Henry law problems

① H_2S a toxic gas with rotten egg like smell is used for the qualetative analysis, if the solubility of H_2S in water, at STP is 0.195 mole $\cdot Kg^{-1}$ the henny law Constant is - - - -

Given $n_{H_2S} = 0.195$ moles

$n_{H_2O} = 55.55$ moles

$$X_{H_2S} = \frac{n_{H_2S}}{n_{H_2S} + n_{H_2O}} = \frac{0.195}{0.195 + 55.5} = \frac{0.195}{55.695} = 0.0035$$

at STP pressure in bar $p = 0.987$ bar

henny law

$$\boxed{P = K_H x}$$

$$K_H = \frac{P}{x} = \frac{0.987}{0.0035} = \underline{\underline{285 \; bar}}$$

② air contains O_2 and N_2 in the ratio $0.2 : 0.8$. if henry law Constant for O_2 & N_2 are 3.3×10^7 torr and 6.6×10^7 Torr respectively, then the ratio of mole fractions of O_2 & N_2 dissolved in water at 1 bar -pressure is

Given $\dfrac{p^{O_2}}{p_{N_2}} = \dfrac{0.2}{0.8} = \dfrac{1}{4}$

$$\frac{K_H^{O_2}}{K_H^{N_2}} = \frac{3.3 \times 10^7}{6.6 \times 10^9} = \frac{1}{2}.$$

$\therefore \quad x = \dfrac{Kg/P/K_H}{}$

$$\frac{X_{O_2}}{X_{N_2}} = \frac{p^{O_2}/K_H}{p^{N_2}/K_H} = \frac{\frac{1}{3.3 \times 10^7}}{\frac{1}{6.6 \times 10^7}} = \underline{\underline{2 : 1}}$$

③ The quantity of CO_2 in 500ml of soda water
when packed under 2.5atm CO_2 pressure at
298K is ——— gm ($K_H = 1.67 \times 10^8$ pa at 298℃)

$P_{CO_2} = 2.5$ atm $= 2.5 \times 10^5$ pascal   (1 atm $= 10^5$ pascal)

henry law $P_{CO_2} = K_H \cdot X_{CO_2}$

$$X_{CO_2} = \frac{P_{CO_2}}{K_H} = \frac{2.5 \times 10^5}{1.67 \times 10^8} = 1.497 \times 10^{-3}$$

moles of water :-

water volume $= 500$ ml
water mass $= 500 \times 1 = 500$ g
                        density

water moles (n) $= \dfrac{500}{18} = \underline{27.78}$

$$X_{CO_2} = \frac{n_{CO_2}}{n_{CO_2} + n_{water}} = \frac{n_{CO_2}}{n_{water}} \qquad \left(\begin{array}{c} \text{moles of } CO_2 \\ \text{negligeable} \end{array} \right)$$

$$n_{CO_2} = X_{CO_2} \times n_{water} = 1.497 \times 10^{-3} \times 27.78 = \underset{\text{moles}}{0.042}$$

∴   1 mole has 44g of CO_2
    0.042 mole has ——g of CO_2

$$0.042 \times 44 = \underline{1.86\,g}$$

Henry law constant for the solubility of methane in benzene at 298 K is 4.27×10^5 mmHg then the solubility of methane in benzene at 298K under 760 mmHg in mol/kg is

$K_H = 4.27 \times 10^5$ mm Hg

$P = 760$ mm Hg

$$P = K_H x$$

$$x = \frac{P}{K_H} = \frac{760}{4.27 \times 10^5} = 178 \times 10^{-5}$$

$$= 1.78 \times 10^{-3}$$

O_2 is bubbled through water at 293K, assuming that O_2 exerts a partial pressure of 0.98 bar the solubility of O_2 in gm.L⁻¹ is — ($K_H = 34$ K bar)

$P_{O_2} = 0.98$ bar

$K_H = 34$ Kbar

$= 34 \times 10^3$ bar

$$P_{O_2} = K_H \times X_{O_2}$$

$$X_{O_2} = \frac{P_{O_2}}{K_H} = \frac{0.98}{34 \times 10^3} = 0.028 \times 10^{-3}$$

$$X_{O_2} = \frac{n_{O_2}}{n_{O_2} + n_{H_2O}} = \frac{n_{O_2}}{n_{H_2O}} = \frac{n_{O_2}}{55.55}$$

↓
negligible

$$n_{O_2} = X_{O_2} \times 55.55$$

$$n_{O_2} = 0.028 \times 10^{-3} \times 55.55 = 1.56 \times 10^{-3} \text{ moles}$$

1 moles has 32-g O_2

1.56×10^{-3} mole has $\longrightarrow O_2$

$$\frac{1.56 \times 10^{-3} \times 32}{1} = 6.05 \text{ g/L}$$

Henry Law problems

① If N_2 gas is bubbled through water at 293K, how many moles of N_2 gas would dissolve in 1L of water. Assume that N_2 exerts a partial pressure of 0.987 bar. (K_H = 76.48 Kbar)

(7.16×10^{-4} mol)

② Henry's Law Constant for oxygen dissolved in water is 4.34×10^4 atm at 25°C. If the partial pressure of oxygen in air is 0.4 atm Calculate moles of O_2? and concentration (in moles per Lit) of the dissolved O_2 in water)

(5.11×10^{-4} mol, 5.11×10^{-4} mol)

③ Henry's Law constant for the solubility of N_2 gas in water at 298 K is 1.0×10^5 atm. The mole fraction of N_2 in air is 0.6. The number of moles of N_2 from air dissolved in 10 moles of water at 298 k and 5 atm pressure is

(3×10^{-4})

(4) For a solution of acetone in chloroform, Henry's law constant is 150 torr at a temp of 300 k @ so Calculate the pressure of acetone when the mole fraction is 0.12

(18 torr) .

RLUP problems

① At 20°C, the vapour pressure of diethyl ether is 442 mmHg. When 6.4g of a non-volatile solute is dissolved in 50g of ether, the vapour pressure falls to 410 mmHg. The molecular weight of the solute is — (molar mass of diethyl ether is = 74 g/mol)

(130.8)

② 139.18 g of glucose is added to 178.2g of water the vapour pressure of water for this aqueous solution at 100°C is — (704 Torr)

③ The vapour pressure of acetone at 20° is 185 torr when 1.2g of a non-volatile substance was dissolved in 100g of acetone at 20°C, its vapour pressure was 183 Torr. The molar mass (58 g/mol) of the substance is — (64)

④ The vapour pressure of pure water at 25°C is 30mm. The vapour pressure of 10% (w/w) glucose solution at 25°C is — (29.69) mmHg

⑤ The weight of urea to be dissolved in 100g of water to decrease the vapour pressure of water by 5%. is   (16.66 g)

⑥ 18g of Glucose is dissolved in 90g of water The Relative lowering of vapour pressure of Solution is ____ $(\frac{1}{51})$

⑦ at a Certain Temp., the vapour pressure of water is 50 mm. The relative lowering of vapour pressure of a solution containing 36g of Glucose in 900 g. of water is   (0.004)

⑧ 3g of urea is dissolved in 36g of boiling water. The Lowering in vapour pressure is ____   (19mm)

⑨ Calculate the vapour pressure of 10% (w/w) aqueous glucose solution at 30°C, if vapour pressure of pure water is 31.8 mm —   (31.45mm)

⑩. Vapour pressure of solvent is 76 mmHg and vapour pressure of solution is 38 cmHg. find out
   a) Lowering in vapour pressure   (38 cmHg)
   b) Relative lowering in vapour pressure. (0.5)

Osmatic pressure problems

1) at 283K, the Osmatic pressure of 2% solution
of "x" is $7.87 \times 10^4 \, Nm^{-2}$. Calculate molar mass of X?

(S = 8.314 $J \bar{K}^{-1} mol^{-1}$)

(598).

② A 5% solution of Cone sugar is isotonic with
0.5% of X. The molecular weight of substance
"X" is ___

(34.2 g/mol)

③ at 300K, a one litre solution of Sucrose (342g/mol)
was prepared by dissolving 40g of sucrose.
What is the approximate Osmatic pressure (in Kpa)
of solution at the same Temperature

(S = 8.514 $\times 10^6 \, cm^3 \, pa \, \bar{K}^{-1} mol^{-1}$)

(292)

④ at 10°C, The Osmatic pressure of urea solution
was formed to be 500 mmHg. The solution is
diluted "x" times and the Temperature raised
to 25°C when the Osmatic pressure was
noticed to be 105.3 mm Hg, then "x" is. (5)

⑤ the Osmatic pressure of 5% aqueous solution of
sugar (342 g/mol) at 15°C is ___

(3.45 atm)

(6) Osmatic pressure of a solution is 0.0821 atm at a temperature of 300K. The concentration in mole/lit will be — (0.3×10^{-2})

(7) The Osmotic pressure of blood at 27°C is 8.21 atm. the amount of Glucose (in gm) should be used per litre for an intravenus injection so that it is isotonic with blood is   (60 gm)

(8) The Osmotic pressure of blood is 7.40 atm at 27°C. number of mole of glucose to be used per liter for an intravenous injection that is to have the same osmatic pressure as cloodis   (0.3)

(9) Two solution of Glucose have osmatic pressures 1.5 and 2.5 atm. 1L of first is mixed with 2Lit of second solution, the osmatic pressure in atm of the solution will be —   (2.16atm)

(10) The osmotic pressure of solution containing 4.0g of solute (molar mass 246) per litre at 27°C is — (R=0.082 Latm K⁻¹ mol⁻¹)   (0.4atm)

Vont Hoff's factor – problems

① if $BaCl_2$ ionizes to an extent of 80% in aqueous solution, the value of Van't hoff factor is _____ (2.6)

② a decimolar solution of $K_4[Fe(CN)_6]$ at 300K is 50% dissociated, then Osmatic pressure of the solution is (7.38 atm)

③ The experimental depression in freezing point of dilute solution is 0.025 K. if the Van't hoff factor is 2. the calculated depression in freezing point is _____ (0.0125 K)

④ which of the following aqueous solution has highest freezing point?

a) 0.1 m $Al_2(SO_4)_3$ ⓑ 0.1m $BaCl_2$

c) 0.1 m $AlCl_3$ d) 0.1 m NH_4Cl

(5) The freezing point of the solution containing 0.3g of acetic acid (mass = 60g/mol) in 30g of benzene is lowerd by 0.42°c then the van't hoff factor is (K_f = 5.12 K kg mol^{-1})

(6) $K_2[HgI_4]$ is 40%. ionised in aqueous solution. The value of its von't hobb factor is ___ (1.8).

(7) molal depression constant for a solvent is 4.0 K kg mol^{-1}. the depression in the freezing point of the solvent for 0.03 mol kg^{-1} solution of K_2SO_4 is ___ (0.36K).

(8) find out i value for following

(a) Na_3PO_4

(b) $NaNO_3$

(c) $BaCl_2$

(d) K_2SO_3

(e) $C_6H_{12}O_6$

(f) $Ca_3(PO_4)_2$

(g) $K_3[Fe(CN)_6]$

(h) $K_4[Fe(CN)_6]$
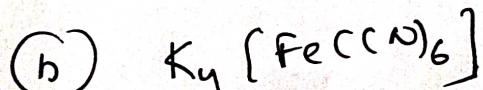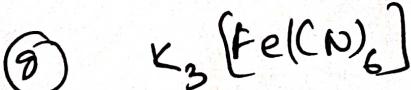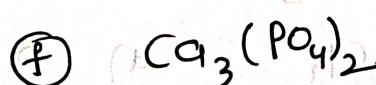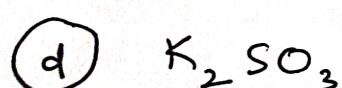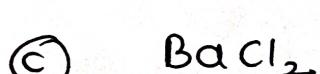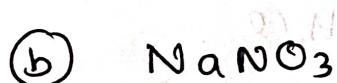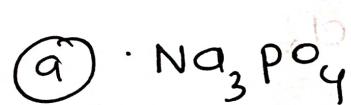
Find out moles & molecules

① $10g$ of $CaCO_3$ = ____ moles = ____ molecules

② $0.4g$ of $NaOH$ = ____ moles = ____ molecules

③ $1.11 g$ of $CaCl_2$ = ____ moles = ____ molecules

④ $49 \times 10^{-2} g$ of H_2SO_4 = ____ moles = ____ molecules

⑤ $365g$ of HCl = ____ moles = ____ molecules

⑥ $5.85g$ of $NaCl$ = ____ moles. = ____ molecules

Find out mass & volume

⑦ $\frac{1}{4}$ moles of CO_2 = ____ ~~moles~~ g . = ____ Lit

⑧ 2 moles of CH_4 = ____ g = ____ Lit

⑨ 10 moles of $CaCO_3$ = ____ g = ____ Lit

⑩ 0.6 moles of KNO_3 = ____ g = ____ Lit

Calculate molar masses & GEW

① H_2SO_4

② HCl

③ HNO_3

④ $H_2C_2O_4$

⑤ $H_2C_2O_4 \cdot 2H_2O$

⑥ CH_3COOH

⑦ $NaOH$

⑧ KOH

⑨ $Be(OH)_2$

⑩ $Mg(OH)_2$

⑪ $Ca(OH)_2$

⑫ $Al(OH)_3$

⑬ $Si(OH)_4$

⑭ $NaCl$

⑮ KCl

⑯ $MgCl_2$

⑰ $MgCl_2$
$AlCl_3$

⑱ Na_2CO_3

⑲ $Mg(NO_3)_2$

⑳ KNO_3

1 * 20g of solute present in 180g of solvent find out its weight-weight percentage?

2 * 150ml of Glucose present in 1250 ml of Solution find out v/v% ?

3 * 10% $\left(\frac{w}{v}\right)$ of Sucrose means

____ g of Sucrose in Solution. ____ of wet Solution.

u * 80g of NaOH present in 200g of solvent find out its w/w%.

5 * 15% $\left(\frac{w}{w}\right)$ of NaCl present in 1000 (grams) of solution, what is the mass of NaCl ____

6 * 75% $\left(\frac{w}{v}\right)$ of KOH solution has 25g of KOH. find out solution volume?