

Experimental technique

Question Paper 4

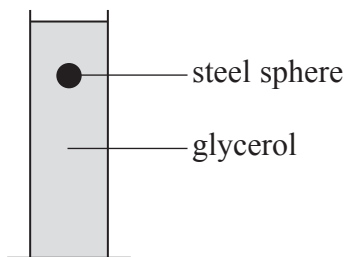
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|-------------------|------------------------|
| Level | International A Level |
| Subject | Physics |
| Exam Board | Edexcel |
| Topic | Experimental technique |
| Sub Topic | |
| Booklet | Question Paper 4 |

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|----------------------|-------------------|
| Time Allowed: | 74 minutes |
| Score: | /61 |
| Percentage: | /100 |

Grade Boundaries:

| | | | | | | |
|------|--------|-----|-------|-------|-----|------|
| A* | A | B | C | D | E | U |
| >85% | '77.5% | 70% | 62.5% | 57.5% | 45% | <45% |

- 1 In an experiment to measure the viscosity η of glycerol, steel spheres are timed falling through a column of glycerol.



The relationship to be used is

$$v = \frac{2r^2g(\rho_s - \rho_g)}{9\eta}$$

where v is the terminal velocity of the sphere, r is the radius of the sphere, ρ_s is the density of steel, ρ_g is the density of glycerol and g is the acceleration of free fall.

The results are shown in the table. The radii of the spheres are taken from data provided by the manufacturer.

| r / mm | $r^2 /$ | v / ms^{-1} |
|-----------------|---------|----------------------|
| 1 | 1 | 0.0098 |
| 2 | 4 | 0.034 |
| 3 | | 0.0781 |
| 4 | 16 | 0.15 |

- (a) Complete the table with the missing value and unit. (1)
- (b) Criticise these results. (2)

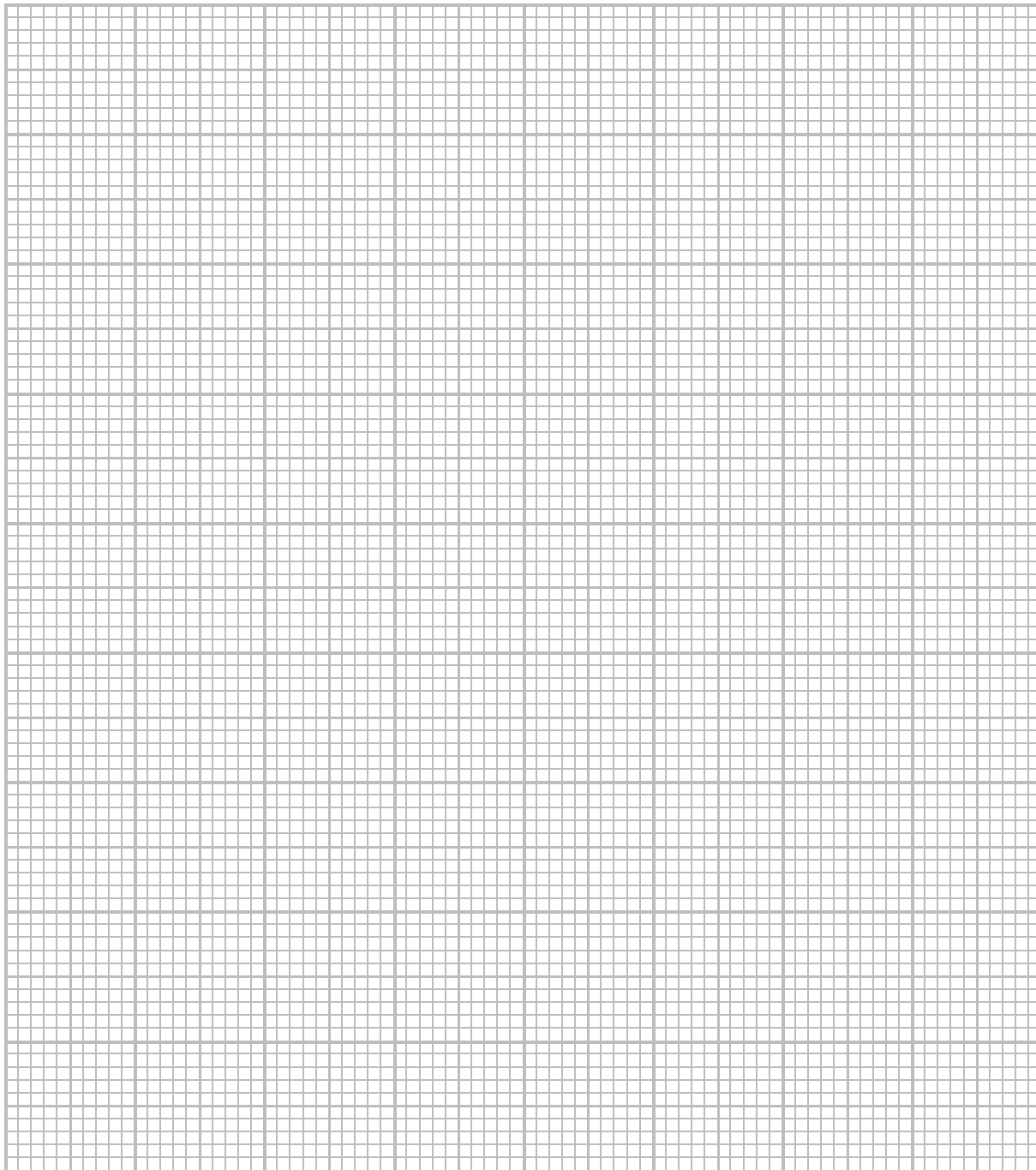
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- (d) Plot a graph of v on the y -axis against r^2 on the x -axis on the grid provided and draw a line of best fit.

(5)



(e) Use your graph to determine a value for the gradient.

(3)

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Gradient =

(f) Use your value for the gradient to calculate a value for η .

(3)

$$\rho_s = 7800 \text{ kg m}^{-3}$$

$$\rho_g \text{ (at room temperature)} = 1200 \text{ kg m}^{-3}$$

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$\eta =$

(g) Suggest **two** factors in the experiment that would affect the value of η .

(2)

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(Total for Question 1 = 18 marks)

- 2 A student is asked to investigate how resistance varies with potential difference 2
a 12 V, 24 W bulb.

Write a plan for an experiment to do this using standard laboratory apparatus and a graphical method.

You should:

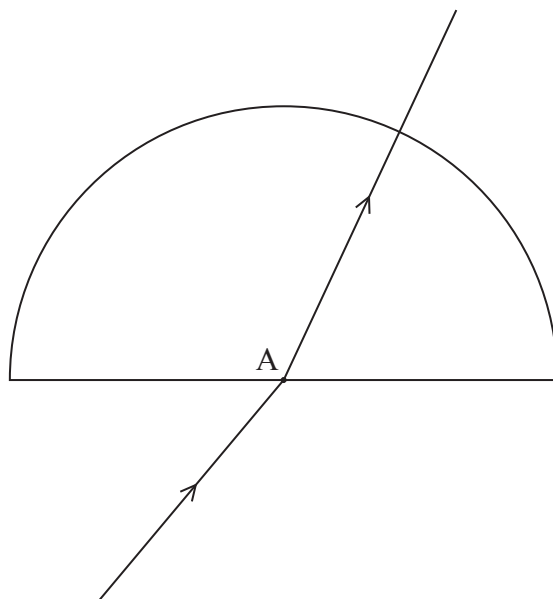
- (a) draw a circuit diagram of the circuit to be used, (2)
- (b) state the quantities to be measured, (1)
- (c) explain your choice of measuring instrument for **two** of these quantities, (4)
- (d) comment on whether repeat readings are appropriate in this case, (1)
- (e) explain how the data collected will be used and sketch the expected graph, (3)
- (f) identify the main sources of uncertainty and/or systematic error, (1)
- (g) comment on safety. (1)

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A series of horizontal dotted lines for writing.

- 4 A student carries out an experiment to determine the refractive index μ for light travelling from air into plastic. She shines a ray of light through a semicircular block of the plastic as shown.



The student measures different angles of incidence i and corresponding angles of refraction r .

- (a) Suggest what the student should do to make her measurements as accurate as possible.

(2)

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(b) The student's results are shown in the table.

| Angle of incidence i | Angle of refraction r |
|------------------------|-------------------------|
| 6 | 4 |
| 15.5 | 10 |
| 21 | 14 |
| 30 | 19 |
| 34 | 22.5 |

Criticise her results.

(3)

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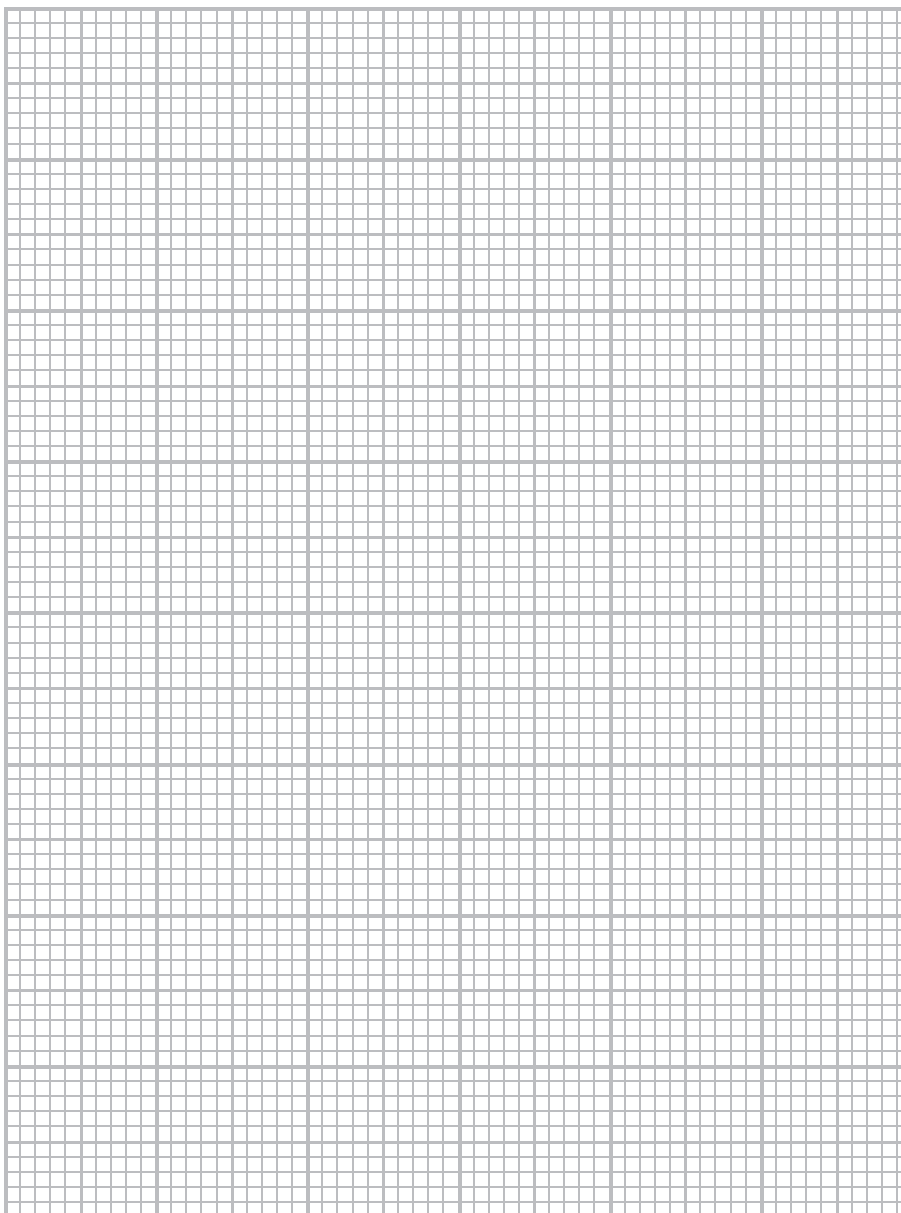
(c) On the diagram, draw a normal at A and take measurements to complete the last row of the table below.

(4)

| Angle of incidence i | Angle of refraction r | $\sin i$ | $\sin r$ |
|------------------------|-------------------------|----------|----------|
| 6 | 4 | 0.105 | 0.070 |
| 15.5 | 10 | 0.267 | 0.174 |
| 21 | 14 | 0.358 | 0.242 |
| 30 | 19 | 0.500 | 0.326 |
| 34 | 22.5 | 0.559 | 0.382 |
| | | | |

- (d) Plot a graph of $\sin i$ on the y -axis against $\sin r$ on the x -axis on the grid provided and draw a line of best fit.

(4)



(e) Use your graph to determine a value for μ .

(3)

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$\mu =$

(Total for Question 4 = 16 marks)
