Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	

4121164271

CO-ORDINATED SCIENCES **0654/62**

Paper 6 Alternative to Practical **February/March 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 (CE/CB) 313655/4

1 A student investigates the nutrient content of two food solutions, **A** and **B**.

Procedure

The student:

- pours some of solution **A** into each of three test-tubes
- adds an equal depth of Benedict's solution to one test-tube
- adds an equal depth of biuret solution to another test-tube
- adds a few drops of iodine solution to the third test-tube
- repeats the procedure with solution **B** instead of solution **A**.

(a) State which **one** of the three testing solutions needs to be heated.

.... [1]

(b) State the **initial** colours of the testing solutions.

Benedict's solution ....

biuret solution ....

iodine solution .... [1]

(c) Table 1.1 shows the **final** colours the student observes.

Table 1.1

food solution	Benedict's solution	biuret solution	iodine solution	nutrient(s) present
A	red	purple	brown	
B	blue	purple	blue-black	

Complete Table 1.1 to state the nutrient(s) present in each food solution. [3]

[Total: 5]

2 A student investigates the vitamin C content of four different fruit juices, **E**, **F**, **G** and **H**.

DCPIP indicator is a blue solution that decolourises (turns colourless) when vitamin C is added to it.

Solutions containing a high concentration of vitamin C need only a few drops to turn the DCPIP indicator colourless.

Solutions containing a low concentration of vitamin C need more drops to turn the DCPIP indicator colourless.

(a) Procedure

The student:

- uses a dropping pipette to place two drops of DCPIP into a well of a white spotting tile
- uses a clean dropping pipette to add drops of fruit juice **E** to the well containing DCPIP
- counts how many drops are needed to decolourise the DCPIP
- records the result
- repeats with the other fruit juice samples.

(i) Draw a table to record the student's results.

[2]

(ii) Fig. 2.1 shows part of the student's notebook.

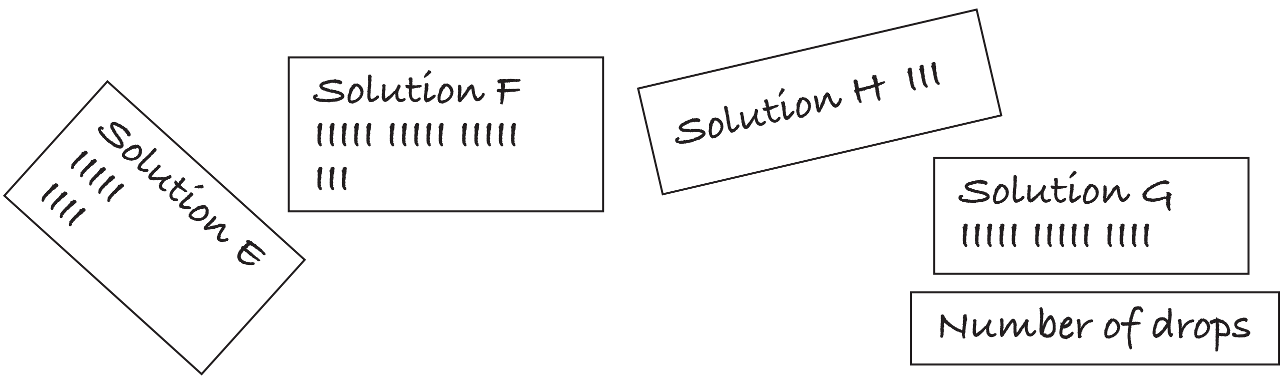


Fig. 2.1

Record the student's results from Fig. 2.1 in your results table in **(a)(i)**. [1]

(b) (i) Identify **one** source of error in the student's procedure and suggest an improvement.

error ....

improvement ....

....
[2]

(ii) Suggest why the procedure is **not** suitable for use with blueberry juice.

.... [1]

(c) (i) A deficiency of vitamin C in the diet causes a disease called scurvy.

State which juice **E**, **F**, **G** or **H** is best at preventing scurvy. Explain your answer.

juice ....

explanation ....

....
[1]

(ii) An adult human needs 0.030 g of vitamin C every day to prevent scurvy.

A 125 cm^3 glass of an orange fruit juice contains 0.060 g of vitamin C.

Calculate the volume of this orange juice an adult human needs to drink every day to prevent scurvy.

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

volume = ... cm^3 [2]

(iii) Suggest how an adult human, who drinks less than the volume of orange juice calculated in **(c)(ii)**, can prevent scurvy.

.... [1]

(d) Citrus fruits are one good source of vitamin C.

Fig. 2.2 shows the cut surface of a citrus fruit.

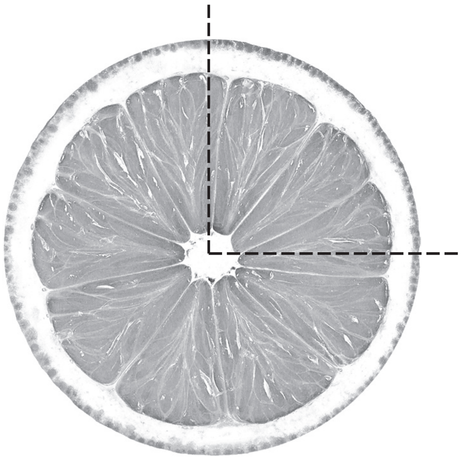


Fig. 2.2

(i) In the box, make a large, accurate drawing of **one quarter** of the cut surface of the citrus fruit. The quarter is shown by the dotted lines on Fig. 2.2. [3]

(ii) The diameter of the citrus fruit in Fig. 2.2 is approximately 55 mm.

The magnification m of Fig. 2.2 is ×0.8.

Use the equation shown.

$$m = \frac{\text{diameter of citrus fruit in Fig. 2.2}}{\text{diameter of actual citrus fruit}}$$

Calculate the approximate diameter of the actual citrus fruit.

diameter = ... mm [2]

[Total: 15]

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

The reaction is exothermic. Thermal energy (heat) is given out and the temperature of the mixture increases.

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

The student assembles the apparatus shown in Fig. 3.1.

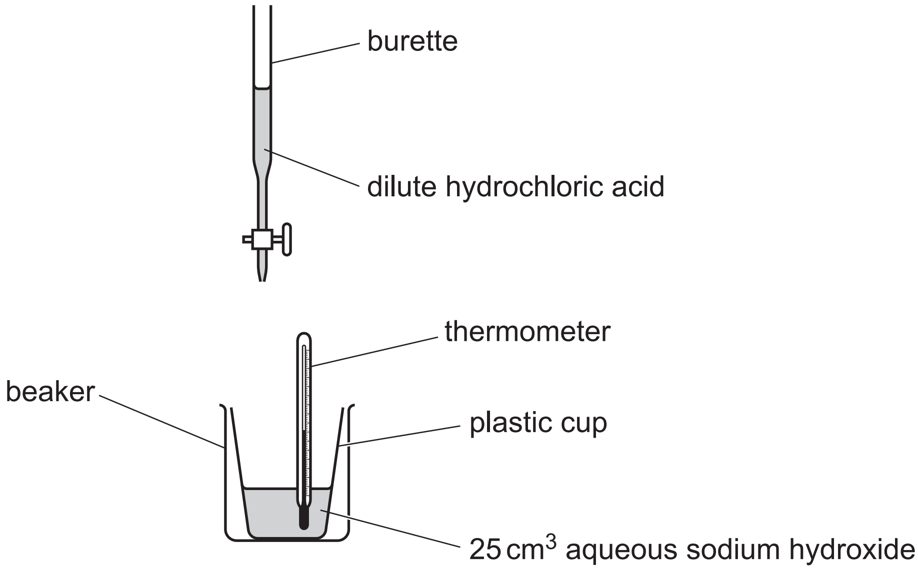


Fig. 3.1

Procedure

The student:

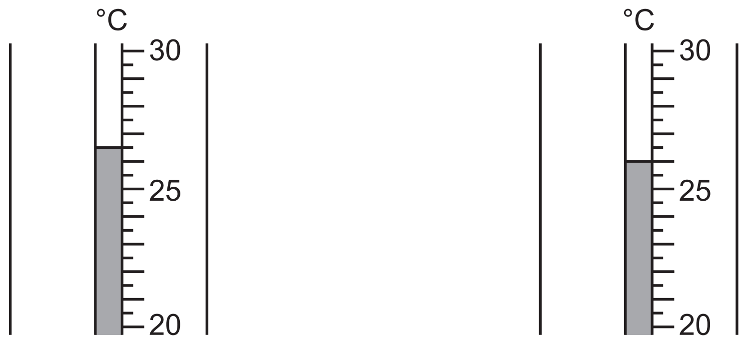
- puts a plastic cup into a glass beaker
- uses a measuring cylinder to put $25\,cm^3$ of aqueous sodium hydroxide into the plastic cup
- records in Table 3.1 the temperature of the aqueous sodium hydroxide in the plastic cup
- adds $5.0\,cm^3$ of dilute hydrochloric acid from a burette to the plastic cup
- stirs the mixture and records the temperature in Table 3.1
- continues adding $5.0\,cm^3$ portions of dilute hydrochloric acid, stirring and recording the temperature of the mixture until $45.0\,cm^3$ of dilute hydrochloric acid have been added.

The student keeps the contents of the plastic cup for Question 4.

Table 3.1

total volume of dilute hydrochloric acid added / cm^3	temperature / °C
0.0	21.5
5.0	24.0
10.0	
15.0	29.0
20.0	30.5
25.0	34.0
30.0	33.0
35.0	29.5
40.0	
45.0	23.0

(a) **(i)** Fig. 3.2 shows the thermometer readings for 10.0 cm^3 and 40.0 cm^3 of dilute hydrochloric acid added.



10.0 cm^3 of dilute hydrochloric acid added

40.0 cm^3 of dilute hydrochloric acid added

Fig. 3.2

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

(ii) State the name of a piece of apparatus suitable for measuring the volume of aqueous sodium hydroxide more accurately than the measuring cylinder.

.... [1]

(iii) The plastic cup is placed into the glass beaker to stop it tipping over when it is stirred.

Suggest another reason why the plastic cup is placed into a glass beaker.

.... [1]

(b) **(i)** On the grid, plot temperature on the vertical axis against volume of dilute hydrochloric acid added.

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

The temperature scale needs to be approximately 5 °C higher than the highest temperature recorded in Table 3.1.

[3]

(ii) Complete the following steps and draw **two** lines of best fit on the graph.

- Draw the best-fit straight line through the increasing temperatures.
- Extrapolate the line past the highest point.
- Draw the best-fit straight line through the decreasing temperatures.
- Extrapolate the line past the highest point.

The maximum temperature T_{max} reached by the reaction is where the two lines intersect (cross).

Deduce the maximum temperature reached.

Show your working on the graph.

T_{max} = ... °C [4]

(iii) Where the lines intersect (cross) on the graph also shows the volume of dilute hydrochloric acid that exactly neutralises the 25 cm^3 of aqueous sodium hydroxide.

This is the point where the reaction is finished.

Use your graph to state the volume of dilute hydrochloric acid V that exactly neutralises the 25 cm^3 of aqueous sodium hydroxide.

V = ... cm^3 [1]

(c) Calculate the increase in temperature, ΔT, for the reaction.

Use the equation shown.

$$\Delta T = T_{max} - T_0$$

T_0 is the temperature when 0.0 cm^3 of dilute hydrochloric acid is added.

ΔT = ... °C

Calculate the thermal energy H given out during the reaction.

Use the equation shown.

$$H = (25 + V) \times 4.2 \times \Delta T$$

where V is your answer in **(b)(iii)**.

H = ... 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) After the reaction, the plastic cup is left on the bench for two hours.

Suggest the temperature of the mixture in the plastic cup after two hours.

temperature ....°C

Explain how you arrived at your answer.

....

.... [1]

[Total: 15]

4 The student investigates the substances from Question 3.

When an acid is added to an alkali a neutralisation reaction occurs.

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

A neutral substance turns universal indicator green and has a pH of 7.

Procedure

The student:

- adds universal indicator to separate samples of dilute hydrochloric acid, aqueous sodium hydroxide and the contents of the plastic cup from the end of the procedure in Question 3
- adds a small piece of magnesium ribbon to separate samples of dilute hydrochloric acid, aqueous sodium hydroxide and the contents of the plastic cup from the end of the procedure in Question 3.

Some of the results are shown in Table 4.1.

Table 4.1

substance	colour with universal indicator	pH	observation with magnesium
dilute hydrochloric acid	red	1	gas given off
aqueous sodium hydroxide	dark blue	12	no reaction
contents of the plastic cup from the end of the procedure in question 3			

(a) State the test that confirms the gas given off with dilute hydrochloric acid is hydrogen. Include the observation for a positive result.

test ....

observation .... [2]

(b) **(i)** Complete Table 4.1 by predicting the results of the procedure with the contents of the plastic cup at the end of the procedure in Question 3. [2]

(ii) Explain your predictions.

....

.... [1]

[Total: 5]

5 A student investigates the resistance of series and parallel combinations of identical resistors.

The student assembles the circuit shown in Fig. 5.1. Resistors R_1 and R_2 are connected in series.

(a) On Fig. 5.1, draw the symbol for a voltmeter and show how it is connected to measure the potential difference between point **X** and point **Y**.

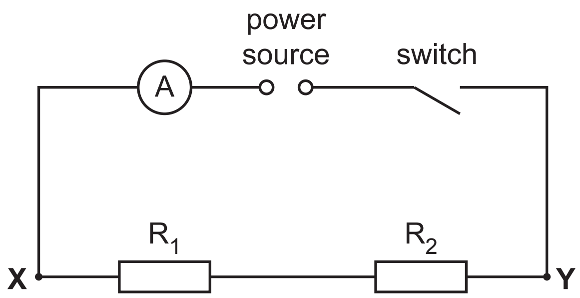


Fig. 5.1

[2]

(b) Procedure

The student:

- connects the voltmeter to measure the potential difference between point **X** and point **Y**
- closes the switch
- takes the readings on the voltmeter and the ammeter
- records the readings
- opens the switch

Fig. 5.2 shows the readings on the voltmeter and the ammeter.

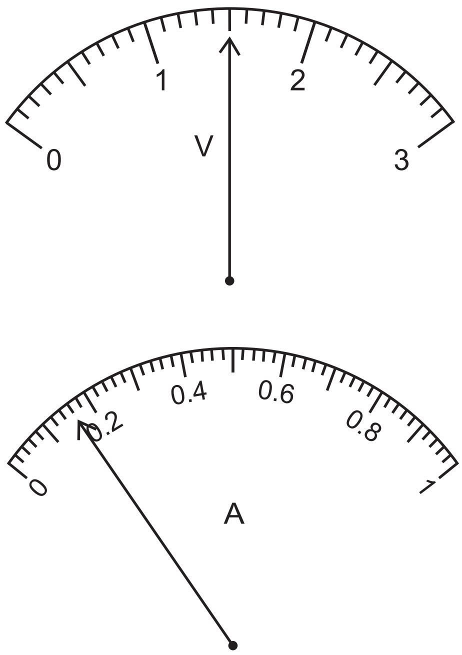


Fig. 5.2

(i) Record the potential difference V and the current I.

V = ... V

I = ... A
[2]

(ii) Calculate the total resistance R_S between point **X** and point **Y**.

Use the equation shown.

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

Give the unit for your answer.

R_S = ... unit = ... [2]

(iii) Explain why it is good practice to open the switch between taking and recording readings from the ammeter and voltmeter.

....

.... [1]

(c) The student needs more values of potential difference V, and current I, to calculate an average value for the resistance R_S.

They connect an extra component in series with the power source, to vary the current.

State the name and draw the symbol for this component.

name ....

symbol

[2]

(d) **Procedure**

The student:

- disconnects the voltmeter
- connects the circuit as shown in Fig. 5.3.

Resistors R_1 and R_2 are now connected in parallel.

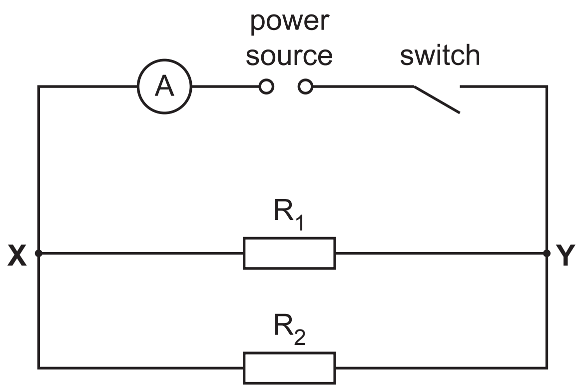


Fig. 5.3

The student:

- reconnects the voltmeter to measure the potential difference between point **X** and point **Y**
- closes the switch
- records the potential difference V and the current I
- opens the switch.

The student's readings are shown below.

$$V = 1.4\,\text{V}$$

$$I = 0.58\,\text{A}$$

Calculate the total resistance R_P between point **X** and point **Y** for the parallel circuit.

Use the equation shown.

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

R_P = ... [1]

(e) The teacher states that if each resistor is identical then $R_S = 4 \times R_P$.

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

State whether your results support the teacher's statement.

Justify your statement by doing a calculation using your values of R_S from **(b)(ii)** and R_P from **(d)**.

statement ....

justification ....

.... [2]

(f) Another student repeats the investigation using lamps instead of resistors.

The lamps are connected in series, as in Fig. 5.1, but they do **not** light up.

Suggest **one** observation that the student makes to check whether one of the lamps is broken.

....

.... [1]

[Total: 13]

BLANK PAGE

6 Water is heated from room temperature to its boiling point in a metal cooking pot.

Plan an experiment to investigate if the time taken for water to reach its boiling point depends on the metal from which the cooking pot is made.

You are provided with:

- a supply of cold water
- a set of three cooking pots of the same size, one made of aluminium, one made of copper and one made of steel
- a Bunsen burner, a tripod and gauze
- a measuring cylinder.

You may use any other common laboratory apparatus.

In your plan include:

- any other apparatus needed
- a brief description of the method, including what you will measure and how you will make sure your measurements are accurate
- the variables you will control
- a results table to record the measurements (you do not need to make any measurements or record any results in the table)
- how you will process your results to draw a conclusion.

You may include a labelled diagram if you wish.

[7]

BLANK PAGE

BLANK PAGE

BLANK PAGE