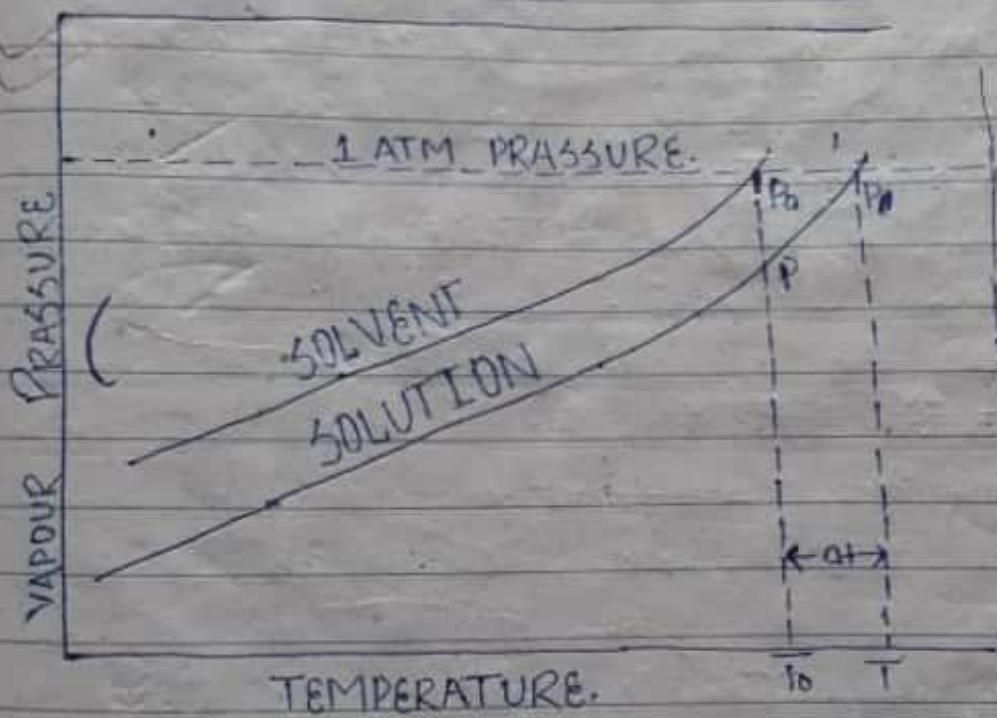


Boiling point \rightarrow

The boiling point of a liquid is the temperature at which its vapour pressure becomes equal to 760 mm (i.e., the atmospheric pressure). Since the vapour pressure of a solution is always lower than that of the pure solvent, it follows that the boiling point of a solution will always be higher than that of the pure solvent.



This fact can be readily understood from the vapour pressure curves plotted in figure. The upper curve represents the vapour pressure-temperature relationship of the pure solvent. The lower curve represents the vapour pressure-temperature relationship between of a dilute solution of a known concentration. It

It is evident that the vapour pressure of the solution (P) is lower than that of the pure solvent (P₀) at every temperature. The temperature (T₀) gives the boiling point of the pure solvent and T, the boiling point of the solution. This is because at these temperatures the vapour pressure curve of the solution, it is evident that P is the vapour pressure because equal to atmospheric pressure, as shown.

Considering the vapour curve of the solution, it is evident that P is the vapour pressure of the solution at temperature T₀ and P₀ is the vapour pressure of the solution at temperature T. Applying integrated form of Clausius-Clapeyron equation, we have

$$\ln \frac{P_0}{P} = \frac{L_v}{R} \left\{ \frac{T - T_0}{T T_0} \right\} \quad \text{--- (1)}$$

where L_v is the vapour molar heat of vaporisation of the solvent at its normal boiling point T₀.

It is evident that T - T₀ is the elevation in boiling point. Let it be denoted by ΔT. Further, since T and T₀ are not far apart from each other, the solution being dilute, Eq (1) may be written, without introducing any serious error, as

$$\ln \frac{P_0}{P} = \frac{L_v}{R T_0^2} \Delta T$$

in a Cup, the walls are which are semipermeable and which is tightly closed by a rubber piston. When this is lowered into a larger beaker containing water (solvent), as shown in figure the water on account of osmosis will have a tendency to flow into the cup through the semipermeable membrane. This tendency can be opposed by applying pressure on the solution by placing increasing weights on the piston, as shown. When a proper weight has been put on the piston, as shown when a paper weight the tendency of the water to enter the cup through the semipermeable membrane will be just balanced by its tendency to flow out as a result of the counter pressure from above.

The excess pressure which must be applied to a solution to prevent the flow ~~out~~ of the solvent into it through a semipermeable membrane is known as the osmotic pressure of the solution.

✓ Determination of Molar masses from ^{osmotic} ~~osmotic~~ Pressure
∴ Osmotic pressure measurements have been used for calculating molar masses of nonvolatile solutions and non-electrolytic solutes. A small amount of the solute is dissolved in a suitable amount of the solvent so as to get a sufficiently dilute solution and its osmotic pressure is measured at a known temperature by any suitable method. The sub-

titration of the various values in the equation $\Pi = CRT$ enables easy calculation of molar mass of the solute, as will be clear from the following ex.

(I) Calculate the molar mass of a substance if at 27°C its solution containing 6.0 g dm^{-3} has an osmotic pressure of 3 mm Hg given $R = 0.08214 \text{ dm}^3 \text{ atm K}^{-1} \text{ mol}^{-1}$.

Sol: from van't Hoff's equation, $\Pi = CRT$
 where Π is the osmotic pressure and C is the molar concentration.

Now, for $w \text{ g}$ of the solute of molar mass M dissolved in a volume $V \text{ dm}^3$, obviously,
 $C = w/MV$. So that

$$\Pi = \frac{wRT}{MV}$$

$$\text{Hence, } M = \frac{wRT}{\Pi V}$$

$$= \frac{(6.0 \text{ g}) (0.08214 \text{ dm}^3 \text{ atm K}^{-1} \text{ mol}^{-1}) (300 \text{ K})}{(3/760) \text{ atm} \times (1 \text{ dm}^3)}$$

$$= 3.70 \times 10^6 \text{ g mol}^{-1} \quad \text{Ans}$$