Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

CO-ORDINATED SCIENCES **0654/62**

Paper 6 Alternative to Practical **February/March 2021**

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.

[Turn over

2

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1   A student investigates the action of an enzyme on milk. Milk contains a nutrient that makes it look
     white (opaque). When the nutrient is broken down, the milk becomes see-through (transparent).

Procedure

The student:

- adds $2.0\,cm^3$ of 5.0% enzyme solution to $3.0\,cm^3$ of milk in a test-tube and starts a stop-clock
- measures the time taken for the contents of the test-tube to go see-through
- records this time in Table 1.1.

The student repeats the procedure, using enzyme concentrations of 4.0%, 3.0%, 2.0% and 1.0%
instead of 5.0%.

(a) Suggest a suitable piece of apparatus the student uses to measure the $2.0\,cm^3$ of enzyme
     solution.

     .... [1]

(b) Fig. 1.1 shows the reading on the stop-clock for 3.0% enzyme concentration.
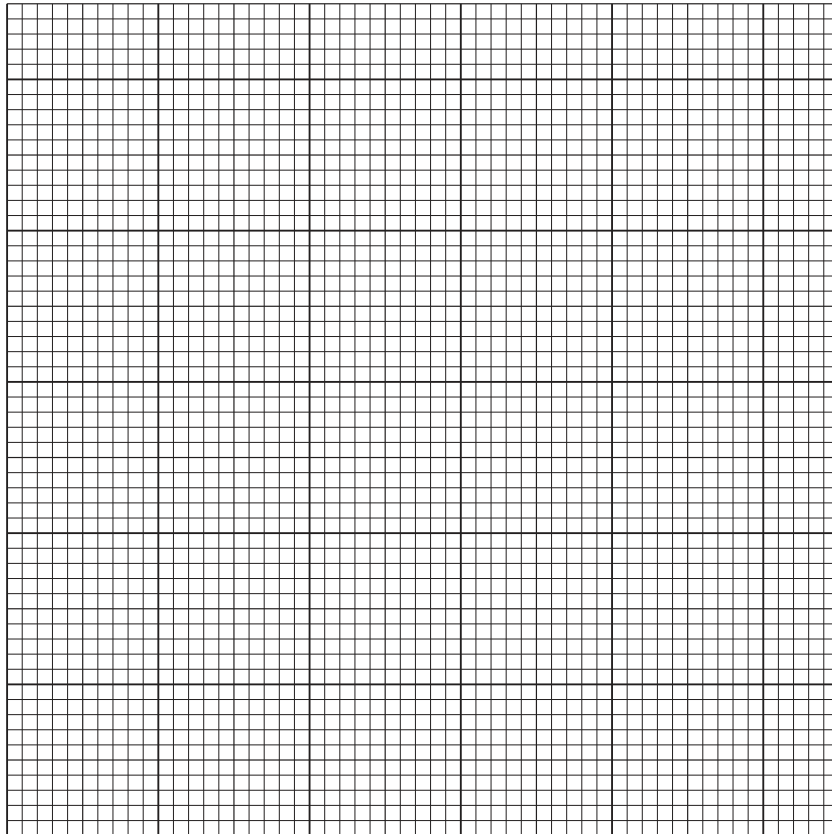

Fig. 1.1

     Record this time, in seconds, in Table 1.1.

Table 1.1

percentage enzyme concentration	time taken to go see-through / seconds
5.0	14
4.0	56
3.0	
2.0	145
1.0	192

[1]

(c) (i) On the grid provided, plot a graph of time taken to go see-through (vertical axis) against enzyme concentration.

[3]

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

(d) (i) State the relationship between the enzyme concentration and the time taken for the milk to go see-through.

....

.... [1]

   (ii) Use your graph to estimate the time taken for the milk to go see-through using an enzyme concentration of 4.5%.

Show on your graph how you arrived at your answer.

time taken = ... seconds [2]

  (iii) The student thinks that the reaction with 1.0% enzyme concentration has the greatest rate.

State whether the student is correct. ....

Explain your answer.

....

....
[1]

(e) State two variables that the student keeps constant.

variable 1 ....

variable 2 ....
[2]

[Total: 12]

 [Turn over

2 A student tests some milk for its nutrient content.

(a) The student adds biuret solution and iodine solution to samples of milk.

(i) Name the nutrients these solutions test for.

biuret solution ....

iodine solution ....
[2]

(ii) The biuret solution turns purple (lilac). The iodine solution stays brown.

State conclusions for these tests on milk.

....

.... [2]

(b) The student tests some milk using Benedict's solution.

(i) Name the nutrient that Benedict's solution tests for.

.... [1]

(ii) State the colour the student observes if the milk contains:

a small amount of this nutrient

....

a large amount of this nutrient.

....
[2]

(iii) State and explain a safety precaution that the student takes when doing the test.

safety precaution ....

explanation ....
[1]

[Total: 8]

3 A student does two different experiments to investigate the reactivity of five metals: aluminium, copper, iron, magnesium and zinc.

(a) In the first experiment, the student measures the voltage (potential difference) produced when two different metals are dipped into salt solution. This happens because the metals have different reactivities.

The larger the difference in reactivity of the two metals, the greater the voltage produced.

(i) Procedure

The student:

- half-fills a beaker with salt solution
- sets up the apparatus shown in Fig. 3.1
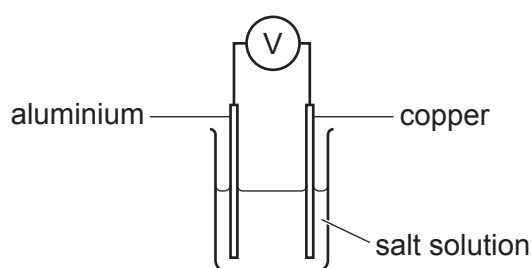
Fig. 3.1

- records, in Table 3.1, the reading on the voltmeter.

The student repeats the procedure four more times using copper, iron, magnesium and zinc strips instead of the aluminium strip.

Table 3.1

metal	potential difference / V
aluminium	
copper	0.0
iron	
magnesium	2.1
zinc	0.7

The voltmeter readings for aluminium and iron are shown in Fig. 3.2.

Record these values, to **one** decimal place, in Table 3.1.

1.38 V		0.14 V
aluminium		iron

Fig. 3.2

[2]

(ii) Use the results in Table 3.1 to complete the order of reactivity of the metals.

Copper has been put in its correct place.

most reactive ....

....

....

....

least reactive   *copper*   [1]

(iii) State two variables which must be controlled in this experiment.

1 ....

2 ....
[2]

(b) In the second experiment, different metal powders are added separately to dilute hydrochloric acid.

The reactivity of each metal is compared.

Procedure

The student:

- half-fills a test-tube with dilute hydrochloric acid
- adds one spatula of aluminium powder to the test-tube
- records, in Fig. 3.3, a description of the reaction.

The student repeats the procedure using copper, iron, magnesium and zinc instead of aluminium.
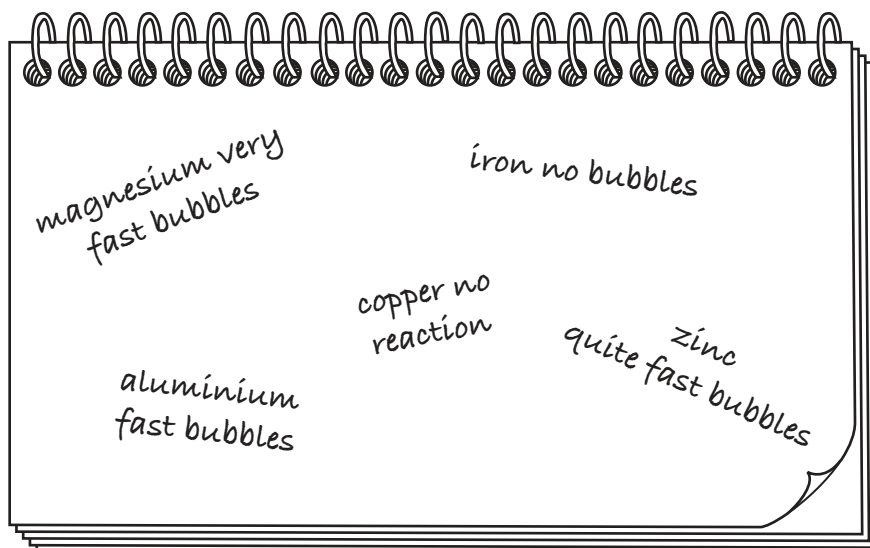
The student's results are shown in Fig. 3.3.

Fig. 3.3

(i) Draw a results table and enter the student's results into it.

[2]

(ii) Use the results in **(b)(i)** to place the metals in order of reactivity.

most reactive ....

....

....

....

least reactive .... [2]

(c) (i) Suggest which method gives a better order of reactivity.

Explain your answer.

....

.... [1]

(ii) Suggest **one** improvement to the second experiment (using hydrochloric acid) to make the results more reliable.

Do **not** include repeating the experiment in your answer.

....

.... [1]

(d) Describe the test for hydrogen gas. State the observation for a positive identification.

test ....

observation ....

[2]

[Total: 13]

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[Turn over

4 Iron reacts with hydrochloric acid, giving off hydrogen gas.

| iron | + | hydrochloric acid | $\rightarrow$ | iron chloride | + | hydrogen |

The rate of the reaction changes as the concentration of the hydrochloric acid changes.

The hydrochloric acid can be made less concentrated by adding distilled water to it.

Plan an experiment to find out if the rate of reaction is proportional to the concentration of hydrochloric acid used.

You may use any common laboratory apparatus and samples of iron powder and hydrochloric acid.

Include in your plan:

- the apparatus needed
- a brief description of the method, explaining any safety precautions
- the measurements you will take, including how to make them as accurate as possible
- the variables you will control
- how you will process your results and use them to draw a conclusion.

You may include a labelled diagram if you wish.

You may also include a table that can be used to record results if you wish. You are **not** required to include any results.

....

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.... [7]

5 A student uses two different methods to determine the maximum volume of liquid that a test-tube holds.

(a) Method 1

The student calculates the volume of the test-tube by considering the test-tube to be an approximate cylinder.

The student measures:

- the length l of the test-tube
- the diameter d of the test-tube.

Fig. 5.1 shows a full-size diagram of the test-tube.
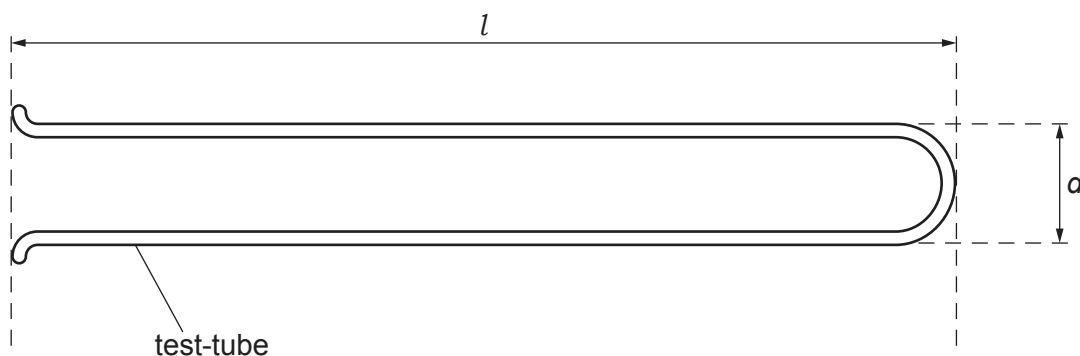
test-tube

Fig. 5.1

(i) Use a ruler to measure the diameter d of the test-tube.

Give your answer to the nearest 0.1 cm.

d = ... cm [1]

(ii) Use a ruler to measure the length l of the test-tube.

Give your answer to the nearest 0.1 cm.

l = ... cm [1]

(iii) Use your value of d from **(a)(i)** and your value of l from **(a)(ii)** to calculate the volume V of the test-tube.

Use the equation shown.

$$V = 0.79 \times d^2 \times l$$

Give your answer to **two** significant figures.

V = ... cm^3 [2]

(b) Method 2

The student:

- pours water into a measuring cylinder
- records the reading R_1 on the measuring cylinder
- pours water from the measuring cylinder into the test-tube until the test-tube is full
- records the new reading R_2 on the measuring cylinder.

The readings R_1 and R_2 are shown in Fig. 5.2.
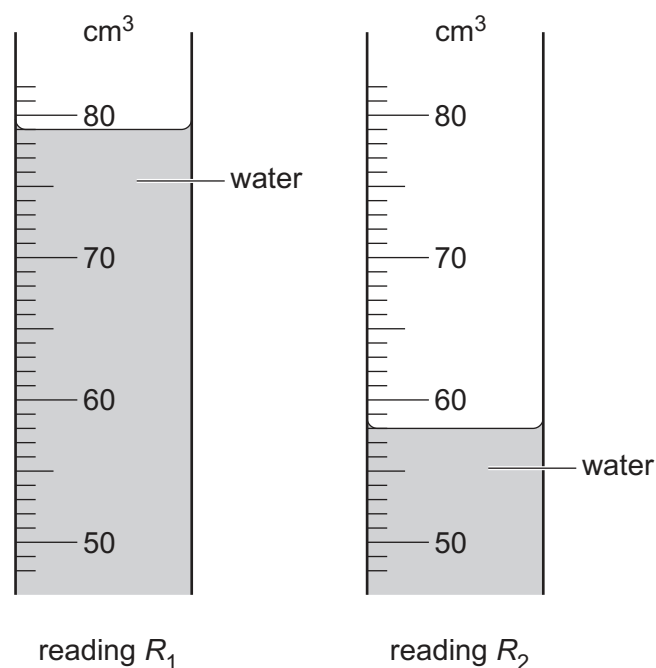
Fig. 5.2

(i) Record the reading R_1 on the measuring cylinder.

$R_1 =$ .... cm^3

Record the new reading R_2 on the measuring cylinder.

$R_2 =$ .... cm^3
[2]

(ii) Determine the maximum volume of water V_W that the test-tube can hold.

Show your working.

$V_W =$ .... cm^3 [1]

(iii) Suggest one possible source of inaccuracy in **Method 2**.

....

.... [1]

(c) Look at Fig. 5.1.

Suggest one reason why *V* in **Method 1** is an over-estimate of the volume of liquid that the test-tube holds.

....

.... [1]

[Total: 9]

6 A student investigates the power output *P* of two different combinations of lamps.

The student sets up the circuit shown in Fig. 6.1. This is circuit **1**.
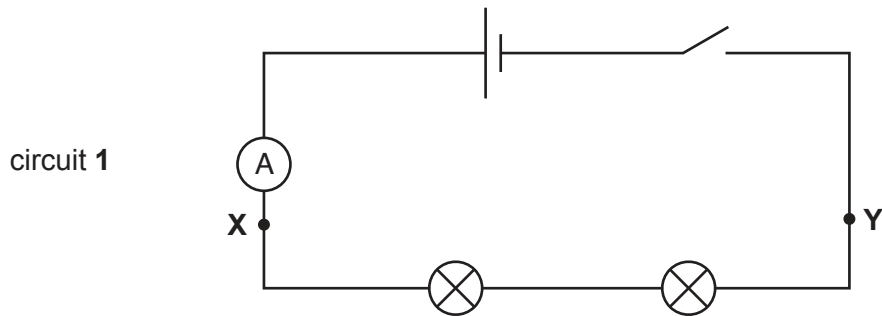
Fig. 6.1

(a) On Fig. 6.1, draw the symbol for a voltmeter connected to measure the potential difference *V* between points **X** and **Y**. [2]

(b) Procedure

The student:

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

Table 6.1

circuit	potential difference V/V	current I/A	power P/.........
1			
2	2.5	0.51	1.28

The voltmeter and ammeter readings are shown in Fig. 6.2.
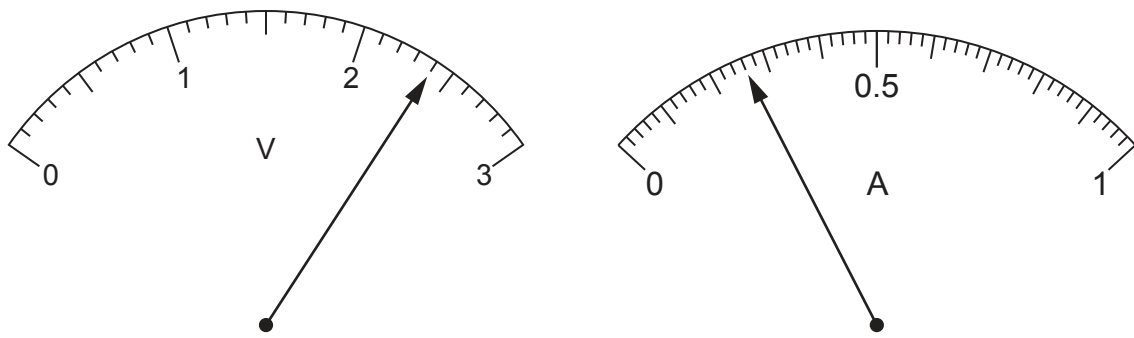
Fig. 6.2

Read the meters for circuit **1** and record the readings in Table 6.1. [2]

(c) Procedure

- The student rearranges the lamps, as shown in Fig. 6.3. This is circuit **2**. The voltmeter remains connected as before.

circuit **2**
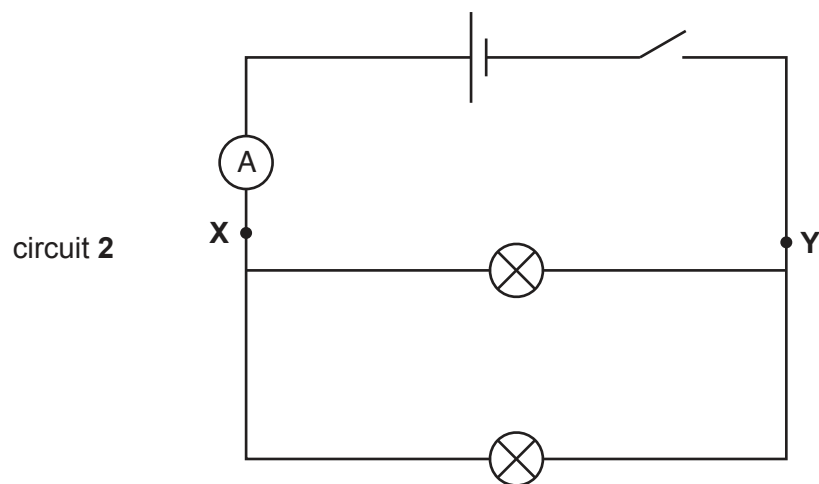
Fig. 6.3

The student:

- closes the switch
- measures, and records in Table 6.1, the potential difference V
- measures, and records in Table 6.1, the current I
- opens the switch.

(i) Complete the column heading in Table 6.1 by giving the unit for power. [1]

(ii) Calculate, and record in Table 6.1, the power output P of the combination of lamps in circuit **1**.

Use the equation shown.

$$P = V \times I$$

[1]

(d) The teacher suggests that, if the lamps are identical, the power output of circuit **2** will be two times the power output of circuit **1**.

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

State whether, within the limits of experimental error, the student's results support the teacher's suggestion.

Justify your answer by using values from Table 6.1.

statement ....

justification ....

....

[2]

(e) A student finds that, when the switch in circuit **1** is closed, the lamps do **not** light up.

Suggest a check that the student does to find out if either of the lamps is broken.

....

.... [1]

(f) The student decides to extend the investigation.

(i) He adds a third lamp in series with the two lamps in circuit **1**. This is circuit **3**.

Draw the circuit diagram for circuit **3**.

[1]

(ii) He adds a third lamp in parallel with the two lamps in circuit **2**. This is circuit **4**.

Draw the circuit diagram for circuit **4**.

[1]

[Total: 11]