**1** **(a)** A solid cylinder of height $h$ and density $\rho$ rests on a flat surface as shown in Fig. 1.1.

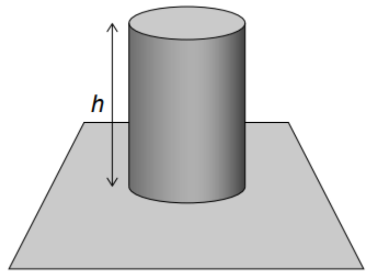


**Fig. 1.1**

Show that $p_C = h\rho g$ where $p_C$ is the pressure exerted by the cylinder on the surface.

**(b)** Fig 1.2 shows a tube of constant circular cross-section, sealed at one end, contains an ideal gas trapped by a cylinder of mercury of length 0.035 m. The whole arrangement is in the Earth's atmosphere. The density of mercury is $1.36 \times 10^4$ kg m$^{-3}$.

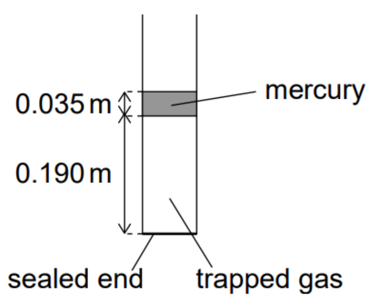


**Fig. 1.2**

When the mercury is above the gas column the length of the gas column is

**(i)** Explain what is meant by *an ideal gas*.

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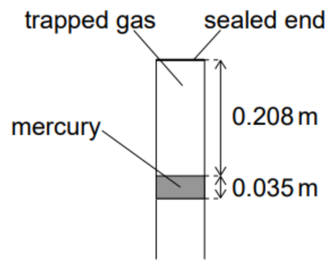
**(ii)** Given

$p_o$ = atmospheric pressure
$p_m$ = pressure due to the mercury column
$T$ = temperature of the trapped gas
$n$ = number of moles of the trapped gas
$A$ = cross-sectional area of the tube

Show that $(p_o + p_m) \times 0.190 = \dfrac{nRT}{A}$.

[1]

**(iii)** The tube is slowly rotated until the gas column is above the mercury.




The length of the gas column is now 0.208 m. The temperature of the trapped gas does not change during the process.

Determine $p_o$.

**(iv)** Using the First Law of Thermodynamics, explain the heat exchange between the gas and the surrounding during the process mentioned in **(b)(iii)**.

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