3 **(a)** Define *simple harmonic motion*.

....

....

.... [2]

(b) A tube, sealed at one end, has a total mass m and a uniform area of cross-section A. The tube floats upright in a liquid of density ρ with length L submerged, as shown in Fig. 3.1a.
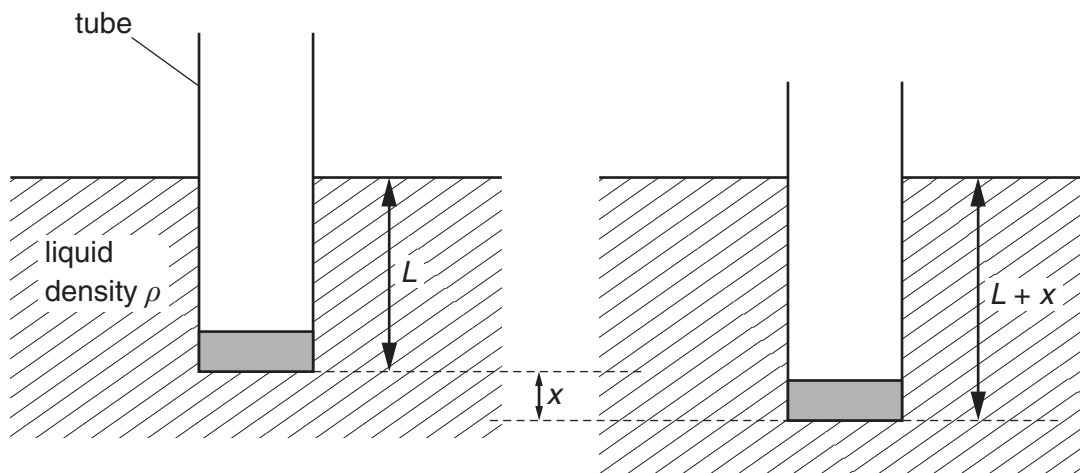

Fig. 3.1a **Fig. 3.1b**

The tube is displaced vertically and then released. The tube oscillates vertically in the liquid.
At one time, the displacement is x, as shown in Fig. 3.1b.

Theory shows that the acceleration a of the tube is given by the expression

$$a = -\frac{A\rho g}{m}x.$$

(i) Explain how it can be deduced from the expression that the tube is moving with simple harmonic motion.

....

....

....[2]

(ii) The tube, of area of cross-section $4.5 \, cm^2$, is floating in water of density $1.0 \times 10^3 \, kg \, m^{-3}$.

Calculate the mass of the tube that would give rise to oscillations of frequency $1.5 \, Hz$.

mass = ... g [4]