

MASS OF A RULE

- 1** An IGCSE student is determining the mass of a metre rule using a balancing method. Fig. 1.1 shows the apparatus.

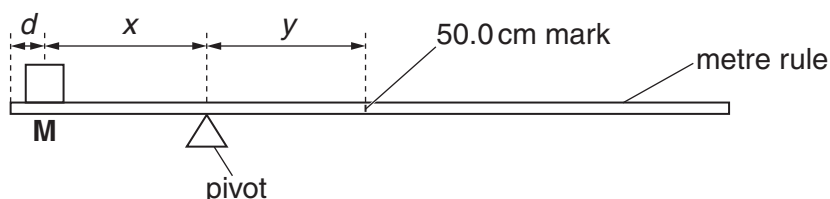


Fig. 1.1

Mass **M** is placed on the rule. The position of the pivot is adjusted until the rule balances.

- (a) The student chooses a mass **M** which is similar to the mass of the metre rule. Suggest a suitable value for the mass.

suitable mass = [1]

- (b) The mass is cylindrical and has a diameter slightly larger than the width of the metre rule.

Describe briefly how you would place the mass so that its centre of mass is exactly over the 90.0 cm mark on the metre rule. You should draw a diagram and mark the position of the centre of mass on the cylinder.

..... [2]

- (c) From your experience of carrying out balancing experiments of this type, suggest one difficulty that you are likely to come across that could make the final result inaccurate.

..... [1]

- (d) The student takes a reading of x and the corresponding reading of y . He then calculates the mass of the metre rule.

Suggest how you would improve the reliability of the value of the mass of the metre rule, using this method.

.....
..... [1]

- (e) Another student carries out a similar experiment to determine the mass of a 50 cm metal strip. She calculates the mass and writes down “mass = 234.872 g”.

She checks the mass on an accurate balance. The value is 235 g. She thinks she must have made a mistake in her experiment.

Write a brief comment on the accuracy of her experimental result.

.....
.....
..... [1]

[Total: 6]

- (a) 50–250 g (or 0.05–0.25 kg) correct unit required [1]
- (b) Centre of mass marked close to centre of cylinder [1]
Clear indication of how centre of mass is placed above the 90.0 cm mark [1]
- (c) Rule unlikely to exactly balance/ difficult to balance
OR rule could slide on pivot
OR mass could slide
OR centre of mass of rule not at 50.0 cm mark
OR rule not uniform1
- Do not accept comments about poor/careless technique [1]
- (d) Repeat readings (wtte) [1]
OR a reference to finding exact position of centre of mass of metre rule
OR a reference to dealing with centre of mass of rule not being at 50.0 cm mark
- (e) Good/ fine/ reasonable/ same to 3 significant figures
OR Within limits of experimental accuracy (wtte)
OR Too many significant figures in experimental result [1]

[Total: 6]

2 The IGCSE class is determining the mass of a metre rule using two methods.

Method 1.

Fig. 1.1 shows the apparatus used.

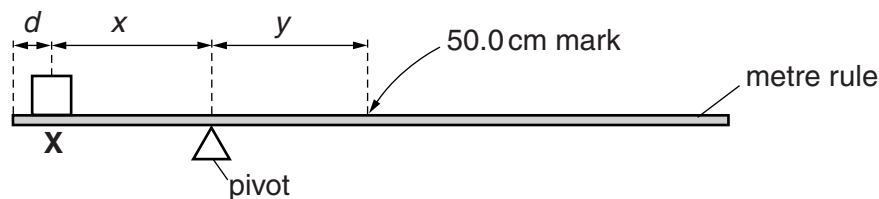


Fig. 1.1

A student places a 100 g mass **X** on the rule so that its centre is at a distance $d = 5.0$ cm from the zero end of the rule, as shown in Fig. 1.1. He adjusts the position of the rule so that it is as near as possible to being balanced.

He measures the distance x from the centre of the mass **X** to the pivot and the distance y from the pivot to the 50.0 cm mark on the rule.

He repeats the procedure using $d = 10.0$ cm.

The readings are shown in Table 1.1.

Table 1.1

d/cm	x/cm	y/cm
5.0	23.7	21.1
10.0	21.0	18.5

- (a) (i) Using the values of x and y in the first row of the table, calculate the mass M of the rule using the equation

$$M = \frac{100x}{y}.$$

$M = \dots\dots\dots$

(ii) Repeat step (a)(i) using the values of x and y in the second row of the table.

$M =$ [2]

(iii) Calculate the average value of M .

average value of $M =$ [1]

Method 2.

- (b) The student measures the mass M of the rule, using a spring balance as shown in Fig. 1.2.

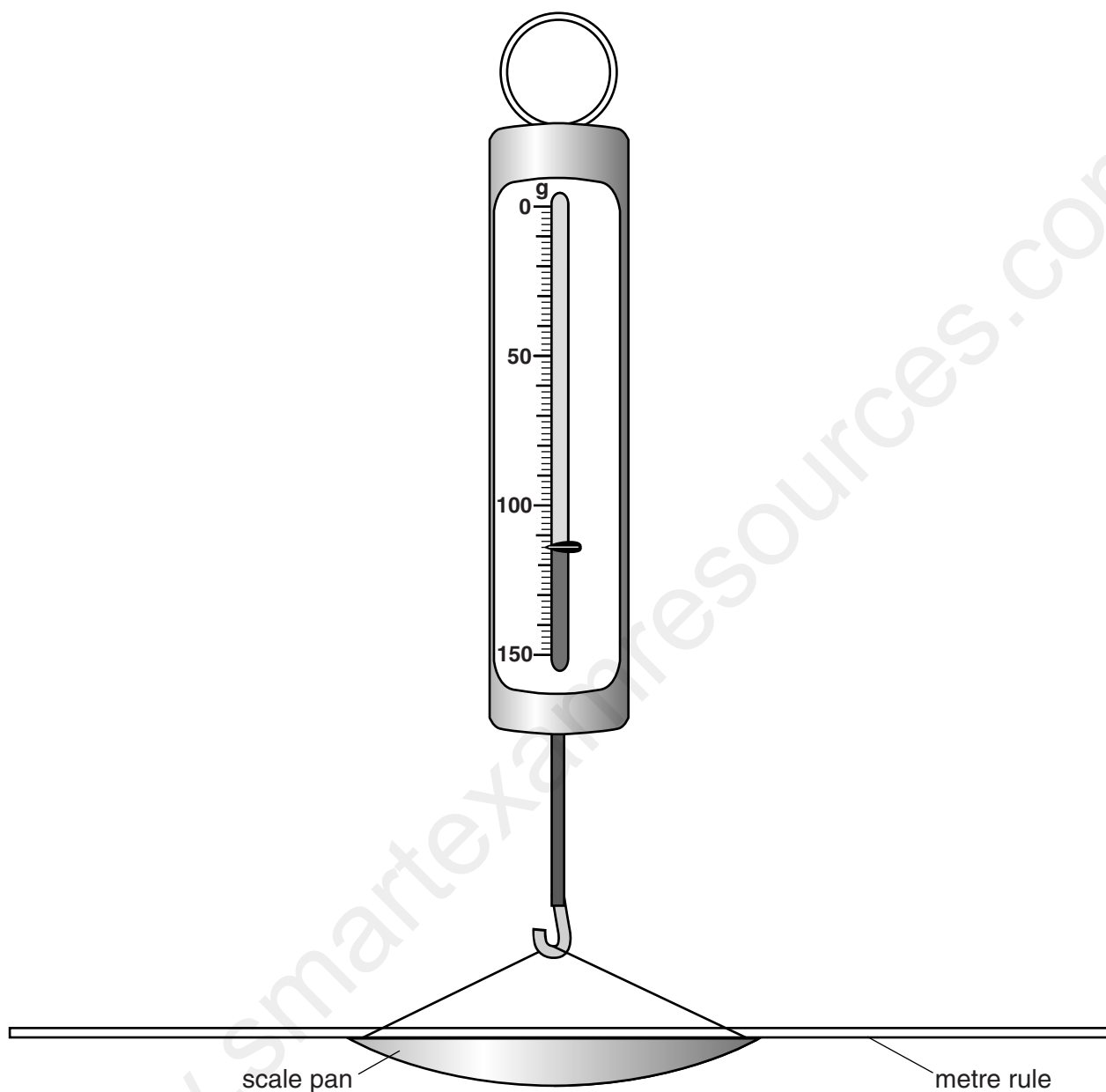


Fig. 1.2

Write down the reading shown in Fig. 1.2.

$M = \dots\dots\dots$ [1]

- (c) The student expects that the values of the mass M obtained by the two methods will be exactly the same.

Suggest two practical reasons why, in spite of following the instructions with care, the values may differ. Assume that the balance used in Method 2 is accurate.

1.

.....

2.

.....

[2]

- (d) Explain briefly how you would judge the position of the centre of the mass X when it is on the rule in Method 1. You may draw a diagram.

.....

.....

.....[1]

[Total: 7]

- (a) (i)(ii) M values 112.3, 113.5 (to 3 or 4 sig. figs **only**) [1]
 g at least once, not contradicted (symbols or words) [1]
- (iii) 113 or 112.9 or correct average of candidate's values (ignore sig. figs) [1]
- (b) 114 (g) c.a.o. [1]
- (c) any two from:
 centre of mass of rule not at 50.0 cm
 mass X not uniform / of varying density
 reference to difficulty in obtaining balance implied o.w.t.t.e.
 mass of pan
 mass not exactly 100 g [2]
- (d) one from:
 mark line through the centre of the mass (can award from diagram)
 use position of edges of mass on rule [1]

[Total: 7]