1 A sphere of radius 2.1 mm falls with terminal (constant) velocity through a liquid, as shown in Fig. 1.1.

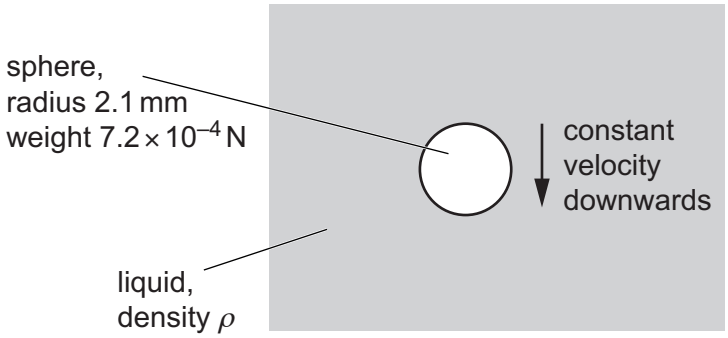

Fig. 1.1

Three forces act on the moving sphere. The weight of the sphere is 7.2×10^{-4} N and the upthrust acting on it is 4.8×10^{-4} N. The viscous force F_V acting on the sphere is given by

$$F_V = krv$$

where r is the radius of the sphere, v is its velocity and k is a constant. The value of k in SI units is 17.

(a) Determine the SI base units of k.

SI base units ..... [2]

(b) Use the value of the upthrust acting on the sphere to calculate the density ρ of the liquid.

ρ = ... kg m^{-3} [3]

(c) **(i)** On the sphere in Fig. 1.1, draw three arrows to show the directions of the weight W, the upthrust U and the viscous force F_V. Label these arrows W, U and F_V respectively. [1]

(ii) Determine the magnitude of the terminal (constant) velocity of the sphere.

velocity = ... $m\,s^{-1}$ [2]

[Total: 8]