Daily Tutorial Sheet-2	JEE Advanced (Archive)

16. **(i) 0.556 (ii) 0.0099**

214.2 gm solution has 34.2 gm sugar (sugar is sucrose, $C_{12}H_{22}O_{11}$)

180 gm H_2O has $\frac{34.2}{342}$ = 0.1 mole sugar

1000 gm H_2O would have = $0.1 \times \frac{1000}{180}$ mole sugar $\Rightarrow$ 0.556 molal

$$\chi_{sugar} = \frac{n_{sugar}}{n_{sugar} + n_{H_2O}} = \frac{0.1}{0.1 + \frac{180}{18}} = \frac{0.1}{10.1} = 0.0099$$

17.(10.42)

Given: 93% H_2SO_4 solution (w/v)

93g H_2SO_4 is present in $\rightarrow$ 100 ml of solution

100 ml solution $\Rightarrow$ 184 gm solution (d = 1.84 gm/cc)

$\therefore$ 184 – 93 = 91 gm solvent has 93 gm $H_2SO_4 = \frac{93}{98}$ moles H_2SO_4

Hence, 1000 gm solvent has $= \frac{93}{98} \times \frac{1000}{91} = 10.42$ molal

18. $Pb(NO_3)_2 = 3.3g$, $NaNO_3 = 1.7g$

Heating below 600°C converts $Pb(NO_3)_2$ into PbO and $NaNO_3$ into $NaNO_2$ as

$$\text{MW:} \quad \underset{330}{Pb(NO_3)_2} \xrightarrow{\Delta} \underset{222}{PbO(s)} + 2NO_2 \uparrow + \frac{1}{2}O_2 \uparrow$$

$$\text{MW:} \quad \underset{85}{NaNO_3} \xrightarrow{\Delta} \underset{69}{NaNO_2(s)} + \frac{1}{2}O_2 \uparrow$$

Weight loss $= 5 \times \frac{28}{100} = 1.4\,g$ $\Rightarrow$ Weight of residue left $= 5 - 1.4 = 3.6\,g$

Now, 330g $Pb(NO_3)_2$ gives 222 g PbO

$\therefore$ x g $Pb(NO_3)_2$ will give $\frac{222x}{330}$ g PbO

Similarly, 85 g $NaNO_3$ gives 69 g $NaNO_2$

$\Rightarrow$ $(5 - x)$g $NaNO_3$ will give $\frac{69(5-x)}{85}$ g $NaNO_2$

$\Rightarrow$ Residue : $\frac{222x}{330} + \frac{69(5-x)}{85} = 3.6\,g$

Solving for x gives, x = 3.3 g $Pb(NO_3)_2$ $\Rightarrow$ $NaNO_3 = 1.7g$.

19.(4.14 g) Molar mass of $CuSO_4 \cdot 5H_2O$

$= 63.5 + 32 + 4 \times 16 + 5 \times 18 = 249.5g$

Also, molar mass represents mass of Avogadro number of molecules in gram unit, therefore

$\because$ 6.023×10^{23} molecules of $CuSO_4 \cdot 5H_2O$ weight 249.5 g

$\therefore$ 10^{22} molecules will weight $\frac{249.5}{6.023 \times 10^{23}} \times 10^{22} = 4.14g$

20. **(i) 0.25M (ii) 0.251m (iii)** $\chi_{Na_2SO_4} = 0.0045$

Glauber's salt $\rightarrow Na_2SO_4 \cdot 10H_2O$ (M. W. = 322 gm/mol)

Moles of Glauber's salt dissolved = $\dfrac{80.575}{322}$ mole = 0.25 mole

$V_{soln} = 1\ dm^3 = 1\ell \quad \Rightarrow \quad$ Molarity = 0.25 M

Mass of 1ℓ solution = 1000 × 1.0772 gm/cc = 1077.2 gm

Mass of solvent in 1ℓ solution = 1077.2 – 80.575 = 996.625 gm

$\therefore$ 996.625 gm solvent has 0.25 mole solute

Hence, 1000 gm solvent has = 0.25 × $\dfrac{1000}{996.625}$ = 0.251 molal

$$\chi_{Na_2SO_4} = \frac{n_{Na_2SO_4}}{n_{Na_2SO_4} + n_{H_2O}} = \frac{0.25}{0.25 + \dfrac{996.625}{18}} = 0.0045$$

21.(70.68 × 10⁶ g)

Specific Volume = $\dfrac{\text{Volume}}{\text{Mass}} = 0.75\ cm^3 / gm$

$V = \pi r^2 h$

$h = 5000 Å$

$r = \dfrac{150}{2} Å = 75 Å$

Volume of virus can be found.

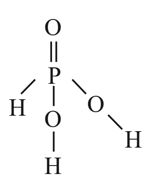
$$V_{virus} = \pi r^2 h = \pi \times (75 \times 10^{-8})^2 \times 5000 \times 10^{-8}\ cm^3 = 8.8 \times 10^{-17}\ cm^3$$

Mass of 1 mole virus $= \dfrac{V_{virus}}{\text{Specific Volume}} \times N_A = \dfrac{8.8 \times 10^{-17}}{0.75} \times N_A = 70.68 \times 10^6$ gm / mole

22.(D) n-factor of $H_3PO_3 = 2$

(In oxyacids H-atom directly attached to oxygen are replaceable)

$N = M \times n - \text{factor} = 0.3 M \times 2 = 0.6 N$



23.(D) Number of e^- weighing 1 kg = $\dfrac{1}{9.108 \times 10^{-31} kg} = \dfrac{1}{9.108} \times 10^{31}$

Number of moles of $e^- = \dfrac{1}{9.108 \times 6.023} \times \dfrac{10^{31}}{10^{23}} = \dfrac{1}{9.108 \times 6.023} \times 10^8$

24.(A) 6.3 gm $(COOH)_2 \cdot 2H_2O$ in 250 ml dihydrate oxalic acid

$\dfrac{6.3}{126}$ mole $(COOH)_2 \cdot 2H_2O$ in 0.25ℓ $(COOH)_2 2H_2O = 126$ gm / moles

Hence molarity of acid is 0.2 M   6.3g $\rightarrow$ 0.05 moles n-factor of $(COOH)_2 \cdot 2H_2O$ is 2

$\therefore$ Normality of $(COOH)_2 \cdot 2H_2O$ = M × n-factor = 0.2 × 2 = 0.4 N

meq of acid consumed = meq of Base consumed

0.4 × 10 ml = 0.1 × V_{ml} $\Rightarrow$ V_{ml} = 40 ml

25.(A)

	Number of atoms
24 gm C	$\frac{24}{12} N_A = 2 N_A$
56 gm of Fe	$\frac{56}{56} N_A = N_A$
27 gm of Al	$\frac{27}{27} N_A = N_A$
108 gm of Ag	$\frac{108}{108} N_A = N_A$

26.(55.56)

$d_{H_2O} = 1000 \text{ kg} / m^3 \equiv 1.0 \text{ gm} / \text{ml}$

Hence, 1000 ml water weighs 1000 gm $\equiv \frac{1000}{18}$ moles $\equiv$ 55.56 moles

Molarity is 55.56 M

27.(C) 120g of urea is present in $\rightarrow$ 1120g of solution

$\therefore$ 1120 gm solution has $\frac{120}{60} = 2$ mole urea

$\frac{1120}{1.15}$ ml solution has 2 moles of urea

$\therefore$ Molarity = $\frac{2}{1120} \times 1.15 \times 1000 = 2.05$ M

28.(8) 29.2% w / w

Molarity = $\frac{10xd}{M_0} = \frac{10 \times 29.2 \times 1.25}{36.5} = 10\,M$

Since, Number of m moles of HCl is conserved $10M \times V_{ml} = 200 \times \frac{4}{10}$ $\Rightarrow$ $V_{ml} = 8m\ell$

29.(8) $H_2X\left(M_w = 80g\right)$

Density = $\frac{\text{mass}}{\text{volume}}$

3.2 M $\Rightarrow$ 3.2 moles of solute is present in 1000 ml of solution (from 1000 ml of solvent)

$\downarrow$

3.2 moles of solute is present in 1000 ml of solvent $(1000 \times 0.4 = 400\,g$ of solvent)

(d= 0.4 gm/ml)

$\therefore$ Number of moles of solute present in 1000 gm. Solvent $= 1000 \times \frac{3.2}{400} = 8$

30.(9) Let total moles be 1

$n_{solute} = 0.1$

$n_{solvent} = 0.9$

At 298 K, molality = molarity (say x)

'x' M $\Rightarrow$ x mole solute in 1 L solution;

x mole solute in 1ℓ solution (2 gm/cc) = 2000 gm solution (d = 2 gm/cc)

'x' molal $\Rightarrow$ and x mole solute in 1000 g solvent

x mole solute in 1000 gm solvent.

2000 gm soln

1000 gm solute   1000 gm solvent

$$\frac{n_{solvent}}{n_{solute}} = \frac{mass_{solvent}}{mass_{solute}} \times \frac{MW_{solute}}{MW_{solvent}} = \frac{0.9}{0.1} = 9$$