3 **(a)** State the conditions for a system to be in equilibrium.

.....

.....

..... [2]

(b) Fig. 3.1 shows an airship in flight. The airship is propelled by identical fans that can be angled to control the motion of the airship.

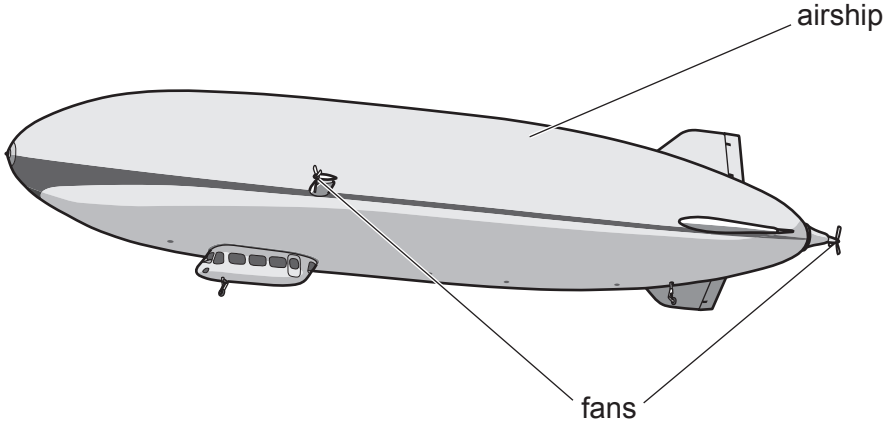

Fig. 3.1

The upthrust on the airship is 93 000 N.
The density of the surrounding air is 1.2 kg m^{-3}.

(i) Calculate the volume of air displaced by the airship.

volume = ... m^3 [1]

(ii) When fully loaded, the weight of the airship is greater than the upthrust.
To maintain horizontal flight, the fans provide a total vertical force of 3.0×10^3 N upwards on the airship.

Calculate the mass of the airship.

mass = ... kg [2]

(c) At a certain time, the airship in **(b)** is stationary. The thrust force exerted by a fan on the airship is 2800 N.

To produce this force, a mass of 64 kg of air is propelled through the blades of the fan in a time of 0.50 s. Assume that this air is initially stationary at the entrance to the fan.

Calculate:

(i) the change in momentum Δp of the air propelled through the fan blades in this time

Δp = ... kg m s^{-1} [2]

(ii) the speed of the air as it leaves the fan

speed = ... m s^{-1} [2]

(iii) the total kinetic energy of this air due to its movement through the fan.

kinetic energy = ... J [2]

[Total: 11]