Experimental technique

Question Paper 4

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

Time Allowed: **74 minutes**

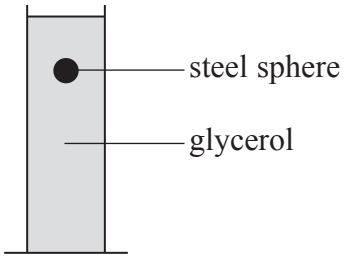
Score: **/61**

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

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

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 / m s^{-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.

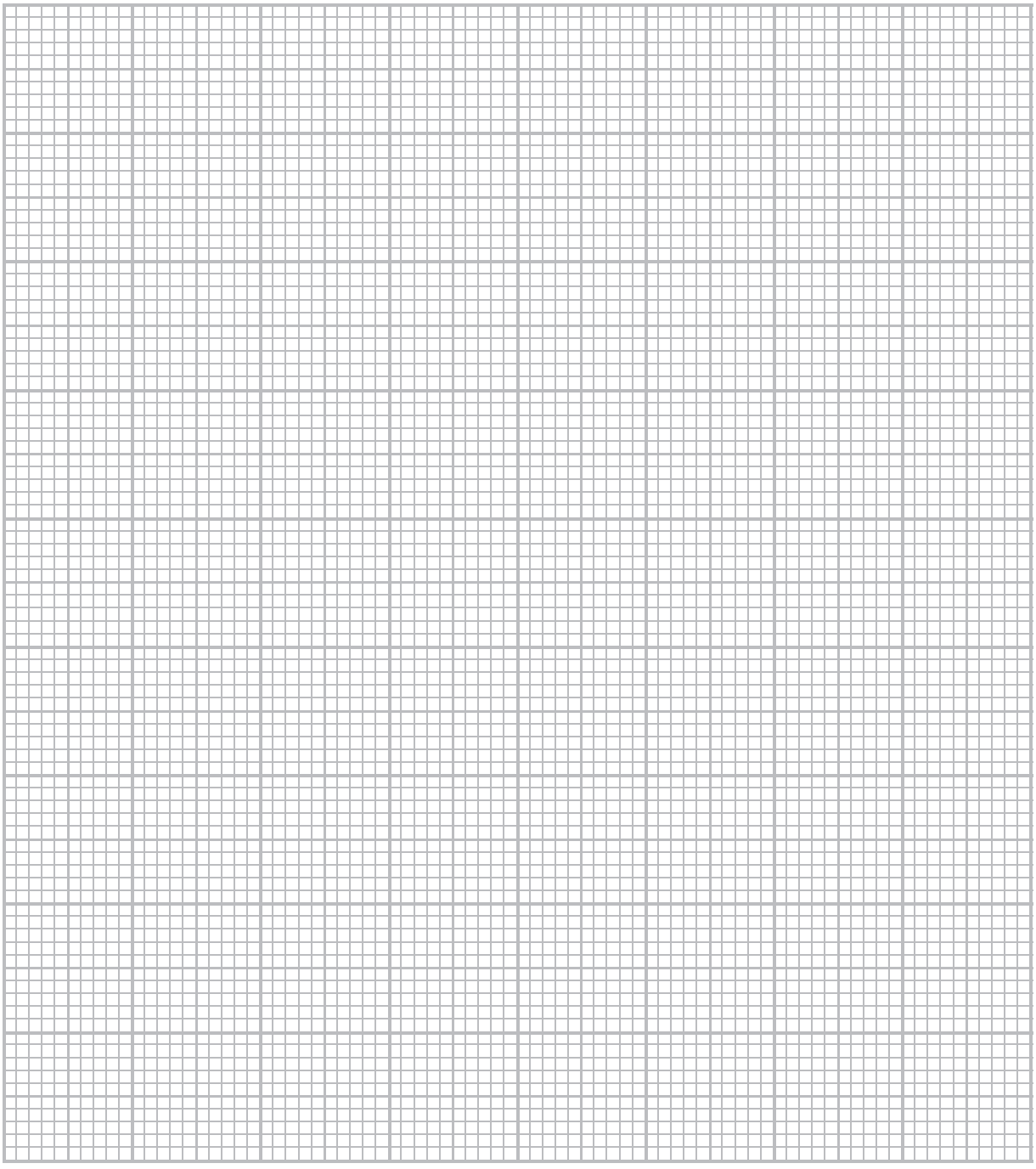
(2)

(c) Explain why a graph of v on the y-axis against r^2 on the x-axis should be a straight line with a gradient of $\frac{2g(\rho_s - \rho_g)}{9\eta}$

(2)

(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)

Gradient = ...

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

(3)

ρ_s = 7800 kg m^{-3} ρ_g (at room temperature) = 1200 kg m^{-3}

η = ...

(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)

(Total for Question 2 = 13 marks)

3 A student is asked to determine the power of another student who runs up some stairs.

Write a plan for an experiment which could be used to achieve this.

You should:

(a) list any apparatus required,

(1)

(b) state the quantities to be measured,

(1)

(c) for two of these quantities explain your choice of measuring instrument,

(4)

(d) comment on whether repeat readings are appropriate in this case,

(2)

(e) explain how the data collected will be used to determine the power,

(3)

(f) identify the main sources of uncertainty and/or systematic error,

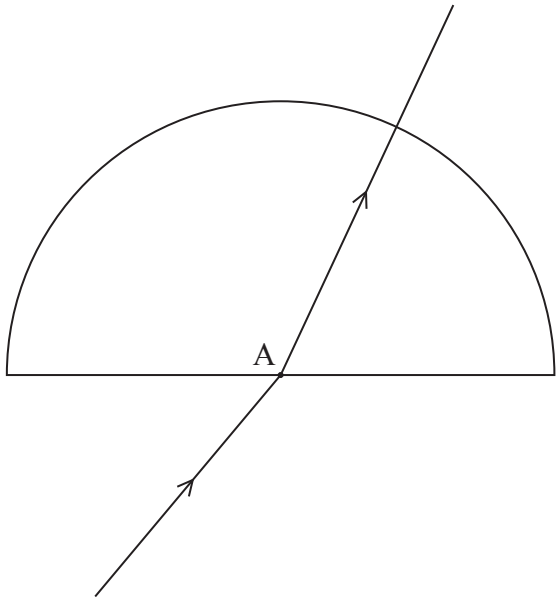
(2)

(g) comment on safety.

(1)

(Total for Question 3 = 14 marks)

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)

(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)

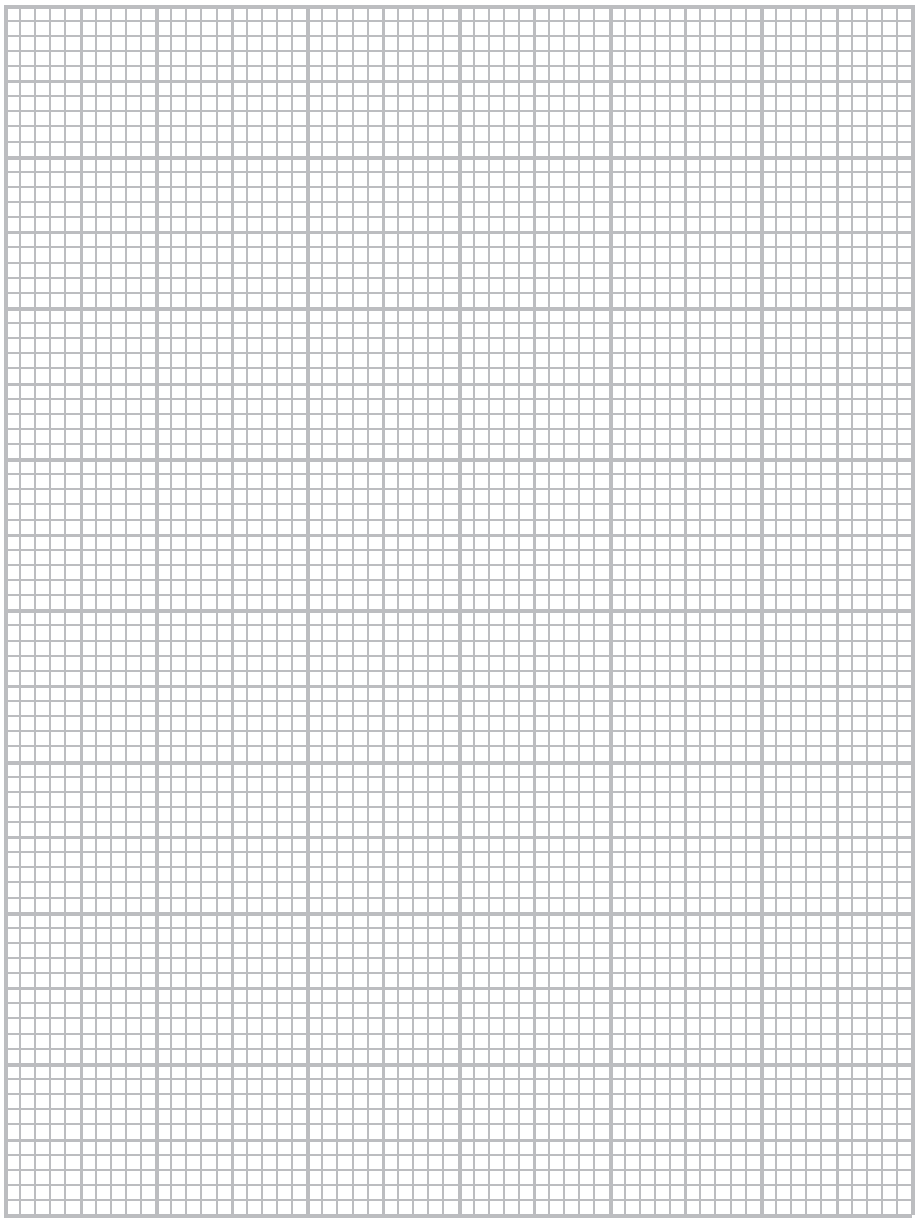
(c) On the diagram, draw a normal at A and take measurements to complete the last row of the table below.

(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)