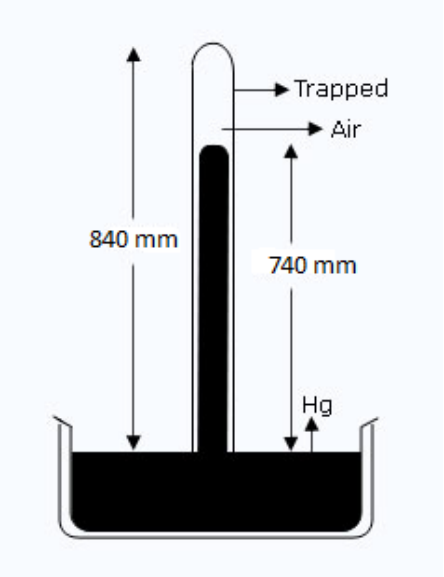
Answer on Question #77369, Physics / Other

A mercury barometer with a tube of uniform diameter and length 840 mm above the mercury level in the reservoir, reads 740 mm on a day when the atmospheric pressure is 760 mmHg. Estimate the pressure of the atmosphere on a day when it reads 720 mm. Assume the average temperature is the same on both days.

Solution:



Initially the length of trapped air in the tube

$$l_1 = 840 - 740 = 100\ mm.$$

Volume of the trapped air

$$V_1 = l_1 A$$

where A is the area of cross–section of the tube.

Pressure of the trapped air

$$P_1 = 760 - 740 = 20\ mm\ of\ Hg.$$

On another day, the volume of the trapped air

$$V_2 = l_2 A$$

where

$$l_2 = 840 - 720 = 120\ mm$$

Let the pressure of the trapped air be P_2 mm of Hg.

By Boyle's law,

$$P_1 V_1 = P_2 V_2$$

So,

$$P_2 = P_1 \frac{V_1}{V_2} = P_1 \frac{l_1}{l_2} = 20 \times \frac{100}{120} = 16.7\ mm\ of\ Hg.$$

Atmospheric pressure

$$P = 720 + 16.7 = 736.7\ mmHg$$

Answer: $736.7\ mmHg.$