$$n_{O_2} + n_{H_2O} \approx n_{H_2O}$$

$$x_{O_2} = \frac{n_{O_2}}{n_{H_2O}}$$

$$x_{O_2} \times n_{H_2O} = n_{O_2}$$

$$4.6 \times 10^{-6} \times 55.5 = n_{O_2}$$

$$n_{O_2} = 2.55 \times 10^{-4} \text{ mol}$$

Since 2.55×10^{-4} mol are present in 1000 mL of solution,

Molarity = **2.55×10^{-4} M.**

❑ **Example 25.**

Dry air contains 79% N_2 and 21% O_2. Determine the proportion of N_2 and O_2 (in terms of mole fractions) dissolved in water at 1 atm pressure. Henry's law constant for N_2 and O_2 in H_2O are 8.54×10^4 atm and 4.56×10^4 atm respectively.

Solution : Total pressure of air over water = 1 atm

Partial pressure of N_2 and O_2 are :

$$p_{N_2} = \frac{1 \times 79}{100} = 0.79 \text{ atm}$$

$$p_{O_2} = \frac{1 \times 21}{100} 0.21 \text{ atm}$$

Applying Henry' law

$$p_{N_2} = K_H \cdot x$$

$$x_{N_2} = \frac{p_{N_2}}{K_{N_2}} = \frac{0.79}{8.54 \times 10^4}$$

$$= 9.25 \times 10^{-6}$$

$$x_{O_2} = \frac{p_{O_2}}{K_{O_2}} = \frac{0.21}{4.56 \times 10^4}$$

$$= 4.60 \times 10^{-6}$$

Proportion of N_2 and O_2

$$= 9.25 \times 10^{-6} : 4.6 \times 10^{-6}$$

$$= \mathbf{2 : 1}$$

Practice Problems

26. What concentration of nitrogen should be present in a glass of water at room temperature ? Assume a temperature of 25°C, a total pressure of 1 atmosphere and mole fraction of nitrogen in air of 0.78.

(K_H for nitrogen = 8.42×10^{-17} M/mm Hg). *(A.I.S.B. 2009)*

27. One litre of water under a nitrogen pressure 1 atm dissolves 0.02g of nitrogen at 293 K. Calculate Henry's law constant.

28. Calculate the amount of CO_2 dissolved at 4 atm in 1 dm^3 of water at 298 K. The Henry's law constant for CO_2 at 298 K is 1.67 *k* bar.

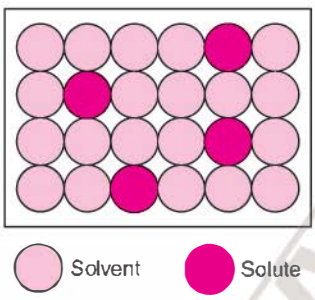
29. At what partial pressure, oxygen will have a solubility of 0.06 gL^{-1} in water at 293 K? Henry's law constant (K_H) of O_2 in water at 303 K is 46.82 k bar. (Assume the density of the solution to be the same as that of water).

30. The mole fraction of He gas in a saturated solution at 20°C is 1.25×10^{-6}. Calculate the pressure of He gas above the solution. (K_H of He at 20°C = 144.98 *k* bar).

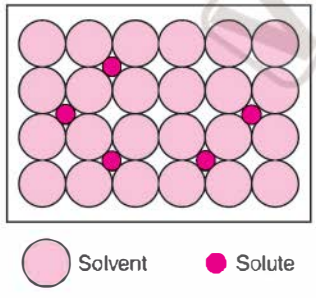
Answers to Practice Problems

26. 4.99×10^{-4} M
27. 7.75×10^4 atm
28. 5.85 g
29. 1.58 bar
30. 0.181 bar

Hints & Solutions on page 66



(*a*) Substitutional solid solution



(*b*) Interstitial solid solution

Fig. 5 Solid solutions

SOLID SOLUTIONS

As we have already learnt, solid solutions are those solutions in which both the components (*i.e.,* solute and the solvent) are solids.

Solid solutions are of two types :

(*i*) *Substitutional solid solutions and*

(*ii*) *Interstitial solid solutions.*

(*i*) ***Substitutional solid solutions*** are those in which atoms, molecules or ions of one substance take the place of particles of another substance in a crystal lattice as shown in Fig. 5 (*a*). Brass is a common example of substitutional solid solution of copper and zinc. Bronze, monel and steel are other familiar examples of this type of solid solution. Zinc sulphide and cadmium sulphide also form such solid solutions in which cadmium ions randomly replace zinc ions in the ZnS lattice.