3 **(a)** State the principle of moments.

.....

.....

..... [1]

(b) A rigid uniform beam rests on a pivot at its centre, as shown in Fig. 3.1.

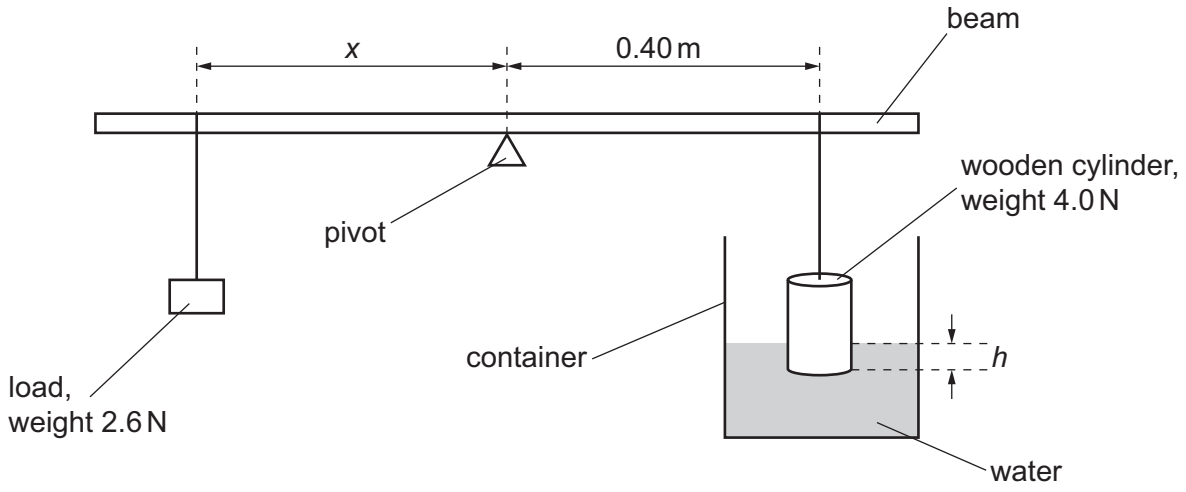

Fig. 3.1 (not to scale)

A load of weight 2.6 N is suspended from the beam at distance *x* from the pivot.

A wooden cylinder of weight 4.0 N is suspended from the beam at a distance of 0.40 m from the pivot on the opposite side of the pivot to the load. The cylinder rests in a container of water. The lower part of the cylinder is immersed in the water to depth *h*.

Initially, *h* is equal to 0.10 m and *x* is equal to 0.40 m. The system is in equilibrium.

(i) Use the principle of moments to show that the upthrust *U* exerted by the water on the cylinder is 1.4 N.

[2]

(ii) The density of the water is $1.0 \times 10^3\,\text{kg m}^{-3}$.

Calculate the area A of the circular cross-section of the cylinder.

A = ... m^2 [3]

(c) More water is gradually added to the container in **(b)**, so that depth h in Fig. 3.1 gradually increases. The length x is continuously adjusted so that the system remains in equilibrium.

On Fig. 3.2, sketch the variation of x with h. Use the space below for any working.

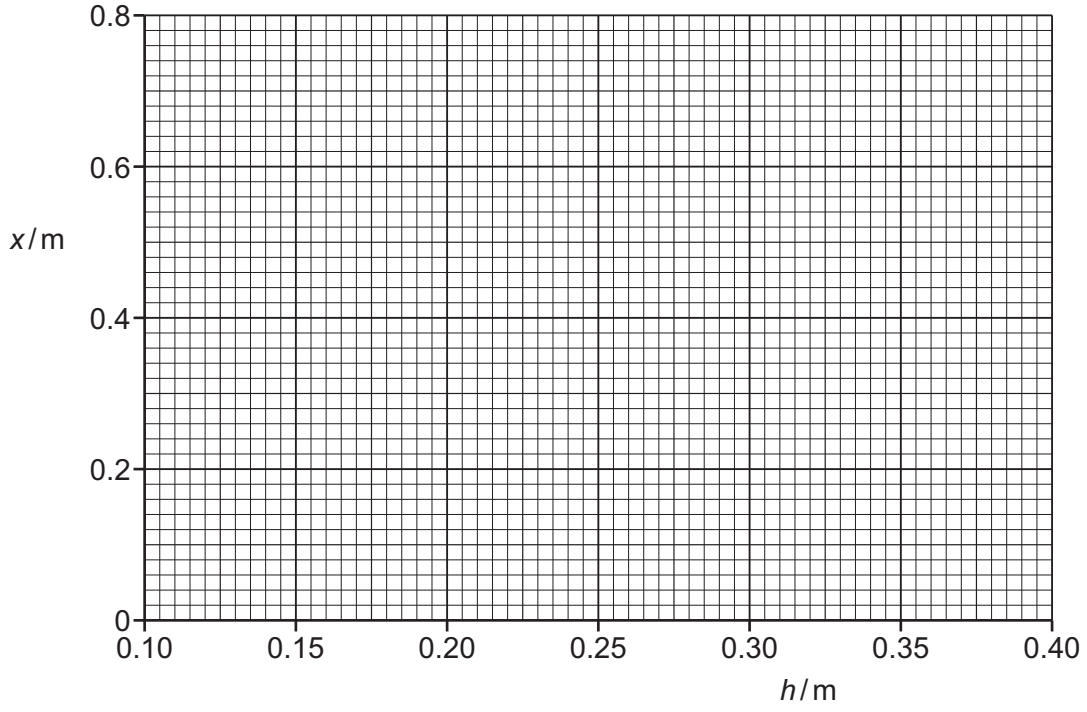

Fig. 3.2

[3]

[Total: 9]