DENSITY OF A CYLINDER

1 An IGCSE student is determining the density of a solid metal cylinder using a balancing method. Fig. 1.1. shows the apparatus.

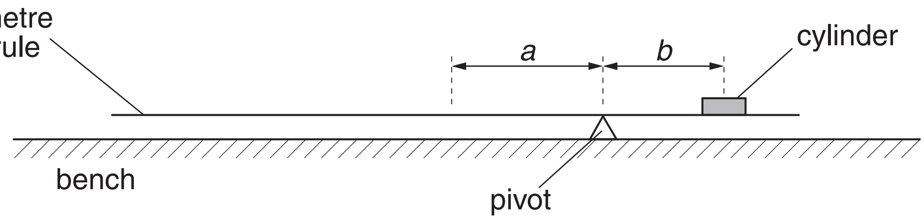

Fig. 1.1

He places the cylinder on the metre rule so that its centre is directly above the 10.0 cm mark. The rule is placed on the pivot so that the rule is as near as possible to being balanced.

He measures and records the distance *a* from the centre of the rule to the pivot and the distance *b* from the centre of the cylinder to the pivot. He repeats the experiment with the same cylinder at different positions on the rule.

The readings are shown in Table 1.1.

Table 1.1

a/	*b*/	*M*/
12.6	27.4	
11.0	24.0	
9.5	20.5	

(a) **(i)** Complete the column headings in Table 1.1.

(ii) For each set of readings, calculate the mass *M* of the cylinder using the equation

$$M = \frac{ka}{b}.$$

The value of *k* is the mass of the rule which is 108 g.

Enter the results in Table 1.1.

[3]

(b) The cylinder completely covers the marks on the metre rule. Describe, with the aid of a diagram, how you would judge that the centre of the cylinder is directly above the 10.0 cm mark.

....

....[1]

(c) Use your answers in Table 1.1 to calculate and record the average of the three values for *M*. Show your working.

average value for *M* = ...[2]

(d) Fig. 1.2 shows the cylinder placed flat on the bench and viewed from one side.

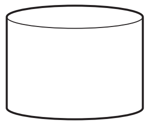

Fig. 1.2

(i) On the diagram, measure the diameter d and the thickness t of the cylinder.

d = ...

t = ...

(ii) Calculate the volume V of the cylinder using the equation

$$V = \frac{\pi d^2 t}{4}.$$

V = ...

(iii) Calculate the density ρ of the cylinder using the equation

$$\rho = \frac{M}{V}.$$

ρ = ... [3]

[Total: 9]

(a) **(i)** cm, cm, g [1]

(ii) 49.66 (or 49.7), 49.50 (or 49.5), 50.05 (or 50.0) [1]
consistent significant figures (3 or 4) [1]

(b) clear explanation/diagram [1]

(c) correct method [1]
value 49.7 (ignore a fourth significant figure)
and allow ecf from **(ii)** [1]

(d) d = 1.8 (cm), t = 1.2 (cm) [1]
V = 3.05 (cm^3) (ecf) [1]
ρ = 16.3 unit g/cm^3, 2/3 significant figures (ecf) [1]

[Total: 9]