

- 2 (a) A sphere of radius  $R$  is moving through a fluid with constant speed  $v$ . There is a frictional force  $F$  acting on the sphere, which is given by the expression

$$F = 6\pi DRv$$

where  $D$  depends on the fluid.

- (i) Show that the SI base units of the quantity  $D$  are  $\text{kg m}^{-1} \text{s}^{-1}$ .

[3]

- (ii) A raindrop of radius 1.5 mm falls vertically in air at a velocity of  $3.7 \text{ ms}^{-1}$ . The value of  $D$  for air is  $6.6 \times 10^{-4} \text{ kg m}^{-1} \text{s}^{-1}$ . The density of water is  $1000 \text{ kg m}^{-3}$ .

Calculate

- the magnitude of the frictional force  $F$ ,

$$F = \dots \text{ N} [1]$$

- the acceleration of the raindrop.

$$\text{acceleration} = \dots \text{ ms}^{-2} [3]$$

- (b) The variation with time  $t$  of the speed  $v$  of the raindrop in (a) is shown in Fig. 2.1.

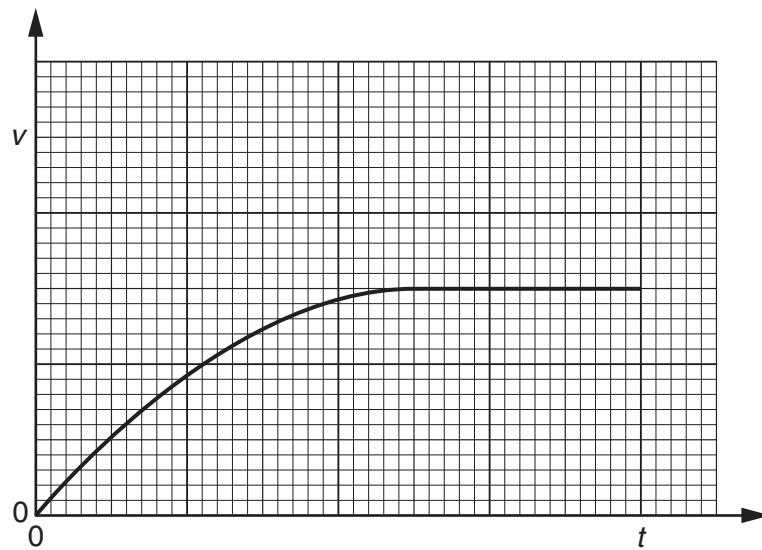


Fig. 2.1

- (i) State the variation with time of the **acceleration** of the raindrop.

.....  
.....  
.....  
.....  
.....

[3]

- (ii) A second raindrop has a radius that is smaller than that given in (a). On Fig. 2.1, sketch the variation of speed with time for this second raindrop. [2]