Paper : Physical Chemistry (I A)
Topic : Physical Properties of Liquids

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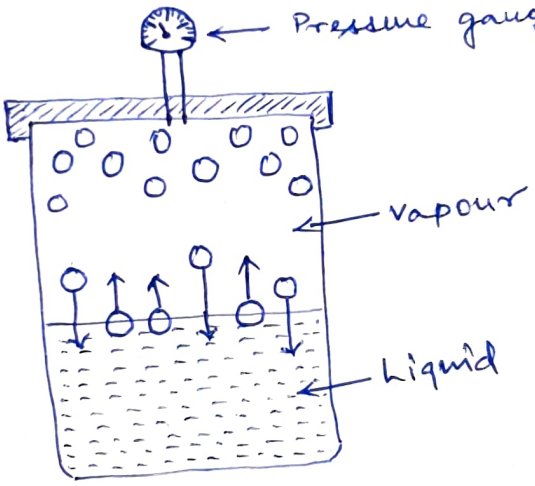
The reverse of vaporisation or evaporation process where gas molecules become liquid molecules is called condensation.

If the liquid is placed in a closed vessel, the molecules with high kinetic energies escape into the space above the liquid. As the number of molecules in the gas phase increases, some of them strike the liquid surface and are recaptured (i.e. condensed). A state comes when the number of molecules escaping from the liquid is equal to the number of molecules returning to the liquid. In other words, the rate of evaporation exactly equals the rate of condensation.

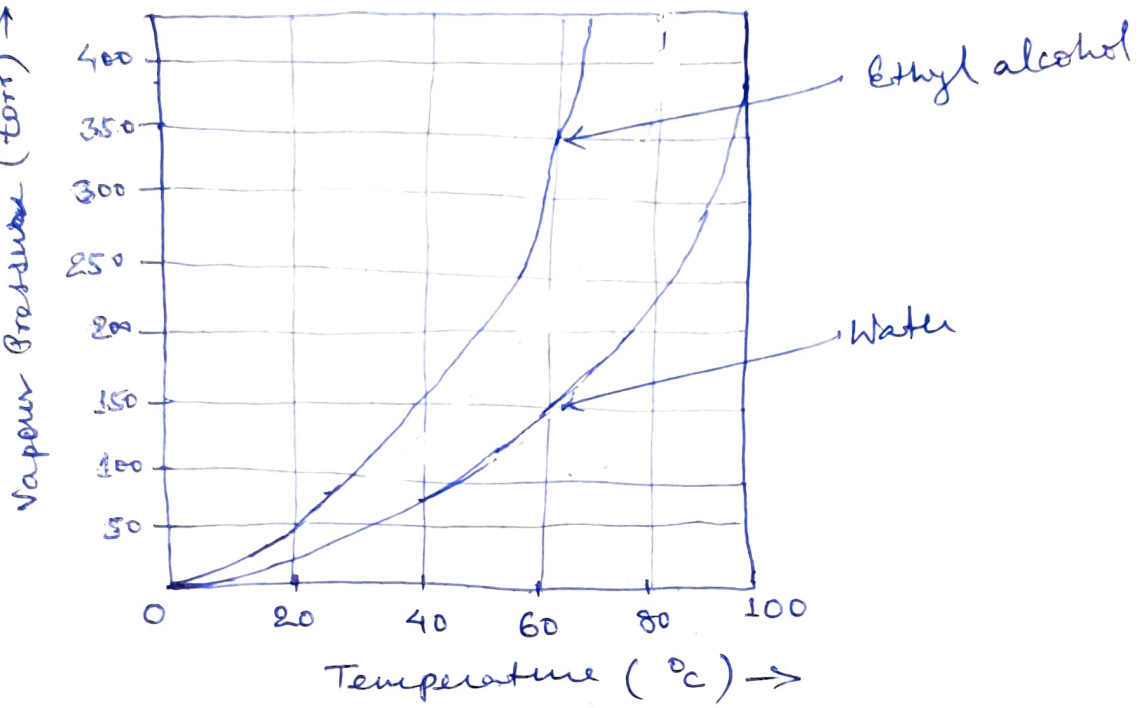


Thus a dynamic equilibrium is established between the liquid and the vapour at the given temperature as shown in the above figure. Liquid $\rightleftharpoons$ Vapour

Now the concentration of the vapour in the space above the liquid will remain unchanged with lapse of time. Hence the vapour will exert a definite pressure at the equilibrium. The vapour pressure of a liquid is thus defined as "the pressure exerted by the vapour in equilibrium with the liquid at a fixed temperature."

The vapour pressures of various liquids differ considerably, depending upon the identity of the liquid with its particular intermolecular forces. Thus ethanol

having weaker hydrogen bonding than water, evaporates faster than water. Hence we expect that ethanol will have higher vapour pressure than water at a given temperature. As shown in the plot given below (plot of vapour pressure versus temperature), the vapour pressures of ethanol and water at 60°C are about 350 torr and 150 torr respectively.



Effect of Temperature on Vapour Pressure :— If the temperature of the liquid is increased, the vapour pressure will increase. This is so because at higher temperature more molecules in the liquid will have larger kinetic energy and will break away from the liquid surface. Therefore, the concentration of vapour molecules will increase before the equilibrium is re-established. Also, at higher temperature, the average kinetic energy of the vapour molecules will increase. Both vapour concentration and kinetic energy are proportional to the temperature. Therefore, any increase of temperature will result in the increase of vapour pressure. The experimental curves in the above plot shows that for both ethanol and water, the vapour pressure rises with temp.

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