An IGCSE student is determining the density of the material of a metre rule.

Fig. 1.1 shows the balancing experiment used to determine the mass of the rule.

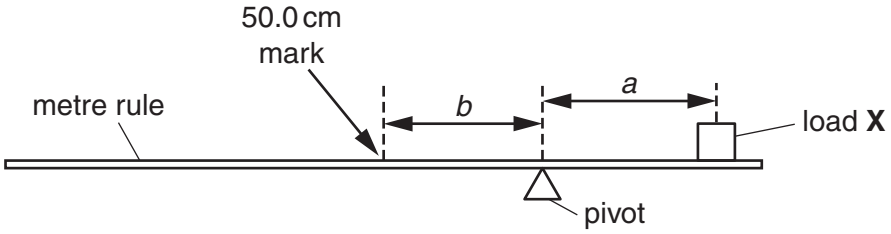

Fig. 1.1

(a) (i) On Fig. 1.1, measure the distance *a* from the centre of the load **X** to the pivot.

a = ... cm

(ii) On Fig. 1.1, measure the distance *b* from the pivot to the 50.0 cm mark on the rule.

b = ... cm
[1]

(b) The diagram is drawn one tenth of actual size.

(i) Calculate the actual distance *x* from the centre of the load **X** to the pivot.

x = ... cm

(ii) Calculate the actual distance *y* from the pivot to the 50.0 cm mark on the rule.

y = ... cm

(iii) Calculate the mass *m* of the metre rule using the equation

$$m = \frac{kx}{y}$$

where $k = 100$ g.

m = ...
[2]

(c) Figs. 1.2 and 1.3 show part of the metre rule drawn actual size.

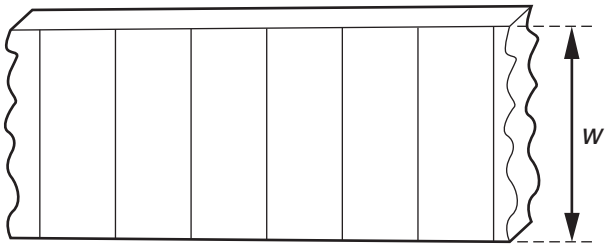

Fig. 1.2

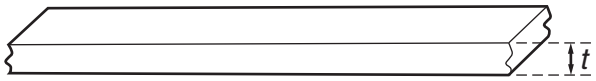

Fig. 1.3

(i) Take and record measurements from Fig. 1.2 to determine the average width w of the metre rule.

w = ... cm

(ii) Take and record measurements from Fig. 1.3 to determine the average thickness t of the metre rule.

t = ... cm

(iii) Calculate the volume V of the metre rule using the equation $V = lwt$ where l is the length of the metre rule (100.0 cm).

V = ...[3]

(iv) Calculate the density ρ of the metre rule using the equation $\rho = \frac{m}{V}$.

ρ = ...[3]

(d) State the assumption that the student has made about the position of the centre of mass of the metre rule.

.....[1]

[Total: 10]

(a) *a* and *b* correct 2.3cm, 2.1cm [1]

(b) **(i)** and **(ii)** *x* and *y* correct (10*a* and 10*b*)/(23cm, 21cm) [1]

(iii) *m* correct arithmetic, in g (110/109.5(2)(g)) [1]

(c) **(i)** and **(ii)** at least two values given for *w* and *t* [1]
more than two values given for *w* or *t* [1]
correct values for *w* and *t* (2.75 – 2.85cm, 0.4cm) [1]

(iii) *V* calculation correct (110 – 114(cm^3)) or ecf [1]

(iv) density to 2 or 3 significant figures (0.960 – 1.00) or ecf [1]
unit g/cm^3 [1]

(d) centre of mass at 50cm mark/midpoint/middle (wtte) [1]

[Total: 10]