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COMBINED SCIENCE **0653/62**

Paper 6 Alternative to Practical **October/November 2020**

1 hour

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 40.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Blank pages are indicated.

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1 **(a)** Diatoms are single-celled organisms that live in water.

Fig. 1.1 shows a diatom.

Fig. 1.1

In the box, make a large drawing of the diatom shown in Fig. 1.1.

[3]

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(b) Fig. 1.2 shows a different species of diatom. The photograph is magnified ×1500.

Fig. 1.2 (magnification ×1500)

(i) Measure the diameter of the photograph of the diatom in Fig. 1.2.

diameter of photograph = ... mm [1]

(ii) Calculate the actual diameter of the diatom.

Use the equation shown.

$$\text{actual diameter} = \frac{\text{diameter of photograph}}{\text{magnification}}$$

actual diameter = ... mm [1]

(c) Describe **one** similarity and **one** difference between the diatom in Fig. 1.1 and the diatom in Fig. 1.2.

similarity .....

.....

difference .....

.....

[2]

[Total: 7]

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2 A student wants to investigate two plant tissues to identify which plant tissue loses the most water when placed in aqueous concentrated salt solution.

The student is provided with a potato, a carrot and aqueous concentrated salt solution.

Plan an investigation to compare the loss of water in pieces of potato and carrot placed in aqueous concentrated salt solution.

In your answer, include:

- the apparatus you will need, including a labelled diagram if you wish
- a brief description of the method and the measurements you will make
- the variables you will control
- how you will process and use the results to draw a conclusion.

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..... [7]

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3 A student investigates the changes in temperature that occur when dilute acid is added to aqueous sodium hydroxide. The student investigates two dilute acids, dilute hydrochloric acid and dilute sulfuric acid.

The student uses methyl orange as an indicator. Methyl orange is yellow in alkaline solutions and red in acidic solutions.

(a) Procedure

The student:

step 1 measures 20 cm^3 aqueous sodium hydroxide in a measuring cylinder and pours it into a conical flask

step 2 adds 6 drops of methyl orange to the aqueous sodium hydroxide in the conical flask

step 3 measures the temperature of the aqueous sodium hydroxide in the conical flask and records the value in Table 3.1

step 4 uses a burette to add 5.0 cm^3 dilute hydrochloric acid to the aqueous sodium hydroxide in the conical flask and swirls the mixture

step 5 measures the temperature of the mixture in the conical flask and records the value in Table 3.1

step 6 records the colour of the methyl orange in the mixture in Table 3.1

step 7 repeats steps 4–6 until a total of 40.0 cm^3 dilute hydrochloric acid has been added.

(i) Fig. 3.1 shows the thermometer readings for 0.0 cm^3, 30.0 cm^3 and 35.0 cm^3 of dilute hydrochloric acid added.

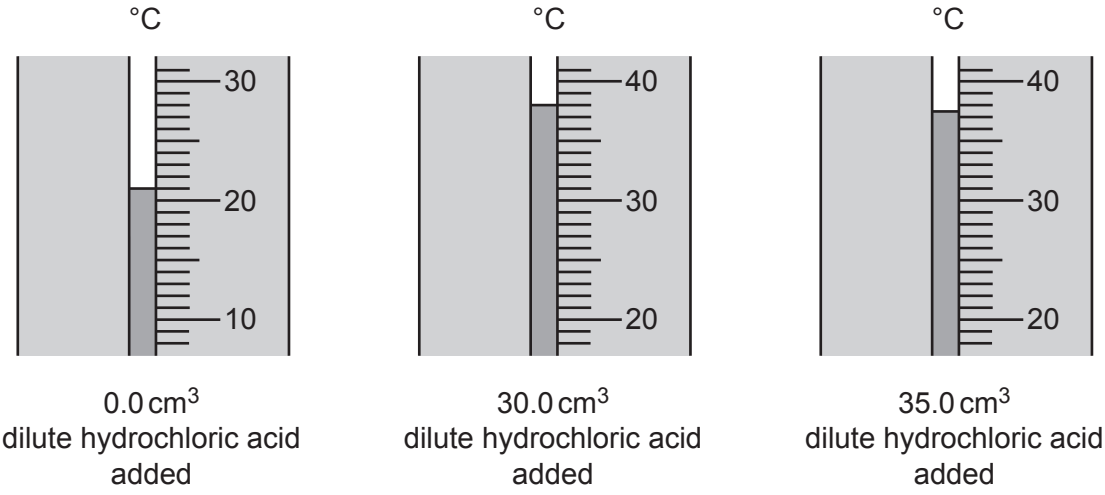

Fig. 3.1

Record these values in Table 3.1.

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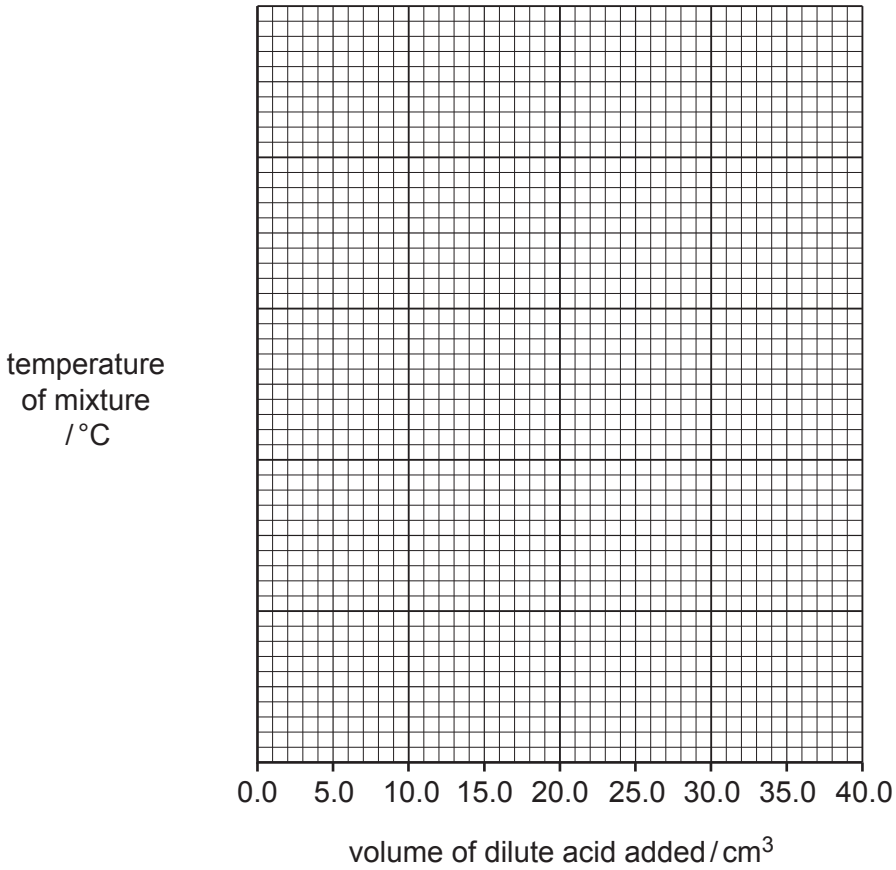
Table 3.1

volume of dilute hydrochloric acid added / cm^3	temperature of mixture / °C	colour of methyl orange
0.0		yellow
5.0	25.5	yellow
10.0	29.5	yellow
15.0	34.5	yellow
20.0	38.0	yellow
25.0	38.5	red
30.0		red
35.0		red
40.0	37.0	red

[3]

(ii) Using the data in Table 3.1, plot on the grid the points for temperature of mixture against volume of dilute hydrochloric acid added.



[2]

(iii) Draw a straight best-fit line for the first **five** points.
Draw a straight best-fit line for the last **four** points.
Extend both lines until they cross.
The point where the two lines cross is the maximum temperature reached.
Label these two lines **hydrochloric acid**. [1]

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(b) The student repeats the procedure in **(a)** using dilute sulfuric acid instead of dilute hydrochloric acid.

The results are shown in Table 3.2.

Table 3.2

volume of dilute sulfuric acid added / cm^3	temperature of mixture / °C	colour of methyl orange
0.0	21.5	yellow
5.0	28.0	yellow
10.0	35.5	yellow
15.0	39.0	red
20.0	38.0	red
25.0	37.0	red
30.0	36.5	red
35.0	35.0	red
40.0	33.5	red

On the grid in **(a)(ii)**, plot the points for temperature against volume of dilute sulfuric acid added.

Draw a straight best-fit line for the first **three** points.
Draw a straight best-fit line for the last **six** points.
Extend both lines until they cross.
The point where the two lines cross is the maximum temperature reached.
Label these two lines **sulfuric acid**. [2]

(c) State the maximum temperature reached for each acid.

dilute hydrochloric acid = ... °C

dilute sulfuric acid = ... °C
[1]

(d) Suggest what happens to the colour of the methyl orange when the mixture is near the maximum temperature.

.....

..... [1]

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(e) The concentrations of the dilute hydrochloric acid and the dilute sulfuric acid are the same.

(i) State which dilute acid neutralises the aqueous sodium hydroxide using a smaller volume of acid.
Use data from your graph to explain your answer.

acid .....

explanation .....

..... [1]

(ii) Hydrochloric acid has the formula HC*l*.
Sulfuric acid has the formula H_2SO_4.

Suggest why the dilute acid chosen in **(e)(i)** uses a smaller volume to neutralise the sodium hydroxide.

.....

..... [1]

(iii) Suggest a change to the apparatus which would give you greater confidence in your answer to **(e)(i)**.

..... [1]

[Total: 13]

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4 The ‘internal resistance’ of a cell is the resistance **inside** the cell.

A student investigates the internal resistance of a cell.

(a) The student uses a series circuit containing:

- a cell
- a switch
- a variable resistor to control the current in the circuit
- an ammeter to measure the current in the circuit
- a voltmeter to measure the potential difference (p.d.) across the cell.

Complete the circuit diagram in Fig. 4.1 to show how the student measures the current in the circuit and the potential difference across the cell.

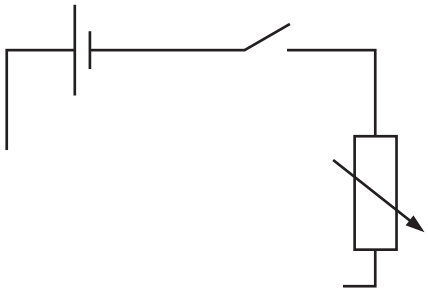

Fig. 4.1

[2]

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(b) Procedure

The student:

- uses the variable resistor to change the current in the circuit
- measures the current in the circuit
- measures the potential difference (p.d.) across the cell
- plots the graph of p.d. against current shown in Fig. 4.2.

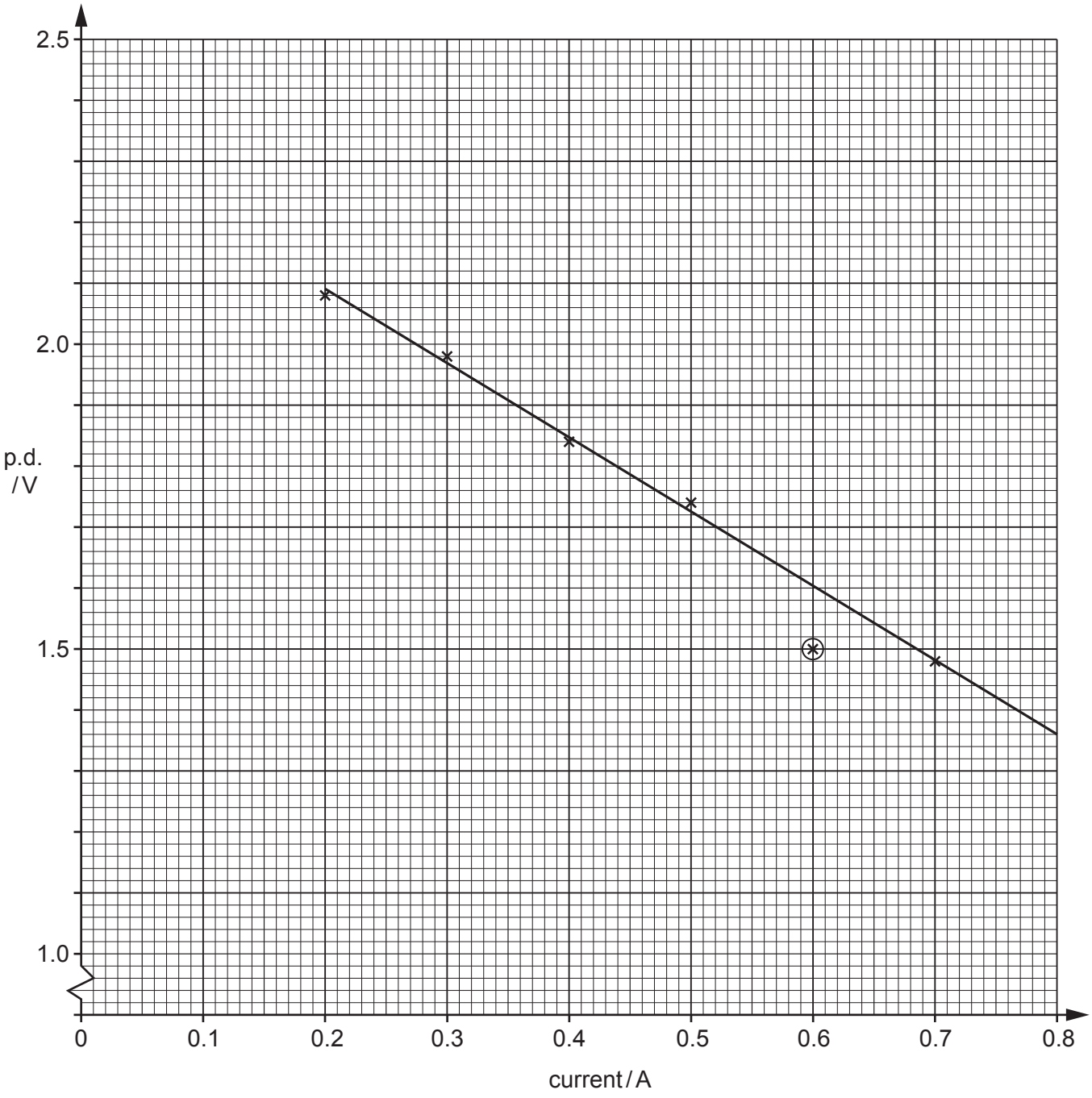

Fig. 4.2

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(i) Use Fig. 4.2 to find the p.d. when the current is 0.44A.

p.d. = ... V [1]

(ii) Fig. 4.3 shows the voltmeter used by the student.

On Fig. 4.3, draw the pointer to show the p.d. in **(b)(i)**.

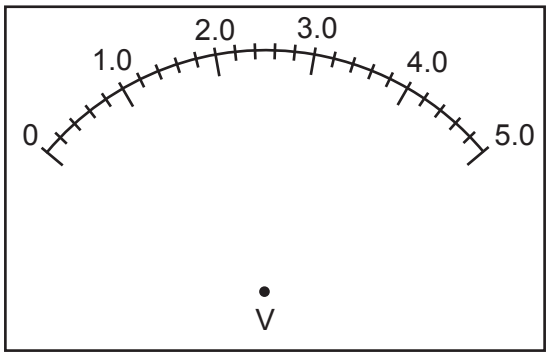

Fig. 4.3

[1]

(iii) The electromotive force (e.m.f.) of the cell is the p.d. when the current = 0A.

Extend the straight best-fit line on Fig. 4.2 to determine the e.m.f. of the cell.

e.m.f. = ... V [2]

(iv) The internal resistance of the cell is found from the gradient of the straight best-fit line in Fig. 4.2.

Determine the gradient of the straight best-fit line in Fig. 4.2.
Show on Fig. 4.2 the values you use to calculate the gradient.
Show your working.

gradient = ... Ω [3]

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(c) The student identifies the point circled on Fig. 4.2 as an anomalous result.

The student repeats the measurements for this point.

Fig. 4.4 shows the repeated ammeter and voltmeter readings.

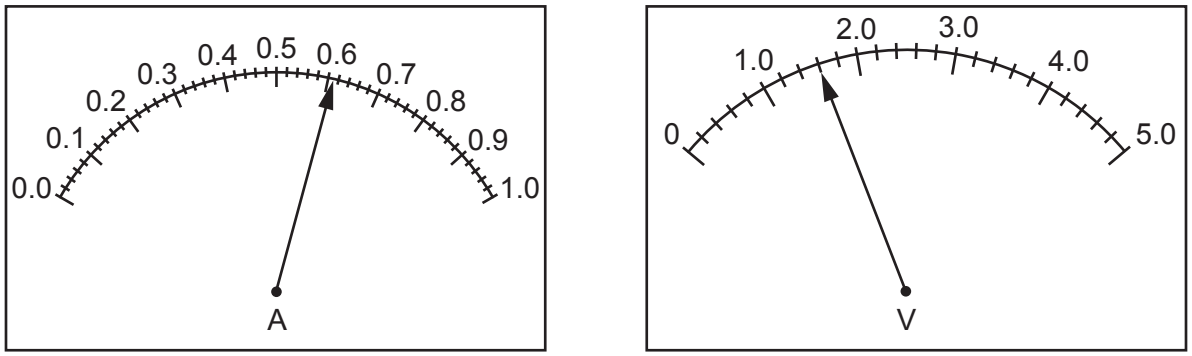

Fig. 4.4

Record the readings of current and potential difference shown in Fig. 4.4.

current = ... A

potential difference = ... V
[2]

(d) A second student predicts that the graph will **not** be straight at higher values of current.

Explain how the first student can extend the investigation to find out if this prediction is correct.

.....

.....

..... [2]

[Total: 13]

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