

- 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 m s^{-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 kg m^{-3} .

Calculate

1. the magnitude of the frictional force F ,

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

2. the acceleration of the raindrop.

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

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

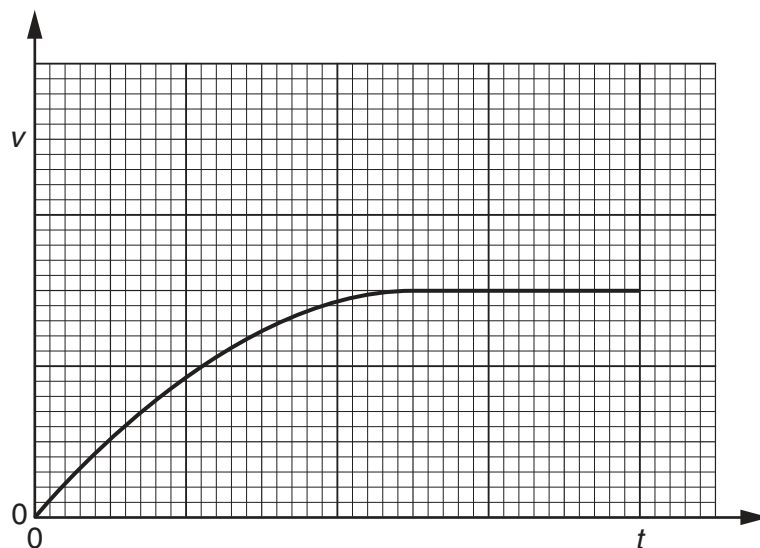


Fig. 2.1

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

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..... [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]