CAMBRIDGE
International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5312091644

PHYSICS **5054/42**

Paper 4 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 [ ].

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

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1 A student investigates the oscillations of a pendulum and determines two values for the acceleration due to gravity.

The student arranges the pendulum in a clamp as shown in Figure 1.1.

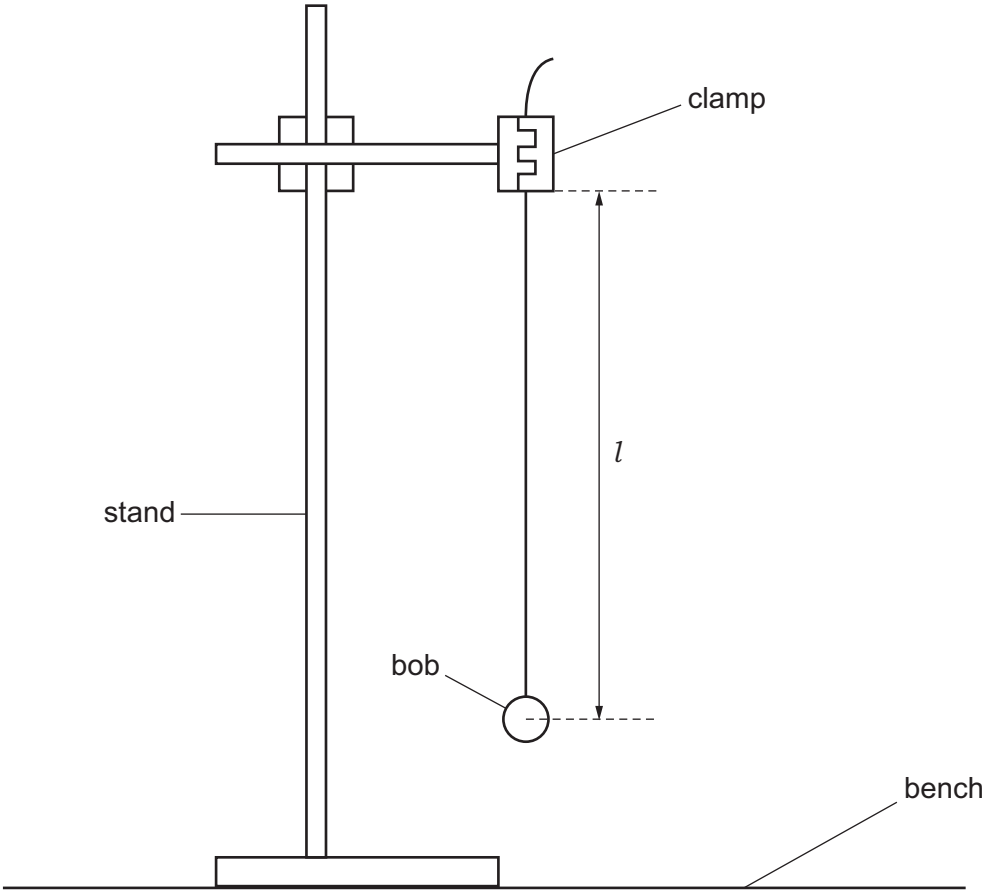

Figure 1.1

The length l of the pendulum is the distance from the bottom of the clamp to the centre of the pendulum bob.

(a) (i) Measure the length l of the pendulum in Figure 1.1.

Record your measurement in centimetres to the nearest 0.1 cm.

l = ... cm [1]

(ii) Figure 1.1 has been drawn to a scale of one-fifth full size.

Calculate the actual length *L* of the pendulum **in metres**.

Record your answer in the first column of Table 1.1.

[1]

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Table 1.1

L / m	t / s	T / s
.....	.....	.....
0.700	34.0	1.70

(b) procedure

The student:

- gives the bob a small sideways displacement and releases it so that it oscillates
- measures the time t for 20 oscillations of the pendulum.

The stopwatch reading is shown in Figure 1.2.



Figure 1.2

(i) Record t to 3 significant figures in the second column of Table 1.1. [1]

(ii) Calculate the period T of the pendulum. The period is the time for 1 oscillation of the pendulum.

Record, in Table 1.1, your answer to 3 significant figures. [1]

(c) The student:

- adjusts the length of the string until the length L of the pendulum is 0.700 m
- repeats the procedure in **1(b)**.

The student records the results in Table 1.1.

Using data from Table 1.1, show that T is **not** proportional to L.

.....

..... [1]

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(d) The acceleration due to gravity in m/s^2 can be calculated using the equation shown.

$$g = \frac{39L}{T^2}$$

(i) Calculate a first value g_1 for the acceleration due to gravity, using your value of L from **1(a)(ii)** and your value of T from **1(b)(ii)**.

Show your working and give your answer to 2 significant figures.

g_1 = ... m/s^2 [1]

(ii) Calculate a second value g_2 for the acceleration due to gravity, using the data for L = 0.700 m from Table 1.1.

g_2 = ... m/s^2 [1]

(e) Two quantities can be considered to be the same within the limits of experimental accuracy if their values are within 10% of each other.

Compare your value of g_1 from **1(d)(i)** with your value of g_2 from **1(d)(ii)**.

State if your two values can be considered to be the same.

Support your statement with a calculation.

calculation

statement .....
[2]

(f) State **one** technique that the student uses when doing the experiment to ensure that the results are accurate.

.....

.....

..... [1]

[Total: 10]

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Turn over

2 A student compares two methods of reducing the rate of temperature decrease in a beaker of hot water.

The student uses two identical beakers, P and Q.

Beaker P is wrapped with a layer of insulation but has no lid. Beaker Q has a lid but no layer of insulation.

The beakers are shown in Figure 2.1.

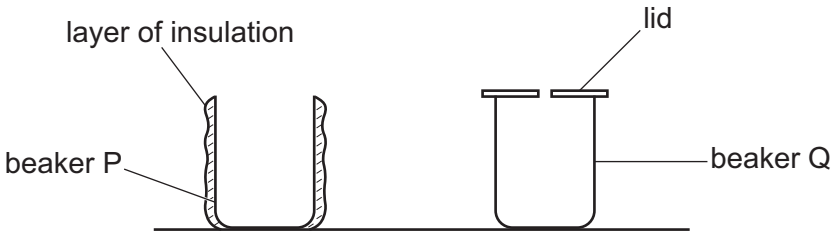

Figure 2.1

(a) procedure

The student:

- pours 200 cm^3 of hot water into beaker P
- places a thermometer into the water
- waits until the thermometer reading has stopped increasing
- records the temperature θ of the hot water
- immediately starts a stopwatch
- allows the hot water to cool for 240 s
- measures the temperature θ of the water in the beaker, and records it in Table 2.1 at time t = 240 s.

The maximum thermometer reading is shown in Figure 2.2.

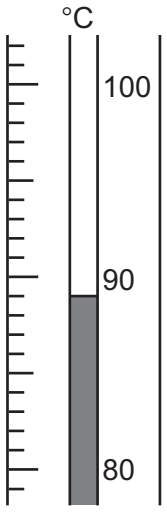

Figure 2.2

(i) Read the temperature θ of the hot water in beaker P at time t = 0. Record your reading in the second column of Table 2.1. [1]

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Table 2.1

	beaker P	beaker Q
t/	*θ*/	*θ*/ .....
0	.....	90
240	77	82

(ii) The student repeats the procedure for beaker Q.

The thermometer readings are shown in Table 2.1.

Add units to the column headings in Table 2.1. [1]

(b) (i) Use the temperature readings in Table 2.1 to calculate the temperature decrease of the hot water in beaker P and in beaker Q after cooling for 240 s.

temperature decrease in beaker P = ... °C

temperature decrease in beaker Q = ... °C
[1]

(ii) Calculate the **rate** of temperature decrease of the water in each beaker using the equation shown.

$$\text{rate of temperature decrease} = \frac{\text{temperature decrease}}{\text{time}}$$

Give your answers to 2 significant figures.

rate of temperature decrease from the water in beaker P = ... °C / min

rate of temperature decrease from the water in beaker Q = ... °C / min
[2]

(iii) State which beaker P or Q has the more effective method of reducing the rate of temperature decrease.

Explain how you reached your conclusion.

.....

.....

..... [1]

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(c) State **two** factors that must be controlled to make a valid comparison between the rates of temperature decrease of beaker P and beaker Q.

1 .....

2 .....

[2]

(d) This experiment compares the effect of a layer of insulation with the effect of a lid on the rate of decrease of temperature.

A student wants to find how the rate of decrease of temperature of the water in a beaker surrounded by a layer of insulation compares with the rate of decrease of temperature of the water in a beaker with no insulation.

Suggest **one** change to the apparatus that will enable this new comparison to be made.

.....

..... [1]

(e) Handling a beaker containing hot water is dangerous.

State **one** safety precaution that the student takes when doing the experiment.

.....

..... [1]

[Total: 10]

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3 A student investigates the potential difference across resistors in a circuit.

The student assembles the circuit shown in Figure 3.1.

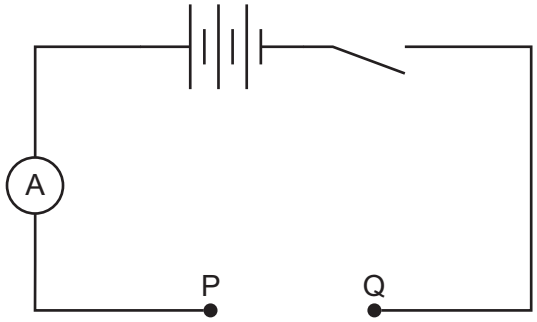

Figure 3.1

procedure

The student:

- connects a 12 Ω resistor into the gap between terminals P and Q in the circuit
- connects a voltmeter to measure the potential difference across the resistor
- closes the switch
- measures and records the potential difference V across the resistor and the current I in the circuit
- opens the switch
- removes the 12 Ω resistor.

(a) (i) On Figure 3.1, using the correct circuit symbol, draw a resistor connected between terminals P and Q. [1]

(ii) On Figure 3.1, using the correct circuit symbol, draw a voltmeter connected to measure the potential difference across the resistor. [1]

(b) The voltmeter and ammeter readings are shown in Figure 3.2.

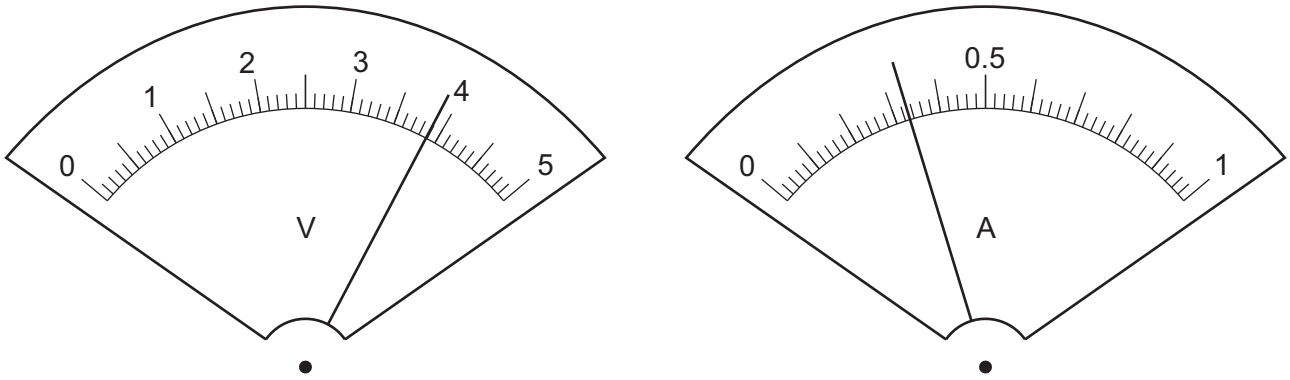

Figure 3.2

(i) Record, in Table 3.1, the potential difference V across the 12 Ω resistor. [1]

(ii) Record, in Table 3.1, the current I in the circuit with the 12 Ω resistor. [1]

(c) The student repeats the procedure for resistors of value 15 Ω, 18 Ω, 22 Ω and 33 Ω.

The student's results are shown in Table 3.1.

Table 3.1

resistance R/Ω	potential difference V/V	current I/A
12	.....	.....
15	4.0	0.27
18	4.1	0.23
22	4.2	0.19
33	4.3	0.13

On the grid provided in Figure 3.3, plot a graph of V on the y-axis against I on the x-axis.

Start the x-axis from I = 0 A.

Do **not** start the y-axis from V = 0 V.

Draw the straight line of best fit. [4]

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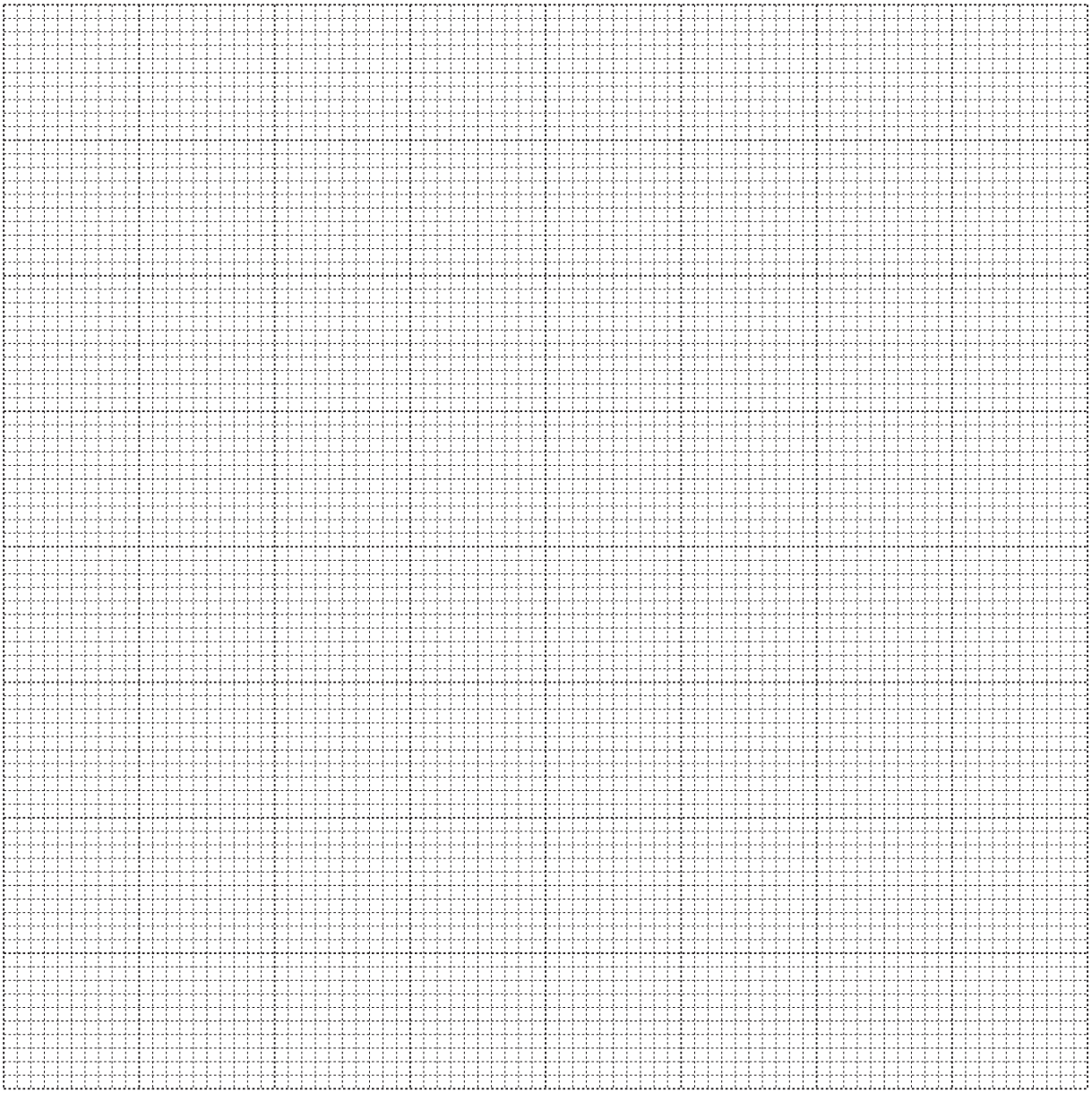

Figure 3.3

(d) Determine the gradient *G* of your line. Show all working, and indicate on the graph the values you use.

G = ... [3]

(e) The magnitude of gradient *G* of your line is equal to the resistance *r* of the battery.

Write down the value of *r*.

Record your answer to the nearest ohm.

r = ... Ω [1]

(f) The student is able to use the graph to find the predicted e.m.f of the battery.

Describe how the student uses the voltmeter to measure the **actual** e.m.f. of the battery.

.....

..... [1]

(g) When doing the experiment, it is important that the terminals P and Q are not allowed to come into contact with each other at any time.

Suggest why terminals P and Q **must not** touch.

.....

..... [1]

[Total: 14]

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Turn over

4 When air moves over the surface of hot water in a beaker, it changes the rate of cooling of the hot water.

Plan an experiment to investigate the relationship between the speed of a fan producing the moving air and the rate of cooling of the hot water in the beaker.

The apparatus available includes:

a supply of hot water
a beaker
a thermometer
an electric fan with five speed settings.

You may also use any apparatus commonly available in a school laboratory.

In your plan include:

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

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