**2** **(a)** A cylinder is suspended from the end of a string. The cylinder is stationary in water with the axis of the cylinder vertical, as shown in Fig. 2.1.

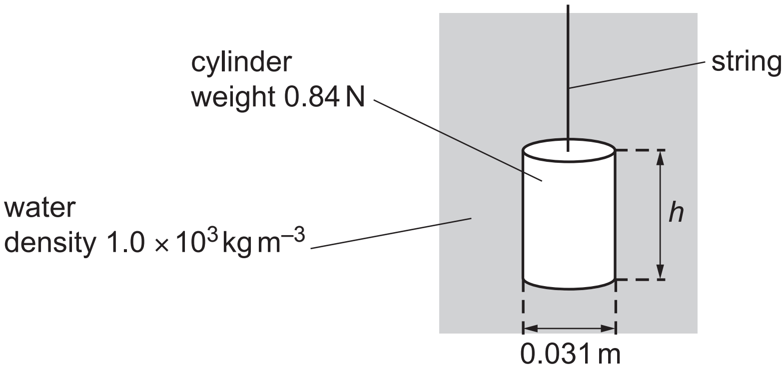


**Fig. 2.1** (not to scale)

The cylinder has weight 0.84 N, height $h$ and a circular cross-section of diameter 0.031 m. The density of the water is $1.0 \times 10^3\,\text{kg}\,\text{m}^{-3}$. The difference between the pressures on the top and bottom faces of the cylinder is 520 Pa.

**(i)** Calculate the height $h$ of the cylinder.

$h$ = .................................................... m [2]

**(ii)** Show that the upthrust acting on the cylinder is 0.39 N.

[2]

**(iii)** Calculate the tension $T$ in the string.

$T$ = .................................................... N [1]

**(b)** The string is now used to move the cylinder in **(a)** vertically upwards through the water. The variation with time $t$ of the velocity $v$ of the cylinder is shown in Fig. 2.2.

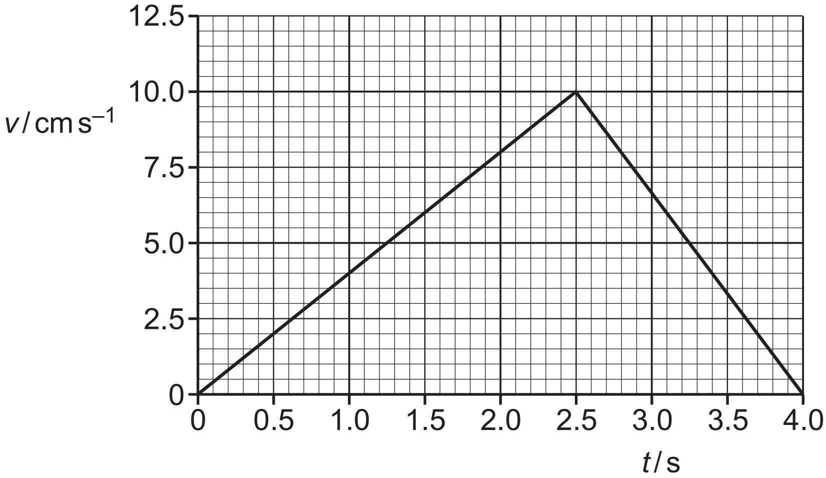


**Fig. 2.2**

**(i)** Use Fig. 2.2 to determine the acceleration of the cylinder at time $t$ = 2.0 s.

acceleration = ................................................ m s$^{-2}$ [2]

**(ii)** The top face of the cylinder is at a depth of 0.32 m below the surface of the water at time $t$ = 0.

Use Fig. 2.2 to determine the depth of the top face below the surface of the water at time $t$ = 4.0 s.

depth = .................................................... m [2]

**(c)** The cylinder in **(b)** is released from the string at time $t = 4.0\,\text{s}$. The cylinder falls, from rest, vertically downwards through the water. Assume that the upthrust acting on the cylinder remains constant as it falls.

**(i)** State the name of the force that acts on the cylinder when it is moving and does not act on the cylinder when it is stationary.

.................................................................................................................................... [1]

**(ii)** State and explain the variation, if any, of the acceleration of the cylinder as it falls downwards through the water.

....................................................................................................................................

....................................................................................................................................

.................................................................................................................................... [2]

[Total: 12]