

CANDIDATE  
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**CO-ORDINATED SCIENCES**

Paper 6 Alternative to Practical

**0654/63**

**May/June 2018**

**1 hour**

Candidates answer on the Question Paper.

No Additional Materials are required.

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

**DO NOT WRITE IN ANY BARCODES.**

Answer **all** questions.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **19** printed pages and **1** blank page.

- 1 A student investigates the effect of temperature on the rate of photosynthesis using the apparatus shown in Fig. 1.1.

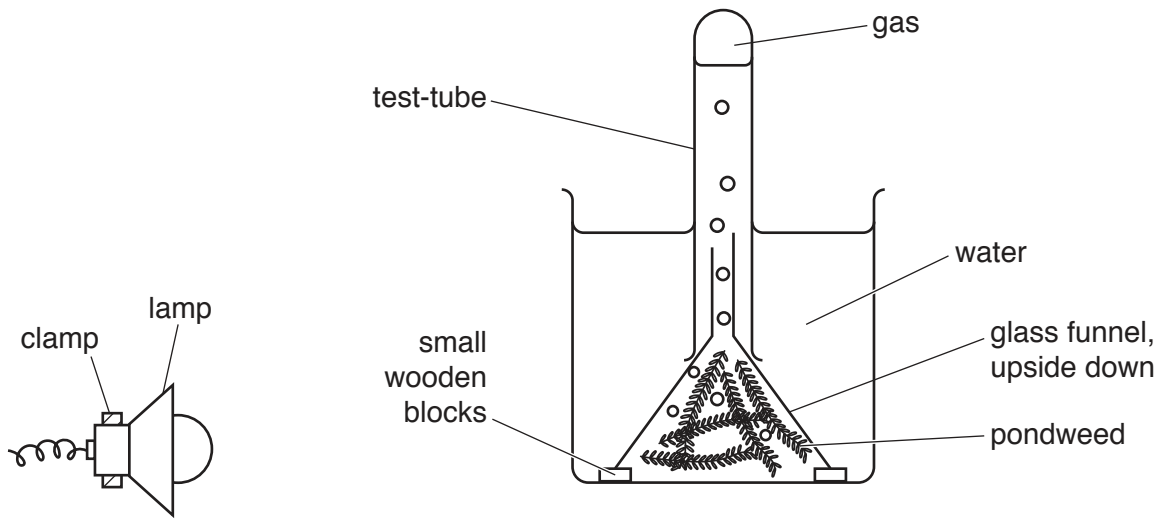


Fig. 1.1

- (a) The student measures the temperature,  $T_1$ , of the water in the beaker.

He counts the number of bubbles of gas produced by the pondweed for 5 minutes and records this number in Table 1.1.

He replaces the water with warm water at temperature  $T_2$ . He then repeats this experiment.

- (i) Use the thermometer diagrams in Fig. 1.2 to read and record, in Table 1.1, the temperatures  $T_1$  and  $T_2$  to the nearest  $0.5^\circ\text{C}$ .

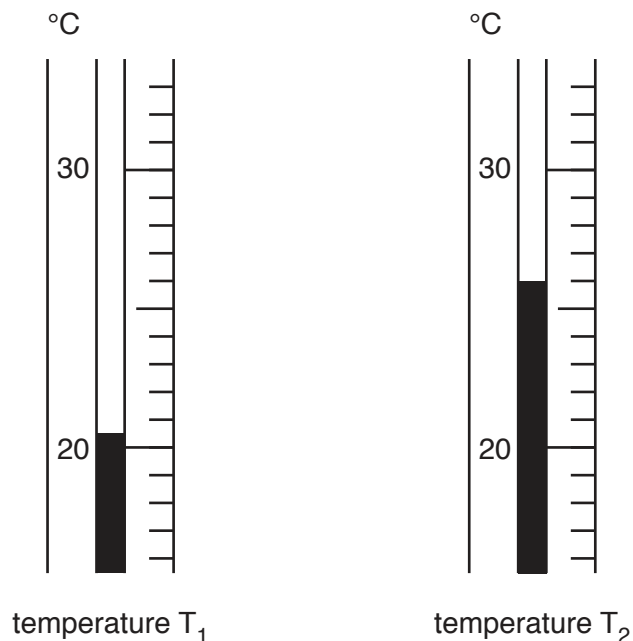


Fig. 1.2

Table 1.1

	temperature $T_1 =$ ..... /°C	temperature $T_2 =$ ..... /°C
number of bubbles in 5 minutes	16	24

[2]

- (ii) Use the results to state **and** explain the effect of temperature on the number of bubbles produced.

effect on number of bubbles .....

.....

explanation .....

.....

[2]

- (iii) State **one** variable, **not** including the lamp, that needs to be kept constant in both of these experiments. Explain why it is important this variable is kept constant.

variable .....

explanation .....

.....

[2]

- (b) The student repeats the experiment at temperature  $T_2$  but switches off the lamp.

Predict **and** explain the effect on the number of bubbles produced in 5 minutes.

.....

.....[1]

- (c) (i) The student tests the gas collected and obtains a positive result for oxygen.

State the test and observation that allows the student to confirm that the gas produced is oxygen.

test .....

observation .....

[1]

- (ii) Another student suggests that measuring the volume of the gas produced would be a more accurate way of carrying out this experiment.

Explain why this student is correct.

.....

.....[1]

- (iii) Complete the apparatus diagram in Fig. 1.3 to show how the volume of gas could be measured.

Include water levels in your diagram.

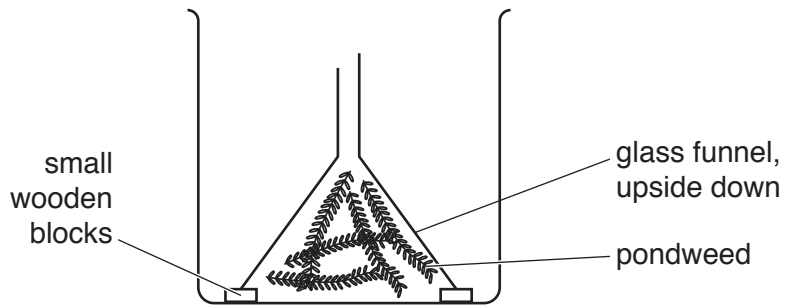
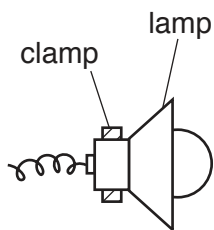


Fig. 1.3

[1]

2 A student investigates the rate of reaction between zinc and hydrochloric acid.

She sets up apparatus to measure the volume of gas produced during the reaction of zinc with hydrochloric acid.

- She places 0.30 g of zinc powder into a conical flask.
- She adds a known concentration of  $25\text{ cm}^3$  hydrochloric acid, which is in excess, to the conical flask.
- Quickly, she connects the conical flask to more apparatus to collect and measure the volume of gas produced.
- She records the volume of gas produced every 2 minutes until the reaction stops.

(a) (i) Draw a **labelled** diagram to show the apparatus when it is connected up.

Include a suitable means of collecting and measuring the volume of gas.

[3]

(ii) State how the student knows when the reaction has stopped.

.....  
.....[1]

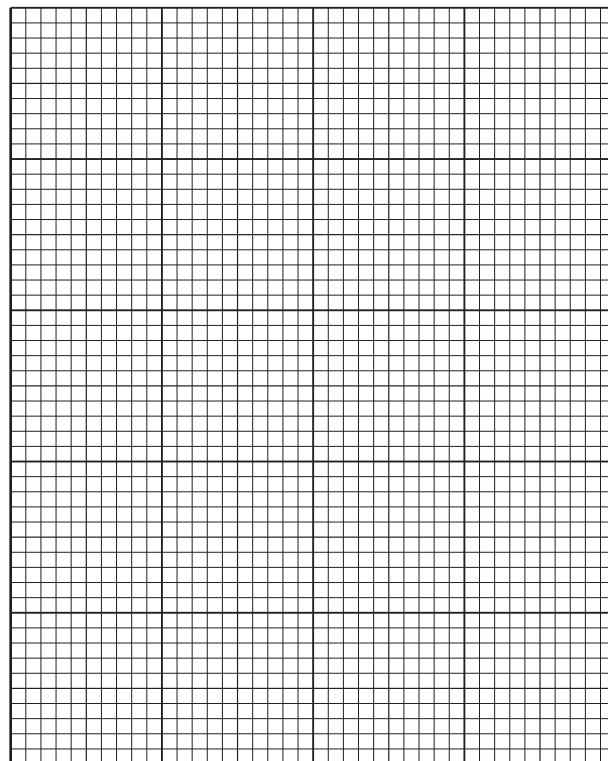
(b) Table 2.1 shows the student's results.

**Table 2.1**

time $t$ /min	total volume $V$ of gas/cm <sup>3</sup>
0	0
2	30
4	54
6	72
8	83
10	91
12	96
14	96

- (i) On the grid provided, plot a graph of volume  $V$  of gas (vertical axis) against time  $t$  using the data in Table 2.1.

$V/\text{cm}^3$



$t/\text{min}$

[2]

- (ii) Draw the best-fit curve **and** label it *experiment 1*. [1]
- (iii) Use your graph to predict the total volume of gas produced at time  $t = 5$  minutes.

Draw lines on your graph to show how you obtained this volume.

volume ..... cm<sup>3</sup> [1]

- (c) The student carries out a second experiment.

She repeats *experiment 1*, keeping everything the same except that she uses hydrochloric acid which is twice as concentrated.

Draw on the grid in **(b)(i)** a second line labelled *experiment 2* to show the expected results. [2]

- 3 A student investigates the power output of lamps connected in series and in parallel. She sets up the series circuit shown in Fig. 3.1.

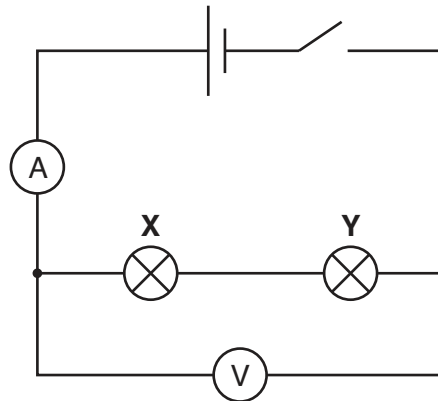


Fig. 3.1

## (a) Procedure

- The student closes the switch.
- She measures the current  $I$  flowing through the lamps.
- She measures the potential difference  $V$  across both lamps.
- She opens the switch.

Fig. 3.2 shows the scales of the ammeter and voltmeter.

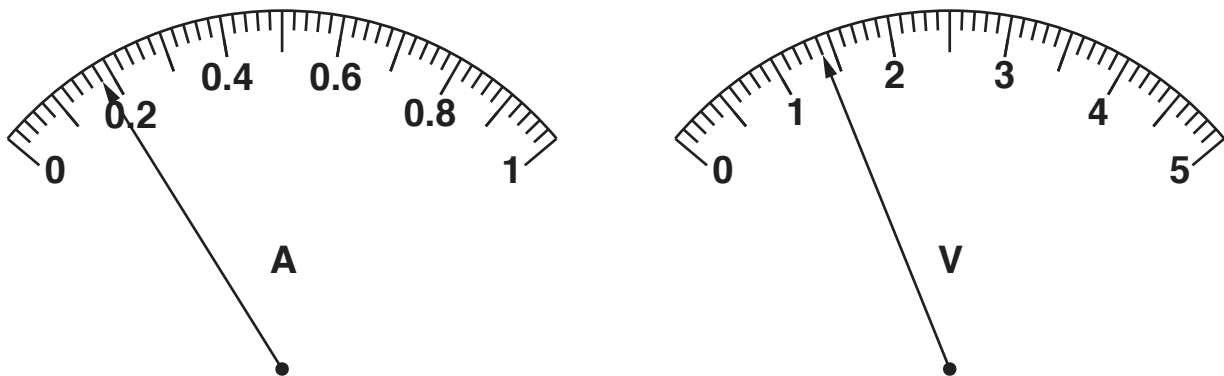


Fig. 3.2

- (i) Read the scales and record the current  $I$  and the potential difference  $V$ .

current  $I = \dots\dots\dots$  A

potential difference  $V = \dots\dots\dots$  V  
[2]

- (ii) Calculate the combined power output  $P_S$  of lamps X and Y when connected in series using the equation shown.

$$P_S = V \times I$$

$P_S = \dots\dots\dots$  W [1]



(iii) Explain why it is good experimental practice to open the switch between taking readings.

.....[1]

(b) The student rearranges the circuit and connects the lamps in parallel as shown in Fig. 3.3.

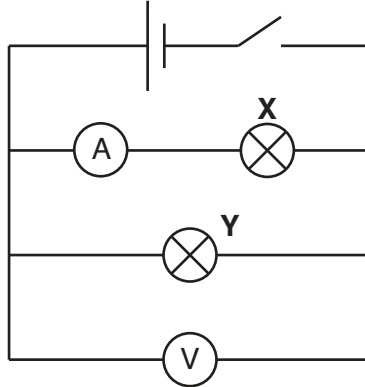


Fig. 3.3

#### Procedure

- The student closes the switch.
- She measures the current  $I$  flowing through lamp **X**.
- She measures the potential difference  $V$  across lamp **X**.
- She records her results in Table 3.1 and opens the switch.

She disconnects the ammeter and reconnects it so that it is now in series with lamp **Y** as shown in Fig. 3.4.

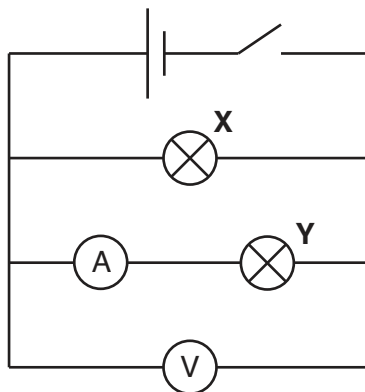


Fig. 3.4

#### Procedure

- The student closes the switch.
- She measures the current  $I$  flowing through lamp **Y**.
- She also measures the potential difference  $V$  across lamp **Y**.
- She records her results in Table 3.1 and opens the switch.

Table 3.1

	potential difference $V/V$	current $I/A$	power $P/W$
lamp <b>X</b>	1.4	0.23	
lamp <b>Y</b>	1.4	0.21	

- (i) Calculate the power output of each lamp using the equation shown.

$$P = V \times I$$

Record your results in Table 3.1 to an appropriate number of significant figures. [2]

- (ii) Calculate the total power output  $P_p$  of lamps **X** and **Y** when connected in parallel.

$$P_p = \dots\dots\dots W [1]$$

- (c) The power output  $P_s$  of the lamps connected in series is less than the power output  $P_p$  in parallel.

State what the student would have seen to confirm this fact.

.....  
 ..... [1]

- (d) The student uses the readings recorded in Table 3.1 to deduce which lamp, **X** or **Y**, has the greater resistance.

Explain how the student is able to do this.

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

4 A student investigates the effects of physical activity on breathing.

He sets up the apparatus shown in Fig. 4.1.

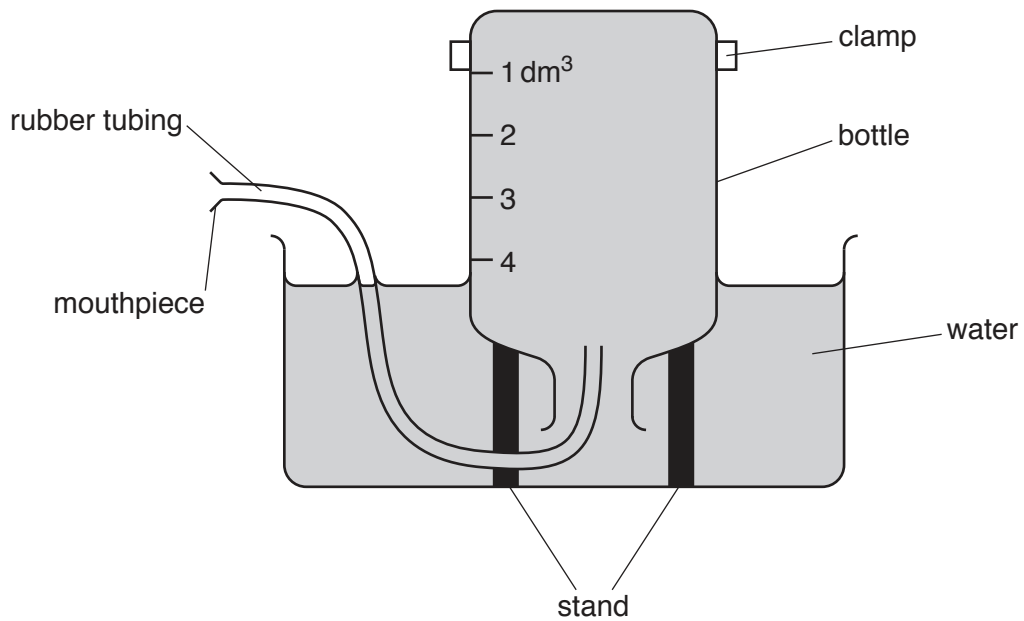


Fig. 4.1

(a) Describe how the student can use the apparatus in Fig. 4.1 to measure the maximum volume of air he can expire (breathe out) from his lungs.

.....

.....

.....

..... [2]

(b) Table 4.1 shows the composition of samples of inspired (breathed in) air and expired air.

**Table 4.1**

gas	sample A / percentage	sample B / percentage
nitrogen	78.00	78.00
oxygen	21.00	16.00
carbon dioxide	0.04	5.04
other gases	0.96	0.96

(i) State which sample, **A** or **B**, is expired air. Use the data in Table 4.1 and your knowledge to explain your answer.

sample .....

explanation .....

.....

.....

.....

[2]

(ii) Describe how you could confirm the presence of carbon dioxide in the air samples.

test .....

observation .....

[1]

- (c) Table 4.2 shows the number of breaths taken per minute and the volume of air in each breath before exercise.

Suggest values for the breathing rate and the volume of air in each breath immediately after exercise.

Record these values in Table 4.2.

**Table 4.2**

	before exercise	after exercise
breathing rate / breaths per minute	12.0	.....
volume of air in each breath / dm <sup>3</sup>	0.5	.....

[2]

- (d) Plan an investigation to show the effect of physical activity on pulse rate.

Include the following in your answer.

- How you would measure pulse rate.
- When you would measure pulse rate.
- How you would make sure you have confidence in your results.

.....

.....

.....

.....

.....

.....

.....

..... [3]



- 5 A group of students investigate the electrolysis of aqueous copper chloride using inert electrodes. The apparatus and circuit diagram are shown in Fig. 5.1.

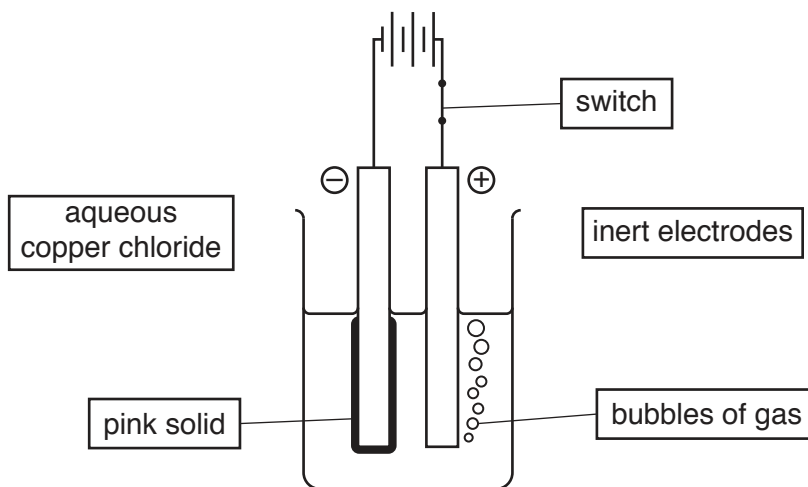


Fig. 5.1

- (a) Add label lines to connect the two boxes labelled *inert electrodes* and *aqueous copper chloride* to the appropriate parts in Fig. 5.1. [2]
- (b) When the switch is closed, the students observe gas bubbles at the anode and a pink solid forming on the cathode as shown in Fig. 5.1.

- (i) One of the students tests the gas forming at the anode and concludes that the gas is chlorine.

State the test and observation that allows the student to make this conclusion.

test .....

observation .....

[2]

- (ii) Another student is sure that the solid forming on the cathode is copper metal.

The teacher reacts a small amount of the pink solid to form a blue solution.

The student adds ammonia solution to this blue solution.

State the observations that the student makes which identifies the presence of  $\text{Cu}^{2+}$  ions.

.....

.....

..... [2]

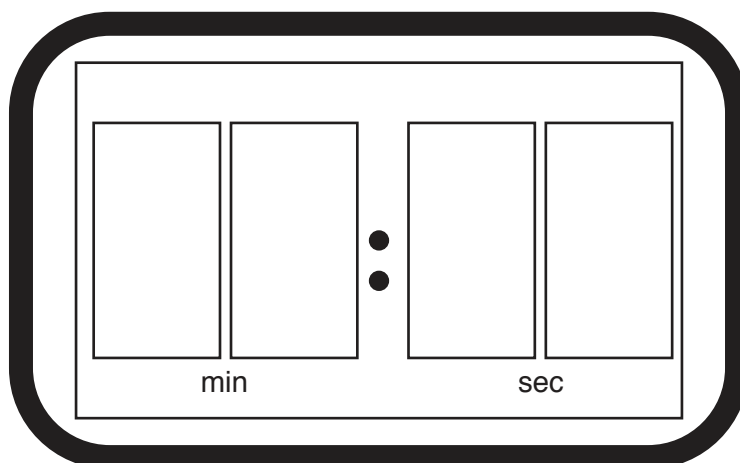
(c) A student repeats the electrolysis in Fig. 5.1 quantitatively.

- He weighs the cathode before the circuit is connected and switched on.
- He records this mass in Table 5.1.
- He switches on the circuit and starts a stopclock.
- After 300 seconds he switches off the circuit.
- The cathode is dried and reweighed.
- He records the new mass in Table 5.1.
- The circuit is reconnected and switched on for another 300 seconds.
- He dries and reweighs the cathode and records the mass in Table 5.1.
- This process is repeated until the electrolysis has taken place for a total of 1200 seconds.
- He calculates the total increase in mass at each time and records the values in Table 5.1.

**Table 5.1**

total time of electrolysis/s	mass of cathode/g	total increase in mass of cathode/g
0	11.63	0.00
300	11.80	0.17
600	11.97	0.34
900		0.51
1200	12.31	0.68

(i) Complete Fig. 5.2 to show the reading on the stopclock in **minutes and seconds** for the time 900 seconds.



**Fig. 5.2**

[1]

(ii) Use the data in Table 5.1 to calculate the mass of the cathode after 900 seconds.

Record this mass in Table 5.1.

[1]



- (iii) Use the data in Table 5.1 to describe the relationship between the total time of electrolysis and the total mass of copper deposited at the cathode.

Show how you have used the data to find this relationship.

.....

.....

.....

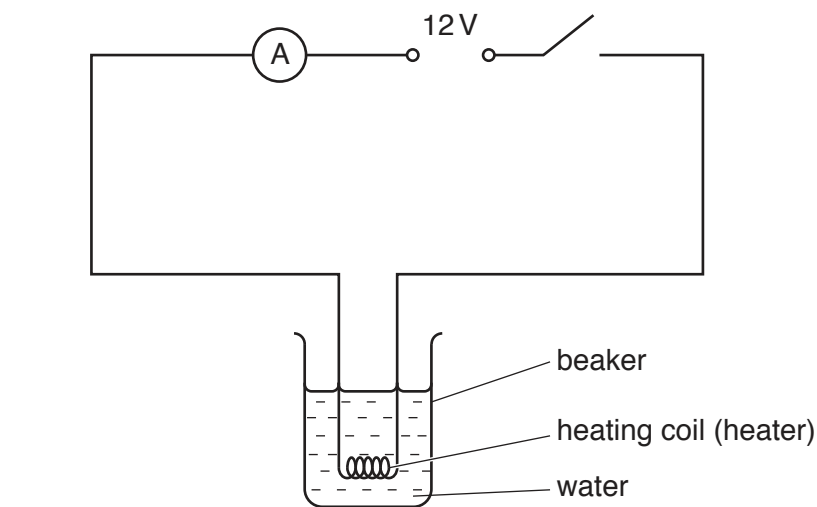
..... [2]

- 6 A student performs an experiment to measure an approximate value for the specific heat capacity of water.

The specific heat capacity  $c$  of water is the amount of thermal energy needed to raise the temperature of 1 g of water by  $1^\circ\text{C}$ .

### Procedure

- The student places a heating coil (heater) into a beaker containing 150 g of water.
- He connects the heater in series with an ammeter to a 12 V power supply as shown in Fig. 6.1.
- He measures the initial temperature  $\theta_1$  of the water.



**Fig. 6.1**

- (a) On Fig. 6.1, draw a voltmeter to measure the potential difference  $V$  across the heating coil.

Use the correct voltmeter symbol.

[1]

**(b) Procedure**

- The student switches on the circuit and starts a stopwatch.
- He switches off the circuit after 500 s.
- He stirs the water and immediately measures the temperature  $\theta_F$  of the water.

(i) State why it is important that he stirs the water before measuring temperature  $\theta_F$ .

.....  
 .....[1]

(ii) The temperature of the water continues to rise after the student has measured  $\theta_F$ .

Suggest a reason for this.

.....  
 .....[1]

(c) The student's results for (a) and (b) are shown in Table 6.1.

**Table 6.1**

mass of water $m/g$	150
initial temperature of water $\theta_1/^\circ\text{C}$	20
temperature of water after heating $\theta_F/^\circ\text{C}$	42
rise in temperature of water $\theta/^\circ\text{C}$	22
current $I/A$	3
potential difference $V/V$	12
time $t/s$	500

Calculate the thermal energy  $E$  supplied by the heater. Use the equation shown.

$$E = V \times I \times t$$

$$E = \dots\dots\dots \text{ J [1]}$$

(d) Use your answer to (c) and the results in Table 6.1 to calculate a value for the specific heat capacity  $c$  of water. Use the equation shown.

$$E = m \times c \times \theta$$

$$c = \dots\dots\dots \text{ J/g}^\circ\text{C [2]}$$

(e) (i) The specific heat capacity  $c$  of water is  $4.2\text{J/g}^\circ\text{C}$ .

Use Fig. 6.1 to suggest **two** practical reasons why your calculated value for  $c$  is inaccurate.

reason 1 .....

.....

reason 2 .....

.....

[2]

(ii) State **one** improvement that could be made to the design of the apparatus to produce a more accurate result.

.....[1]

(f) The student forgets to switch the heater off at the end of his experiment.

The temperature of the water continues to rise until it reaches  $72^\circ\text{C}$  and then remains constant at this value.

Suggest a reason why the water does **not** reach its boiling point.

.....

.....[1]

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