Q.6) H_2S, a toxic gas with rotten egg like smell, is used for the qualitative analysis. If the solubility of H_2S in water at STP is 0.195 m, calculate Henry's law constant.

Sol:

Mole fraction of H_2S (x)

No of moles of water in 1000 g = $\frac{\text{Given Mass}}{\text{Molar mass}}$

$= \frac{1000\ g}{18\ g\ mol^{-1}} = 55.55\ mol$

Mole fraction of H_2S (x_{H_2S}) = $\frac{n_{H_2S}}{n_{H_2S} + n_{H_2O}} = \frac{0.195}{0.195 + 55.55}$

$= \frac{0.195\ mol}{55.745\ mol} = 0.0035$

A/C to Henry's law,

$$p = x \times k_H$$

$$0.987\ bar = 0.0035 \times k_H$$

$$\Rightarrow k_H = \frac{0.987\ bar}{0.0035} = 282\ bar.$$

Q.7) Henry's law constant for CO_2 in water is 1.67×10^8 Pa at 298 K. Calculate the quantity of CO_2 in 500 ml of soda water when packed under 2.5 atm CO_2 pressure at 298 K.

Sol. 1/p Henry's law

$$x_{CO_2} = \frac{p}{k_H}$$

1.67×10^8 Pa

$= \frac{1 \text{ atm}}{101325 \text{ Pa}} \times 1.67 \times 10^8 \text{ Pa}$

$= 1.648 \times 10^3$ atm.

$$x_{CO_2} = \frac{2.5}{1.648 \times 10^3 \text{ atm}}$$

$= 1.52 \times 10^{-3}$ ~~$= n_{H_2O} =$~~

Moles of Water $= \frac{\text{Given mass}}{\text{Molecular mass}} = \frac{500 \text{ g}}{18 \text{ g mol}^{-1}} = 27.78$ mol

$$x_{CO_2} = \frac{n_{CO_2}}{n_{CO_2} + n_{H_2O}} = \frac{n_{CO_2}}{27.78 \text{ mol}}$$

$$1.52 \times 10^{-3} = \frac{n_{CO_2}}{27.78 \text{ mol}} \Rightarrow n_{CO_2} = 1.52 \times 10^{-3} \times 27.78$$

$= 0.0422$ mol

Mass of CO_2 = Molecular mass × no. of moles

$= 44 \times 0.0422 = 1.857$ g.