



- 1 A student determines the weight of a metre rule using a balancing method.

Fig. 1.1. shows the apparatus.

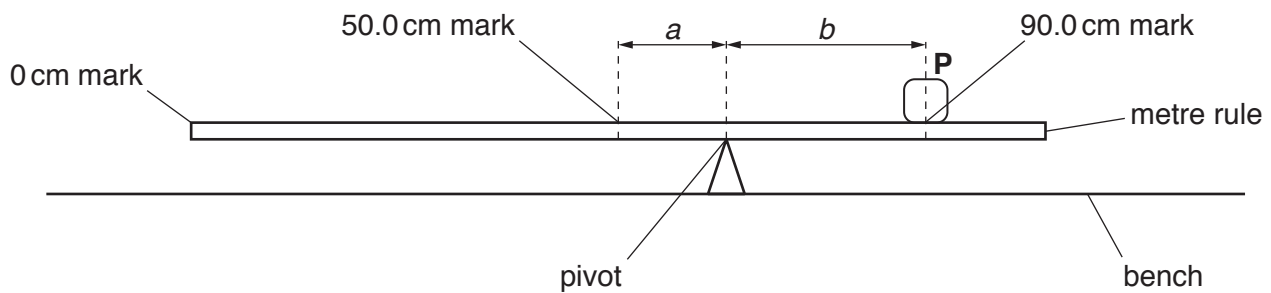


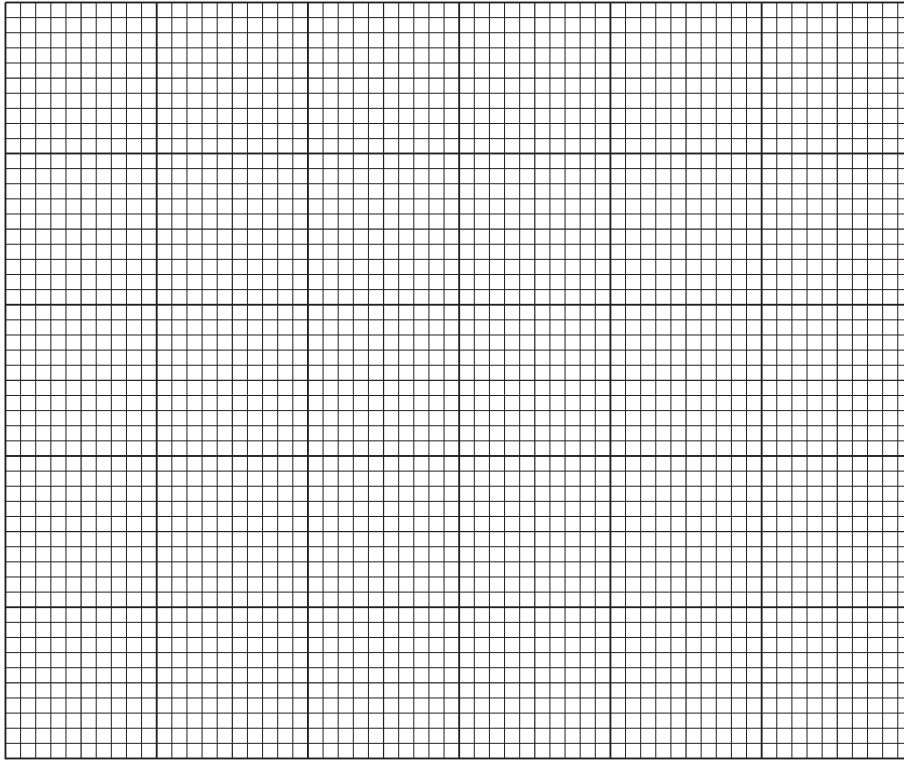
Fig. 1.1

- (a)
- The student places the metre rule on the pivot.
  - He places the load **P**, labelled **1.5 N**, on the metre rule at the 90.0 cm mark.
  - Keeping **P** at the 90.0 cm mark, he adjusts the position of the metre rule on the pivot so that the metre rule is as near as possible to being balanced.
  - In Table 1.1, he records the distance *a* from the 50.0 cm mark to the pivot.
- (i) Calculate, and record in Table 1.1, the distance *b* between the centre of load **P** and the pivot. [1]
- (ii) Calculate  $\frac{a}{b}$ . Record its value in Table 1.1. [1]
- (b) The student repeats the procedure using loads of 1.2 N, 1.0 N, 0.8 N and 0.5 N. The readings and results are shown in Table 1.1.

Table 1.1

Weight of load, <b>P</b> /N	<i>a</i> /cm	<i>b</i> /cm	$\frac{a}{b}$
1.5	23.1		
1.2	21.2	18.8	1.13
1.0	18.9	21.1	0.900
0.8	16.8	23.2	0.724
0.5	12.5	27.5	0.455

Plot a graph of weight of load  $P/N$  ( $y$ -axis) against  $\frac{a}{b}$  ( $x$ -axis). You do **not** need to begin your axes at the origin, (0,0).



[4]

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

$G = \dots\dots\dots$  [2]

- (d) The gradient  $G$  is numerically equal to the weight  $W$  of the metre rule. Write down the value of  $W$  to an appropriate number of significant figures for this experiment. Include the unit.

$W = \dots\dots\dots$  [2]

- (e) The student has assumed that the centre of mass of the metre rule is at the 50.0cm mark. Explain briefly how you would find as accurately as possible the position of the centre of mass of the metre rule. No extra apparatus or materials are available.

.....  
 .....  
 .....

[1]

- (f) Briefly state the main difficulty that you would have when carrying out this type of balancing experiment.

.....

..... [1]

[Total: 12]

2 A student investigates the resistance of lamps.

She uses the circuit shown in Fig. 2.1.

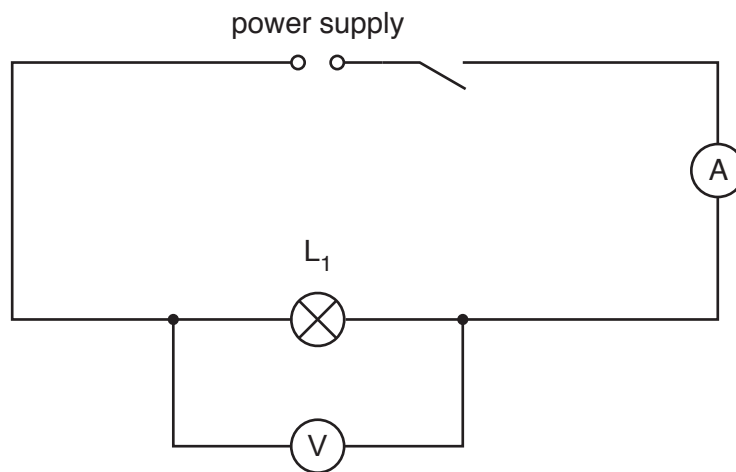


Fig. 2.1

(a) She records the potential difference  $V_1$  across the lamp  $L_1$  and the current  $I_1$  in the circuit. The meters are shown in Fig. 2.2 and Fig. 2.3.

(i) Write down the meter readings.

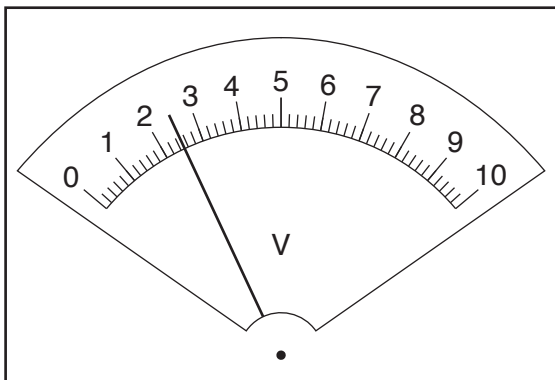


Fig. 2.2

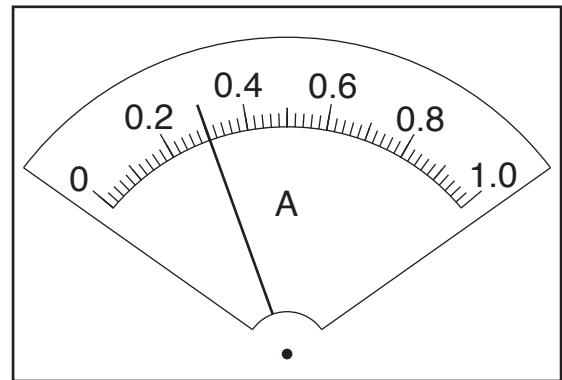


Fig. 2.3

$V_1 = \dots\dots\dots$

$I_1 = \dots\dots\dots$

[3]

(ii) Calculate the resistance  $R_1$  of the lamp  $L_1$  using the equation  $R_1 = \frac{V_1}{I_1}$ .

$R_1 = \dots\dots\dots$  [1]

- (b) The student connects a lamp  $L_2$  in series with lamp  $L_1$ .

She records the potential difference  $V_2$  across lamps  $L_1$  and  $L_2$  and the current  $I_2$  in the circuit.

$$V_2 = \dots\dots\dots 2.4 \text{ V} \dots\dots\dots$$

$$I_2 = \dots\dots\dots 0.21 \text{ A} \dots\dots\dots$$

Calculate the combined resistance  $R_2$  of lamps  $L_1$  and  $L_2$  connected in series, using the equation  $R_2 = \frac{V_2}{I_2}$ .

$$R_2 = \dots\dots\dots [1]$$

- (c) She connects a lamp  $L_3$  in series with lamps  $L_1$  and  $L_2$ .

She records the potential difference  $V_3$  across the three lamps and the current  $I_3$  in the circuit.

She calculates the combined resistance  $R_3$ .

$$V_3 = \dots\dots\dots 2.4 \text{ V} \dots\dots\dots$$

$$I_3 = \dots\dots\dots 0.17 \text{ A} \dots\dots\dots$$

$$R_3 = \dots\dots\dots 14.1 \Omega \dots\dots\dots$$

A student suggests that the resistance  $R_3$  of the three lamps connected in series should be given by the equation  $R_3 = 3 \times R_1$ . State whether the results agree with this suggestion. Justify your answer by reference to the results.

statement .....

justification .....

.....  
 .....

[2]

(d) Complete the circuit diagram in Fig. 2.4 to show:

- the three lamps connected in parallel
- the voltmeter connected to measure the potential difference across the lamps
- a variable resistor connected to control the current in all three lamps.

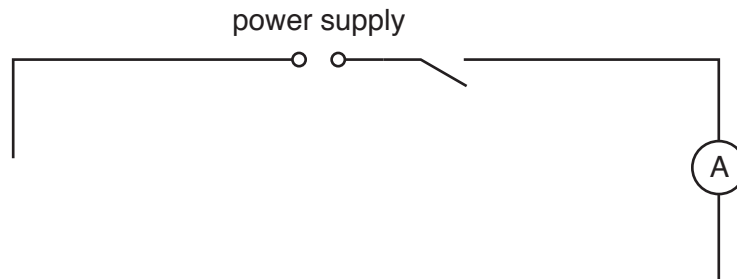


Fig. 2.4

[3]

[Total: 10]

3 A student investigates the cooling of water.

- (a) The thermometer in Fig. 3.1 shows room temperature  $\theta_R$  at the beginning of the experiment. Record  $\theta_R$ .

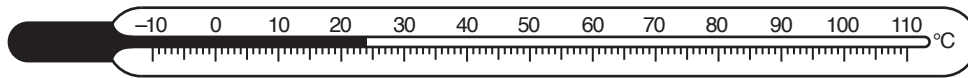


Fig. 3.1

$$\theta_R = \dots\dots\dots [1]$$

- (b) • The student pours  $200\text{cm}^3$  of hot water into a beaker. He places a thermometer in the water.
- He measures the temperature  $\theta$  of the hot water in the beaker.
  - He immediately starts the stopclock and continues recording the temperature of the water every 60s. The temperature readings are shown in Table 3.1.

Table 3.1

$t/$	$\theta/$
0	95
	89
	85
	81
	78

- (i) Complete the time column in Table 3.1. [1]
- (ii) Complete the column headings in Table 3.1. [1]
- (c) • Calculate the decrease in temperature  $\Delta\theta_1$  during the **first** 120s.

$$\Delta\theta_1 = \dots\dots\dots$$

- Calculate the decrease in temperature  $\Delta\theta_2$  during the **last** 120s.

$$\Delta\theta_2 = \dots\dots\dots [1]$$



(d) (i) Tick the box to show your conclusion from the results in (c).

The average rate of cooling is greater in the first 120s than the average rate of cooling in the last 120s.

The average rate of cooling is less in the first 120s than the average rate of cooling in the last 120s.

The average rate of cooling is the same in the first 120s as the last 120s.

[1]

(ii) Justify your conclusion in (d)(i) by reference to the results.

.....

.....

..... [2]

(e) Suggest **two** ways in which the student could reduce the rate of loss of thermal energy from the beaker in this type of experiment.

1 .....

2 .....

[2]

(f) Draw a diagram of a measuring cylinder being used to determine the volume of water. Show clearly the water level and draw, with a ruler, a straight line showing the line of sight required to obtain an accurate reading of the volume of water.

[2]

[Total: 11]

- 4 A student is investigating the time taken for metal balls to stop moving after being released on a curved track. Fig. 4.1 shows the shape of the track. The track is flexible, so the shape of the curve can be changed.

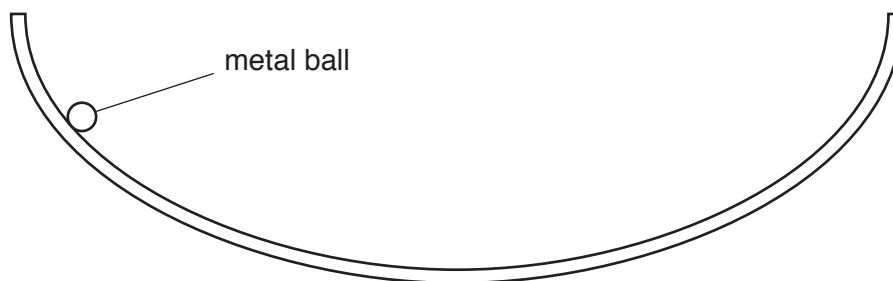


Fig. 4.1

The following apparatus is available:

a selection of metal balls of different masses  
the flexible track  
clamps to hold the track  
a stopwatch  
a tape measure  
a metre rule

The student can also use other apparatus and materials that are usually available in a school laboratory.

Plan an experiment to investigate a factor that affects the time taken for metal balls to stop moving after being released on a curved track.

In your plan, you should:

- state how you would expect the balls to move
- explain how you would carry out the investigation
- state which variables you would keep constant and which variable you would change
- draw a table, or tables, with column headings, to show how you would display your readings (you are **not** required to enter any readings in the table)
- explain how you would use your readings to reach a conclusion.



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