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COMBINED SCIENCE

0653/63

Paper 6 Alternative to Practical

May/June 2026

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. Do **not** use correction fluid or tape.
- 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 [].
- Notes for use in qualitative analysis are provided in the question paper.

This document has **16** pages. Any blank pages are indicated.



- 1 (a) A student investigates the effect of changing the concentration of sugar solution on osmosis in potatoes.

The student is provided with five cylinders of potato.

One cylinder of potato with diameter D and length L is shown drawn to scale in Figure 1.1.



Figure 1.1

- (i) Measure D and L .

Record your answers to the nearest 0.1 cm.

$D =$ cm

$L =$ cm
[2]

- (ii) Calculate the volume of the cylinder of potato shown in Figure 1.1.

Use the equation shown.

$$\text{volume} = 0.79 \times L \times D^2$$

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

volume = cm³ [2]

(b) Procedure

The student:

- step 1** measures the **initial** masses of the five cylinders of potato and records these values in Table 1.1
- step 2** puts one cylinder of potato into each of five different concentrations of sugar solution (0%, 5%, 10%, 20% and 30%)
- step 3** leaves the cylinders of potato in the sugar solutions for 4 hours
- step 4** removes the cylinders of potato from the sugar solutions and dries them with a paper towel
- step 5** measures the **final** mass of each cylinder of potato and records these values in Table 1.1.

Table 1.1

percentage concentration of sugar solution	initial mass /g	final mass /g	change in mass /g
0	6.00		
5	6.10	6.19	+0.09
10	6.15	6.12	−0.03
20	5.82	5.74	−0.08
30	5.97	5.80	

- (i) Figure 1.2 shows the final mass reading for the cylinder of potato from the 0% sugar solution.

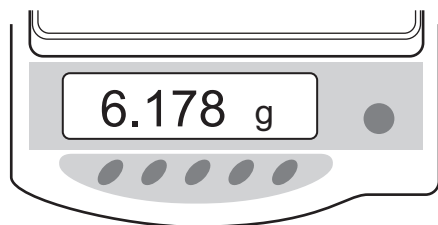


Figure 1.2

Record this final mass in Table 1.1.

[1]



- (ii) Calculate the change in mass for the cylinders of potato from the 30% sugar solution and the 0% sugar solution.

Record these values in Table 1.1.

[2]

- (iii) Estimate the concentration of sugar solution that will cause **no** change in mass to the cylinder of potato.

concentration of sugar solution =% [1]

- (iv) Suggest a change in the procedure that allows you to have a more exact estimate in 1(b)(iii).

..... [1]

- (v) Describe the effect of the percentage concentration of sugar solution on the change in mass in Table 1.1.

..... [2]

- (c) (i) Suggest why the cylinders of potato are dried in **step 4**.

..... [1]

- (ii) Describe how the surface area of the potatoes is controlled.

..... [1]

[Total: 13]

- 2 A student investigates the temperature increase when aqueous sodium hydroxide is added to dilute hydrochloric acid.

(a) **Procedure**

The student:

- step 1** measures the temperature of a large volume of dilute hydrochloric acid
- step 2** pours 20.0 cm^3 of the dilute hydrochloric acid into a glass beaker
- step 3** adds 5.0 cm^3 of aqueous sodium hydroxide to the glass beaker
- step 4** records the maximum temperature of the reaction mixture in the beaker
- step 5** repeats **step 2** to **step 4** using the volumes of aqueous sodium hydroxide shown in Table 2.1.

Figure 2.1 shows the temperature readings when 10 cm^3 and 20 cm^3 of aqueous sodium hydroxide are added.



Figure 2.1

- (i) Record in Table 2.1 these temperatures to the nearest 0.5 °C .

Table 2.1

volume of dilute hydrochloric acid / cm^3	volume of aqueous sodium hydroxide added / cm^3	highest temperature of the reaction mixture / °C	temperature increase / °C
20.0	5.0	26.0	5.0
20.0	10.0		
20.0	15.0	32.0	11.0
20.0	20.0		
20.0	25.0	45.5	24.5
20.0	30.0	50.5	29.5

[2]



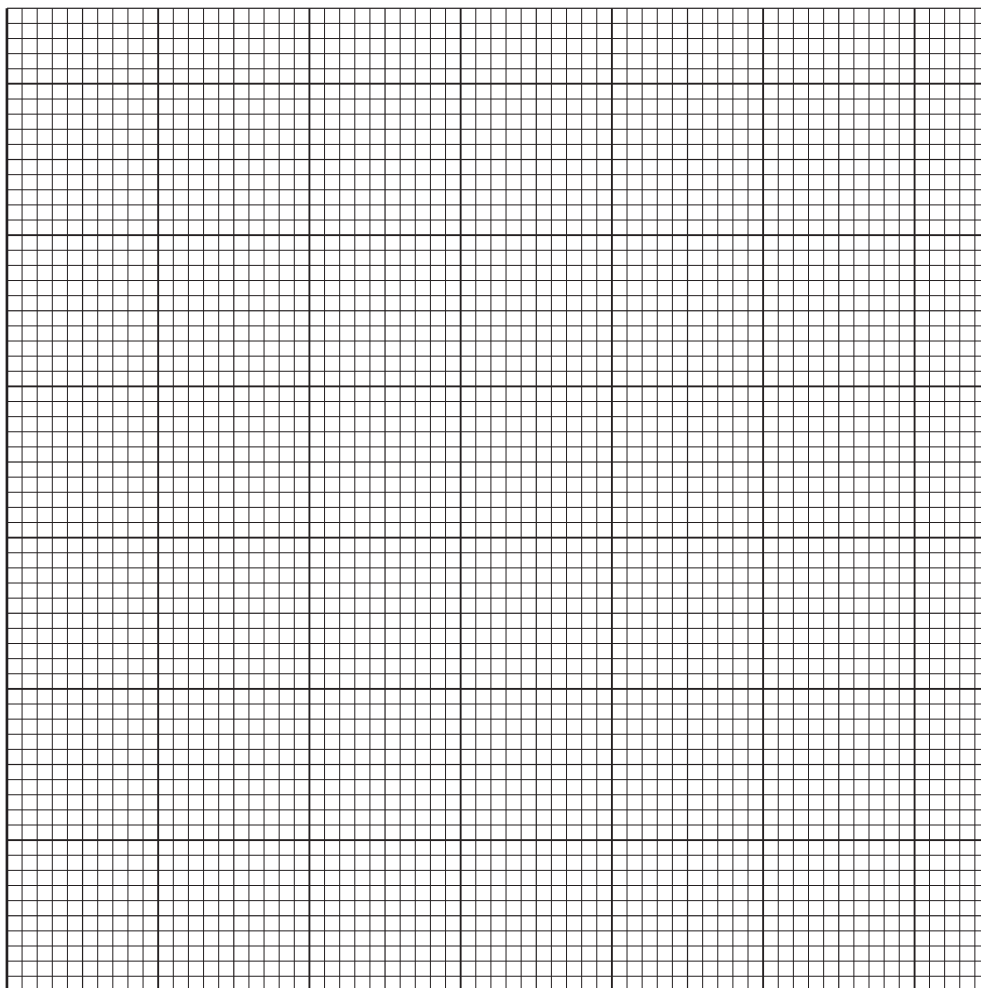
- (ii) The temperature of the hydrochloric acid in **step 1** is 21.0°C .

Calculate the temperature increase when 10.0 cm^3 and when 20.0 cm^3 of aqueous sodium hydroxide are added.

Record in Table 2.1 these values to the nearest 0.5°C .

[1]

- (b) (i) On the grid, plot the temperature increase (vertical axis) against the volume of aqueous sodium hydroxide added.



[3]

- (ii) One of the results is anomalous.

Circle on the grid this anomalous result.

[1]

- (iii) Draw the line of best fit.

[1]

- (iv) Explain what actions the student takes to confirm that the result in **2(b)(ii)** is anomalous.

.....

..... [1]





- (v) The student thinks the temperature increase is proportional to the volume of sodium hydroxide added.

Explain if the student is correct.

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

- (c) Explain why the student needs at least two different sizes of measuring cylinder to measure the different volumes of aqueous sodium hydroxide.

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

- (d) Suggest **two** changes to the investigation that improve confidence in the values of the temperature increase.

1
.....
2
..... [2]

[Total: 13]





Turn over

3 A student investigates an electrical circuit.

The student is given the circuit shown in Figure 3.1.

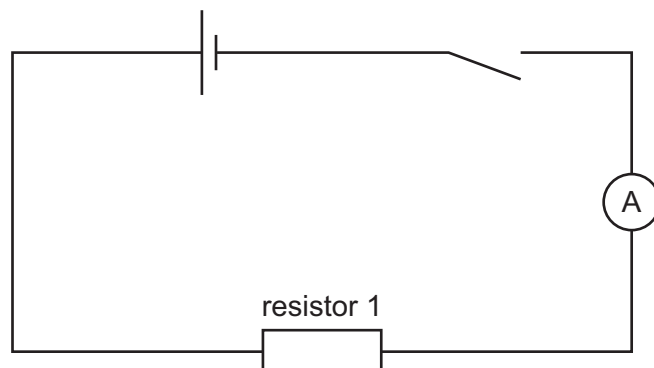


Figure 3.1

Procedure

The student:

- closes the switch
- records the ammeter reading
- opens the switch.

(a) Figure 3.2 shows the ammeter reading I_1 .

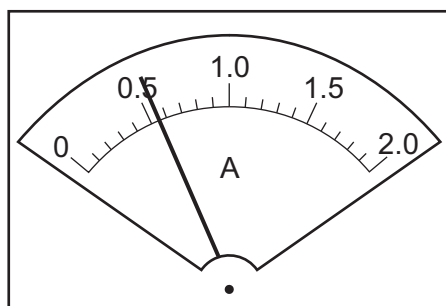


Figure 3.2

Record I_1 to the nearest 0.05A.

$I_1 = \dots\dots\dots$ A [1]



(b) The student connects an identical resistor in parallel with resistor 1.

Draw this resistor connected to the circuit on Figure 3.1.

Label this resistor as resistor 2.

[1]

(c) **Procedure**

The student:

- closes the switch
- records the ammeter reading
- opens the switch.

Figure 3.3 shows the ammeter reading I_2 .

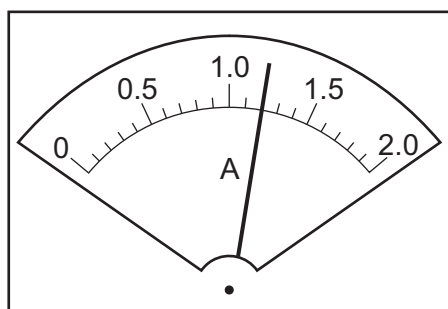


Figure 3.3

Record I_2 to the nearest 0.05A.

$I_2 = \dots\dots\dots$ A [1]

(d) A student suggests that if resistor 2 has the same resistance as resistor 1 then

$$I_2 = 2 \times I_1.$$

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

State if your values of I_1 and I_2 support the student's suggestion within the limits of experimental error.

Justify your answer with a calculation.

.....

..... [2]



- (e) The student suggests that if a third identical resistor, resistor 3, is connected in parallel with the other two resistors, the relationship between the resulting current I and I_1 is

$$I = 3 \times I_1$$

Suggest a value for I if resistor 3 is added to the circuit in Figure 3.1.

$I = \dots\dots\dots$ A [1]

- (f) Another student repeats the investigation using the same circuit but makes a mistake.

The student finds it difficult to read the ammeter because the value keeps decreasing.

Suggest the error the student makes and explain why the value keeps decreasing.

error $\dots\dots\dots$

explanation $\dots\dots\dots$

[1]

[Total: 7]





Turn over

4 Figure 4.1 shows a flexible metre ruler resting on two supports.



Figure 4.1

An identical mass is placed on each end of the metre ruler.

The centre of the metre ruler bends upwards through a distance y as shown in Figure 4.2.

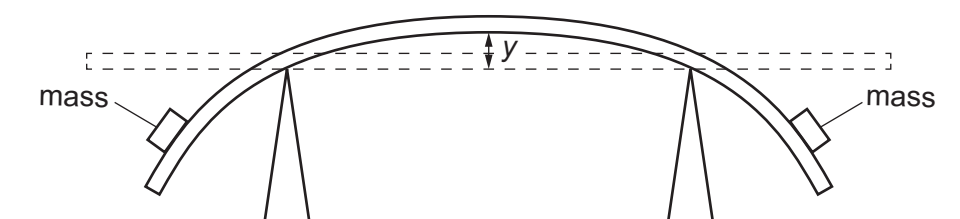


Figure 4.2

Plan an investigation to determine the relationship between distance y and the mass placed on each end of the metre ruler.

You are provided with a metre ruler and two supports.

You may use any common laboratory apparatus in your plan.

In your plan, include:

- any additional apparatus you will use
- a brief description of the method
- what you will measure
- which variables you will control
- how you will process your results to form a conclusion.

You may include a results table if you wish (you are **not** required to enter any readings into the table).





[7]

NOTES FOR USE IN QUALITATIVE ANALYSIS

Tests for anions

anion	test	test result
carbonate, CO_3^{2-}	add dilute acid, then test for carbon dioxide gas	effervescence, carbon dioxide produced
chloride, Cl^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
bromide, Br^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	cream ppt.
iodide, I^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
sulfate, SO_4^{2-} [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.

Tests for aqueous cations

cation	effect of aqueous sodium hydroxide	effect of aqueous ammonia
ammonium, NH_4^+	ammonia produced on warming	—
calcium, Ca^{2+}	white ppt., insoluble in excess	no ppt. or very slight white ppt.
copper(II), Cu^{2+}	light blue ppt., insoluble in excess	light blue ppt., soluble in excess, giving a dark blue solution
iron(II), Fe^{2+}	green ppt., insoluble in excess, ppt. turns brown near surface on standing	green ppt., insoluble in excess, ppt. turns brown near surface on standing
iron(III), Fe^{3+}	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc, Zn^{2+}	white ppt., soluble in excess, giving a colourless solution	white ppt., soluble in excess, giving a colourless solution

Tests for gases

gas	test and test result
ammonia, NH_3	turns damp red litmus paper blue
carbon dioxide, CO_2	turns limewater milky
chlorine, Cl_2	bleaches damp litmus paper
hydrogen, H_2	'pops' with a lighted splint
oxygen, O_2	relights a glowing splint

Flame tests for metal ions

metal ion	flame colour
lithium, Li^+	red
sodium, Na^+	yellow
potassium, K^+	lilac
copper(II), Cu^{2+}	blue-green

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