1 The drag force F_D acting on a sphere falling through a liquid is given by

$$F_D = 6\pi\eta r v$$

where r is the radius of the sphere,
v is the speed of the sphere in the liquid and
η is a property of the liquid called the viscosity.

(a) Show that the SI base units of viscosity are $kg\,m^{-1}\,s^{-1}$.

[2]

(b) The sphere has a radius of 3.0 cm and is falling vertically downwards at a terminal velocity of $2.0\,m\,s^{-1}$ through the liquid. The drag force acting on the sphere is 0.096 N.

Calculate the viscosity of the liquid.

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

(c) The sphere is shown in Fig. 1.1.

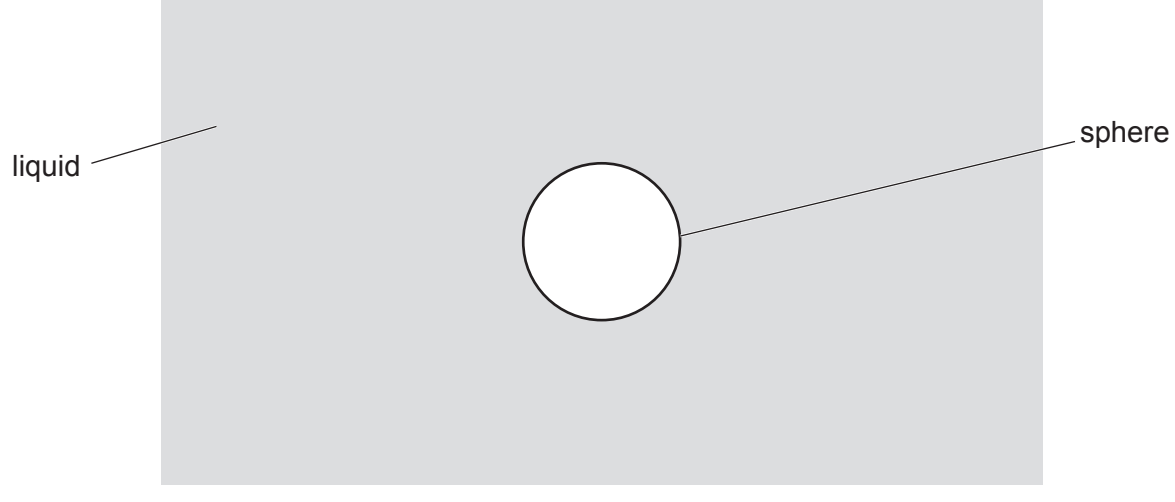

Fig. 1.1

On Fig. 1.1, draw and label arrows to represent the directions of the **three** forces acting on the sphere as it falls at terminal velocity through the liquid. [2]

(d) (i) The density of the liquid is 920 kg m^{-3}.

Show that the upthrust acting on the sphere is 1.0 N.

[2]

(ii) Calculate the mass of the sphere.

mass = ... kg [2]

[Total: 10]