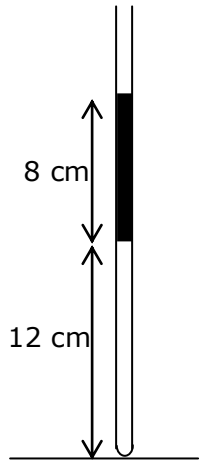
Q- Air is trapped in the lower part of a thin tube that stands vertically with 8cm of mercury in the middle with 12 cm of air trapped below it. The top is open and the system is at equilibrium. What will be the length of the trapped air column if the tube is now tilted so that it makes an angle of 60 degrees to the vertical?" Take the pressure of air to be 76cm Hg.

The air inside the tube will be compressed due to the pressure of *mercury column in the tube.*



When the tube is in vertical position:

If the atmospheric pressure is P_0 (= 76 cm of Hg) then the total pressure of the air trapped inside will be

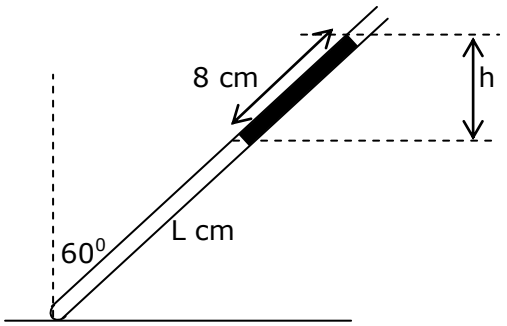
$P_1 = (P_0 + 8) = 84$ cm of Hg.

The volume of the air trapped is

$V_1 = A*12$ cm^3

Where A is the area of cross section of the tube

When the tube is in tilted position:



The mercury column will also get tilted and hence the vertical height of the mercury column is given by

$h = (8\text{cm})*\cos 60^0 = 8*0.5$
$= 4.0$ cm

Hence the pressure of the gas trapped in the tube in this position will be

$P_2 = (P_0 + 4.0) = 80.0$ cm of Hg.

If the length of the air column be L then the volume of the air trapped

$V_2 = A*L$ cm^3

Now as the temperature of the air inside the tube is constant, applying Boyle's law we have

$P_2V_2 = P_1V_1$

Substituting the values we get

$80.0*A*L = 84*A*12$

Gives $L = 84*12/80.0 = 12.6$ cm.