# SMART EXAM RESOURCES
# IGCSE PHYSICS
# ATP- TOPIC QUESTIONS+MARKSCHEMES
# MASS OF A METER RULE USING BALANCING METHOD

**1** A student determines the mass $M_R$ of a metre ruler by a balancing method.

He uses the apparatus shown in Fig. 1.1.

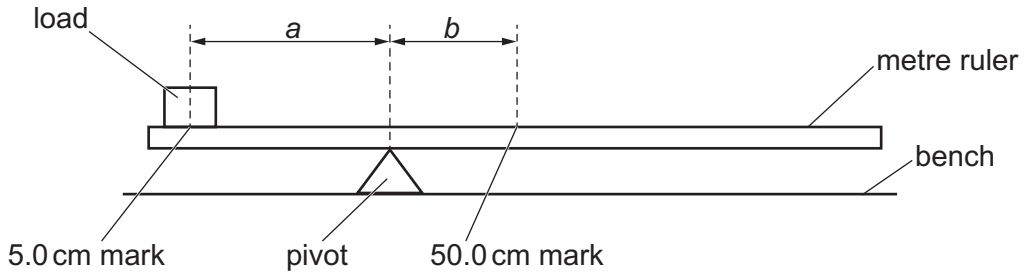


**Fig. 1.1**

**(a)** The student places a circular load of mass $M$ = 20 g on the metre ruler but in a position different from that shown in Fig. 1.1.

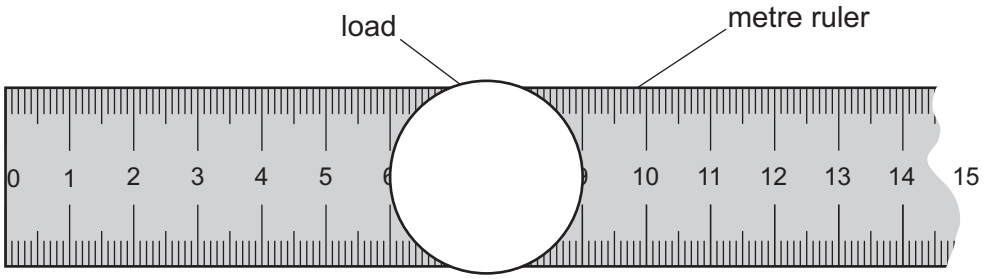


**Fig. 1.2** (not to scale)

Determine the distance $d_0$ of the centre of the load from the zero end of the ruler, as shown in Fig. 1.2. Fig. 1.2 is **not** to scale.

$d_0$ = ..... cm [1]

**(b) (i)** The student places the metre ruler on the pivot and changes the position of the load so that the centre of the load is at the 5.0 cm mark.

He adjusts the position of the metre ruler on the pivot until the metre ruler is as near as possible to being balanced.

Describe a technique for ensuring that the ruler is as near as possible to being balanced.

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..... [1]

**(ii)** The student determines the scale reading $p$ on the ruler at the position of the pivot.
He calculates the distance $a$ between the 5.0 cm mark and the pivot and the distance $b$ between the 50.0 cm mark and the pivot, using the equations

$$a = p - 5.0$$

$$b = 50.0 - p.$$

He repeats the procedure for values of $M$ = 40 g, 60 g, 80 g and 100 g.
His results are shown in Table 1.1.

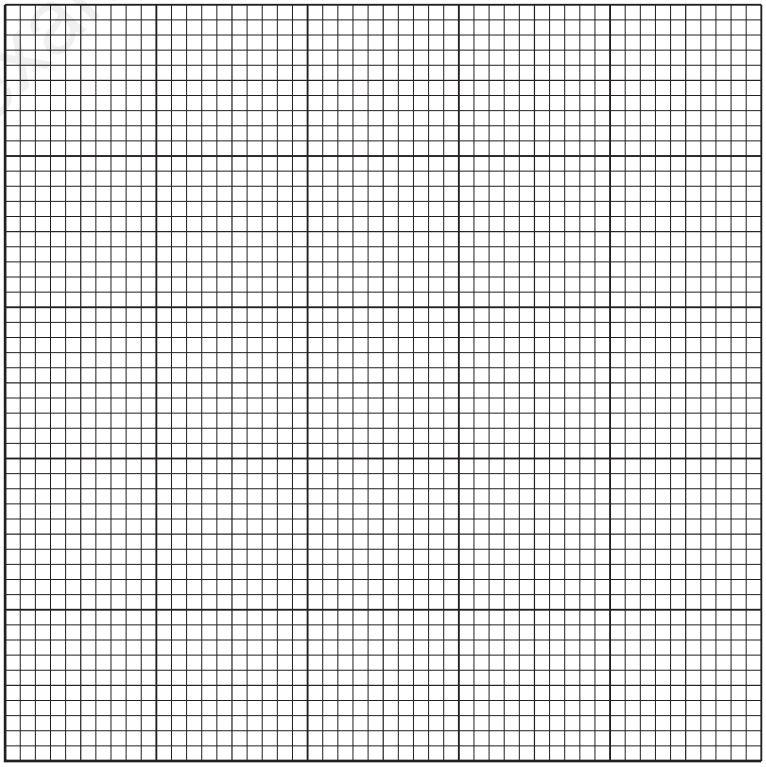
**Table 1.1**

| $M$ / g | $a$ / cm | $b$ / cm | $\frac{b}{a}$ |
|---|---|---|---|
| 20 | 39.5 | 5.5 | |
| 40 | 35.7 | 9.3 | 0.26 |
| 60 | 32.6 | 12.4 | 0.38 |
| 80 | 29.0 | 16.0 | 0.55 |
| 100 | 27.0 | 18.0 | 0.67 |

For the value of $M$ = 20 g, calculate and record in Table 1.1 the value of $\frac{b}{a}$. [1]

**(c)** Plot a graph of $M$/g ($y$-axis) against $\frac{b}{a}$ ($x$-axis).

Draw the best-fit line.



[4]

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

$G$ = ..... [1]

**(ii)** The mass $M_R$ of the metre ruler is numerically equal to $G$.

Write down the value of $M_R$ in this experiment. Include the unit.

$M_R$ = ..... [1]

**(e)** **(i)** The determination of $M_R$ by this method assumes that the centre of mass of the metre ruler is at the 50.0 cm mark.

Suggest how you could use apparatus from Fig. 1.1 to test whether the centre of mass of the metre ruler is at the 50.0 cm mark. You may draw a diagram.

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**(ii)** A student finds that the centre of mass of her metre ruler is at the 48.7 cm mark.

Suggest how she changes the procedure in **(b)(ii)** to allow for this.

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[Total: 11]

# MARK SCHEME:

| Question | Answer | Marks |
|---|---|---|
| 1(a) | $d_0$ = 7.5 (cm) | 1 |
| 1(b)(i) | idea of allow to (just) tip one way then the other way / owtte | 1 |
| 1(b)(ii) | $b / a$ = 0.14 | 1 |
| 1(c) | graph:<br>• axes labelled with quantity and unit | 1 |
| | • appropriate scales (plots occupying at least ½ grid between plotted points) | 1 |
| | • plots all correct to ½ small square and precise plots | 1 |
| | • well-judged line and thin line | 1 |
| 1(d)(i) | $G$ present and triangle method seen on graph | 1 |
| 1(d)(ii) | $M_R$ in range 140 to 170 and with unit of g | 1 |
| 1(e)(i) | metre ruler on pivot without mass $M$, read position of pivot when ruler as near to balance as possible / owtte | 1 |
| 1(e)(ii) | $b$ calculated from $b = 48.7 - p$ | 1 |