

Determination of unknown masses by using the principle of moments

Practical question — PH3 2009 Task A2

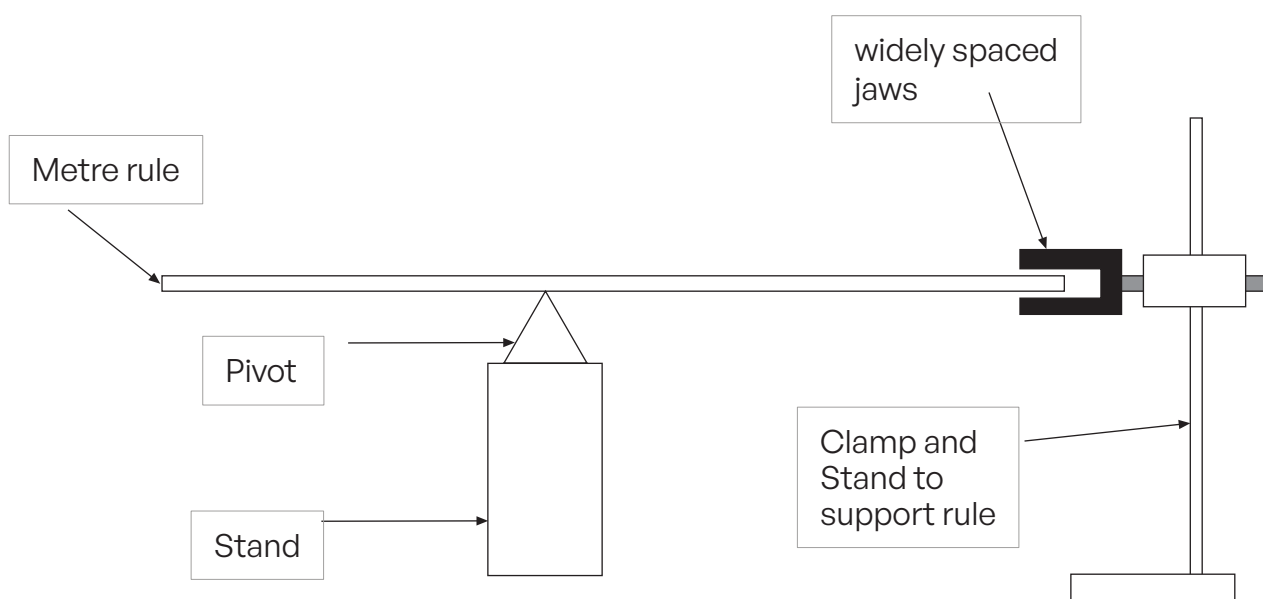
Total

/8

INSTRUCTIONS

The candidates will be expected to investigate the balance of a metre rule, both loaded and unloaded.

Test 1



The above apparatus should be set up for the candidates at the start of the task. The clamp should support the metre rule only loosely.

Apparatus required:

- 1 × metre rule with a resolution of 1mm
- 1 × 2.0 N weight (200g including hanger) - the candidates should easily be able to hang it from the rule at any position
- 1 × clamp and stand

- 1 × stand and pivot, e.g. wooden block and prism (which need not have a sharp edge)
- 1 × unknown weight, labelled S. This should have a mass of approximately 60 grams, and could consist of a glass stopper or a small coil of wire. Other objects of approx. this mass could also be used. Please check before the experiment that the unknown mass is suitable to balance the 2.0 N weight. This object should be attached to a thread loop to allow it to be hung from the ruler without the candidates' having to tie any knots.

N.B. For ease of marking, centres should, where possible, select ruler with similar mass and which balance near the 50cm mark.

Additional information for supervisors

It is not anticipated that candidates should spend a long time to balance the rule exactly; answers within a couple of mm will be good enough. If you feel a candidate is taking too long then please encourage them to move on to complete the rest of the question.

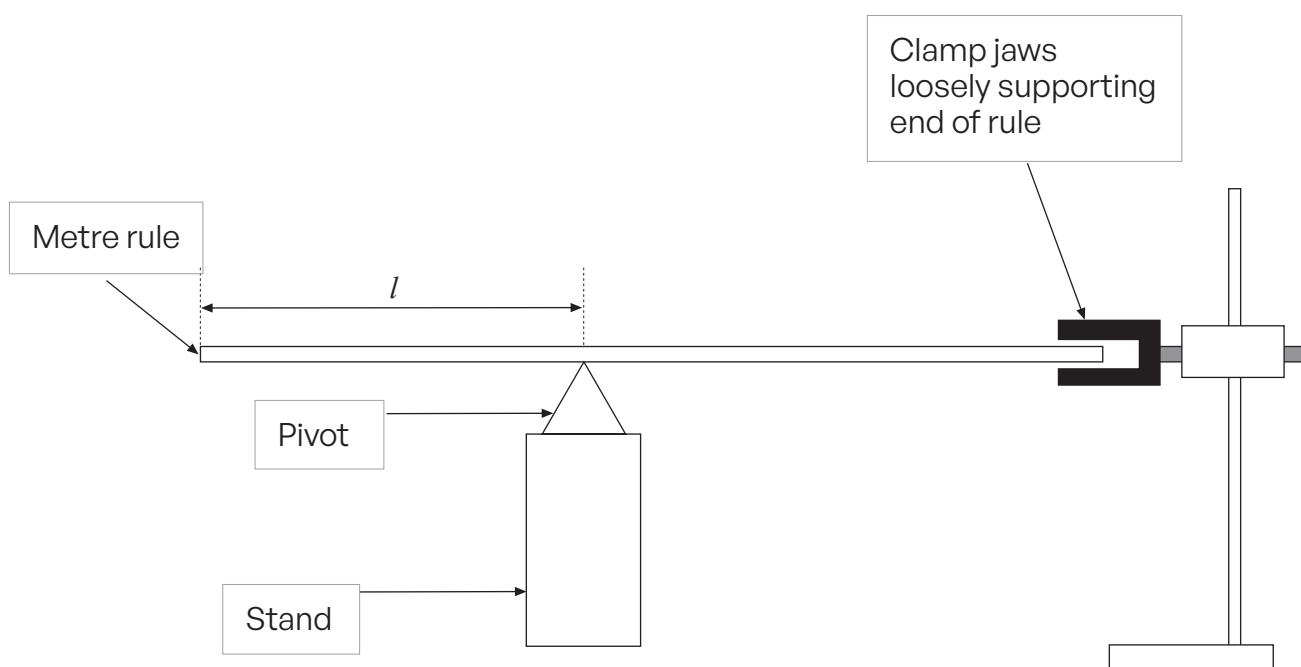
Test 2

The apparatus is as for Test 1 except that a different unknown mass (e.g. 70-80 g) should be used.

TASK A2

Repeat readings are not required for this task.

1. You are provided with the following apparatus.

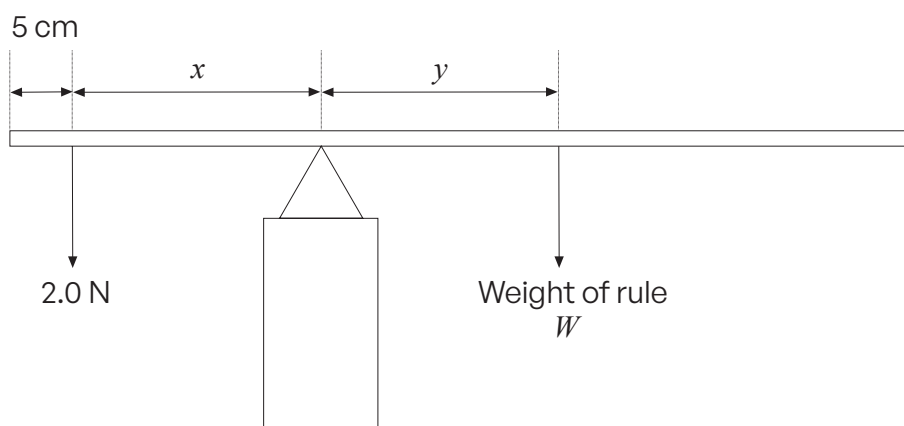


Adjust the rule until it is just, or very nearly, balanced. The balance point is known as the centre of gravity of the rule. This is the point through which the whole of the weight of the rule, W , can be thought to act. Make a note of the length, l .

[1]

$l =$ _____ cm

2. Hang a weight of 2.0N a distance of 5.0 cm from the left hand end of the rule, as shown, and once again adjust the rule so that it balances.



- (a) Measure the distances x and y . [1]

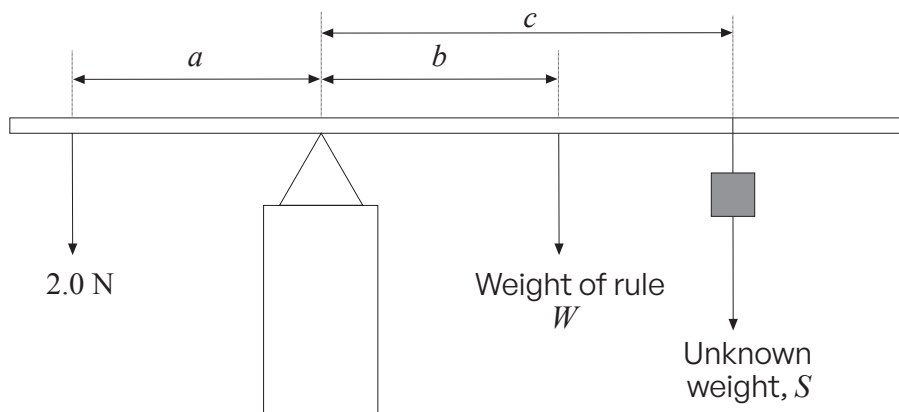
$x =$ _____ cm $y =$ _____ cm

- (b) The Principle of Moments applied to this situation leads to the following equation:

$$2.0x = Wy$$

Use your results in 2.(a) to determine a value for W . [2]

3. Hang the unknown weight, S , on the opposite side to the 2.0 N weight and once again balance the rule.



Record the values of a , b and c .

[1]

$a =$ _____ cm $b =$ _____ cm $c =$ _____ cm

Use the above information, and your value for the weight of the rule in **2.** to calculate the unknown weight.

[3]

MARK SCHEME

Question		Marks available
1.		Answer given to 1 d.p. within 0.5cm of the centre value (1)
2.	(a)	Both values to 1 d.p. and within 0.5cm of centre value (1)
	(b)	Weight correct to 5% of true value (1) Units newton / N (1) [Accept: Newton(s)]
3.	(a)	All values recorded to 1 d.p. (1)
	(b)	$2a = Wb + Sc$ (1) [or by impl.] S calculated correctly (1) S correct to $\pm 0.2\text{N}$ of centre value (1)