammeter in circuit **1**.

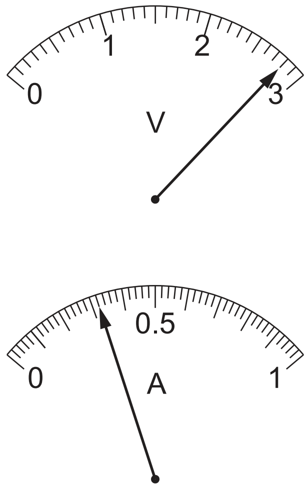


Fig. 5.2

Record the readings in Table 5.1. [2]

(c) **(i)** Calculate the total resistance R measured between points **X** and **Y** for circuit **1**.

Record your answer in Table 5.1.

Use the equation shown.

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

[1]

(ii) Complete the headings in Table 5.1 by adding the unit of resistance. [1]

(d) **Procedure**

The student:

- connects a second lamp between **X** and **Y** as shown in Fig. 5.3. This is circuit **2**.
- closes the switch

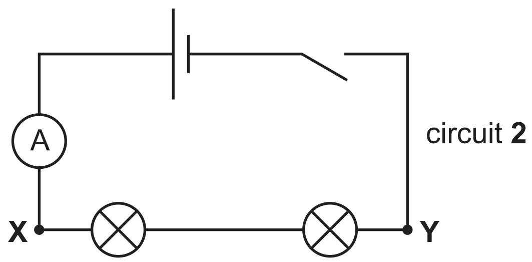


Fig. 5.3

- records in Table 5.1, the potential difference V, the current I and also if the lamps are bright or dim
- opens the switch
- reconnects the two lamps as shown in Fig. 5.4. This is circuit **3**.

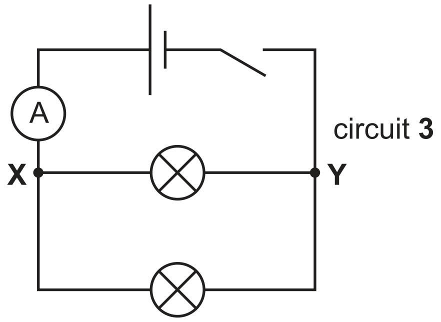


Fig. 5.4

- closes the switch and repeats the measurements of the potential difference V and the current I
- opens the switch
- calculates the total resistance between **X** and **Y** for both circuits and records the values in Table 5.1.

State why the student opens the switch after taking each reading from the ammeter and voltmeter.

....

.... [1]

(e) **(i)** State what the student observes if one of the lamps in circuit **2** breaks while taking the measurements of V and I.

.... [1]

(ii) Describe how the student uses this apparatus to find out which lamp has broken.

....

.... [1]

(f) State in which circuit the total power of the lamps is smallest.

Use the results in Table 5.1 to explain your answer.

circuit ....

explanation ....

....

[1]

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

The teacher makes the following statement.

'If each lamp has the same resistance, the total resistance between points **X** and **Y** in circuit **1** should be half the total resistance between **X** and **Y** in circuit **2**.'

State if your results support the teacher's statement, within the limits of experimental accuracy.

Justify your statement by using the values of *R* in Table 5.1.

statement ....

explanation ....

....

....
[2]

(h) The student extends the experiment and investigates the resistance of three lamps connected first in series, and then in parallel between points **X** and **Y**.

Draw the circuit diagram for each circuit.

Three lamps connected in series between **X** and **Y**:

Three lamps connected in parallel between **X** and **Y**:

[2]

[Total: 13]

6 Plan an experiment to investigate whether the material a wire is made from affects the mass required to break the wire.

One end of the wire is securely held by a clamp and masses can be attached to the other end as shown in Fig. 6.1. Masses are added until the wire breaks.

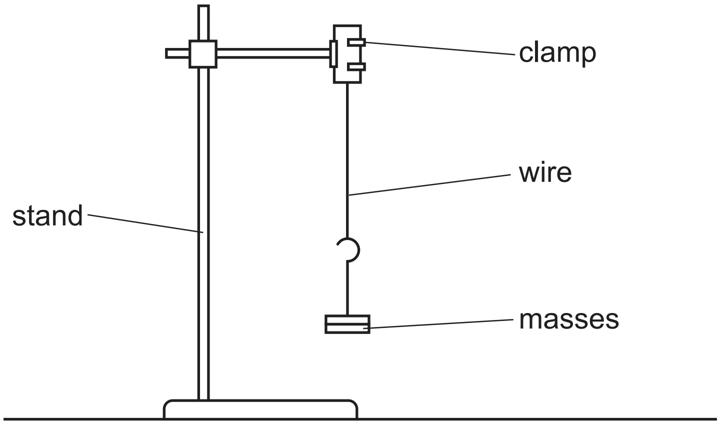


Fig. 6.1

You are provided with:

- wires of different lengths and diameters made from different metals
- a set of masses, together with a hanger
- a boss, stand and clamp.

You may use any other common laboratory apparatus.

In your plan include:

- a brief description of the method, including what you will measure and how you will make sure your measurements are accurate
- any safety precautions you will take
- the variables you will control
- a results table to record your measurements (you are not required to enter any readings in the table)
- how you will process your results to draw a conclusion.

[7]

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