Moments/Centre of Mass

Question Paper 1

Level	IGCSE
Subject	Physics
Exam Board	CIE
Topic	General Physics
Sub-Topic	Moments/ Centre of Mass
Paper Type	Alternative to Practical
Booklet	Question Paper 1

Time Allowed: **53 minutes**

Score: **/44**

Percentage: **/100**

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

The apparatus is shown in Fig. 1.1.

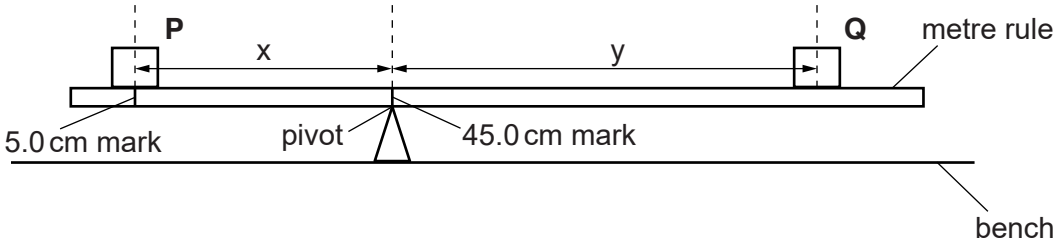


Fig. 1.1 (not to scale)

(a)
- The student places the load **P** on the metre rule at the 5.0 cm mark.
- She places the metre rule on the pivot at the 45.0 cm mark.
- She places load **Q** on the rule and adjusts its position so that the metre rule is as near as possible to being balanced.
- She measures the distance x between the centre of load **P** and the pivot and the distance y from the centre of load **Q** to the pivot.
- She repeats the procedure, placing the load **P** at the 10.0 cm mark, at the 15.0 cm mark, at the 20.0 cm mark and at the 25.0 cm mark. The readings are shown in Table 1.1.

Table 1.1

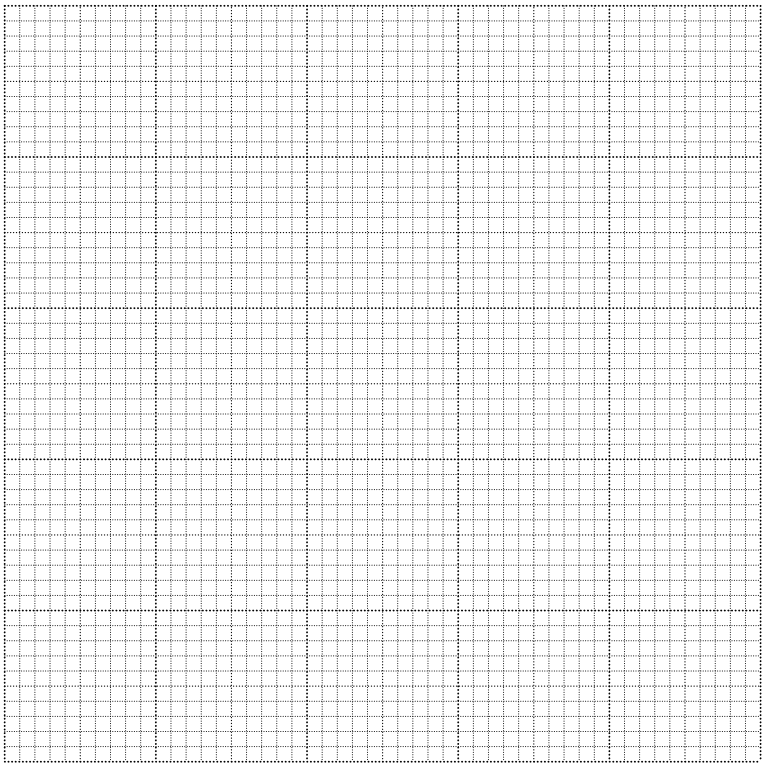
x /	y /	A /	B /
40.0	42.5		
35.0	36.0		
30.0	30.0		
25.0	24.0		
20.0	17.5		

(i)
- For each value of x, calculate A = Px, where P = 1.00 N. Record the values in the table. P is the weight of load **P**.
- For each value of y, calculate B = Qy, where Q = 0.80 N. Record the values in the table. Q is the weight of load **Q**.

[1]

(ii) Complete the column headings in the table. [1]

(b) Plot a graph of A / N cm (y-axis) against B / N cm (x-axis). Start both axes at the origin (0,0).



[4]

(c) Using the graph, determine the vertical intercept Y (the value of A when B = 0 N cm). Show clearly on the graph how you obtained this value.

Y = ... [1]

(d) Calculate the weight W of the metre rule using the equation $W = \frac{Y}{z}$, where z = 5.0 cm.

W = ... [1]

(e) Suggest one practical reason why it is difficult to obtain exact results with this experiment.

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..... [1]

(f) The student uses an accurate electronic balance to obtain a second value for the weight of the metre rule.

weight obtained on the balance = 1.24 N

State and explain whether the two values for the weight agree within the limits of experimental accuracy.

statement .....

justification .....

.....

[1]

[Total: 10]

2 A student is using a balancing method to determine the weight of a piece of soft modelling clay. The apparatus is shown in Fig. 2.1.

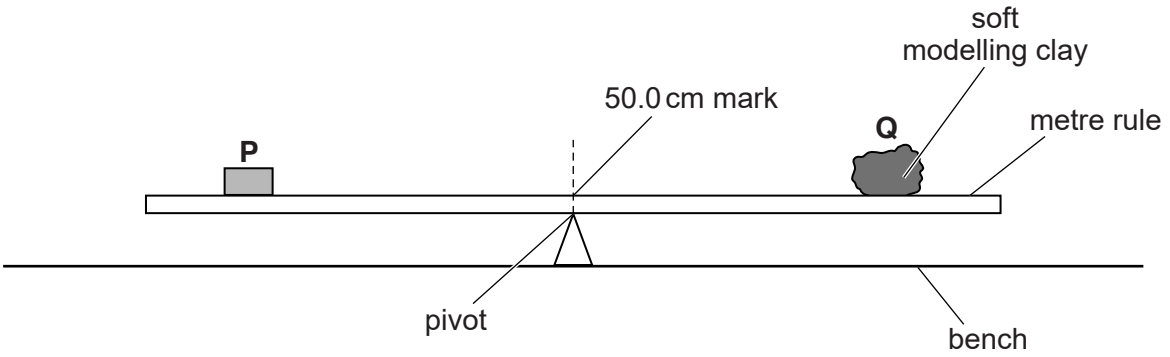

Fig. 2.1

P is a metal cube of weight P = 1.0 N. **Q** is the piece of soft modelling clay.

The student places the cube **P** so that its weight acts at a distance x from the pivot.

He adjusts the position of **Q** to balance the rule and measures the distance y from the centre of **Q** to the pivot. He calculates the weight W of **Q** using the equation $W = \frac{Px}{y}$.

(a) **On Fig. 2.1**, mark clearly the distance x. [1]

(b) Suggest a change to **Q** that would make it easier to find the value of y accurately.

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.....[1]

(c) It is difficult to achieve an exact balance of the metre rule in this type of experiment. This can make the result unreliable.

Explain how you would reduce the effect of this problem to improve the reliability of the experiment.

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.....[1]

(d) The metal cube **P** is larger than the width of the metre rule.

Explain briefly how you would determine the reading of the metre rule scale at the position of the centre of mass of **P**. You may draw a diagram.

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.....[2]

(e) Before starting the experiment, the student determines the position of the centre of mass of the metre rule.

Explain briefly how you would do this.

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.....[1]

[Total: 6]

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

Fig. 1.1 shows the apparatus.

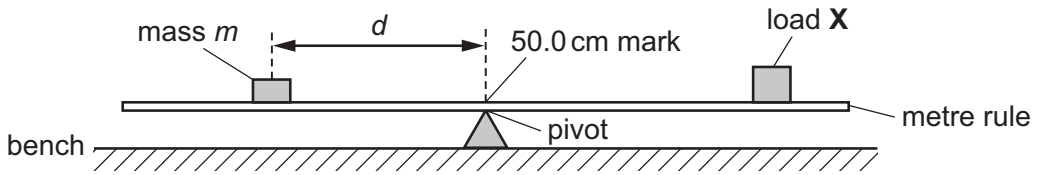

Fig. 1.1

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.

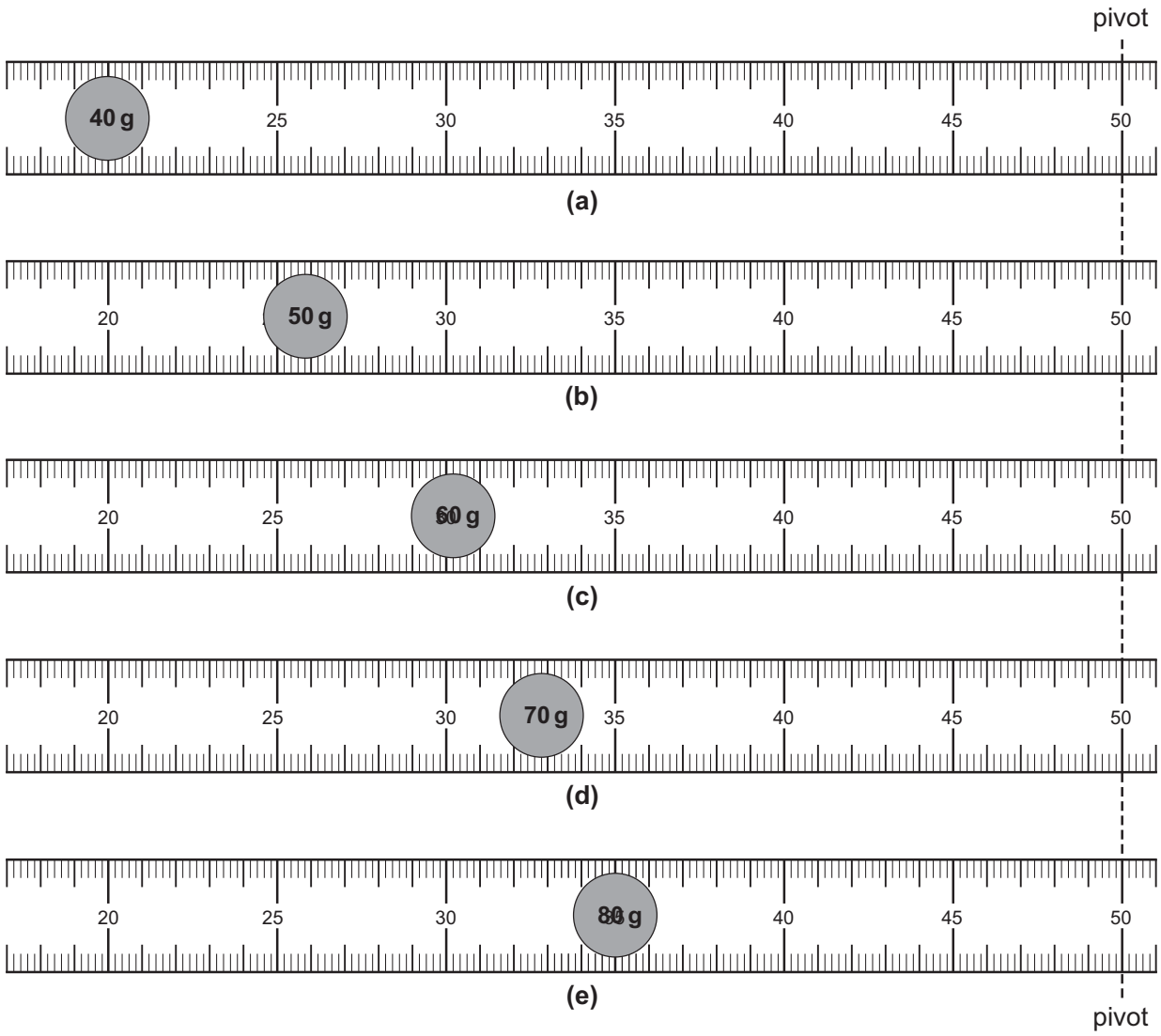

Fig. 1.2

(a) **(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]

Table 1.1

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

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

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

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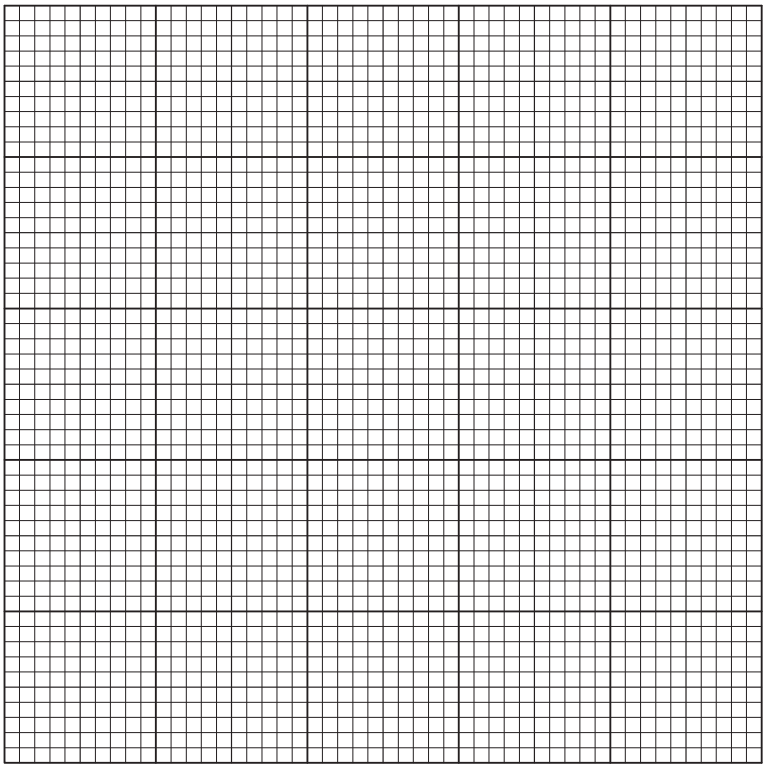
..... [2]

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



[4]

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

G = ... [1]

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

μ = ... g [1]

[Total: 12]

4 A student's plastic bottle of water tips over in class.

Plan an experiment to investigate how the quantity of water in a plastic bottle affects its stability.

The plastic bottle holds up to 2000 cm^3 of water and has a height of 42 cm.

(a) Write a plan for the experiment, including:

- the apparatus needed
- instructions for carrying out the experiment
- the values you will use for the quantity of water
- how you will make sure your results are as accurate as possible
- the graph you will plot from your results

A diagram is not required, but you may add to Fig. 4.1, or draw your own diagram, if it helps to explain your plan.

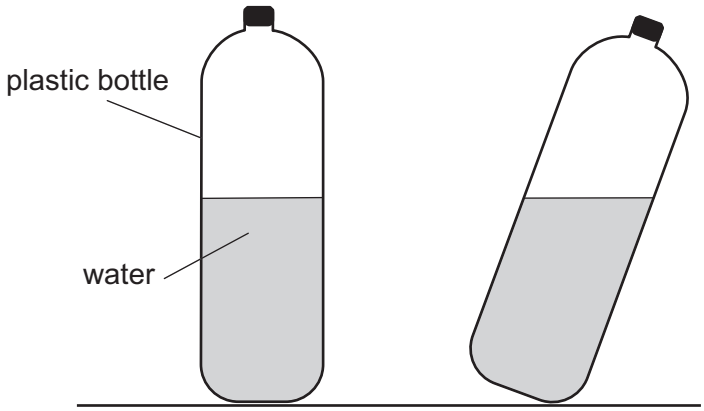


Fig. 4.1

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(b) On Fig. 4.1, measure the angle through which the bottle has been tilted.

angle = ... [1]

[Total: 8]

5 The class is determining the weight of a metre rule using a balancing method.

The apparatus is shown in Fig. 1.1.

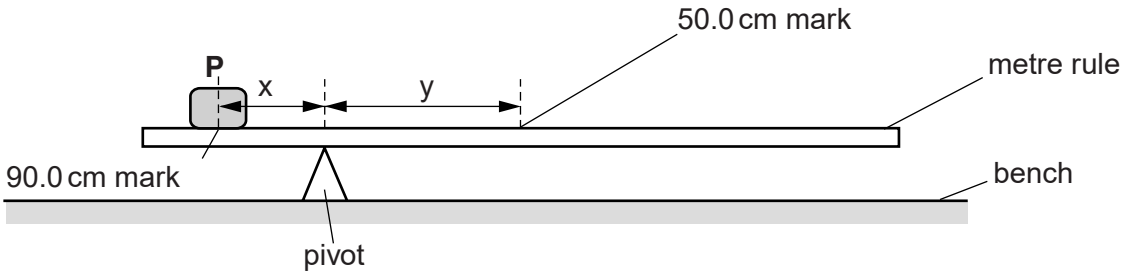

Fig. 1.1

(a) A student places a load **P** at the 90.0 cm mark on a metre rule and then balances the rule on a pivot.

(i) On Fig. 1.1, measure the distance x from the 90.0 cm mark to the pivot.

x = ...[1]

(ii) On Fig. 1.1, measure the distance y from the pivot to the centre of the rule.

y = ...[1]

(b) Fig. 1.1 is drawn one tenth of actual size.

(i) Calculate the actual distance X from the 90.0 cm mark to the pivot.

X = ...

(ii) Calculate the actual distance Y from the pivot to the centre of the rule.

Y = ...
[1]

(iii) Determine a value W_1 for the weight of the metre rule using the equation $W_1 = \frac{PX}{Y}$, where P = 2.0 N. P is the weight of the load **P**.

W_1 = ...[1]

(c) The student keeps the pivot at the same position and moves load **P** to the 95.0 cm mark. He places a load **Q** of weight Q = 1.0 N, on the metre rule. He adjusts its position so that the rule balances.

On Fig. 1.2 mark, with a letter Z, the approximate position of the load **Q**. You do not need to carry out a detailed calculation.

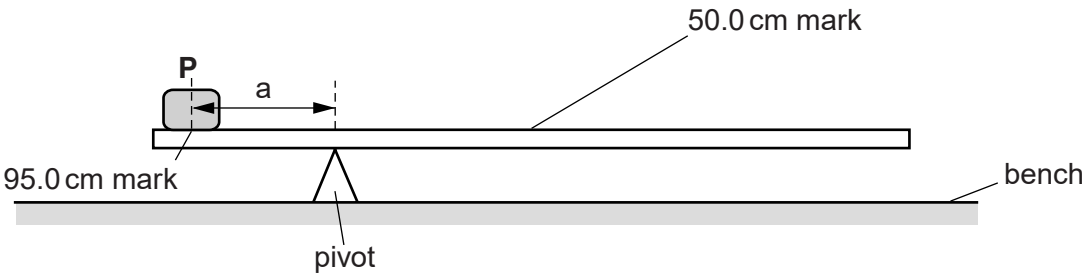

Fig. 1.2

[1]

(d) The student uses the values of **P** and **Q** and their distances from the pivot to calculate a second value W_2 for the weight of the rule.

W_2 = 1.12 N

The student expects W_1 and W_2 to be the same.

State whether the results support his idea. Justify your answer by reference to the results.

statement .....

justification .....

.....

.....

[2]

(e) Suggest one practical reason why it is difficult to obtain exact results with this experiment.

.....

.....[1]

[Total: 8]