PreDP revision questions for Section C of the exam

The PreDP class is investigating the resistance of a wire.

The circuit is shown in Fig. 3.1.

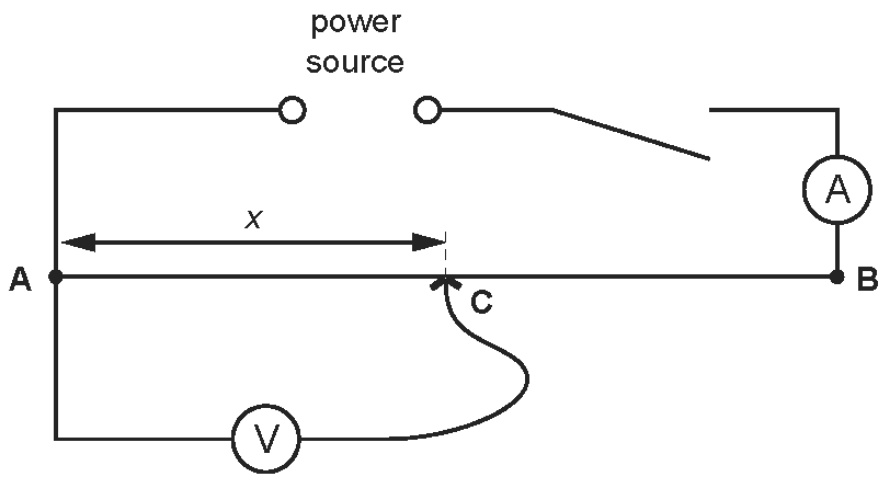


Fig. 3.1

AB is a resistance wire. The students place the sliding contact **C** on the resistance wire **AB** at a distance x = 0.100 m from **A**. They switch on and measure the p.d. V across the wire between **A** and **C**. They also measure the current I in the wire. The value of I is 0.38 A.

They repeat the procedure several times using different values of x. The readings are shown in Table 3.1. The current I is 0.38 A for each value of x.

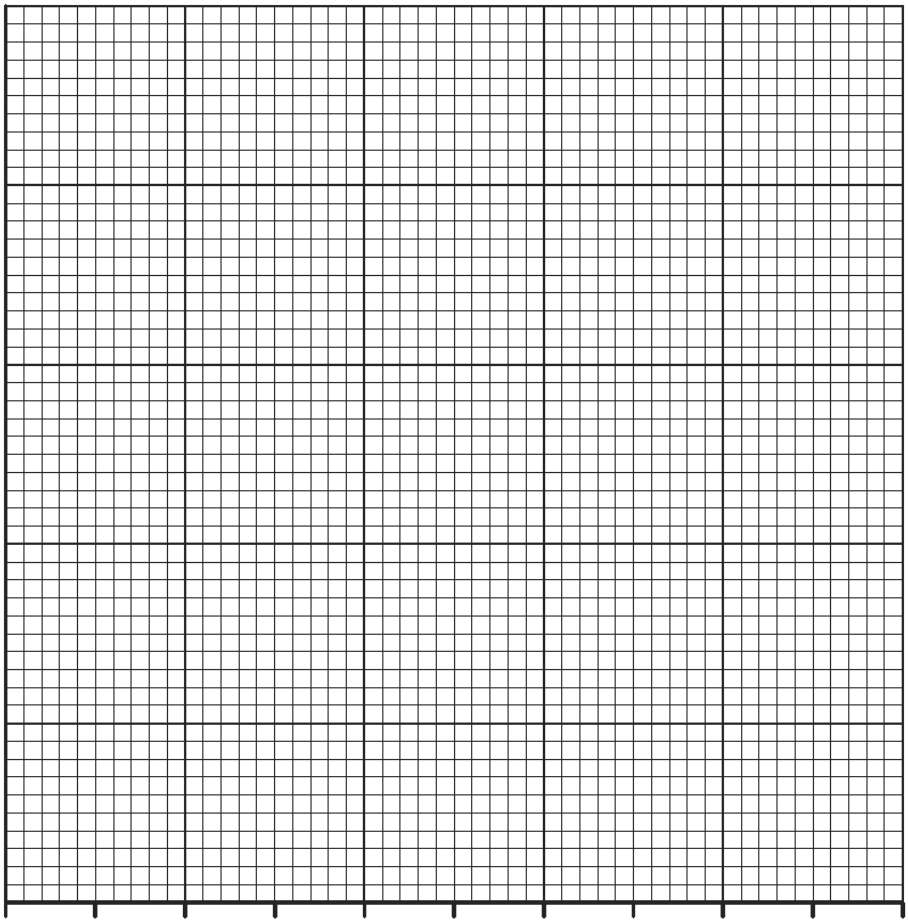
Table 3.1

x/m	V/V	R/Ω
0.100	0.21	
0.300	0.59	
0.500	1.04	
0.700	1.42	
0.900	1.87	

[2]

(a) Calculate the resistance R of the section **AC** of the wire for each value of x using the equation $R = \frac{V}{I}$. Record the values of R in the table.

(b) Use the results in Table 3.1 to plot a graph of R/Ω (y-axis) against x/m (x-axis). Draw the best fit line.



[5]

(c) Within the limits of experimental accuracy, what do you conclude about the variation of resistance with distance along the wire? Justify your conclusion by reference to your graph.

statement .....

justification .....

..... [2]

(d) Using your graph, determine the value for R when $x = 0.750\,\text{m}$. Show clearly on your graph how you obtained the necessary information.

R = ... [2]

(e) A variable that may be difficult to control in this experiment is the heating effect of the current, which affects the resistance of the wire. Suggest how you would minimise the heating effect.

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A PreDP student is investigating moments using a simple balancing experiment.

He uses a pivot on a bench as shown in Fig. 5.1.

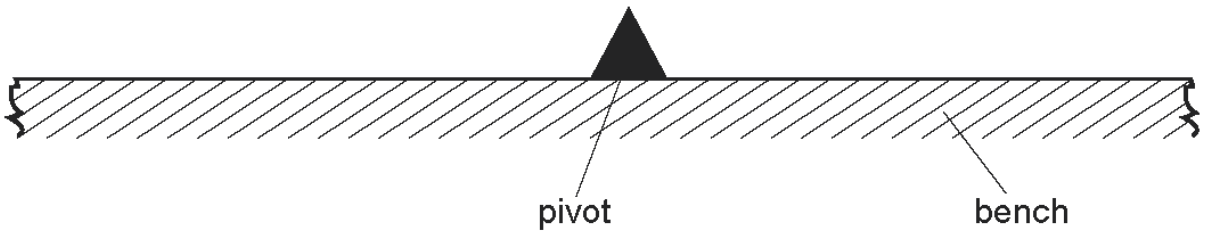


Fig. 5.1

First, the student balances the metre rule, without loads, on the pivot. He finds that it does not balance at the 50.0 cm mark, as he expects, but it balances at the 49.7 cm mark.

Load **Q** is a metal cylinder with diameter a little larger than the width of the metre rule, so that it covers the markings on the rule. Load **Q** is placed carefully on the balanced metre rule with its centre at the 84.2 cm mark. The rule does not slip on the pivot.

(a) Draw on Fig. 5.1 the metre rule with load **Q** on it. [2]

(b) Explain, using a labelled diagram, how the student would ensure that the metre rule reading at the centre of **Q** is 84.2 cm.

[2]

(c) Calculate the distance between the pivot and the centre of load **Q**.

The PreDP class is investigating the period of oscillation of a simple pendulum.

Fig. 1.1 shows the set-up.

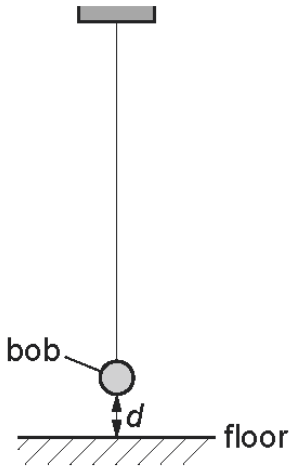


Fig. 1.1

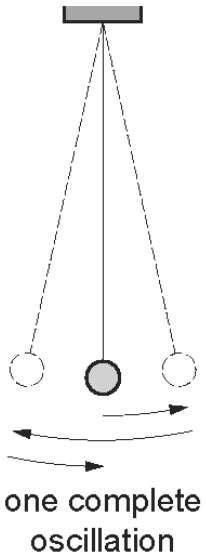


Fig. 1.2

(a) (i) On Fig. 1.1, measure the vertical distance *d* from the floor to the bottom of the pendulum bob.

d = ...

(ii) Fig. 1.1 is drawn one twentieth actual size. Calculate the actual distance *x* from the floor to the bottom of the pendulum bob. Enter this value in the top row of Table 1.1.

The students displace the pendulum bob slightly and release it so that it swings. They measure and record in Table 1.1 the time *t* for 20 complete oscillations of the pendulum (see Fig. 1.2).

Table 1.1

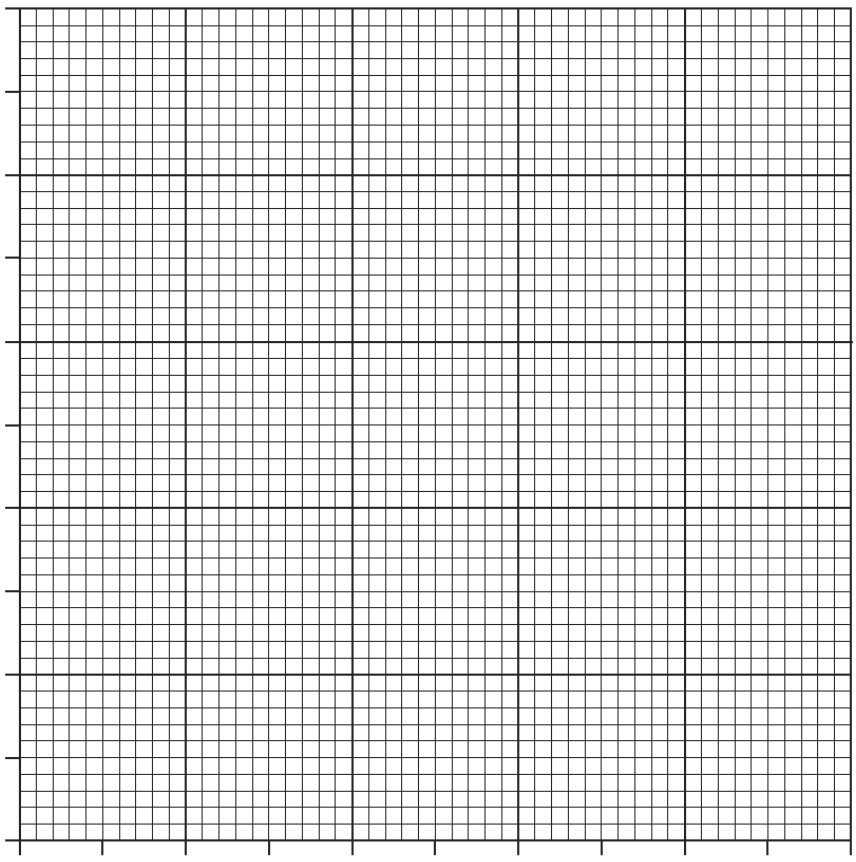
x/cm	*t*/s	*T*/s	T^2/s^2
	20.0		
20.0	19.0		
30.0	17.9		
40.0	16.8		
50.0	15.5		

[4]

(b) **(i)** Calculate the period T of the pendulum for each set of readings. The period is the time for one complete oscillation. Enter the values in Table 1.1.

(ii) Calculate the values of T^2. Enter the T^2 values in Table 1.1.

(c) Use your values from Table 1.1 to plot a graph of T^2/s^2 (y-axis) against x/cm (x-axis). Draw the best-fit line.



(d) State whether or not your graph shows that T^2 is directly proportional to x. Justify your statement by reference to the graph.

statement .....

justification .....

..... [1]

The PreDP class is comparing the combined resistance of lamps arranged either in series or in parallel.

The circuit shown in Fig. 3.1 is used.

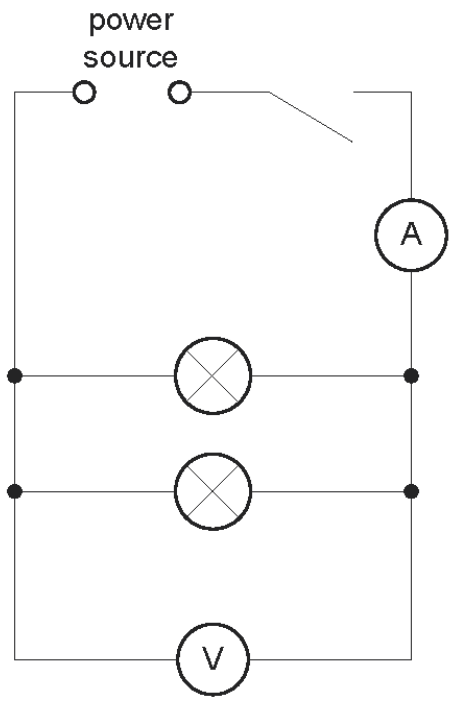


Fig. 3.1

A student measures and records the current I in the circuit and the p.d. V across the two lamps.

Fig. 3.2 shows the readings on the two meters.

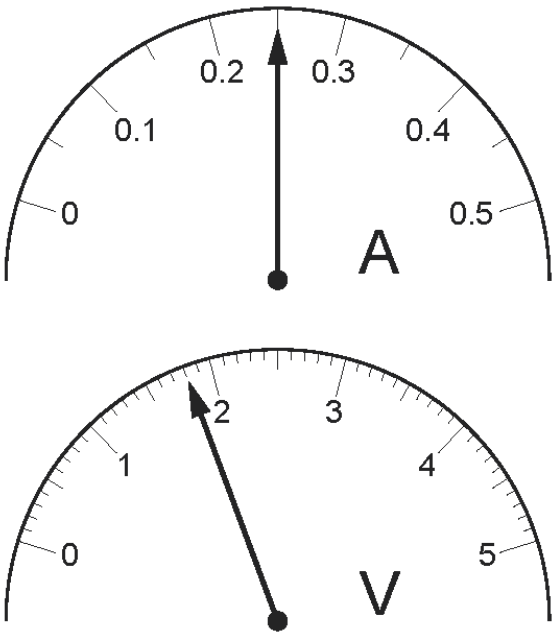


Fig. 3.2

(a) **(i)** Write the voltage and current readings in Table 3.1, below.

(ii) Complete the column headings in Table 3.1.

[3]

(b) The student then sets up the circuit shown in Fig. 3.3 and records the readings. These readings have already been entered in Table 3.1.

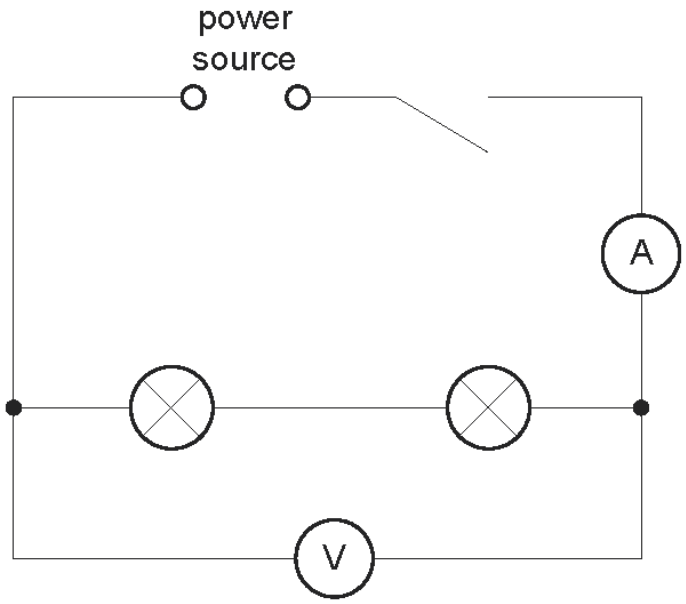


Fig. 3.3

For each set of readings in the table, calculate the combined resistance R of the two lamps using the equation $R = V/I$. Record the values of R in Table 3.1. [2]

Table 3.1

	V/	I/	R/
Circuit of Fig. 3.1			
Circuit of Fig. 3.3	1.8	0.52	

(c) Using the values of resistance you have obtained, calculate the ratio y of the resistances using the equation

$$y = \frac{\text{resistance of lamps in series}}{\text{resistance of lamps in parallel}}.$$

(d) Fig. 3.4 shows a circuit including two motors **A** and **B**.

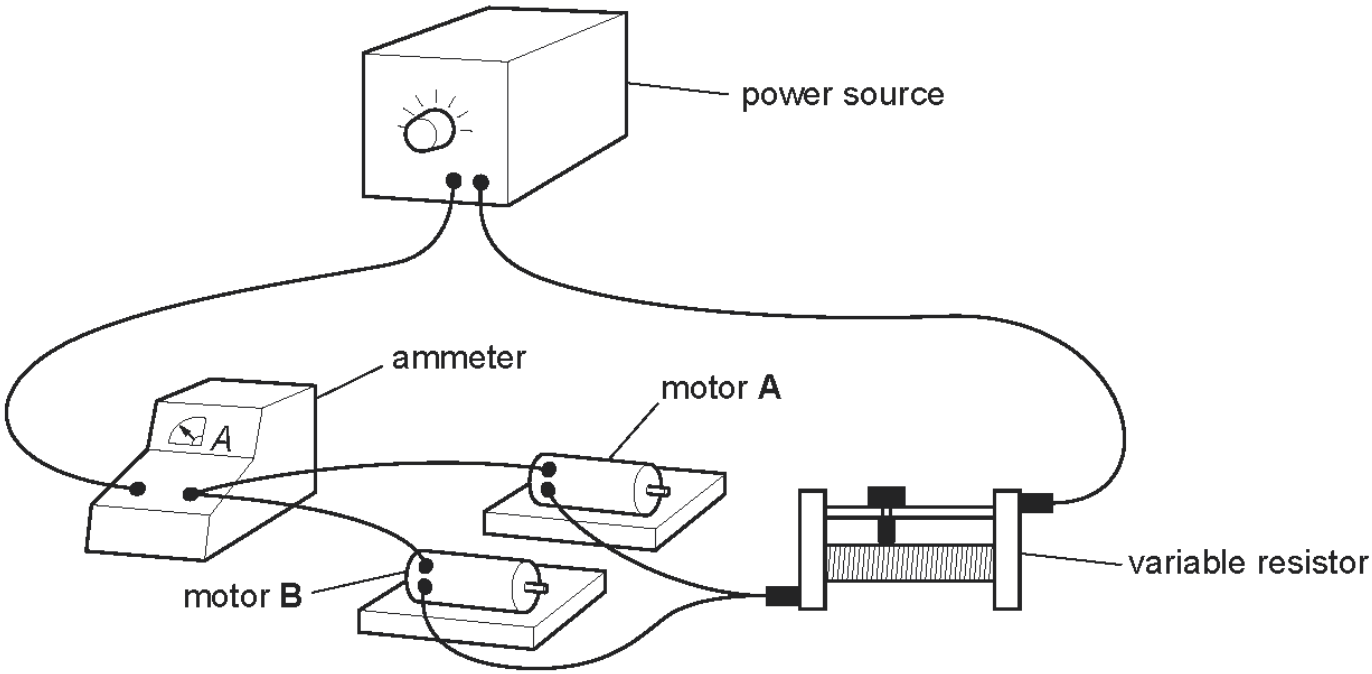
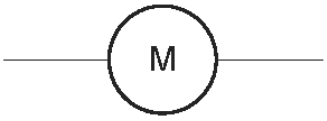


Fig. 3.4

(i) Draw a diagram of the circuit using standard circuit symbols. The circuit symbol for a motor is:



(ii) An engineer wishes to measure the voltage across motor **A**.

1. On Fig. 3.4, mark with the letters **X** and **Y** where the engineer should connect the voltmeter.

2. State the purpose of the variable resistor.

.....

.....

[3]

Ar PreDP student is investigating the stretching of springs.

Fig. 1.1 shows the apparatus used for the first part of the experiment.

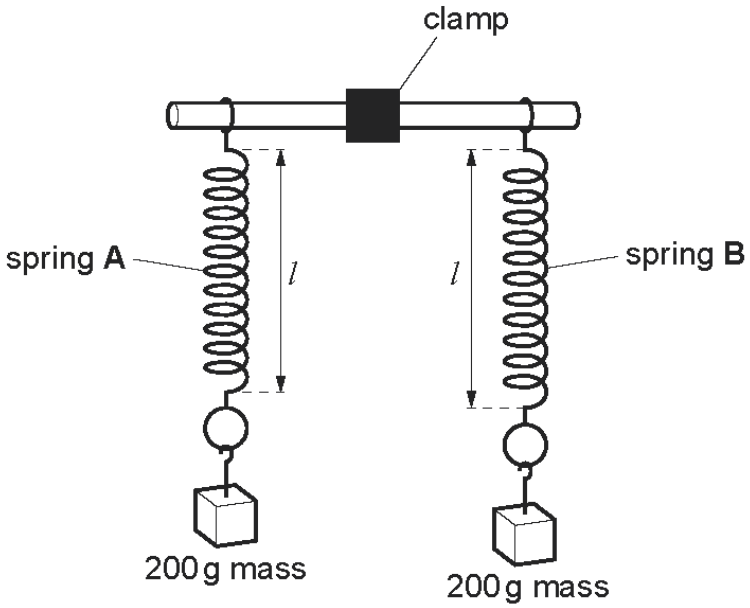


Fig. 1.1

The unstretched length l_A of spring **A** is 15 mm.

The unstretched length l_B of spring **B** is 16 mm.

(a) The student hangs a 200 g mass on each spring, as shown in Fig. 1.1.

(i) On Fig. 1.1 measure the new length l of spring **A**.

l = ... mm

(ii) Calculate the extension e_A of the spring using the equation $e_A = (l - l_A)$.

e_A = ... mm

(iii) On Fig. 1.1 measure the new length l of spring **B**.

l = ... mm

(iv) Calculate the extension e_B of the spring using the equation $e_B = (l - l_B)$.

(b) The student then sets up the apparatus as shown in Fig. 1.2.

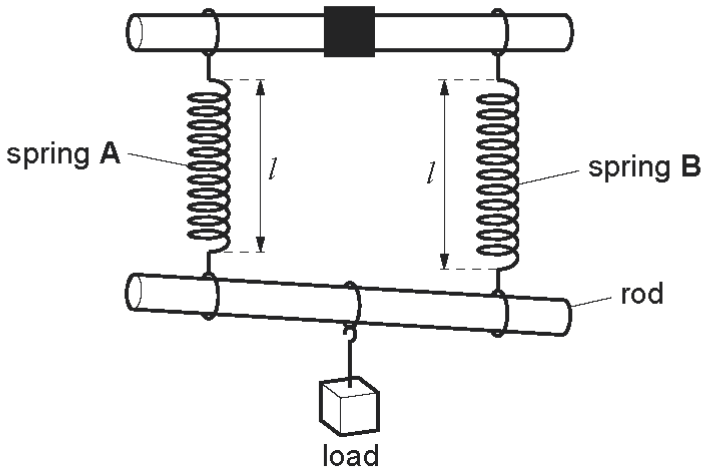


Fig. 1.2

(i) On Fig. 1.2 measure the new length of each of the springs.

spring **A**: l = ... mm

spring **B**: l = ... mm

(ii) Calculate the extension of each spring using the appropriate equation from part **(a)**.

spring **A**: e = ... mm

spring **B**: e = ... mm

(iii) Calculate the average of these two extensions e_{av}. Show your working.

e_{av} = ...mm
[3]

(c) It is suggested that $(e_A + e_B)/4 = e_{av}$.

State whether your results support this theory and justify your answer with reference to the results.

Statement .....

Justification .....

..... [2]

(d) Describe briefly one precaution that you would take to obtain accurate length measurements.

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[1]

The PreDP class is determining the mass of a load using a balancing method.

Fig. 1.1 shows the apparatus.

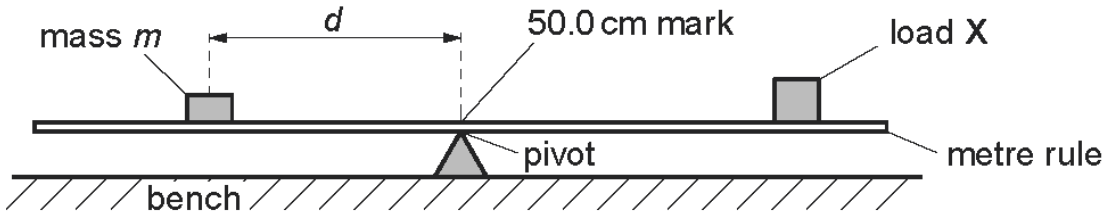


Fig. 1.1

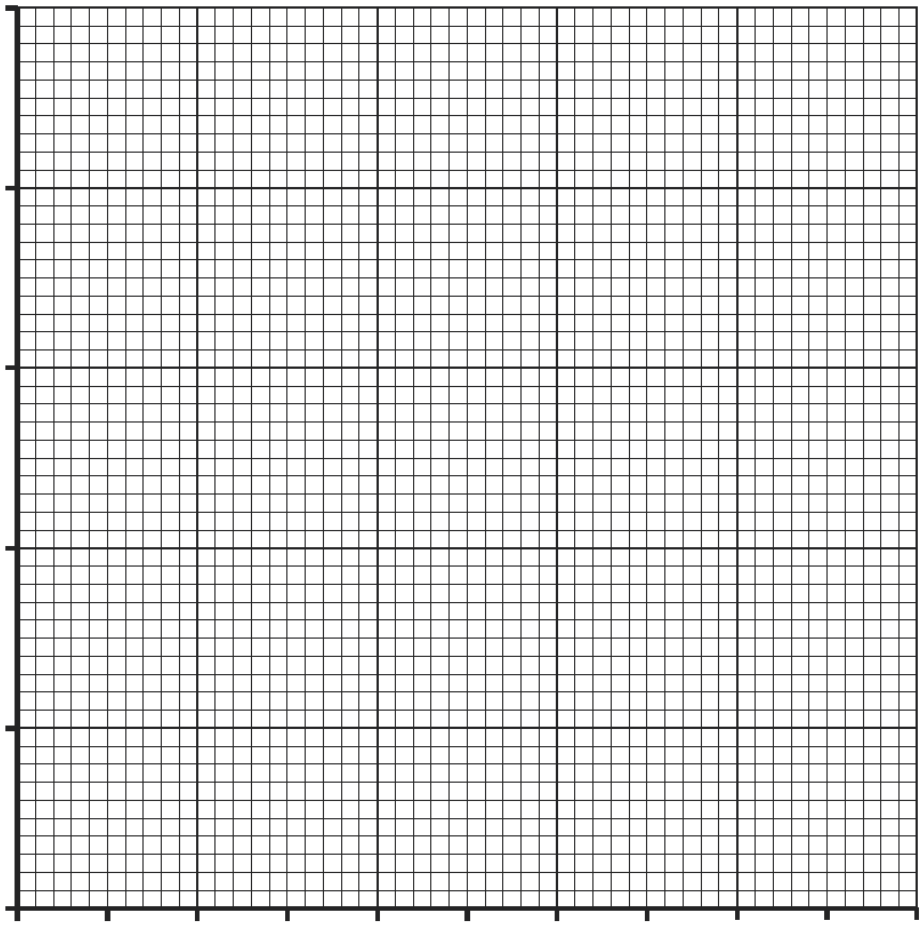
The load **X** has been taped to the metre rule so that its centre is exactly over the 90.0 cm mark. It is not moved during the experiment. A mass *m* of 40 g is placed on the rule and its position adjusted so that the rule is as near as possible to being balanced with the 50.0 cm mark exactly over the pivot. This is repeated using a range of masses. The readings are shown in Table 1.1

Table 1.1

m/g	*d*/cm	$\frac{1}{d}$ / $\frac{1}{\text{cm}}$
40	30.2	
50	23.9	
60	20.0	
70	17.1	
80	15.1	

(a) For each value of *d*, calculate 1/*d* and record it in the table. [2]

(b) Plot a graph of m/g (y-axis) against $\frac{1}{d} \Big/ \frac{1}{\text{cm}}$ (x-axis).



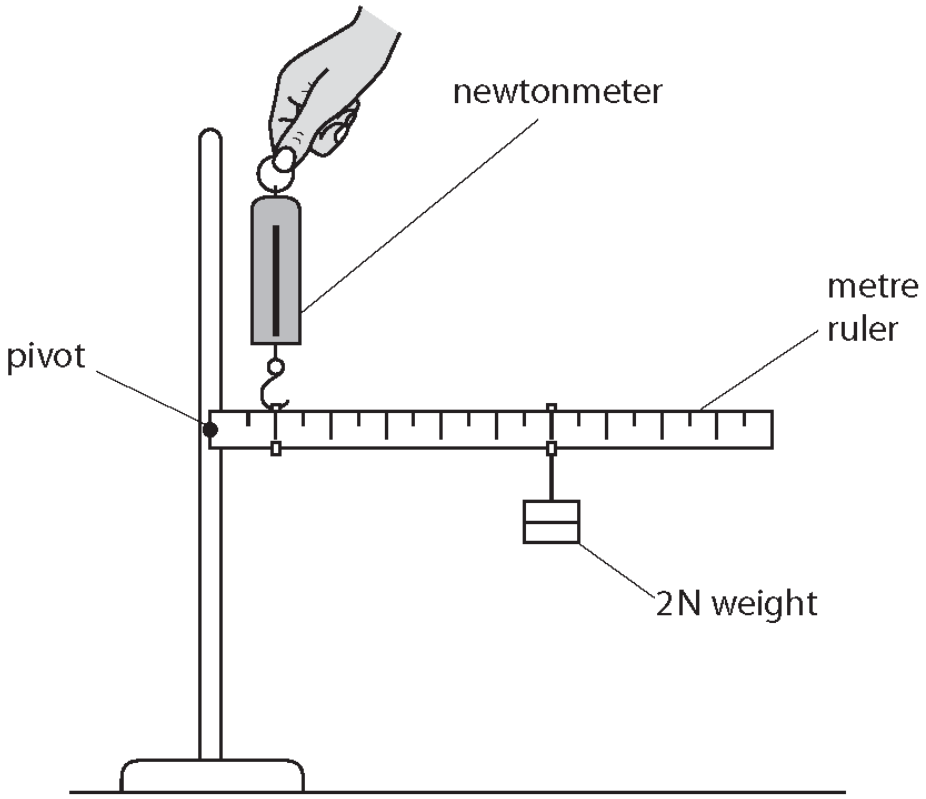
[4]

(c) Determine the gradient G of the graph. Show clearly on the graph how you obtained the necessary information.

G = ... [2]

(d) Determine the mass μ of the load **X** using the equation $\mu = G/k$ where k = 40.0 cm.

The diagram shows the apparatus used to investigate moments.



The 2 N weight is placed 60 cm from the pivot.

The newtonmeter is placed 10 cm from the pivot.

(a) (i) State the equation linking moment, force and perpendicular distance from the pivot.

(1)

(ii) Calculate the reading on the newtonmeter.

Ignore the weight of the ruler.

(3)

(b) The metre rule is replaced by an iron bar.

The iron bar is 1 m long and has a weight of 10 N.

The newtonmeter and the 2 N weight stay in their original position.

Explain how this change affects the reading on the newtonmeter.

(3)

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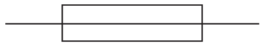
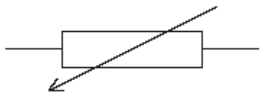
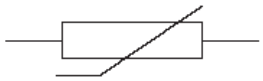
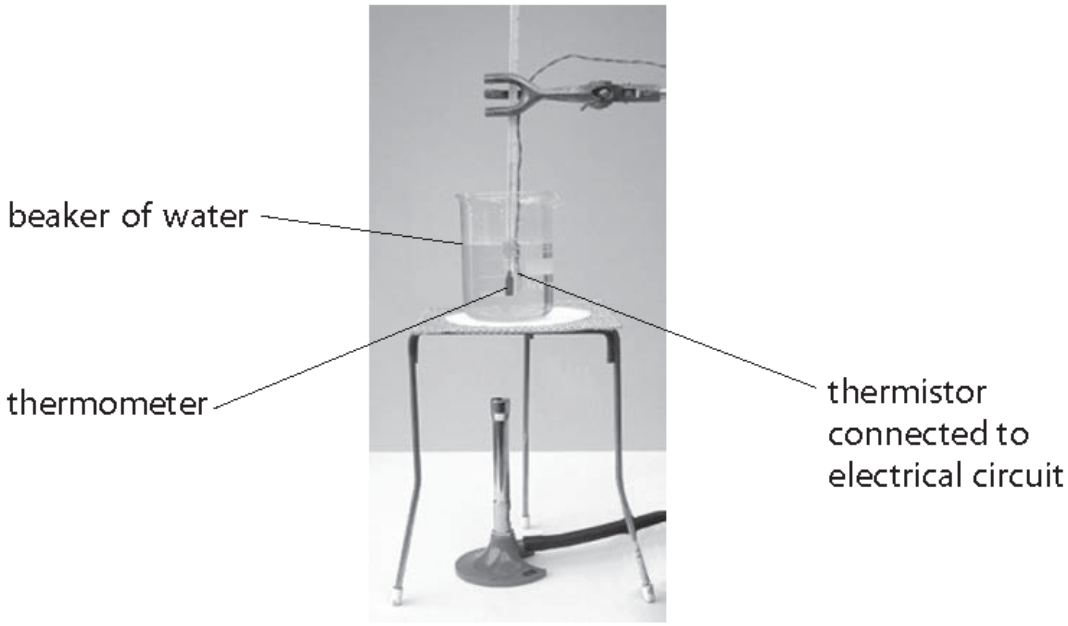
A student investigates the resistance of a thermistor.

(a) Which of these is the correct symbol for a thermistor

(1)

☒	**A**	
☒	**B**	
☒	**C**	
☒	**D**	

(b) The student uses this apparatus to investigate how the resistance of a thermistor changes with temperature.



(i) Explain why the student places the thermistor in a beaker of water.

(2)

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(ii) The student also uses a voltmeter and an ammeter.

How should the voltmeter and the ammeter be connected in his circuit?

(1)

	Voltmeter	Ammeter
☒ **A**	in parallel across the power supply	in parallel across the thermistor
☒ **B**	in parallel across the thermistor	in series with the thermistor
☒ **C**	in series with the power supply	in series with the thermistor
☒ **D**	in series with the thermistor	in parallel across the thermistor

(c) The table shows the student's results.

Temperature in °C	Resistance in Ω
0	10 000
10	7 060
20	5 000
40	2 670
60	2 350
80	1 080
100	609

(i) Plot a graph of these results on the grid.

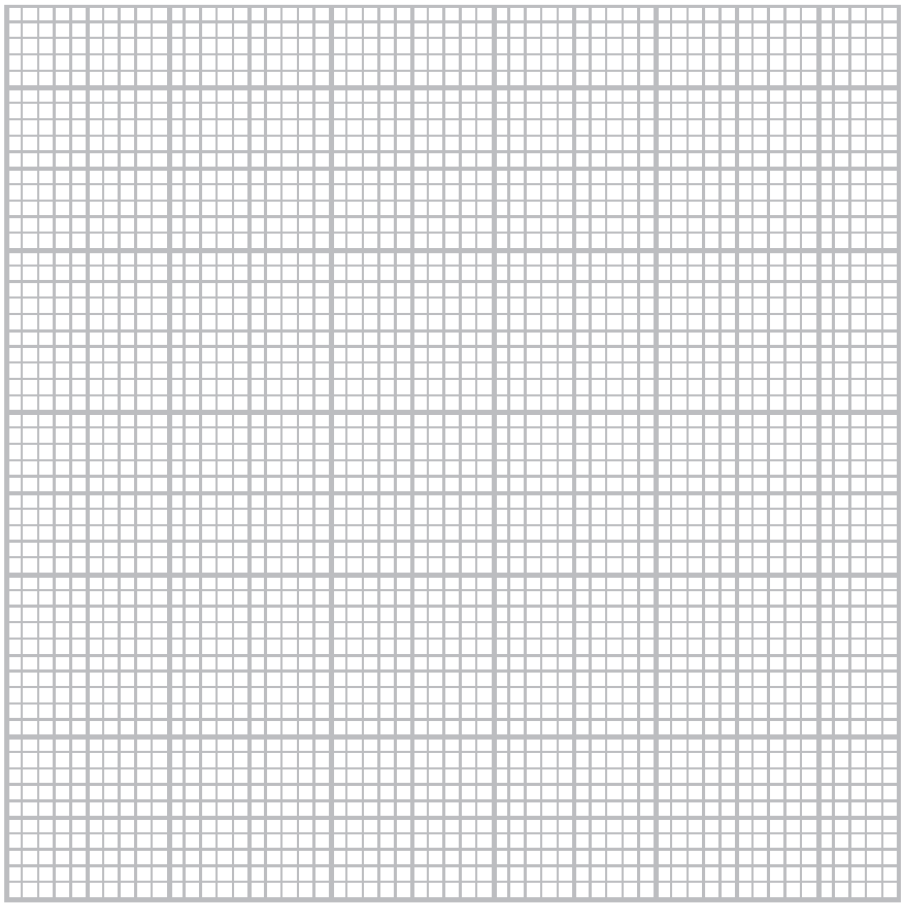
(4)

(ii) Circle the anomalous point on the graph.

(1)

(iii) Draw a curve of best fit.

(1)



(d) (i) Why is the maximum temperature in the student's investigation limited to 100 °C?

(1)

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.....

(ii) Suggest how the student obtains readings below room temperature.

(1)

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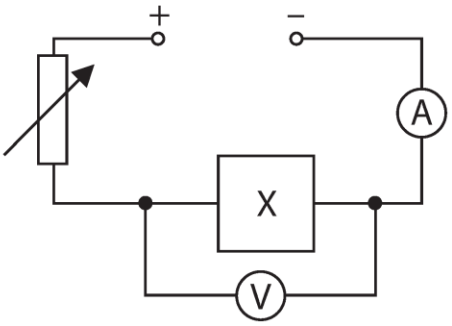
A student is given an unknown electrical component, X.

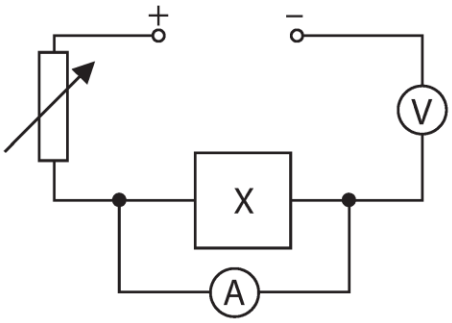
He uses a circuit to investigate how the current in X varies with the voltage across it.

(a) Which of these circuits is correct for his investigation?

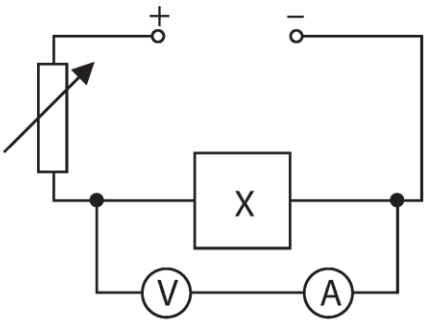
(1)



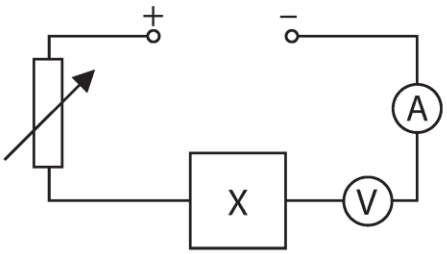
A ☒



B ☒



C ☒



D ☒

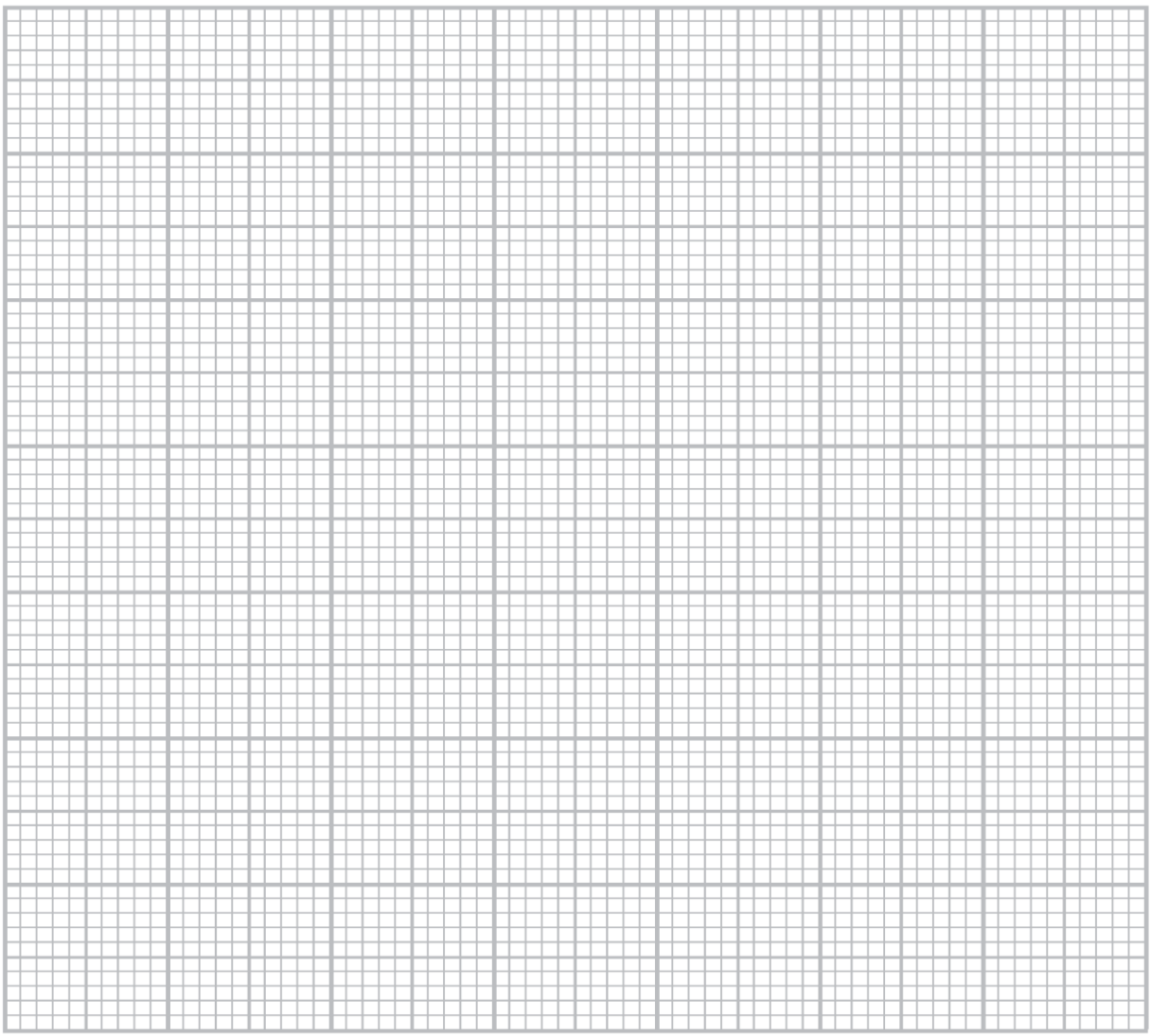
(b) The table shows the student's results.

Voltage across X in V	Current in X in A
0	0
3.0	0.5
14.5	2.3
19.5	2.9
25.0	3.2
29.5	3.3

(i) Plot a graph of these results and draw a curve of best fit.

(4)

current in A



voltage in V

(ii) State the equation linking voltage, current and resistance.

(1)

(iii) Calculate the resistance of component X when the voltage across it is 10.0 V.

Give the unit.

(4)

resistance = ... unit .....

(iv) Describe the pattern shown by this graph.

(3)

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(v) Suggest a conclusion for the investigation.

(2)

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.....

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(a) A student measures the weight of a cannonball as 50 N.

(i) Name a piece of equipment he could use to measure the weight.

(1)

.....

(ii) State the equation relating weight, mass and *g*.

(1)

(iii) Calculate the mass of the cannonball.

(2)

mass = ... kg

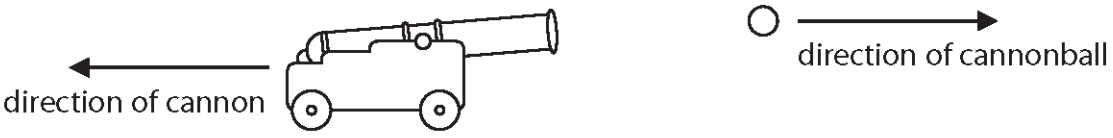
(b) Describe how the student could find the density of the cannonball.

You should include details of any further measurements he would need to make.

(3)

(c) A cannonball is fired from a cannon.

When the cannonball is fired, the cannon moves in the opposite direction, as shown in the diagram.



Using ideas about momentum, explain why the cannon moves in the opposite direction to the cannonball.

(3)

An experiment is carried out to investigate how the current I required to melt a wire varies with the diameter d of the wire.

The equipment is set up as shown in Fig. 2.1.

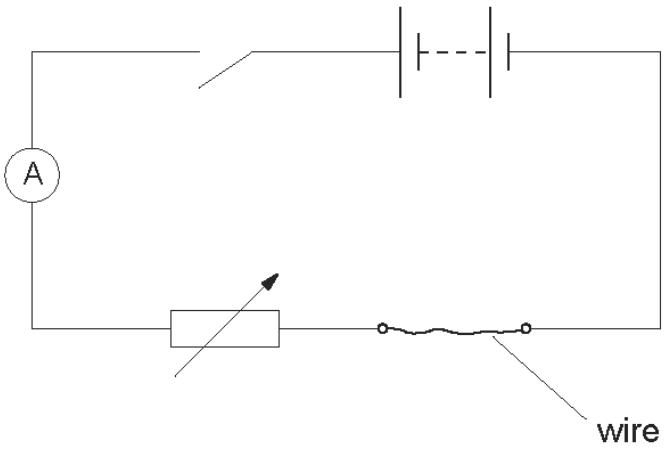


Fig. 2.1

It is suggested that I and d are related by the equation

$$I = pd^q$$

where p and q are constants.

(a) A graph is plotted with lg I on the y-axis and lg d on the x-axis. Express the gradient and y-intercept in terms of p and q.

gradient = ...

y-intercept = ...
[1]

(b) Values of d and I are given in Fig. 2.2.

$d/10^{-5}$m	I/A	lg ($d/10^{-5}$m)	lg (I/A)
15	2.6 ± 0.1		
19	3.5 ± 0.1		
23	4.4 ± 0.1		
27	5.4 ± 0.1		
31	6.4 ± 0.1		

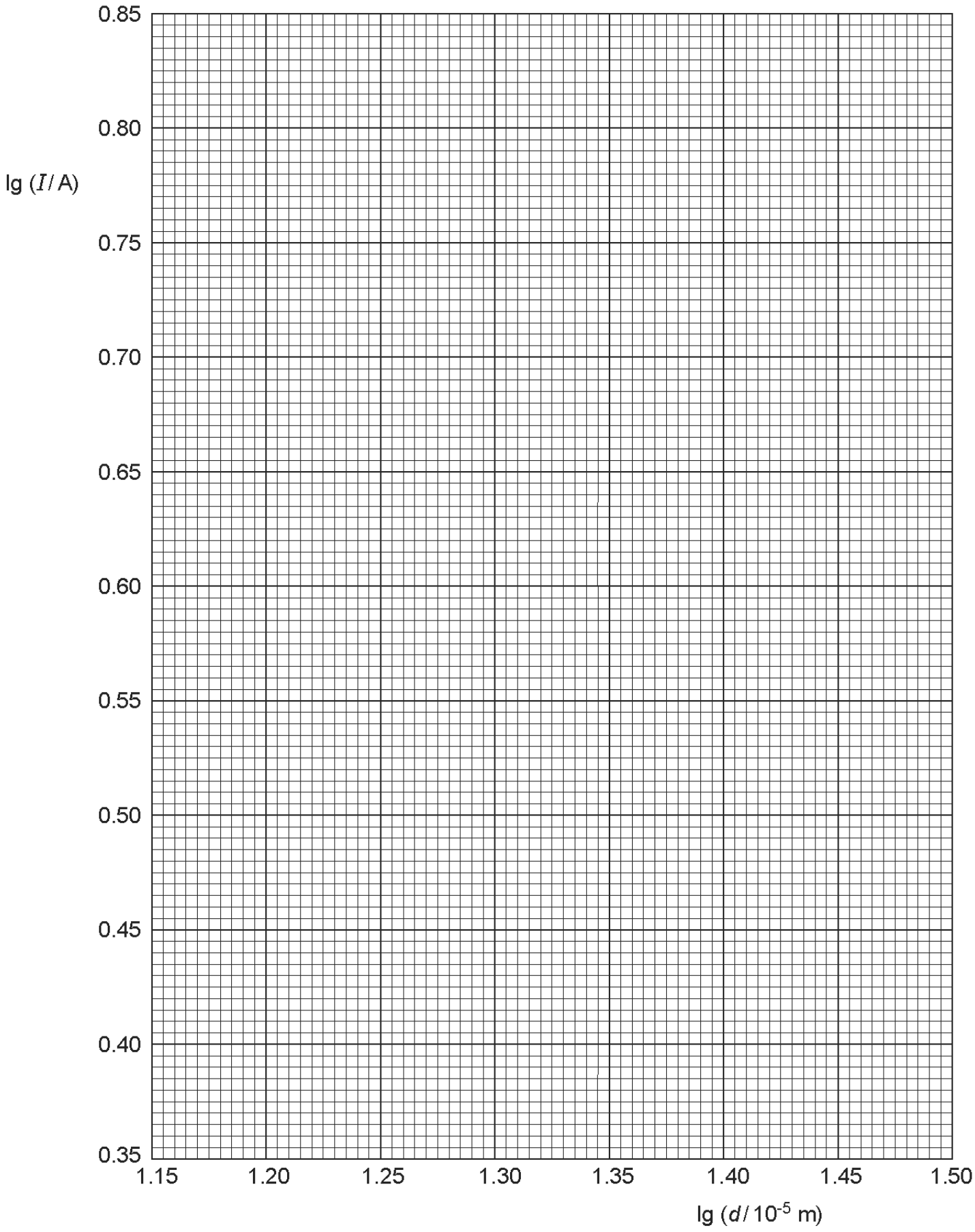
Fig. 2.2

Calculate and record values of lg ($d/10^{-5}$m) and lg (I/A) in Fig. 2.2. Include in the table the absolute errors in lg (I/A). [3]

(c) **(i)** Plot a graph of lg (I/A) against lg ($d/10^{-5}$m). Include error bars for lg (I/A). [2]

(ii) Draw the line of best fit and a worst acceptable straight line on your graph. Both lines should be clearly labelled. [2]

(iii) Determine the gradient of the line of best fit. Include the error in your answer.


0.85
0.80
lg (I / A)
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
1.15
1.20
1.25
1.30
1.35
1.40
1.45
1.50
lg (d / 10-5 m)

(iv) Determine the *y*-intercept of the line of best fit. Include the error in your answer.

y-intercept = ... [2]

(d) Using your answers to **(c)(iii)** and **(c)(iv)**, determine the values of *p* and *q*. Include the error in your values. You need not give the units of *p* and *q*.

p = ...

q = ...
[3]

When a current passes through a wire, the wire becomes hot and expands.

This can be investigated in a laboratory by passing a current through a wire of diameter d and measuring the displacement y, as shown in Fig. 1.1.

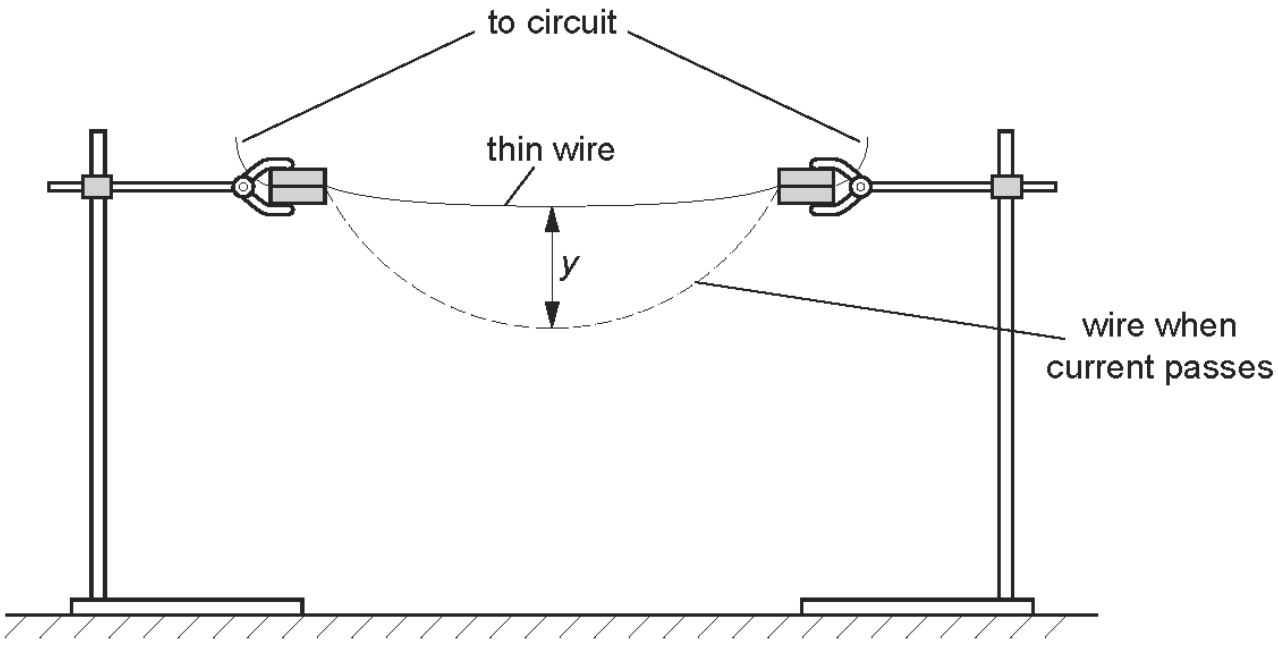


Fig. 1.1

It is suggested that the diameter d of the wire is related to y by the equation

$$y = pd^q$$

where p and q are constants.

Design a laboratory experiment to investigate the relationship between d and y, so as to determine a value for q. You should draw a diagram showing the arrangement of your equipment. In your account you should pay particular attention to

(a) the procedure to be followed,

(b) the measurements to be taken,

(c) the control of variables,

(d) the analysis of the data,

(e) the safety precautions to be taken.

[15]

An experiment is carried out to investigate how the resistance R of a thermistor varies with temperature T.

An ohmmeter is used to measure R. The equipment is set up as shown in Fig. 2.1.

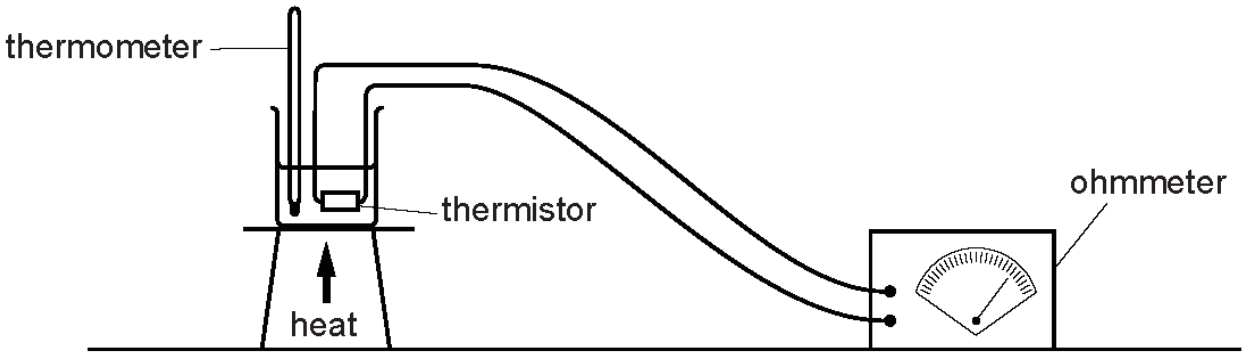


Fig. 2.1

It is suggested that R and T are related by the equation

$$R = \frac{T^h}{g}$$

where g and h are constants.

(a) A graph is plotted with lg R on the y-axis and lg T on the x-axis. Express the gradient and y-intercept in terms of g and h.

gradient = ...

y-intercept = ...
[1]

(b) Values of T and R are given in Fig. 2.2.

T/K	R/Ω	lg (T/K)	lg (R/Ω)
293	990 ± 10		
303	860 ± 10		
313	760 ± 10		
323	680 ± 10		
333	610 ± 10		

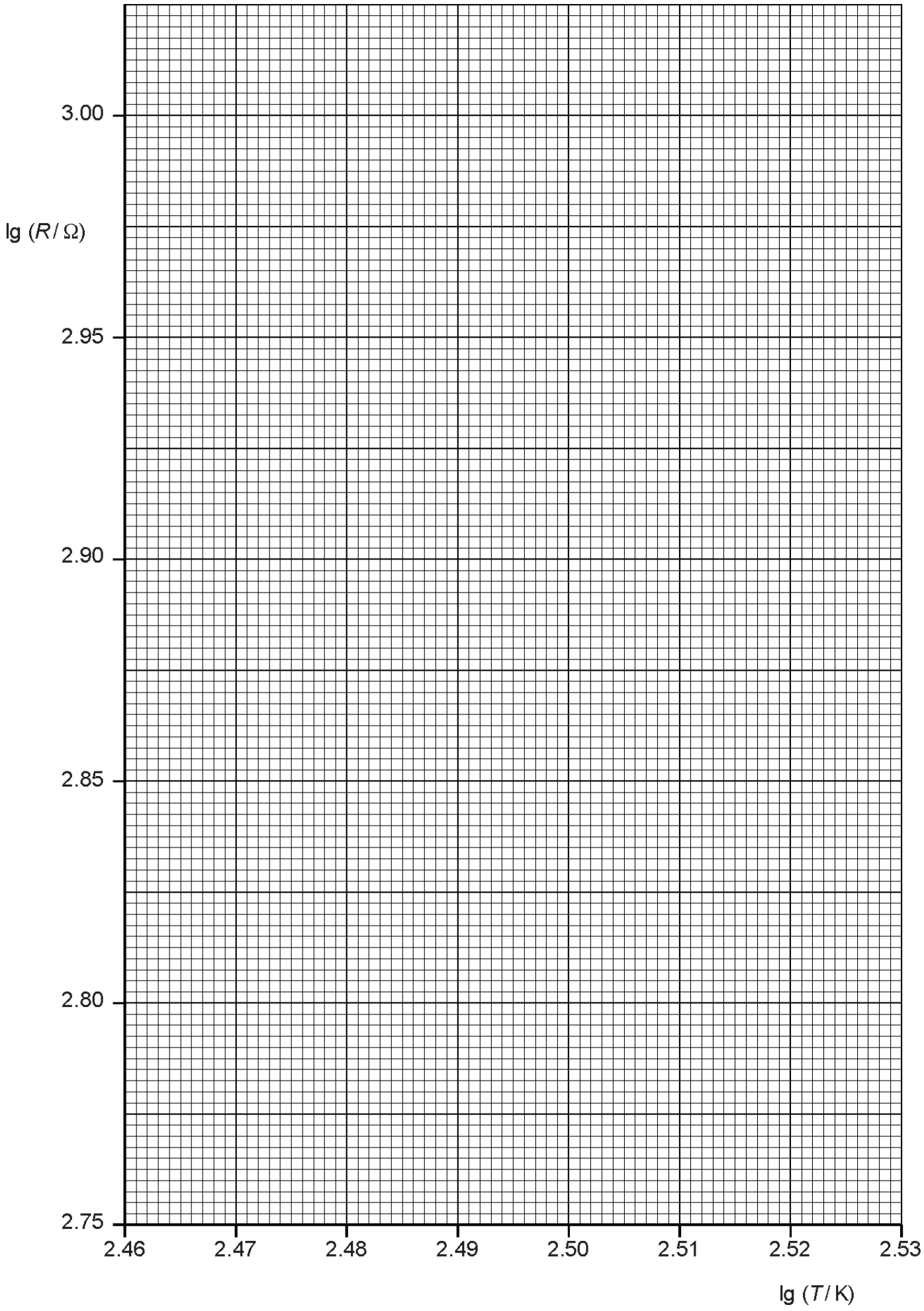
Fig. 2.2

Calculate and record values of lg (T/K) and lg (R/Ω) in Fig. 2.2. Include the absolute errors in lg (R/Ω). [3]

(c) **(i)** Plot a graph of lg (R/Ω) against lg (T/K). Include error bars for lg (R/Ω). [2]

(ii) Draw the line of best fit and a worst acceptable straight line on your graph. Both lines should be clearly labelled. [2]

(iii) Determine the gradient of the line of best fit. Include the error in your answer.


3.00
2.95
2.90
2.85
2.80
2.75
lg (R / Ω)
2.46
2.47
2.48
2.49
2.50
2.51
2.52
2.53
lg (T / K)

(iv) Determine the *y*-intercept of the line of best fit. Include the error in your answer.

y-intercept = ...[2]

(d) Using your answers to **(c)(iii)** and **(c)(iv)**, determine the values of *g* and *h*. Include the error in your values. You need not be concerned with the units of *g* and *h*.

g = ...

h = ...
[3]