DETERMINING DENSITYOF IRREGULAR OBJECTS

1 A student is determining the density of modelling clay.

He is using the block shown in Fig. 1.1 and Fig. 1.2.

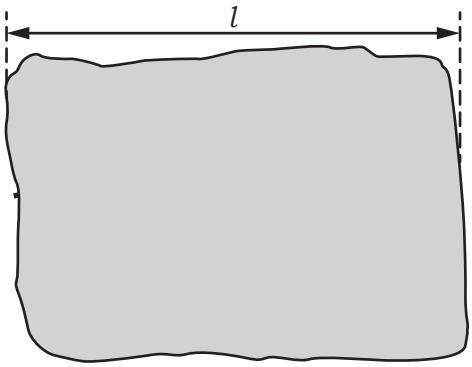

Fig. 1.1

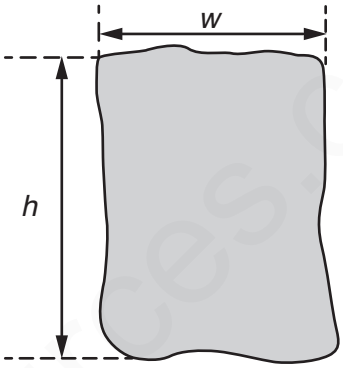

Fig. 1.2 (side view)

(a) **(i)** Measure the dimensions of the block of modelling clay, as shown in Fig. 1.1 and Fig. 1.2.

length l = ... cm

width w = ... cm

height h = ... cm
[1]

(ii) Calculate the volume V_1 of the block, using your measurements from **(a)(i)** and the equation $V_1 = l \times w \times h$.

V_1 = ... cm^3 [1]

(b) Suggest a possible source of inaccuracy in measuring the dimensions of the block and describe an improvement to the procedure that will produce more reliable measurements of the block.

suggestion .....

.....

improvement .....

.....

.....
[2]

(c) The student suspends the piece of modelling clay from a forcemeter, as shown in Fig. 1.3.

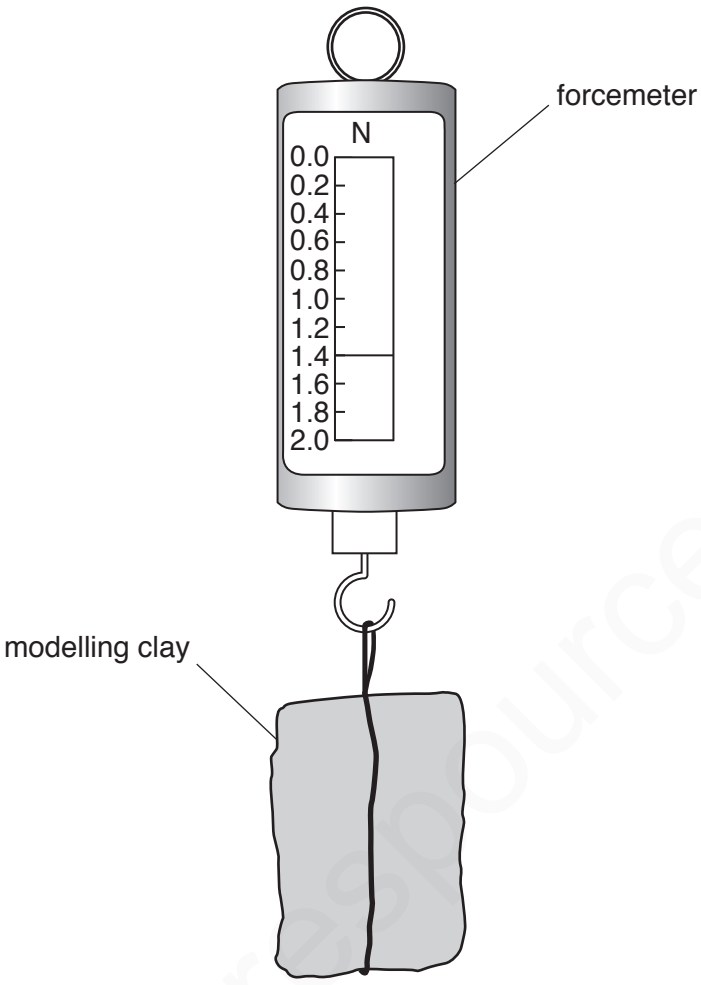

Fig. 1.3

Record the weight W of the block of modelling clay shown in Fig. 1.3.

W = ... N [1]

(d) Calculate a value ρ_1 for the density of the modelling clay, using your results from **(a)(ii)** and **(c)** and the equation

$$\rho_1 = \frac{W \times k}{V_1},$$

where $k = 100\,\text{g/N}$.

ρ_1 = ... [2]

(e) The student pours some water into a measuring cylinder, as shown in Fig. 1.4.

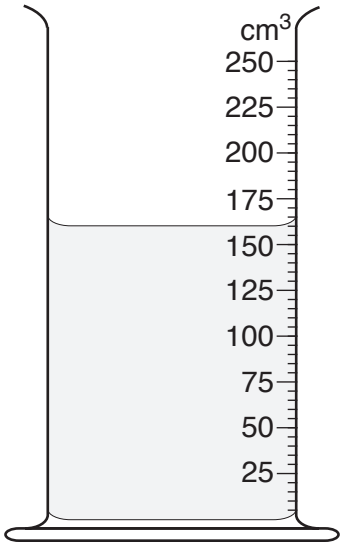

Fig. 1.4

(i) Record the volume V_2 of the water in the measuring cylinder shown in Fig. 1.4.

V_2 = ... cm^3 [1]

(ii) Describe how a measuring cylinder is read to obtain an accurate value for the volume of water. You may draw a diagram to help you.

.....

.....

..... [1]

(f) The student lowers the modelling clay into the water, as shown in Fig. 1.5.

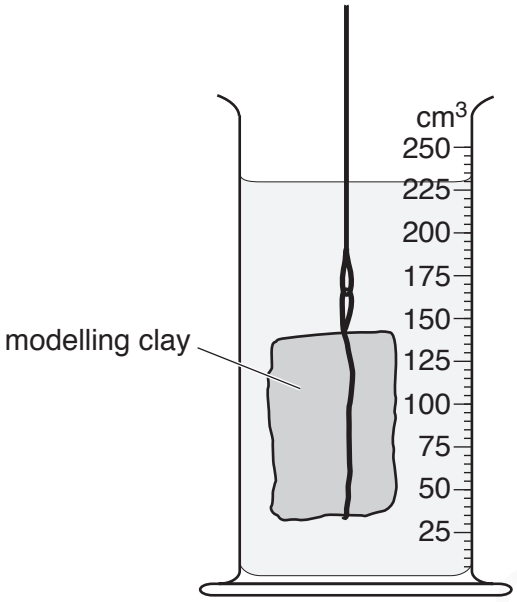

Fig. 1.5

(i) • Record the new reading V_3 of the measuring cylinder in Fig. 1.5, with the block of modelling clay in the water.

V_3 = ... cm^3

• Calculate another value ρ_2 for the density of modelling clay, using your value for V_3, your readings from **(c)** and **(e)(i)** and the equation

$$\rho_2 = \frac{W \times k}{(V_3 - V_2)},$$

where $k = 100\,g/N$.

ρ_2 = ...
[1]

(ii) Suggest which of ρ_1 or ρ_2 is likely to be the more accurate value for the density of the modelling clay.

Justify your answer by referring to the procedure.

.....

.....

..... [1]

[Total: 11]

MARKING SCHEME

1(a)(i)	l = 6.0, w = 3.0, h = 4.0 (cm)	**1**
1(a)(ii)	V_1 = 72 (cm^3)	**1**
1(b)	difficult to measure irregular dimensions / owtte	**1**
	repeat (in several places for each dimension and take averages)	**1**
1(c)	W = 1.4 (N)	**1**
1(d)	ρ_1 = 1.9(4)	**1**
	unit g / cm^3	**1**
1(e)(i)	V_2 = 160 (cm^3)	**1**
1(e)(ii)	line of sight perpendicular	**1**
1(f)(i)	V_3 present and ρ_2 = 2.0(g / cm^3)	**1**
1(f)(ii)	*suggestion supported by valid reason e.g.* ρ_2 as volume is measured directly; ρ_1 as measuring cylinder is less precise; string adds to volume displaced.	**1**