Cambridge Assessment International Education

Cambridge IGCSE™ (9–1)

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

6434263320

CO-ORDINATED SCIENCES **0973/61**

Paper 6 Alternative to Practical **October/November 2025**

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 [ ].
- Notes for use in qualitative analysis are provided in the question paper.

This document has **20** pages. Any blank pages are indicated.

1 A student tests potato and milk for their nutrient content.

(a) Procedure

The student:

- puts some potato into two test-tubes
- adds biuret solution to one of the test-tubes
- adds iodine solution to the other test-tube
- observes the final colour in each test-tube.

The student repeats the procedure with milk instead of potato.

The potato tests negative with the biuret solution and positive with the iodine solution.

The milk tests positive with the biuret solution and negative with the iodine solution.

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

[2]

(ii) Record in the table in **(a)(i)** the final colours the student observes in each test-tube. [4]

(iii) State the nutrients the potato and milk contain.

potato contains .....

milk contains .....

[2]

(b) A student tests 10 cm^3 of two fruit juices, **A** and **B**, with Benedict's solution.

Both juices produce a precipitate.

(i) State the name of the nutrient identified by Benedict's solution.

..... [1]

(ii) Suggest a suitable temperature the student uses for the test.

temperature = ... °C [1]

(iii) Method 1

The precipitates produced in the tests in **(b)** are filtered, dried and weighed.

The greater the mass of precipitate, the more nutrient the fruit juice contains.

The student repeats the experiment two more times.

Table 1.1 shows the masses the student obtains.

Table 1.1

fruit juice	mass of precipitate / g			
	trial 1	trial 2	trial 3	average
A	0.55	0.59	0.58	
B	0.81	0.86	0.87	

Calculate the average mass for each juice.

Record in Table 1.1 your values to **two** significant figures.

[2]

(iv) Method 2

The student repeats the tests in **(b)** using the same volumes of fruit juice and Benedict's solution.

The student observes and records the colour of the solution formed.

The student repeats the experiment two more times.

Benedict's solution gives a range of colours to indicate how much of the nutrient is present.

Explain why **method 1** allows the student to have more confidence in determining how much of the nutrient is present in each fruit juice.

.....

.....

..... [1]

(v) Suggest why the Benedict's solution needs to be in excess in **method 1**.

.....

..... [1]

[Total: 14]

2 Fig. 2.1 is a photograph of a leaf, **C**.

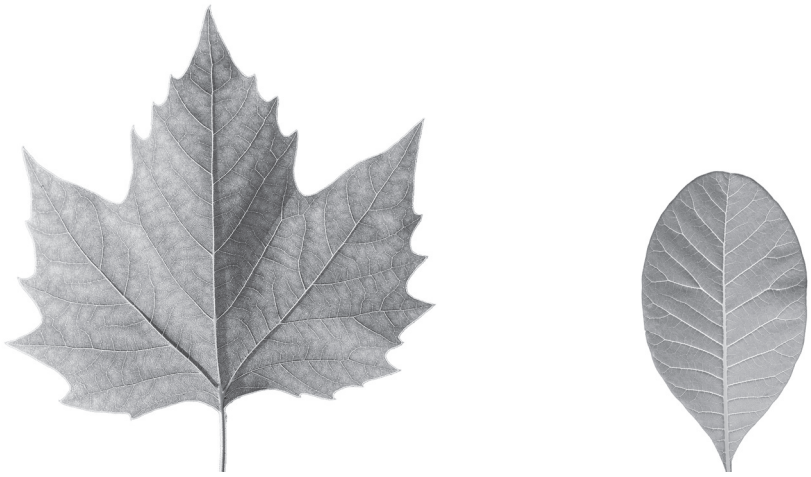
leaf **C**

Fig. 2.1

(a) In the box make a large, detailed pencil drawing of leaf **C**.

[3]

(b) Fig. 2.2 shows photographs of leaves, **C** and **D**, from two different trees. The photographs are at the same magnification.



leaf **C** leaf **D**

Fig. 2.2

State **one** similarity and **two** differences between leaf **C** and leaf **D** visible in Fig. 2.2.

similarity .....

.....

difference 1 .....

.....

difference 2 .....

.....

[3]

[Total: 6]

3 A student investigates the effect of concentration on the rate of a reaction.

Copper carbonate reacts with dilute hydrochloric acid forming carbon dioxide gas.

Copper carbonate does not dissolve in or react with water.

An aqueous solution is made less concentrated by adding water to it.

(a) Procedure

The student:

- puts 5 cm^3 of dilute hydrochloric acid into a conical flask
- adds 20 cm^3 of water to the conical flask
- adds 2 g of copper carbonate to the conical flask
- swirls the flask and immediately starts a stop-watch
- stops the stop-watch when the reaction finishes
- records in Table 3.1 the time taken to the nearest second for the reaction to finish. This is the reaction time.

The student repeats the procedure using the volumes shown in Table 3.1.

Table 3.1

volume of dilute hydrochloric acid / cm^3	volume of water / cm^3	reaction time / s
5	20	
10	15	59
15	10	
20	5	39
25	0	22

(i) Explain how the student knows when the reaction has finished.

.....

..... [1]

(ii) Suggest why this experiment is **not** done using 0 cm^3 of dilute hydrochloric acid, 25 cm^3 of water and 2 g of copper carbonate.

.....

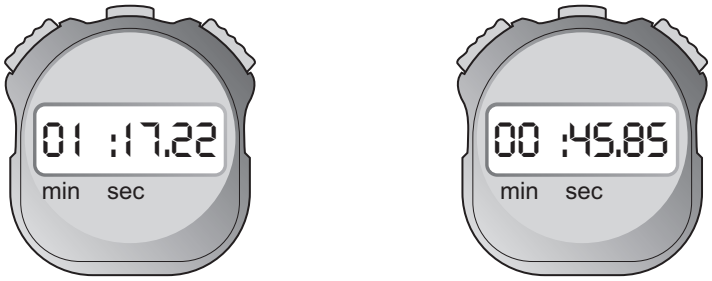
..... [1]

(iii) Explain why a 100 cm^3 measuring cylinder is **not** used to measure 5 cm^3 of dilute hydrochloric acid.

.....

..... [1]

(b) Fig. 3.1 shows the readings on the stop-watch for 5 cm^3 of dilute hydrochloric acid and 15 cm^3 of dilute hydrochloric acid.



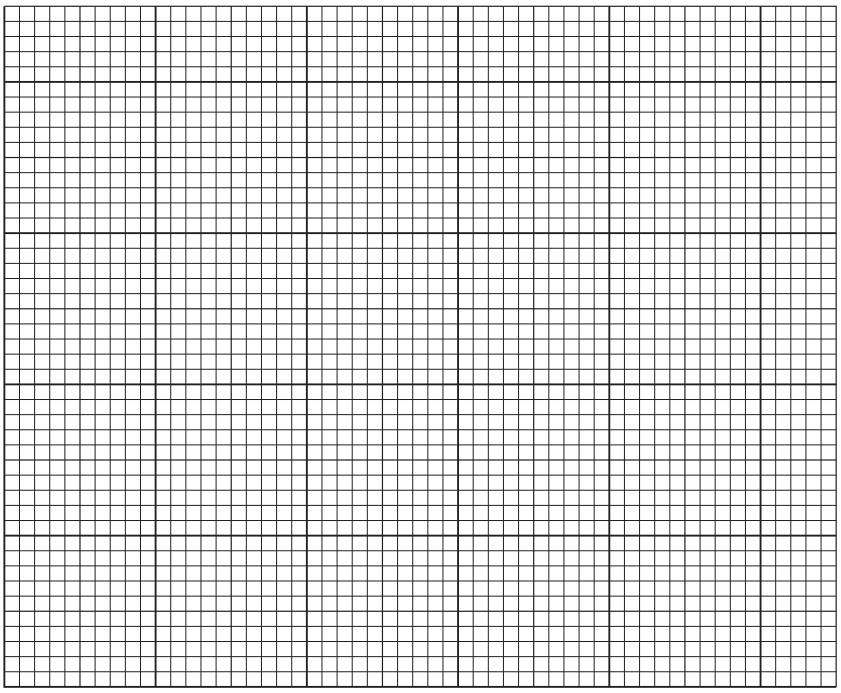
5 cm^3 15 cm^3

Fig. 3.1

Record in Table 3.1 these values to the nearest second. [2]

(c) The volume of dilute hydrochloric acid is used to represent the concentration of the dilute hydrochloric acid.

(i) On the grid, plot reaction time (vertical axis) against volume of dilute hydrochloric acid.



[3]

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

(iii) State the relationship between the concentration of dilute hydrochloric acid and the rate of the reaction.

.....

..... [1]

(iv) Use the graph to predict the reaction time when 12 cm^3 of dilute hydrochloric acid is used.

reaction time = ... s [1]

(v) The student repeats the procedure in **(a)** two more times to calculate the average reaction time for each volume of dilute hydrochloric acid.

Explain why repeating the procedure produces results for the reaction times which are more valid.

.....

.....

..... [1]

(d) (i) Increasing the temperature of a reaction increases the rate of a reaction.

On the grid, draw a line to show the expected results of the investigation done at a higher temperature. Label this line **H**. [1]

(ii) When the temperature of a substance increases the particles move more quickly.

A reaction happens when the particles collide.

Suggest why the rate of the reaction is faster when the temperature of the reaction mixture is increased.

.....

..... [1]

(e) It is possible to collect and measure the volume of carbon dioxide gas given off in the reaction.

Name the **one** piece of apparatus used to collect and measure the volume of carbon dioxide gas.

..... [1]

[Total: 15]

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4 A student identifies some of the ions in aqueous **X** and aqueous **Y**.

Only **one** of these two solutions contains the sulfate ion.

(a) (i) Procedure

The student:

- puts approximately 2 cm depth of aqueous **X** into a test-tube
- adds a few drops of aqueous barium nitrate
- records the observations in Table 4.1.

The student repeats the procedure with aqueous **Y** instead of aqueous **X**.

Both aqueous **X** and aqueous **Y** give the observation for the presence of sulfate ions.

Complete Table 4.1 with the student's observations.

Table 4.1

solution	observations with barium nitrate
X	
Y	

[1]

(ii) Suggest an improvement to the test which will identify the solution that contains the sulfate ion.

Explain your answer.

improvement .....

.....

explanation .....

.....

[2]

(b) Aqueous **X** and aqueous **Y** each contain the same cation.

Procedure

The student:

- puts approximately 2 cm depth of aqueous **X** into a test-tube
- soaks a splint in aqueous **X**
- puts the splint into the top of a blue Bunsen burner flame
- observes the first colour seen and records this in Table 4.2.

The student repeats the procedure with another splint and uses aqueous **Y** instead of aqueous **X**.

Table 4.2

solution	colour of flame
X	lilac
Y	yellow

A teacher confirms that the cation in **X** and **Y** is the potassium ion.

State which one of the student's observations is **not** correct.

Suggest what causes this **incorrect** colour to be observed.

incorrect colour .....

suggestion .....

.....

[1]

(c) State the name of the substance used to find the pH of aqueous **Y**.

..... [1]

[Total: 5]

5 A student does an experiment to calculate the focal length *f* of a converging lens.

Fig. 5.1 shows the apparatus the student uses.

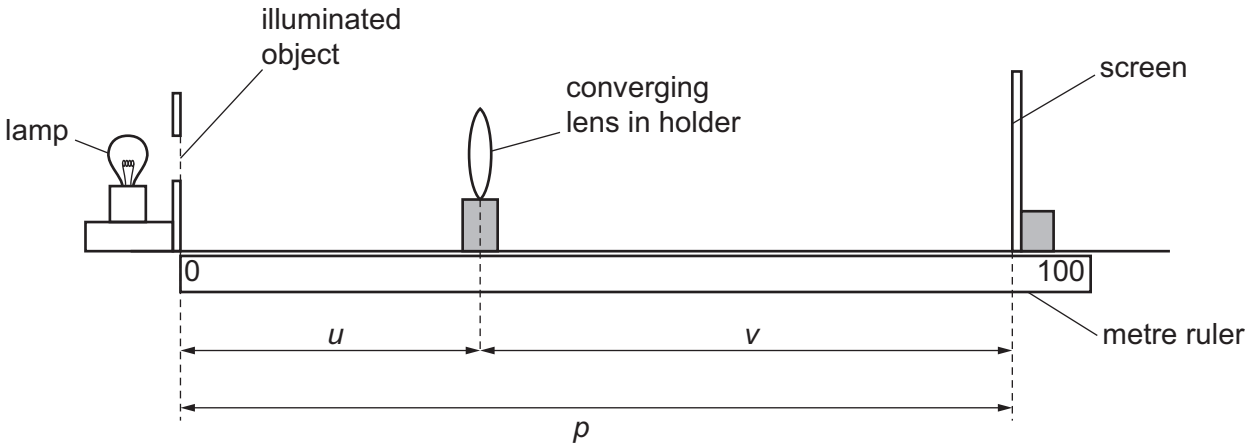

Fig. 5.1

(a) Procedure

The student:

- places the lens so that its centre is at a distance u = 30.0 cm from the illuminated object
- switches on the lamp
- moves the **screen** to make a focused, sharp image on the screen
- measures the distance p between the illuminated object and the screen.

(i) Fig. 5.2 shows the position of the screen when the image is sharp.

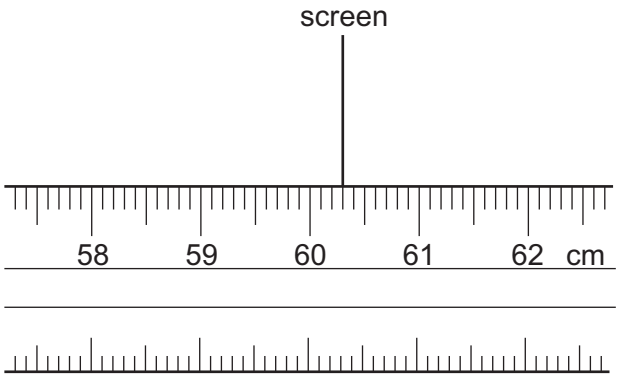

Fig. 5.2

Record the distance p of the screen in cm to the nearest 0.1 cm.

p = ... cm

Calculate the distance v between the centre of the lens and the screen.

Use the equation shown.

$$v = p - 30.0$$

Record in Table 5.1 this distance v in cm to the nearest 0.1 cm.

[2]

Table 5.1

u / cm	v / cm	$u \times v$	$u + v$ / cm	f / cm
30.0				
50.0				

(ii) The student:

- moves the lens to a distance $u = 50.0$ cm from the illuminated object
- moves the **screen** to make a focused, sharp image on the screen.

Fig. 5.3 shows the new distance p of the screen.

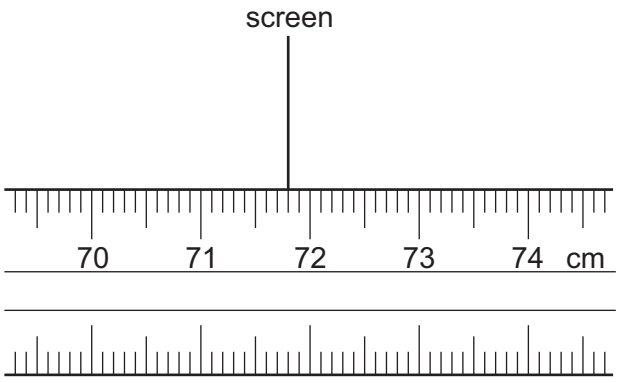

Fig. 5.3

Record the distance p of the screen in cm to the nearest 0.1 cm.

p = ... cm

Calculate the distance v between the centre of the lens and the screen.

Use the equation shown.

$$v = p - 50.0$$

Record in Table 5.1 this distance v in cm to the nearest 0.1 cm.

[1]

(iii) State **one** difficulty the student has when following the procedure.

Describe how this difficulty is overcome.

difficulty .....

.....

how to overcome .....

.....

[1]

(b) (i) Calculate $u \times v$ for both values of u.

Record these values in Table 5.1.

[1]

(ii) State the unit for $u \times v$.

..... [1]

(iii) Calculate $u + v$ for both values of u.

Record these values in Table 5.1.

[1]

(iv) Calculate f for both values of u.

Use the equation shown.

$$f = \frac{u \times v}{u + v}$$

Record these values in Table 5.1.

[1]

(v) The student repeats the procedure in **(a)** using a distance u = 40.0 cm between the illuminated object and the lens.

The distance v = 23.9 cm.

Describe the relationship between u and v.

Use these values of u and v and the values from Table 5.1.

.....

..... [1]

(c) (i) Two students do another experiment to determine the focal length *f* of a different lens.

The lens has a focal length *f* of 10.6 cm.

The students each determine a value for *f* and repeat the experiment three more times.

Their values for *f* are shown in Table 5.2.

Table 5.2

	f / cm			
	trial 1	trial 2	trial 3	trial 4
student **A**	10.7	10.2	12.3	10.1
student **B**	10.6	10.4	10.6	10.5

The results for student **B** are more accurate than the results for student **A**.

Use the data in Table 5.2 to explain why the results for student **B** are more accurate.

.....

..... [1]

(ii) The students use an identical ruler to measure the height of an image on a screen.

The students each take a single measurement of the height.

The students record their results in mm as shown.

student **A**, height of image = 21.2 mm

student **B**, height of image = 21 mm

The result from student **A** is **not** correct.

Explain why.

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..... [1]

(d) Fig. 5.4 shows an illuminated object.

The object is drawn actual size in Fig. 5.4.

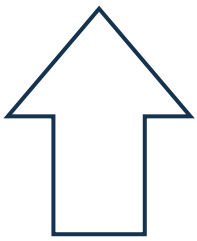

Fig. 5.4

The image produced on a screen by a lens is inverted and enlarged. This is image **C**.

With a different lens system, the image on a screen is upright and diminished.
This is image **D**.

Draw both images.

image C **image D**

[2]

[Total: 13]

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6 A student investigates the time taken for one swing of a pendulum (period).

Plan an experiment to determine the relationship between the time for one swing of a pendulum (period) and the length of the string, l.

You are provided with the assembled apparatus shown in Fig. 6.1.

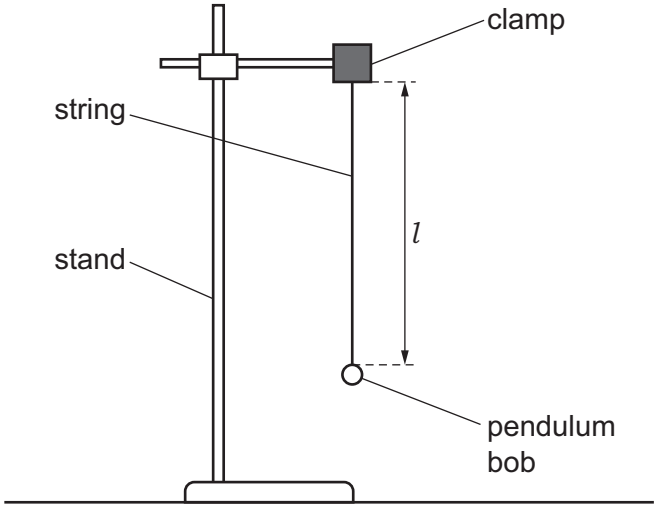

Fig. 6.1

You may use any common laboratory apparatus in your plan.

In your plan, include:

- any additional apparatus
- what you will measure including how you make sure your results are accurate
- the variables you will control
- a results table to record your measurements (you are **not** required to enter any readings into the table)
- how you will process your results to form a conclusion.

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..... [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.
nitrate, NO_3^- [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
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