Answer on Question #50648, Physics, Molecular Physics | Thermodynamics |

Question

Explain the working of a constant volume gas thermometer with the help of a neat and labelled diagram.

Answer

The schematic diagram of a constant-volume gas thermometer is shown in Fig.1. The volume of an ideal gas in the sensing bulb D is kept constant by adjusting the level of mercury in the arm B of the manometer. The arm B and the arm A are connected by a flexible tube to form a U-tube manometer. The arm B is also connected to the gas bulb D via a capillary tube C, while the other arm A of the manometers is open to atmosphere and can be moved vertically to adjust the mercury level, so the mercury just touches the mark L of the capillary. The pressure in the bulb b is used as a thermometric property and can be given by

$$p = p_{atm} + \rho g h \tag{1}$$

where p_{atm} is atmospheric pressure; ρ is the density of the mercury; h is the mercury column in manometer.

The gas bulb D is first placed in constant-temperature bath at the triple point temperature T_{tp} of water and the level of mercury is adjusted to touch the mark L by moving the manometer arm A up and down.

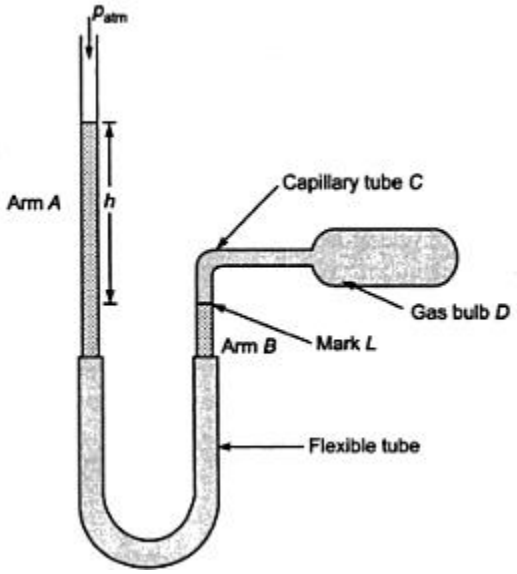

Fig.1

As the volume of the bulb becomes constant and the height difference of the mercury in the two arms is recorded as h_{tp} the pressure, p_{tp} corresponding to the mercury column at the triple point is calculated by Eq. (1)

Now the bulb is brought in contact with a system whose temperature T, is to be measured. Again, in a similar manner, by keeping the volume of gas in the bulb constant, the height difference of the mercury in the two arms is recorded and the corresponding new pressure p is calculated by Eq. (2).

From the ideal gas equation, the new temperature is given by

$$T = 273.15 \cdot \frac{p}{p_{tp}} \tag{2}$$

where 273.15K is the triple point temperature of water.

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