BALANCING A METER RULE

1 A student investigates the balancing of a metre rule.

Fig. 1.1 shows the arrangement.

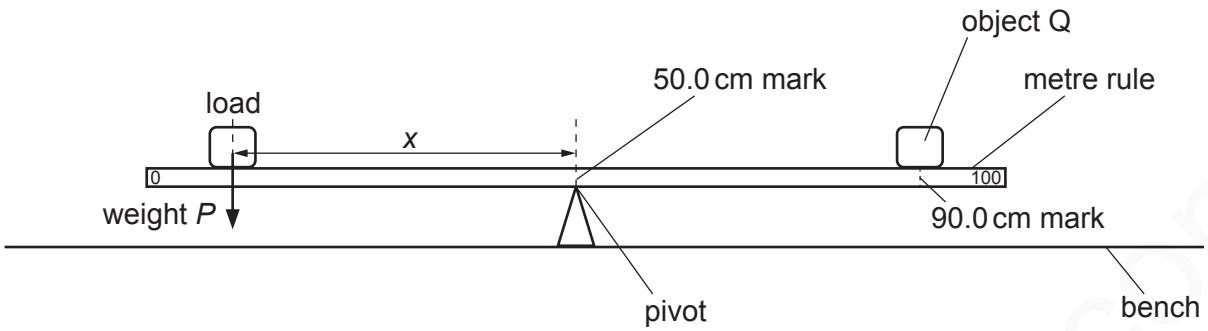


Fig. 1.1

(a) The student places the metre rule on the pivot at the 50.0 cm mark. He places an object Q on the metre rule with its centre at the 90.0 cm mark. He places a load of weight P = 2.0 N on the metre rule and adjusts the position of the load so that the metre rule is as near as possible to being balanced.

He measures the distance x from the centre of the load to the pivot.

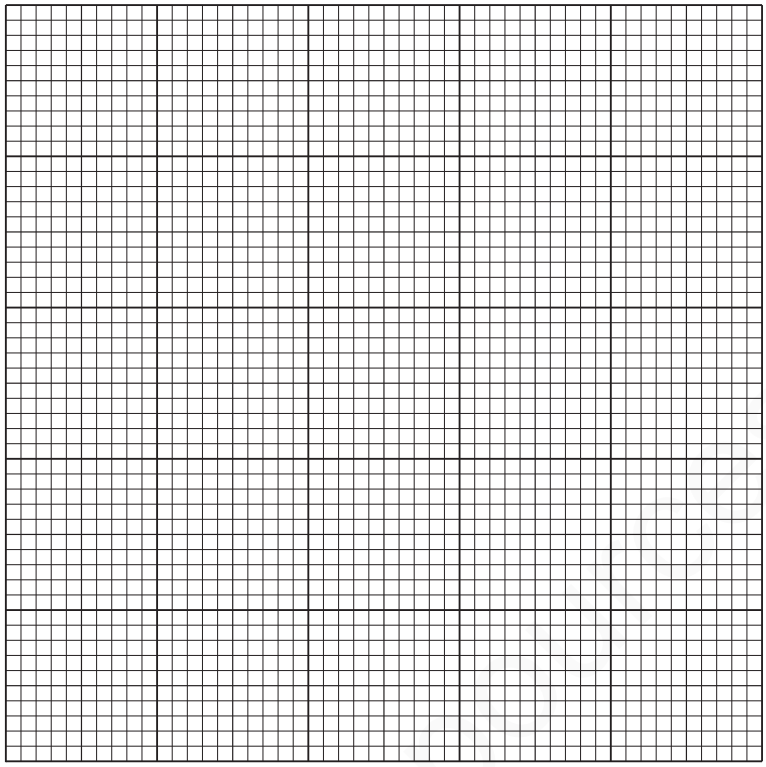
He repeats the procedure using loads of weight P = 3.0 N, 4.0 N, 5.0 N and 6.0 N. All the values of P and x are recorded in Table 1.1.

Table 1.1

P/N	x/cm	$\frac{1}{x} \Big/ \frac{1}{\text{cm}}$
2.0	40.0	
3.0	27.0	
4.0	20.0	
5.0	15.9	
6.0	13.3	

Calculate, and record in Table 1.1, the values of $\frac{1}{x}$. [2]

(b) Plot a graph of P/N (y-axis) against $\frac{1}{x} \Big/ \frac{1}{\text{cm}}$ (x-axis). Start both axes at the origin (0,0).



[4]

(c) In this experiment, x_{max}, the maximum possible value for x is 50.0 cm. Calculate $\frac{1}{x_{max}}$.

$\frac{1}{x_{max}}$ = ... $\frac{1}{\text{cm}}$

Use the graph to determine the minimum value of P required to balance the metre rule in this experiment. Show clearly on the graph how you determined this value.

minimum value of P = ... [2]

(d) In this experiment, the width of object Q is slightly greater than the width of the metre rule. Explain briefly how you would place the object Q as accurately as possible on the 90.0 cm mark of the metre rule. You may draw a diagram.

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..... [1]

(e) In this experiment, it is difficult to determine the exact position of the load that will make the metre rule balance.

(i) Explain briefly why this is difficult.

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(ii) Explain briefly how you would find the best position of the load that will make the metre rule balance.

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..... [1]

[Total: 11]

MARKING SCHEME

1(a)	0.025, 0.037, 0.050, 0.063, 0.075	**1**
	Consistent significant figures	**1**
1(b)	Graph: Axes correctly labelled and right way round	**1**
	Suitable scales	**1**
	All plots correct to $\frac{1}{2}$ small square	**1**
	Good line judgement, thin, continuous line	**1**
1(c)	(0.02) Method shown clearly on graph	**1**
	Value correct to $\frac{1}{2}$ small square	**1**
1(d)	Clear wording or diagram	**1**
1(e)(i)	Difficult to obtain balance point	**1**
1(e)(ii)	Idea of obtaining nearest to balance	**1**