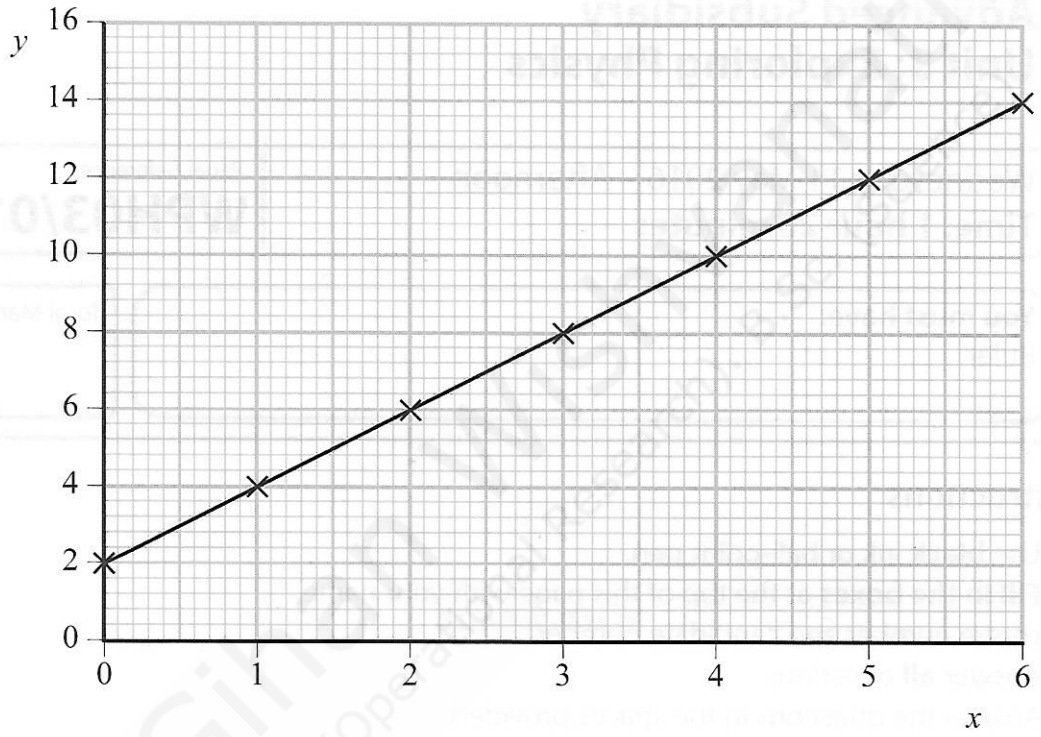
SECTION A

Answer ALL questions.

For questions 1–5, in Section A, select one answer from A to D and put a cross in the box ☒. If you change your mind put a line through the box ☒ and then mark your new answer with a cross ☒.

1 The graph shows the results from an experiment.



Which statement about the two quantities is correct?

☐ **A** They are directly proportional.

☐ **B** They are inversely proportional.

☐ **C** There is a negative relationship.

☒ **D** There is a linear relationship.

(Total for Question 1 = 1 mark)

2 Which of the following is a derived SI quantity?

☐ **A** mass ← base

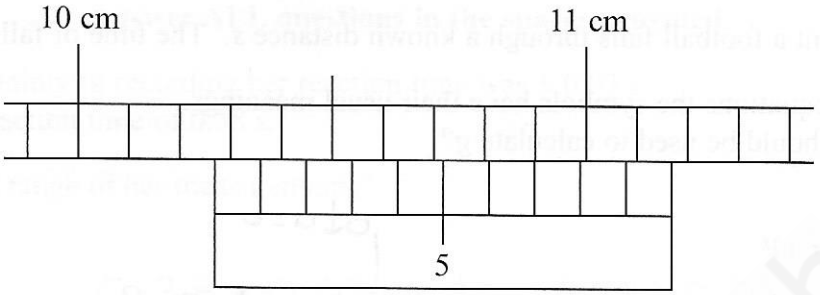
☐ **B** pascal ← unit

☐ **C** second ← unit

☒ **D** velocity

(Total for Question 2 = 1 mark)

3 A vernier scale is used to make a measurement.



Which is the correct reading of the scale in centimetres?

☒ **A** 10.27

☐ **B** 10.50

☐ **C** 10.70

☐ **D** 12.70

$10.2 + 0.01 \times 7$

$= 10.27$ cm

(Total for Question 3 = 1 mark)

Questions 4 and 5 are about an experiment to measure the acceleration of free fall *g*.

During this experiment a football falls through a known distance *s*. The time of fall *t* is measured.

4 In the following equations the symbols have their usual meanings.
Which equation should be used to calculate *g*?

- ☒ **A** $s = \frac{1}{2}(u + v)t$
- ☒ **B** $s = ut + \frac{1}{2}at^2$
- ☒ **C** $v = u + at$
- ☒ **D** $v^2 = u^2 + 2as$

u = 0
s ↓ g = ?
t = t

any eq^n with v is not possible

(Total for Question 4 = 1 mark)

5 Three measurements of *s* are:

2.55 m 2.56 m 2.59 m

Which of the following should be stated as the average result?

- ☐ **A** 2.56 m
- ☐ **B** 2.566 m
- ☐ **C** 2.567 m
- ☒ **D** 2.57 m

$\frac{2.55 + 2.56 + 2.59}{3} = 2.57$ m

(Total for Question 5 = 1 mark)

TOTAL FOR SECTION A = 5 MARKS

SECTION B

Answer ALL questions in the spaces provided.

6 A student's uncertainty in recording her reaction time was ± 0.03 s.
She recorded a reaction time of 0.38 s.

(a) What was the range of her measurements?

(1)

0.38 − 0.03 to 0.38 + 0.03

0.35 s to 0.41 s range = 0.41 − 0.35 = 0.06 s

(b) Calculate the percentage uncertainty in her measurement.

(2)

$\%U_t = \frac{\frac{1}{2}(\text{range})}{0.38} \times 100\% = \frac{\frac{1}{2} \times 0.06}{0.38} \times 100\%$

$= 7.89\%$ to 2 s.f.

or $\%U_t = \frac{0.03}{0.38} \times 100\% = 7.89\%$

Percentage uncertainty = 7.89 %

(c) The student plans to use a stopwatch to measure the time taken for a trolley to move down a slope. She estimates this time to be about 3 s.
Comment on her plan.

(2)

$\%U_{measurement} = \frac{0.1}{3} \times 100\% = 3.3\% < 7.9\%$

- As the percentage uncertainty of reaction time is greater than the percentage uncertainty of estimated time
- Stop watch is suitable to use.

(Total for Question 6 = 5 marks)

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7 A student is asked to determine the refractive index of glass.

Write a plan for this experiment that uses a rectangular glass block, standard laboratory apparatus and a graphical method.

You should:

(a) draw a labelled diagram of the apparatus to be used and list any additional apparatus needed,

(2)

(b) show on your diagram the quantities to be measured,

(2)

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

(2)

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

(1)

(e) explain how to determine the refractive index,

(3)

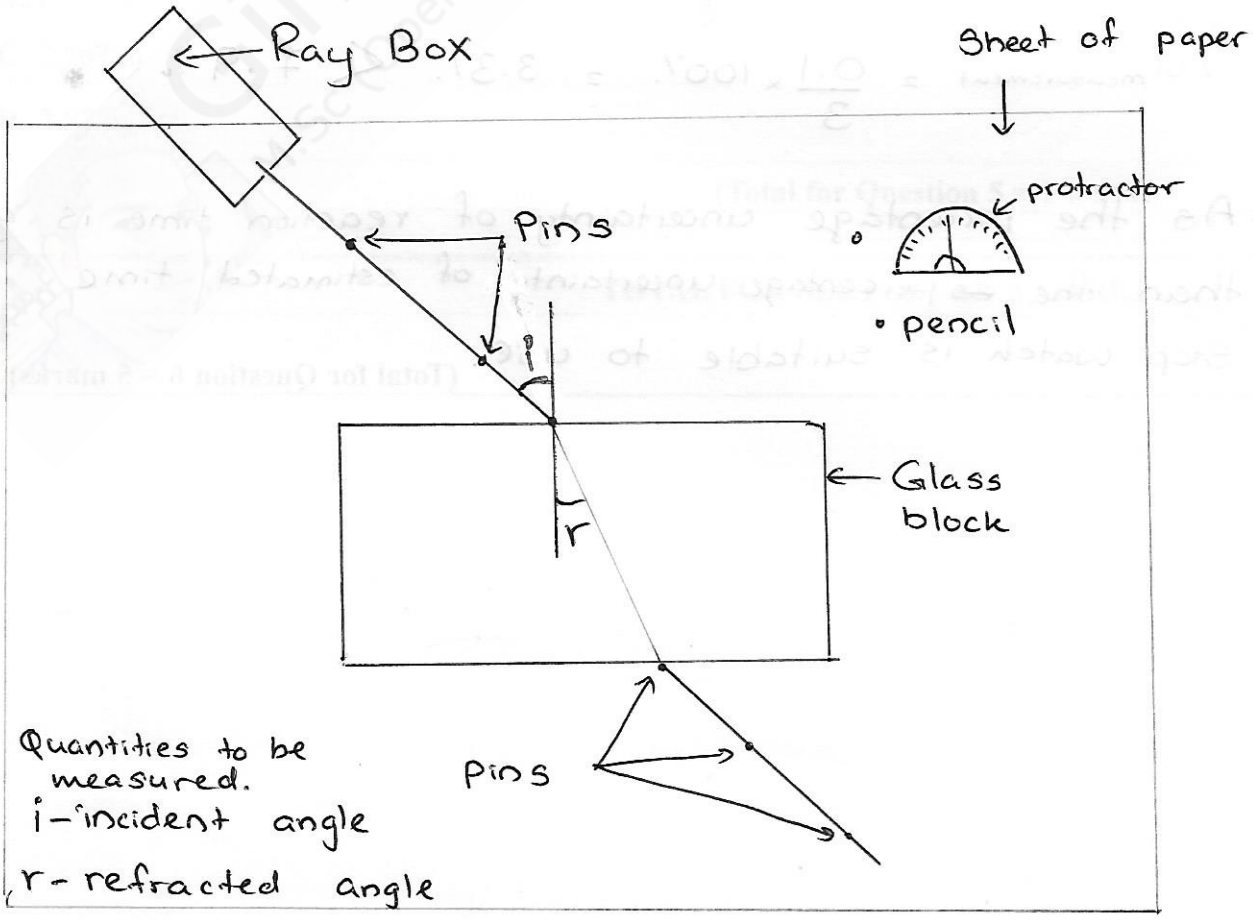
(f) identify the main source of uncertainty and/or systematic error,

(1)

(g) comment on safety.

(1)

(b)



Quantities to be measured.
i - incident angle
r - refracted angle

(c) protractor with a least measure of 1°

(d) with repeat readings we can Average the measurements and avoid anomalies so its appropriate.

(e) $n = \frac{\sin i}{\sin r}$ $\underbrace{\sin i}_{y} = \underbrace{n}_{m} \underbrace{\sin r}_{x}$

- For different incident angles "i" measure refracted angle "r"
- plot a graph of sin i against sin r
- Its a straight line passing through the origin where gradient = n
- refractive index = Gradient.

(f)
- Ray should be sharp and thin otherwise angles can't be measured accurately.
- Zeroth error in the protractor.

(g) low risk experiment however weare boots to protect foot in case if glass block falls to foot.

8 In an experiment to determine the resistivity of the material of a wire, a student measured the diameter of the wire to be 0.56×10^{-3} m.

(a) Describe how the student should measure the diameter of the wire.

(2)

using a micrometer screw guage take measurements at different places of the wire. avoid pressing the wires. Average the results.

(b) During this experiment, the student kept the current constant at 0.11 A and recorded the following results.

Length / m	Potential difference / V	Resistance / Ω
1.00	0.52	4.7
0.80	0.41	3.7
0.60	0.27	2.5
0.40	0.19	1.7
0.20	0.1	0.91

(i) Criticise his results.

(2)

- Inconsistent significant figures for Potential difference
- only 5 readings
- ~~length easy wire.~~ • No repeats

(ii) Suggest how the student could keep the current constant.

(1)

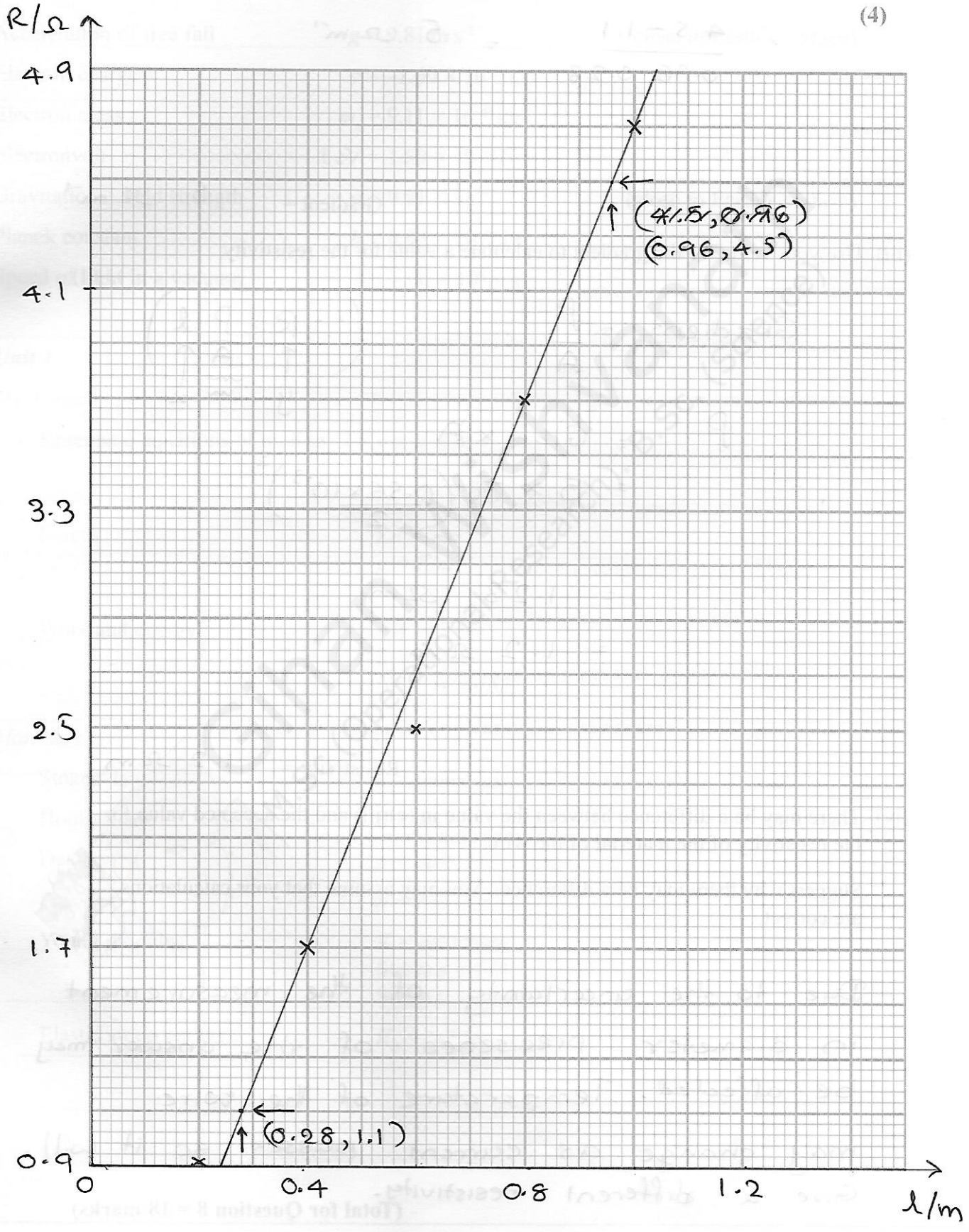
By using a variable resistor connected in series with the wire

(iii) Complete the last column of the table.

(2)

(c) (i) Plot a graph of resistance on the y-axis and length on the x-axis and draw a line of best fit.

(4)



(ii) Determine the gradient of the graph.

(2)

$\frac{4.5 - 1.1}{0.96 - 0.28} = 5 \ \Omega m^{-1}$

Gradient = $5 \ \Omega m^{-1}$

(iii) Use your value for the gradient to calculate a value for the resistivity.

(4)

$\text{Gradient} = \frac{\rho}{A} \quad \left(\because R = \frac{\rho l}{A} \right)$

$\rho = \text{Grad} \times A$

$= 5 \times \pi \left(\frac{0.56 \times 10^{-3}}{2} \right)^2$

$= 1.23 \ \Omega m$

$= 1.2 \ \Omega m$

Resistivity = $1.2 \ \Omega m$

(iv) There may be a difference between the value in (c)(iii) and the accepted value for the resistivity of the material of the wire.

Suggest why there may be a difference. You may assume that your calculations are correct.

(1)

Due to the uncertainty of the measurement in diameter precisenes of the answer may be affected. Temparature of the wire may change as current passes so it will Give a different resistivity.

(Total for Question 8 = 18 marks)

TOTAL FOR SECTION B = 35 MARKS

TOTAL FOR PAPER = 40 MARKS