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

....

....

.... [2]

(b) A solid plastic cylinder floats in water. It is used to support one end of a horizontal uniform beam AB as shown in Fig. 2.1.
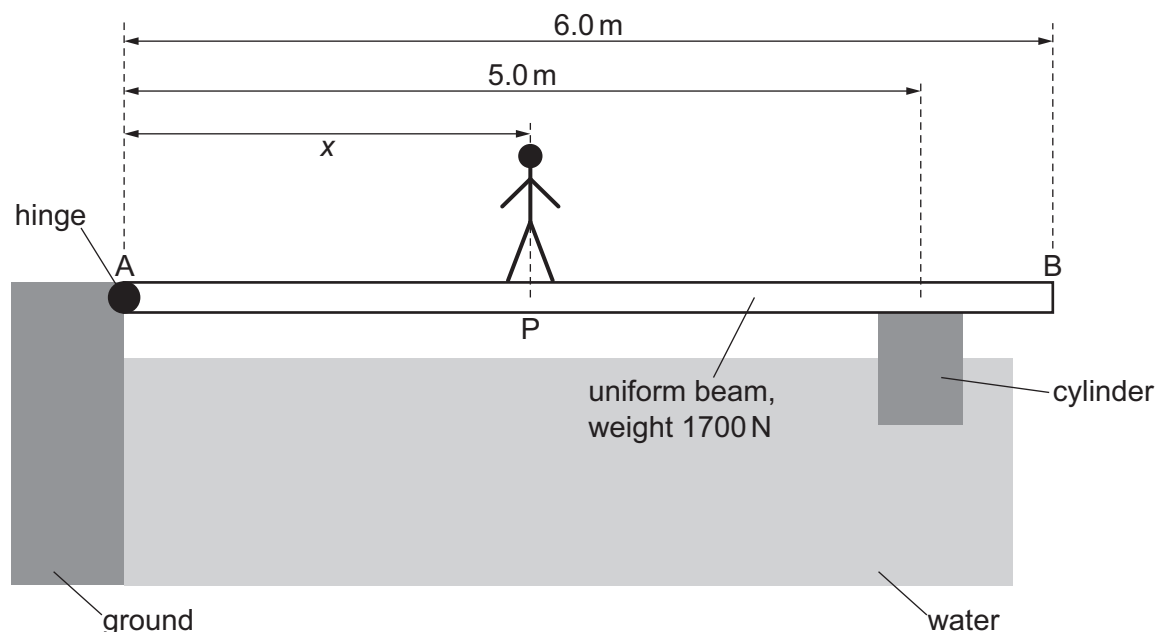

Fig. 2.1 (not to scale)

The beam has length 6.0 m and weight 1700 N. The beam is attached to solid ground with a hinge at end A.

The cylinder is floating vertically in the water. The top of the cylinder is attached at its centre to the beam at a horizontal distance of 5.0 m from end A. The cylinder applies a vertical force of 1300 N to the beam.

A person of weight 660 N stands on the beam at point P.

The beam AB is in equilibrium.

(i) By taking moments about end A, determine the distance x from A to P.

distance = ... m [3]

(ii) The bottom of the cylinder is submerged in the water to depth y as shown in Fig. 2.2. The beam is still attached to the cylinder but not shown.

force from beam, 1300 N
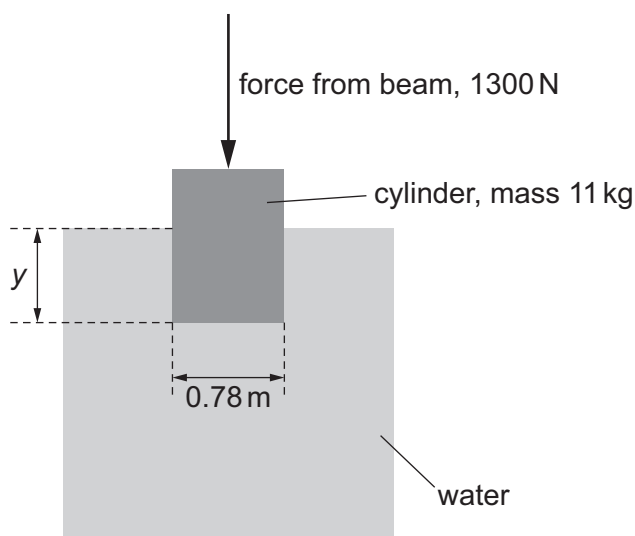
cylinder, mass 11 kg

y

0.78 m

water

Fig. 2.2 (not to scale)

The cylinder has mass 11 kg and diameter 0.78 m. The beam exerts a vertical force of 1300 N on the cylinder. The cylinder is in equilibrium.

Show that the upthrust acting on the cylinder is 1400 N.

[1]

(iii) The water has density 990 kg m^{-3}.

Calculate the depth y.

$y =$ .... m [2]

(iv) The person can stand anywhere between A and B.

On Fig. 2.3, sketch the variation of the depth of the bottom of the cylinder with the distance of the person from A, for distances between 0 and 6.0 m. Numerical values are not required.
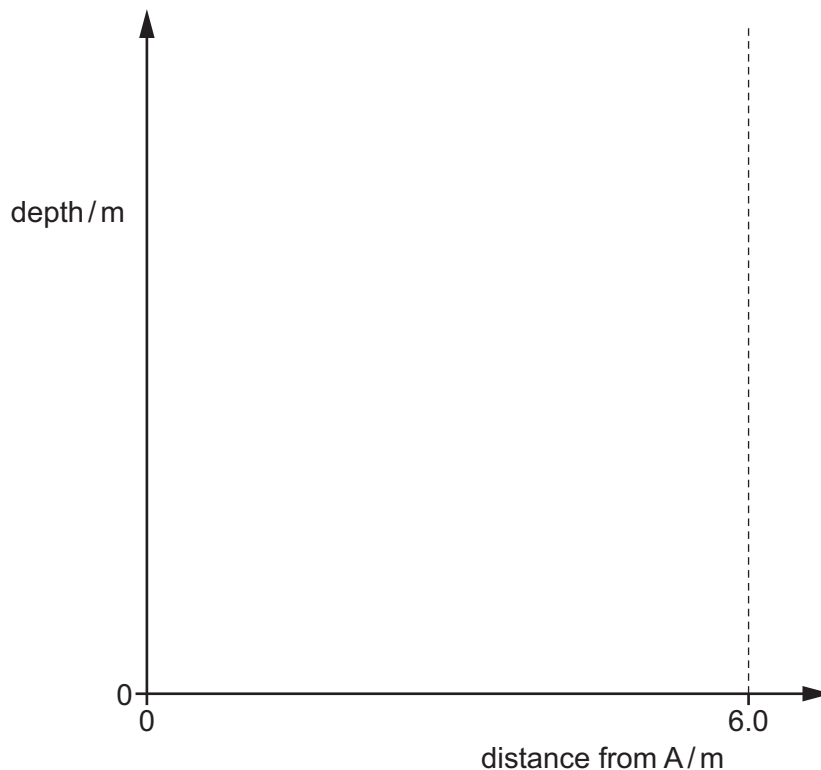
Fig. 2.3

[2]