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Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER | CANDIDATE NUMBER

7313246689

PHYSICS **5054/32**

Paper 3 Practical Test **May/June 2025**

1 hour 30 minutes

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

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 40.
- The number of marks for each question or part question is shown in brackets [ ].

For Examiner's Use	
1	
2	
3	
4	
Total	

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

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1 In this experiment, you will investigate the refraction of a ray of light passing through a transparent block and determine the refractive index *n* of the block.

You are provided with:

- a transparent, rectangular block
- a 30 cm ruler
- a protractor
- an illuminated slit or a raybox with a slit.

(a) Fig. 1.2 is on page 3 of your question paper.

On Fig. 1.2, draw a normal to the line PQ at the point R. Extend your normal 6 cm above and at least 8 cm below PQ. Measure the angle θ between SR and the normal.

θ = ...° [1]

(b) Place the block on Fig. 1.2, with one of its long sides along the line PQ. The top left-hand corner of the block must be at A, as shown in Fig. 1.1.

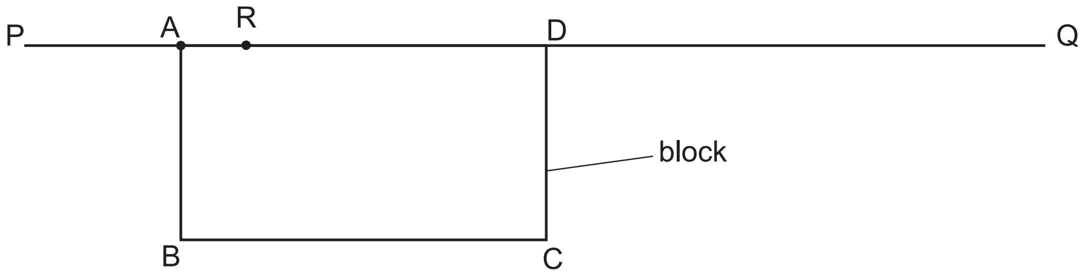

Fig. 1.1

On Fig. 1.2, draw around the outline of the block.

Remove the block and label the outline of the block ABCD as shown in Fig. 1.1.

Mark the point where the normal crosses side BC of the block with the letter T.

Replace the block and switch on the lamp.

Position the illuminated slit so that a ray of light passes along the line SR towards R.

On Fig. 1.2, mark with small crosses (X) two points on the ray that leaves side BC of the block. Choose the position of the points so that the ray leaving the block can be accurately marked.

Switch off the lamp. [1]

(c) Remove the block.

Draw a straight line through the two crosses to meet side BC of the block.

Label the point where the line meets BC with the letter E. Label the other end of the line as F.

Draw a straight line from E to R. This shows the path of the ray of light through the block.

Fig. 1.2

(i) Measure and record the length *a* of ET. *a* = ... cm [1]

(ii) Measure and record the length *b* of ER. *b* = ... cm [1]

(iii) Extend the line FE into the block until it meets the line RT.

Label the point where FE meets RT with the letter G.

Measure the length *c* of EG. *c* = ... cm [1]

(d) **(i)** Use your values for *a* and *b* from **(c)(i)** and **(c)(ii)** to calculate a first value n_1 for the refractive index of the block.

Use the equation shown.

$$n_1 = \frac{b}{2a}$$

n_1 = ... [1]

(ii) Use your values for *b* and *c* from **(c)(ii)** and **(c)(iii)** to calculate a second value n_2 for the refractive index of the block.

Use the equation shown:

$$n_2 = \frac{b}{c}$$

n_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 n_1 for the refractive index calculated in **(d)(i)** with the value n_2 calculated in **(d)(ii)**.

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

Support your statement with a calculation.

calculation

statement ....

[2]

(f) One source of inaccuracy in this experiment is careless measurement.

Suggest **another** source of inaccuracy in this experiment.

....

.... [1]

[Total: 10]

2 In this experiment you will investigate the resistance of a thermistor at different temperatures.

You are provided with:

- a power source
- a switch
- a voltmeter with two leads that may be connected between different points in the circuit shown in Fig. 2.1
- a thermistor placed inside an empty beaker
- a 220 Ω resistor
- a stirring thermometer
- a supply of hot water from the supervisor
- paper towels to mop up spillages.

The supervisor has set up the circuit shown in Fig. 2.1.

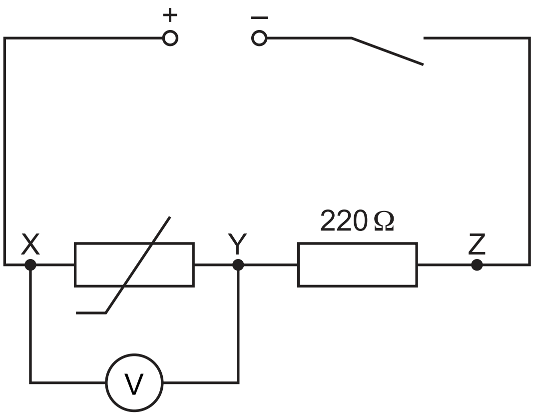

Fig. 2.1

(a) **(i)** Measure the room temperature θ_R and record it on the answer line.

θ_R = ... °C

Close the switch.

Record the potential difference across the thermistor V_{XY} while the thermistor is at room temperature θ_R in Table 2.1 on page 6.

Open the switch. [1]

(ii) Disconnect the voltmeter from points X and Y.

Reconnect the voltmeter across the 220 Ω resistor between points Y and Z.

Close the switch.

Record the potential difference across the 220 Ω resistor V_{YZ} while the thermistor is at room temperature θ_R in Table 2.1 on page 6.

Open the switch. [1]

Table 2.1

	V_{XY}/V	V_{YZ}/V	I/A
thermistor at room temperature θ_R			
thermistor at temperature of hot water θ_H			

(b) **(i)** Disconnect the voltmeter from points Y and Z.

Reconnect the voltmeter across points X and Y.

Ask your supervisor to pour hot water into the beaker until it is about half full.

Carefully place the thermometer in the hot water and stir the water gently.

Wait for about 30 s.

Measure the temperature of the hot water θ_H and record it on the answer line.

θ_H = ... °C [1]

(ii) Close the switch.

Record the new potential difference V_{XY} while the thermistor is at the temperature of the hot water θ_H in the bottom row of Table 2.1.

Open the switch. [1]

(c) Disconnect the voltmeter from points X and Y.

Reconnect the voltmeter across the 220 Ω resistor between points Y and Z.

Close the switch.

Record the new potential difference V_{YZ} while the thermistor is at the temperature of the hot water θ_H in the bottom row of Table 2.1.

Open the switch.

Hold the thermistor by its connecting leads and carefully remove it from the hot water. Place it on the bench away from the rest of the circuit. [1]

(d) **(i)** Explain why you waited for 30 s before measuring the temperature of the hot water.

....

.... [1]

(ii) Explain why you stirred the water before reading the temperature of the hot water.

....

.... [1]

(e) The current I in the circuit is calculated using the equation

$$I = \frac{V_{YZ}}{R}$$

where $R = 220\,\Omega$.

Use your measurements recorded in Table 2.1 to calculate the current I at room temperature θ_R **and** at the temperature of the hot water θ_H.

Record your answers in Table 2.1. [1]

(f) The resistance R_T of the thermistor is calculated using the equation:

$$R_T = \frac{V_{XY}}{I}$$

Use your data in Table 2.1 to calculate R_T at room temperature θ_R and R_T at the temperature of the hot water θ_H.

R_T at room temperature θ_R = ... Ω

R_T at temperature of the hot water θ_H = ... Ω

[1]

(g) Calculate α, the average change in the resistance per degree Celsius for the thermistor as its temperature rises from room temperature θ_R to the temperature of the hot water θ_H.

Use the equation shown.

$$\alpha = \frac{\text{change in resistance of thermistor}}{\text{change in temperature}}$$

α = ... Ω / °C [1]

[Total: 10]

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3 In this experiment you will investigate the stretching of a spring.

You are provided with:

- two bosses, clamps and stands
- a steel spring
- a set square
- a metre rule with a millimetre scale
- a set of 1.0 N loads.

The spring and the metre rule have been set up for you as shown in Fig. 3.1.

Do **not** remove the spring from the clamp or adjust the height of the clamp.

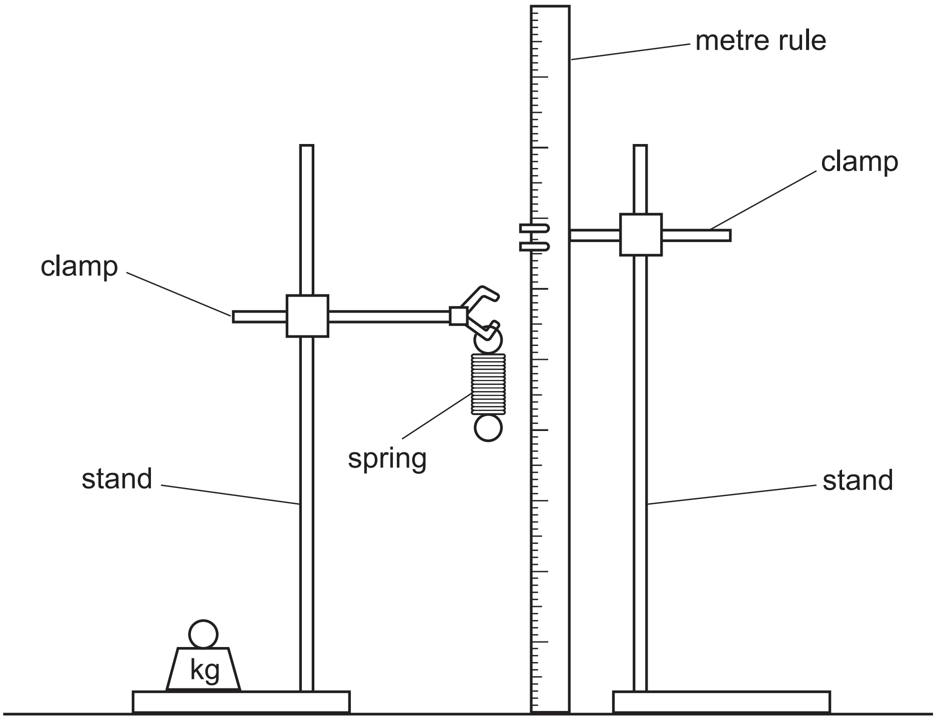

Fig. 3.1

(a) **(i)** Take the reading R_t on the metre rule level with the top of the spring.

Take the reading R_b on the metre rule level with the bottom of the spring.

Do **not** include the loads at the top and the bottom of the spring in your measurements. Use the set square to help you take the readings.

Record your readings to the nearest 0.1 cm.

reading R_t = ... cm

reading R_b = ... cm
[2]

(ii) Draw on Fig. 3.1 to show how you use the set square to take a reading from the metre rule level with the bottom of the spring. [1]

(iii) Calculate the length l of the spring with no load suspended from it. Use the equation shown:

$$l = R_b - R_t$$

Show your working.

Record R_b and l in Table 3.1 for load L = 0.0 N. [1]

(b) **(i)** Place a load L = 1.0 N on the spring.

Take readings to determine the new length l of the spring.

Record the new reading R_b and the new length l of the spring for load L = 1.0 N in Table 3.1. [1]

(ii) Repeat the procedure in **(b)(i)** for loads L = 2.0 N, 3.0 N, 4.0 N and 5.0 N, and record your values of R_b and l in Table 3.1. You may use the space provided for working.

Table 3.1

load L / N	0.0	1.0	2.0	3.0	4.0	5.0
reading R_b / cm						
length l / cm						

[1]

(c) On the grid provided in Fig. 3.2 on page 11, plot a graph of l on the y-axis against L on the x-axis.

Start from the origin (0, 0).

Draw the straight line of best fit. [4]

(d) Use your data in Table 3.1 and the graph in Fig. 3.2 to determine the **extension** of the spring when a load of 3.5 N is added to the spring.

Show your working.

extension = ... cm [2]

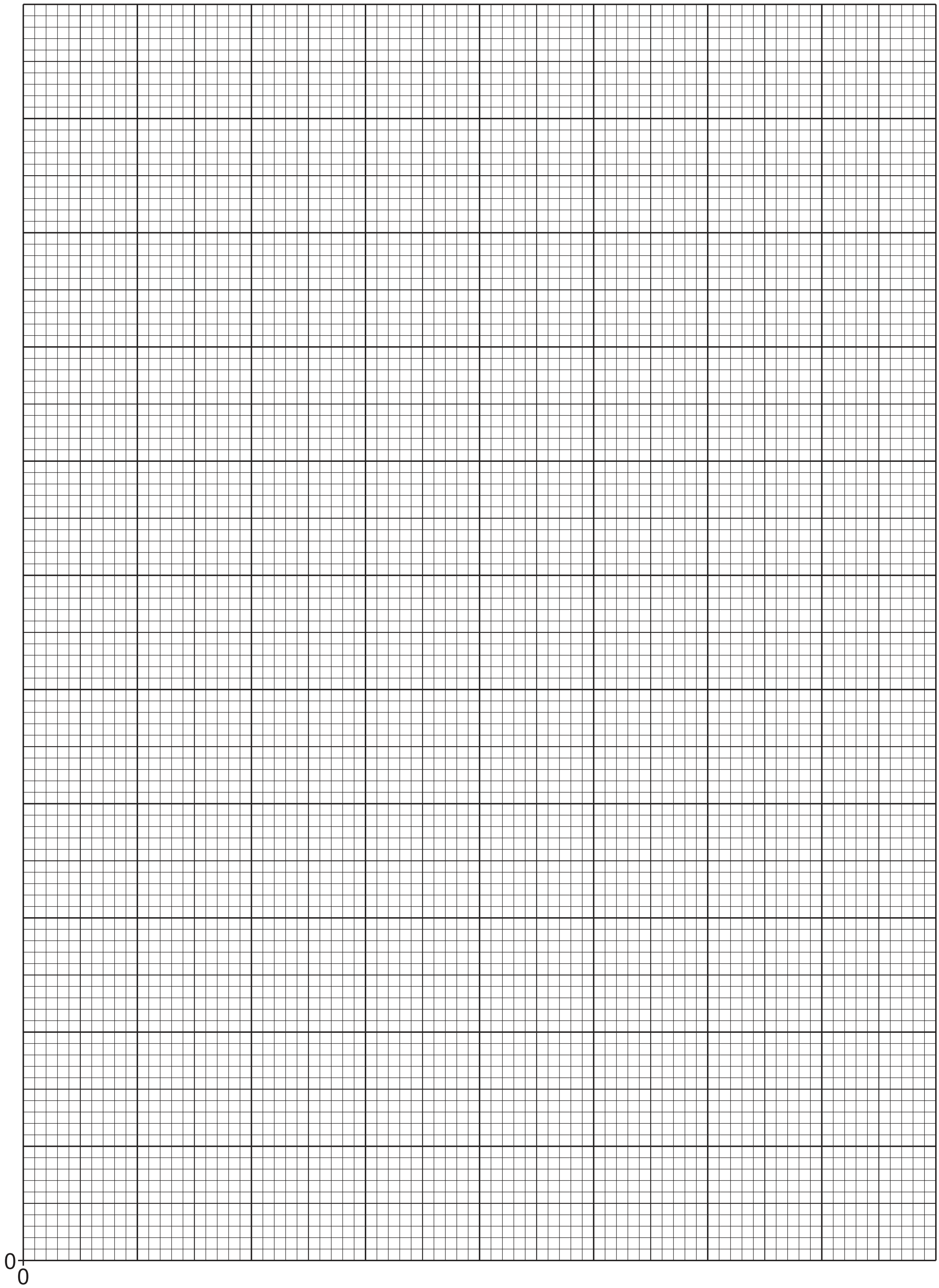

Fig. 3.2

(e) A student suggests that the stretched length l of the spring is directly proportional to load L.

State if your data supports this suggestion.

Justify your statement using your data in Table 3.1 on page 10 or the graph in Fig. 3.2 on page 11.

statement ....

justification ....

....

.... [1]

(f) Line of sight (parallax) errors can occur when readings are taken from a metre rule.

State one practical technique, other than using a set square, that ensures accurate readings are taken from a metre rule.

....

.... [1]

[Total: 14]

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4 As a metal ball falls through a liquid, it experiences a frictional force from the liquid that opposes the motion of the metal ball.

Plan an experiment to determine the relationship between the density of a liquid contained in a measuring cylinder and the average speed of a metal ball falling through the liquid from the surface of the liquid to the bottom of the cylinder.

The average speed of the ball is calculated using the equation:

$$\text{average speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

The arrangement of the apparatus is shown in Fig. 4.1.

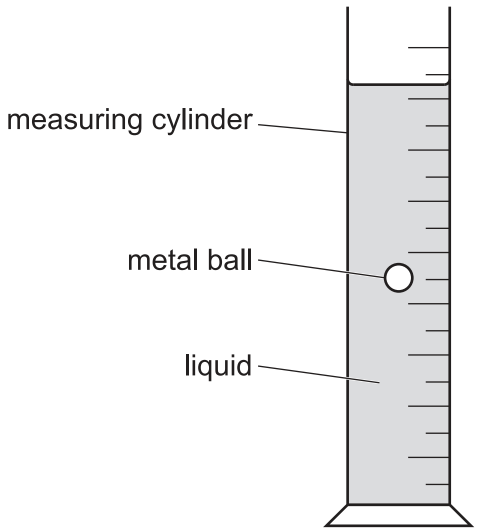

Fig. 4.1

The apparatus available includes:

- a measuring cylinder
- a metal ball
- a selection of different liquids whose densities are known.

You are **not** required to do this experiment.

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 draw a conclusion.

[6]