

c) Effect of pressure - The solubility of gases increases with increase of pressure. For a solution of a gas in a solvent. At pressure p and temperature T , lower part is solution and the upper part is gaseous.

At eqm equilibrium, rate of gaseous particles entering and leaving the solution phase is the same.

1) On increasing the pressure over the solution phase by compressing the gas to a smaller volume. There will be increase in number of gaseous particles per unit volume over the solution and also the rate at which the gaseous particles are striking the surface of a solution to enter it. The solubility of the gas will increase until a new equilibrium is reached ~~result~~ resulting in an increase in pressure of a gas above the solution and thus its solubility increases. (Fig 2.1).

The relation between pressure and solubility is given by Henry's law: ⁶ the partial pressure of the gas in vapour phase (p) is proportional to the ~~not~~ mole fraction of the gas (x) in the solution. (Fig 2.2)

$$p = k_H \cdot x$$

k_H = Henry's law constant.

Different gases have different K_H values at the same temperature.

Thus, higher the value of K_H at a given pressure, the lower is the solubility of the gas in liquid. From table 2.2, K_H values for both N_2 and O_2 increase with increase of temperature indicating that the solubility of gas increases with decrease of temperature.

It is due to this reason that aquatic species are more comfortable in cold water than warmer water.

3.2.2 Applications of Henry's law.

i) To increase solubility of CO_2 in soft drinks and soda water, the bottle is sealed under high pressure.

ii) Scuba divers carry cylinders with dissolved gases. Increased pressure increases solubility of atmospheric gases in blood. At the surface the solubility of gases decreases which leads to release the dissolved gases, nitrogen forms bubble in the blood which blocks capillaries i.e. bends, life threatening.

To avoid bends, ~~with~~ the tanks used by scuba divers are filled with air diluted with helium (11.7% He, 56.2% N, 32.1% O₂) -

⇒ At high altitudes, the partial pressure of oxygen in the blood and tissues is less than that of at ground level. This leads to low concentration of oxygen in body which make climbers weak and unable to think clearly, causing anoxia.

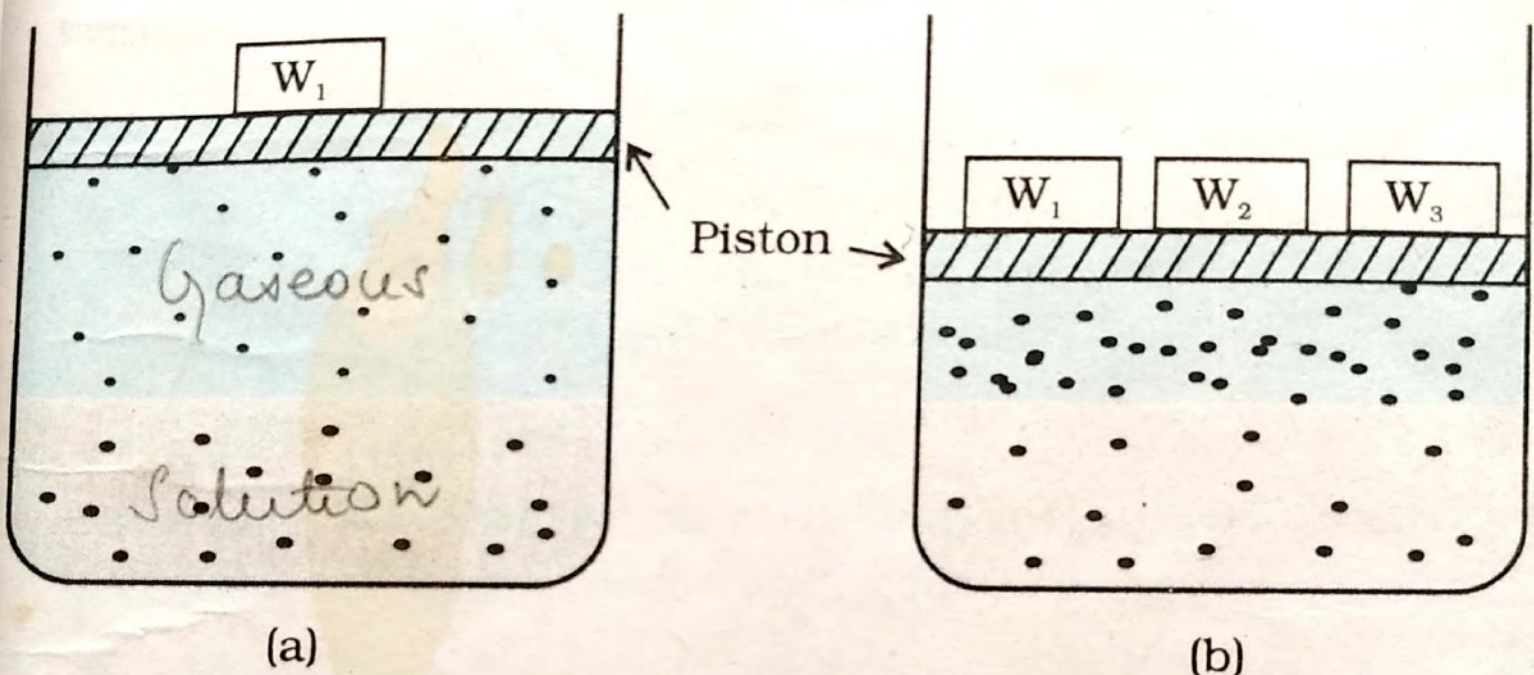
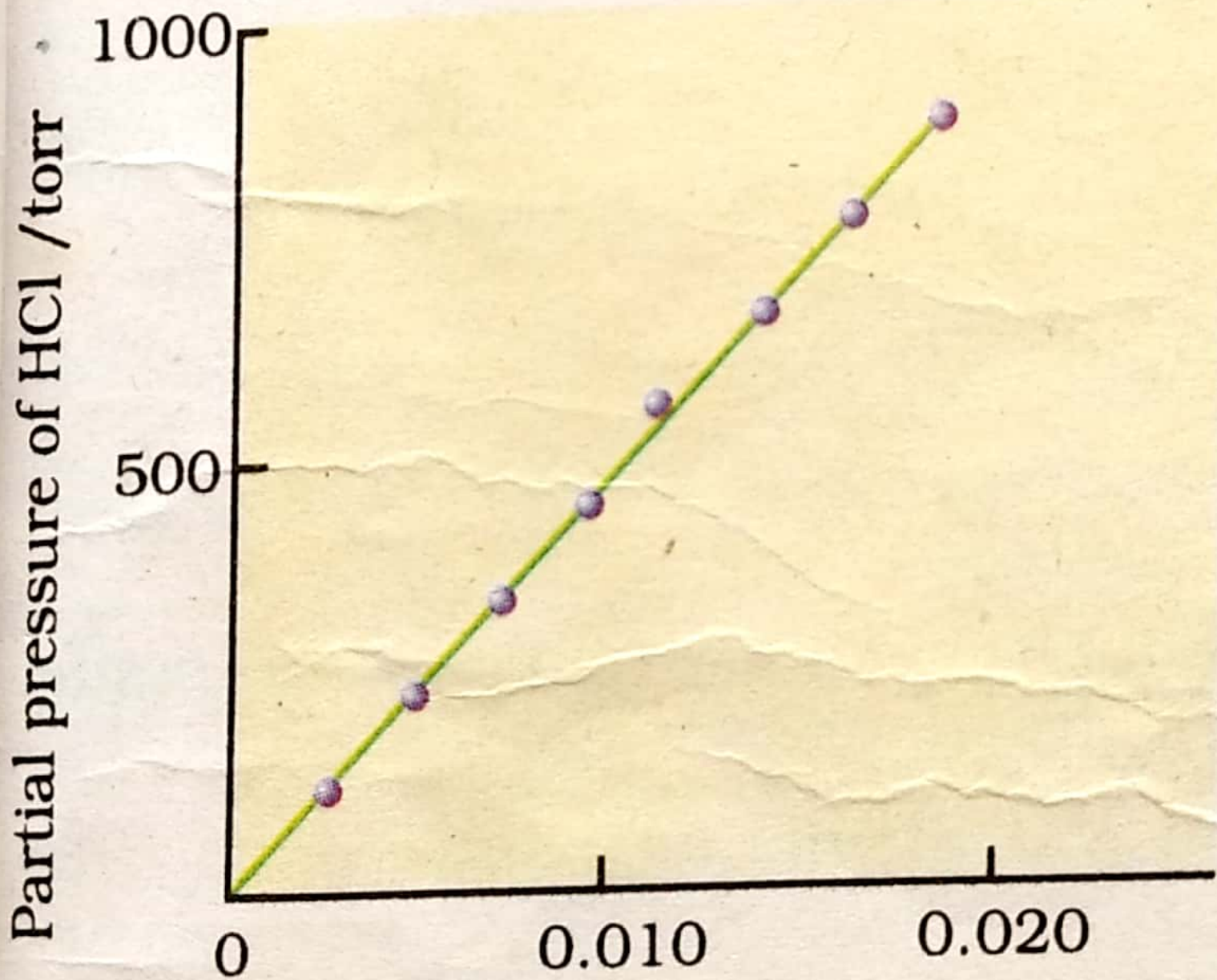


Fig. 2.1: Effect of pressure on the solubility of a gas. The concentration of dissolved gas is proportional to the pressure on the gas above the solution.



Mole fraction of HCl in its solution in cyclohexane

Fig. 2.2: Experimental results for the solubility of HCl gas in cyclohexane at 293 K. The slope of the line is the Henry's Law constant, K_H .

Table 2.2: Values of Henry's Law Constant for Some Selected Gases in Water

Gas	Temperature/K	K_H /kbar	Gas	Temperature/K	K_H /kbar
He	293	144.97	Argon	298	40.3
H ₂	293	69.16	CO ₂	298	1.67
N ₂	293	76.48	Formaldehyde	298	1.83×10 ⁻⁵
N ₂	303	88.84	Methane	298	0.413
O ₂	293	34.86	Vinyl chloride	298	0.611
O ₂	303	46.82			