Moments

Question Paper

Course	CIE IGCSE Physics
Section	1. Motion, Forces & Energy
Topic	Moments
Difficulty	Medium

Time Allowed 60

Score /45

Percentage /100

Question 1a

A student investigates the balancing of a metre rule.

Fig. 1.1 shows the arrangement.

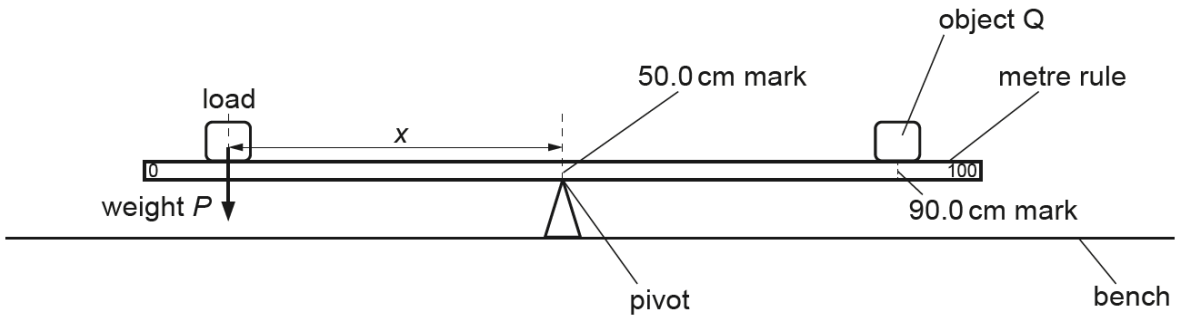


Fig. 1.1

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

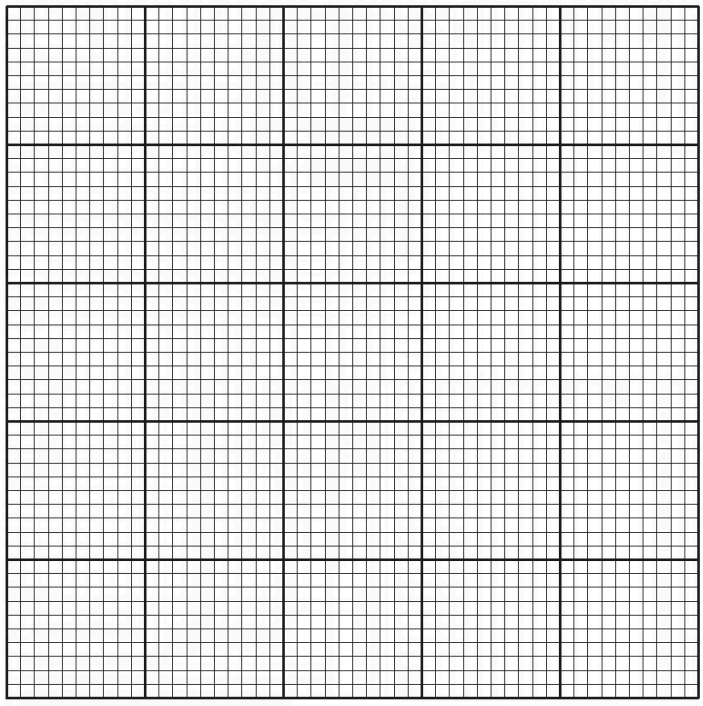
P/N	x/cm	$\frac{1}{x} / \frac{1}{\text{cm}}$
2.0	40.0	
3.0	27.0	
4.0	20.0	
5.0	15.9	
6.0	13.3	

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

[2 marks]

Question 1b

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



[4 marks]

Question 1c

In this experiment, x_{max}, the maximum possible value for x is 50.0cm. 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 marks]

Question 1d

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.

[1 mark]

Question 1e

Extended tier only

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.

[1]

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

[1]

[2 marks]

Question 2a

Extended tier only

A student is determining the weight of a metre rule using a balancing method.

Fig. 1.1 shows the apparatus.

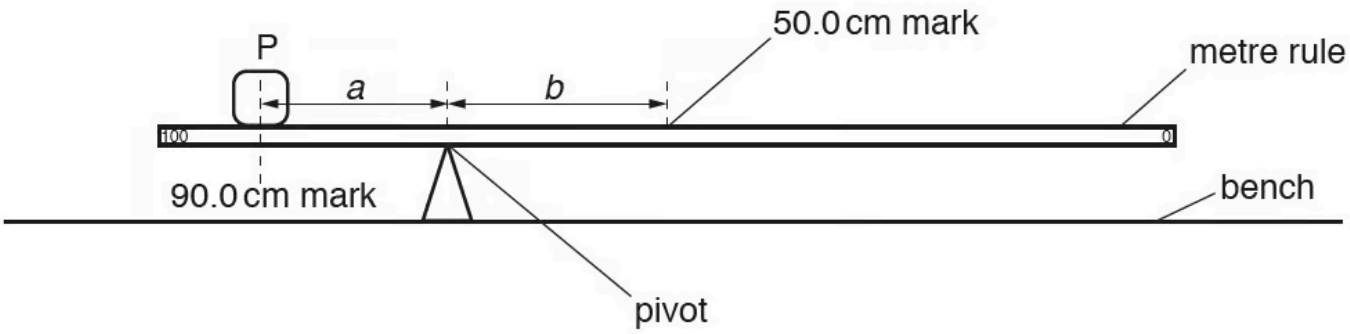


Fig. 1.1

The student places the metre rule on the pivot. He places the load P on the metre rule at the 90.0 cm mark. Keeping load 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.

He records the distance *a* from the 90.0 cm mark to the pivot.

He records the distance *b* from the pivot to the 50.0 cm mark.

He repeats the steps, placing the load P at the 85.0 cm, the 80.0 cm, the 75.0 cm and the 70.0 cm marks.

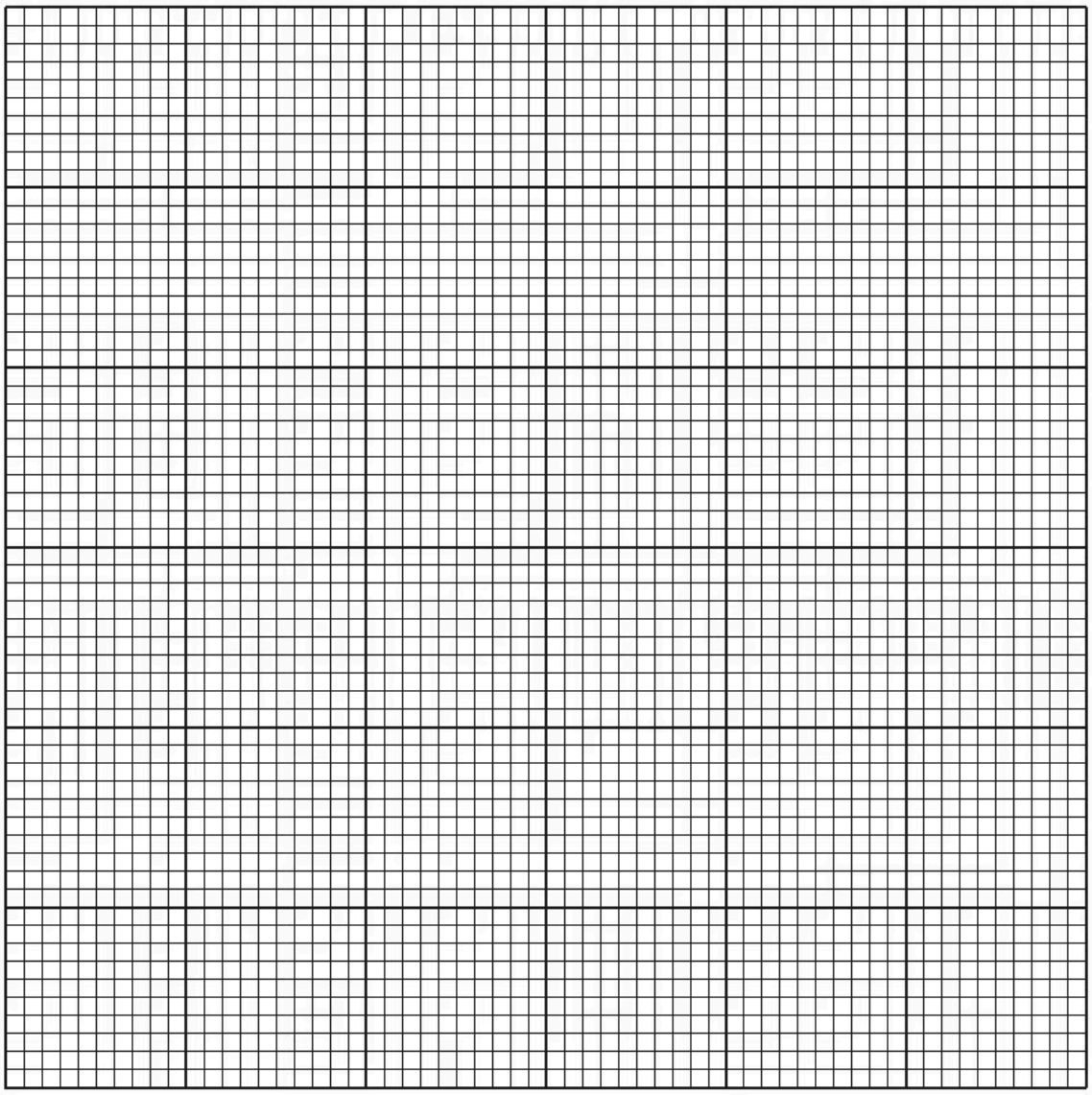
The readings are shown in Table 1.1.

Table 1.1

a/cm	*b*/cm

21.0	19.1
18.0	17.2
16.0	14.1
13.0	11.8
10.5	9.5

Plot a graph of a/cm (y-axis) against b/cm (x-axis). You do **not** need to begin your axes at the origin (0,0).



[4 marks]

Question 2b

Determine the gradient *G* of the graph. Show clearly on the graph how you obtained the necessary information.

G = ...

[2 marks]

Question 2c

Calculate the weight W_1 of the metre rule using the equation $W_1 = G \times P$, where $P = 1.0$ N.

W_1 = ...

[2 marks]

Question 2d

Extended tier only

Suggest **one** practical reason why it is difficult to obtain accurate readings for *a* and *b* in this type of experiment.

[1 mark]

Question 2e

The student measures the mass of the rule on a balance. Write down the mass *m* shown on the balance in Fig. 1.2 to the nearest gram.

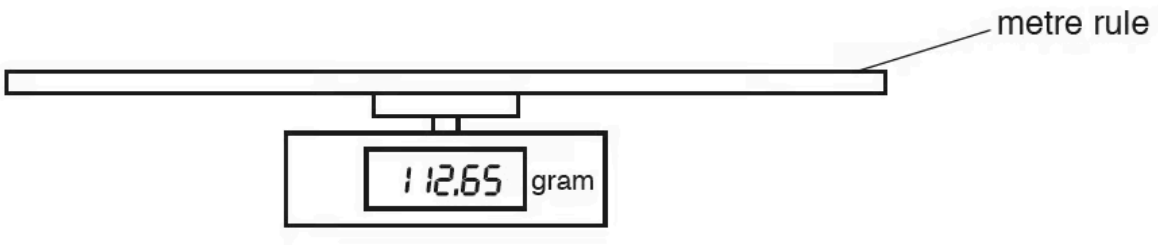


Fig. 1.2

m = ... g

[1 mark]

Question 2f

(i) Calculate the weight W_2 of the metre rule using the equation $W_2 = mg$, where $g = 9.8$ N/ kg.

W_2 = ... N [1]

(ii) State and explain whether this value of W_2 can be considered equal to the value of W_1 obtained in part **(c)** within the limits of experimental accuracy.

[1]

[1 mark]

Question 3a

Extended tier only

A student is determining the mass of a metre rule by a balancing method.

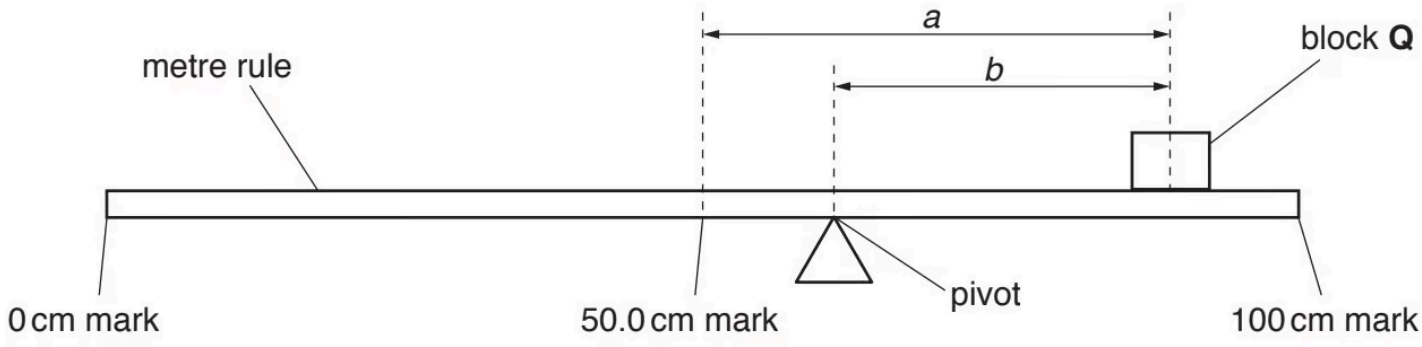


Fig. 1.1

He is using the apparatus shown in Fig. 1.1.

He places the metre rule on the pivot and then places block Q with its centre at the 95.0 cm mark.
The student stated that it is difficult to place the mass accurately at the 95.0 cm mark.

Explain how the student could overcome this. You may draw a diagram to help your explanation.

[1 mark]

Question 3b

The student keeps block **Q** at the 95.0 cm mark and adjusts the position of the metre rule on the pivot until the metre rule is as near to being balanced as possible.

Describe a method to find the point at which the metre rule is as near to being balanced as possible.

[2 marks]

Question 3c

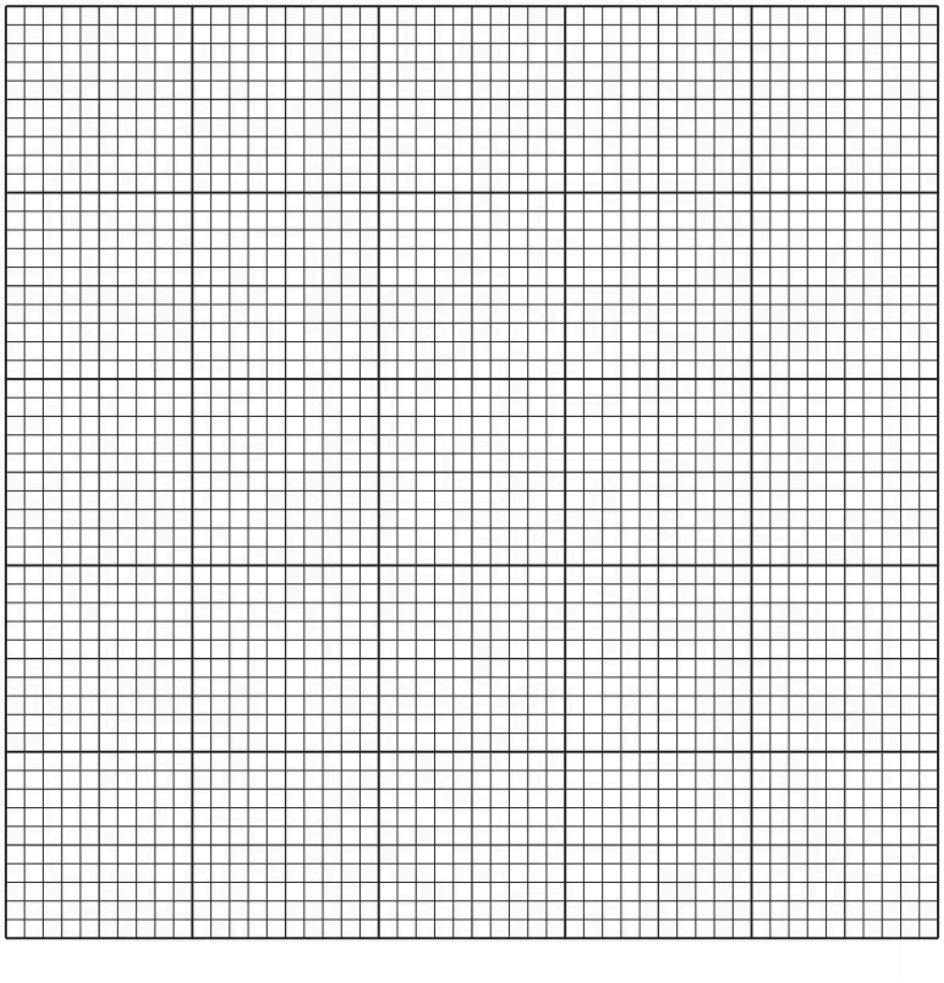
The student determines the distance a between the centre of block **Q** and the 50.0 cm mark and also the distance b between the centre of block **Q** and the pivot.

He repeats the procedure for positions of block **Q** at the 90.0 cm, 85.0 cm, 80.0 cm and 75.0 cm marks. His results are shown in Table 1.1.

Table 1.1

position of **Q**/cm	*a*/cm	*b*/cm
95.0	45.0	39.0
90.0	40.0	34.3
85.0	35.0	30.0
80.0	30.0	25.2
75.0	25.0	21.4

(i) Plot a graph of *a*/cm (*y*-axis) against *b*/cm (*x*-axis). You do not need to start your axes at the origin (0,0).



[4]

(ii) Determine the gradient *G* of your line. Show clearly on the graph how you obtained the necessary information.

G = ...[1]

(iii) Calculate the mass M_R of the metre rule using the equation

$$M_R = \frac{M}{(G - 1)},$$

where M = 20 g. Record the value for M_R to a suitable number of significant figures for this experiment.

M_R = ...[2]

[7 marks]

Question 3d

Two students carry out the experiment correctly but with different values for the mass of block **Q**. One student obtains values of *b* that are larger than those obtained by the other student.

State and explain whether the larger values of *b* are likely to produce a more accurate value for the mass of the metre rule.

[1 mark]

Question 4a

A student is determining the mass of a load using a balancing method.

Fig. 1.1 shows the apparatus.

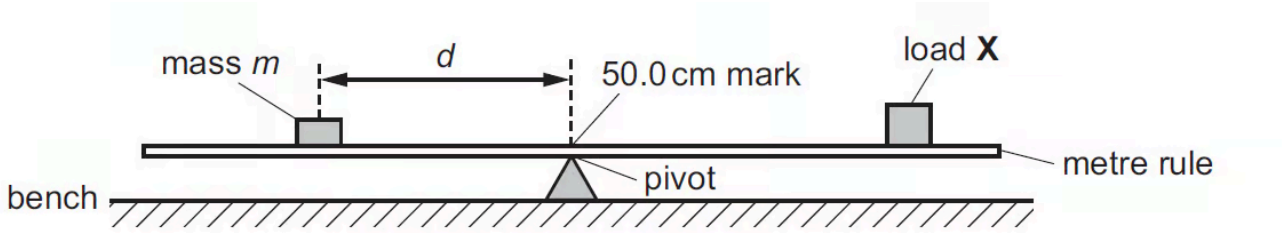


Fig. 1.1

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. Fig. 1.2(a) shows part of the rule when it is balanced.

The procedure is repeated for a range of masses. Fig. 1.2(b) – (e) shows the rule when balanced for values of *m* of 50 g, 60 g, 70 g and 80 g.

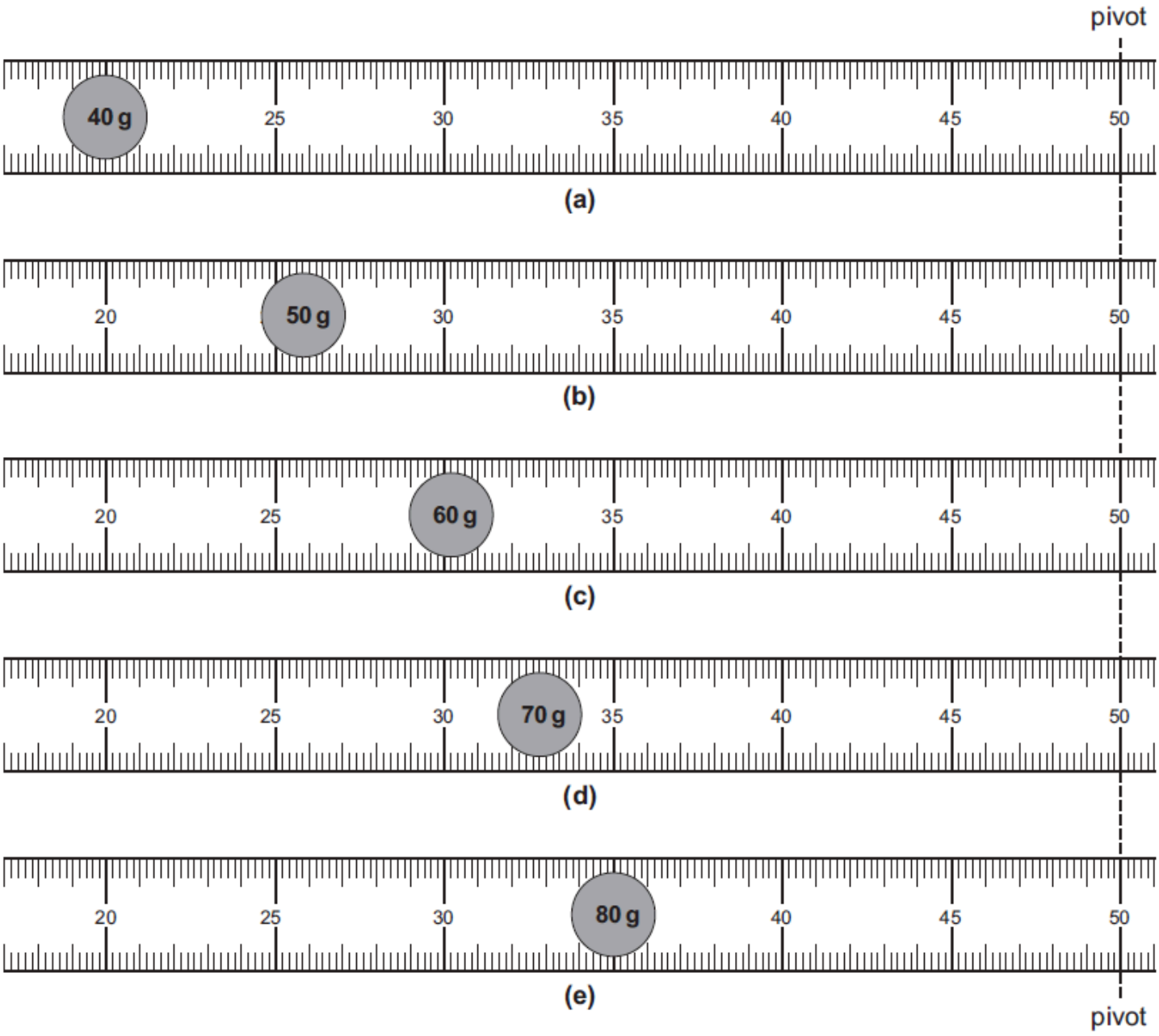


Fig. 1.2

(i) Use Fig. 1.2 to determine *d*, the distance between the mass and the pivot at balance, for each value of m. Record your results in Table 1.1.

[3]

m/g	*d*/cm	$\frac{1}{d}$ / $\frac{1}{\text{cm}}$
40		
50		
60		
70		
80		

(ii) For each value of *d*, calculate $\frac{1}{d}$ and record it in the table.

[1]

[4 marks]

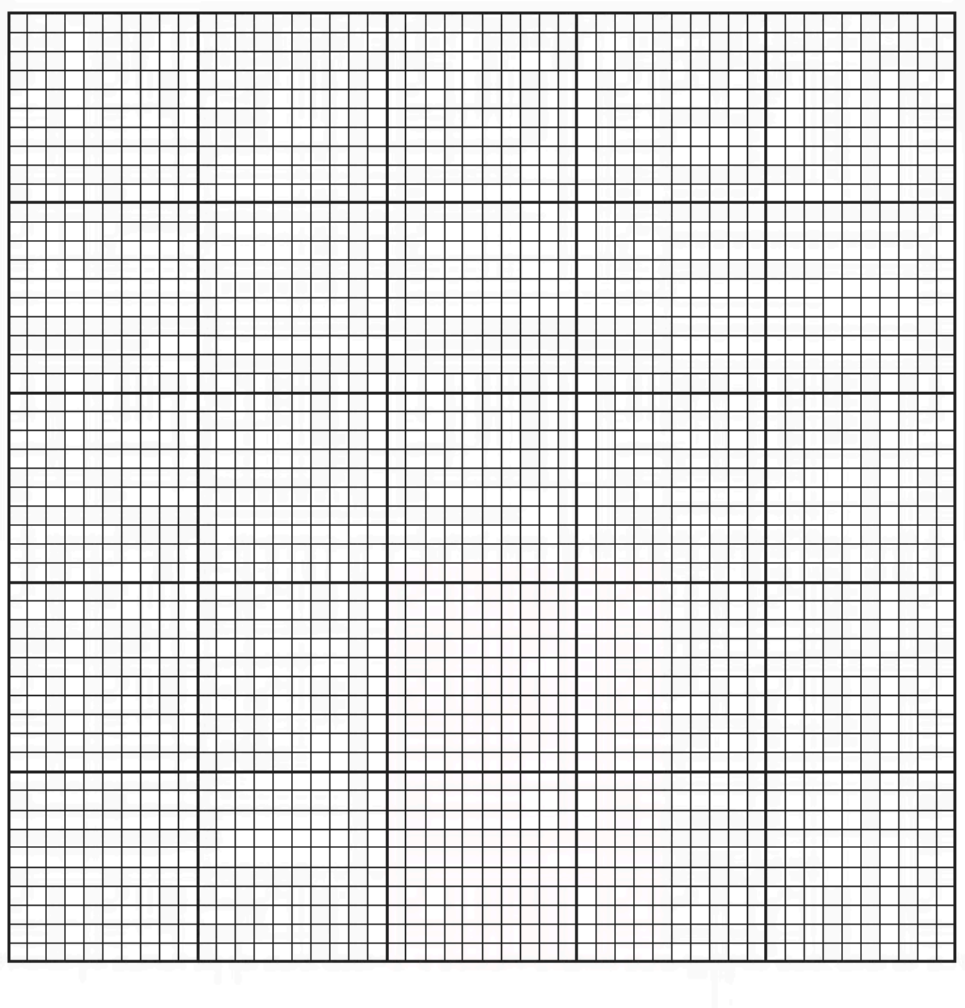
Question 4b

Describe one difficulty the student might have when carrying out this experiment, and how he might overcome this difficulty.

[2 marks]

Question 4c

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



[4 marks]

Question 4d

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

G = ...

[1 mark]

Question 4e

Determine the mass μ, in grams, of the load **X**. Use the equation $\mu = \frac{G}{40.0}$

μ = ... g

[1 mark]