L-1/01

$1U = 1.66 \times 10^{-24} g$

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Some Basic Concepts of Chemistry.

$1U = 1.66 \times 10^{-24} g$

MOLE-CONCEPT.

N_0 or N_A } Avogadro-Number

$\Downarrow$

6.022×10^{23} particle → unit
mole

Eg. 6.022×10^{23} Na-atoms ≡ 1 mole Na-atoms
≡ 23 g/mole → molar mass of Na
≡ 1 g-atom of Na

→ 6.022×10^{23} CO_2 molecules ≡ 1 mole CO_2 molecule
≡ 44 g/mole → molar mass of CO_2
≡ 1 g molecule of CO_2

→ 6.022×10^{23} $Cl^{(-)}$ ions ≡ 1 mole Cl^- ions
≡ 35.5 g/mole → molar mass of $Cl^{(-)}$
≡ 1-g-Ion of Cl^-

H_2O → 18 g/mole, 18 u/molecule

CO_2 → 44 g/mole, 44 u/molecule } Equal Value

PROOF

6.022×10^{23} molecules of CO_2 ≡ 44 g

1 molecule of CO_2 ≡ $\frac{44 \times 1}{6.022 \times 10^{23}}$

* 1 amu = $\frac{1}{12}$ th of mass of C-12 ≡ $44 \times \frac{1}{6} \times 10^{-23}$ g

$= 1.66 \times 10^{-24}$ g ≡ $44 \times \underbrace{1.66 \times 10^{-24} g}_{1u}$

≡ 44 u

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$$n = \frac{\text{Given-mass}}{\text{Molar-mass}}$$

Q. Calculate the No. of moles of glucose in 18 mg of it

$$n = \frac{\text{Given-Mass}}{\text{molar-mass}} = \frac{18 \times 10^{-3}\ g}{180\ g/mol} \Rightarrow 10^{-4}\ mol$$ Ans.

$$\text{No. of Particles} = n \times N_A \times p_f$$ → Particle-factor

$C_6H_{12}O_6$

- No. of molecules ⇒ $p_f = 1$
- No. of atoms ⇒ $p_f = 24$
- No. of C-atom ⇒ $p_f = 06$
- No. of valence e^- ⇒ $p_f = 72$ → 24 + 12 + 36

PYQ (pg-18)

Q.2 No. of atoms = $\frac{1}{24} \times N_A$

$\frac{1}{32} \times N_A \times 2$

$\frac{1}{7\cancel{8}} \times N_A$ → opt ③ ✓

$\frac{1}{108} \times N_A$ → opt ①

Q.7 $\frac{18 \times 10^{-3}}{18} N_A = \cancel{10^{-3} N_A}\ 18N_A$ solve it later

$\frac{18 \times 10^{-2}}{18} N_A = 10^{-2} N_A$ → ~~opt ②~~ X.

$\frac{10^{-3}}{18} \cdot N_A = \frac{10^{-3}}{18}$ 18×10^{-3} L.

$22.4 \times 10^{-4} N_A = \frac{10^{-4}}{1} N_A$ $\frac{\cancel{1\ Kg}/1}{1000\ Kg/L}$

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Q.18 :- $\frac{8}{2}$ NA $\quad \frac{64g}{64}$ NA $\quad \frac{44}{44}$ NA $\quad \frac{48}{48}$ NA

↓

opt ①

Q.29 $\frac{4.2}{42}$ NA $= 0.1 \times 16 \Rightarrow 1.6$ NA $\rightarrow$ opt ③

Q.37 :- NA $\frac{4.25}{17} \times 4 \Rightarrow \frac{17.00}{17} \Rightarrow 6 \times 10^{23} \rightarrow$ opt ④

Q.41 : $\frac{7}{28}$ NA $\quad \frac{2}{2}$ NA $\quad \frac{16}{46}$ NA $\quad \frac{16}{32}$ NA.

↓

opt ②.

Q.48 :- $0.1 \times 3 \times 6 \times 10^{23} \rightarrow$ opt ③

Q.49 :- $\frac{2}{20}$ NA $\times 10$ $\Rightarrow \frac{1}{10} \times 16$ opt ② same

$\frac{1.8}{18}$ NA $\times 10$ $\quad \frac{1}{10}$ 4

Q.50 :- $\frac{200 \times 10^{-3}}{44}$ NA $\Rightarrow \frac{NA}{220} - x = 2.89 \times 10^{-3}$.

$\Rightarrow \frac{6.022 \times 10^{23} - 2.89 \times 10^{-3}}{220}$

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@ STP & NTP: Volume of 1 mole of an Ideal gas ~ 22.4L

0.1

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Ques:- i) 1.6g CH_4 (10) which of the following has
ii) 1.7g NH_3 (10) max. No. of e⁻ ?
iii) 1.8g H_2O (10)
iv) All of these

Soln → (i) $\frac{1.6}{16} N_A \times 10 = N_A$ (ii) $\frac{1.7}{17} N_A \times 10 = N_A$

(iii) $\frac{1.8}{18} N_A \times 10 = N_A$

Ans. opt iv) All of these

Ques: 7 (PYQ)

1g/1ml → Density of water

Ques.
i) 1.6g CH_4 which of the following has max. No.
ii) 1.7g NH_3 of atoms?
iii) 1.8g H_2O
iv) All of these

Sol: (i) $n = \frac{\text{mass}}{\text{molar-mass}} = \frac{1.6}{16} = 0.1 \Rightarrow 0.1 N_A \times 5$ ✓

(ii) $n = \frac{1.7}{17} = 0.1 \Rightarrow 0.1 N_A \times 4$

(iii) $n = \frac{1.8}{18} = 0.1 \Rightarrow 0.1 N_A \times 3$

Ans. opt i)

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Q.50 PYQ

$200\,mg\ CO_2 - x\ molecules = 2.089 \times 10^{-3}$

$\frac{200 \times 10^{-3}}{44} \times 6 \times 10^{23} - x = 2.089 \times 10^{-3} \times 6 \times 10^{23}$

$\left(\frac{\cancel{200}^{100}}{\cancel{44}^{22}} - 2.89\right) 6 \times 10^{20} = x$

$\frac{300}{11} \times 10^{20} = x$

$\Rightarrow 27.27 \times 10^{20} = x$

$\Rightarrow 2.73 \times 10^{21} = x \longrightarrow$ opt ④

$\left(\frac{\cancel{100}^{50}}{\cancel{22}^{11}} - 2.89\right) \times 6 \times 10^{20}$

$(\overset{3}{\cancel{4}}.\overset{14}{\cancel{5}}4 - 2.89) \times 6 \times 10^{20}$

$1.65 \times 6 \times 10^{20}$

$9.90 \times 10^{20} \approx 10^{21} \longrightarrow$ opt ④

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L-2/2 → (Intensive properties) = Independent of amount of substance

CONCENTRATION - TERMS :

1) Molarity
2) Molality
3) Mole-fraction
4) Normality

1) MOLARITY :

* MOLARITY = $\frac{\text{moles of Solute}}{\text{Vol. of sol}^n}$

Ques^n : calculate molarity of pure water ? [$d_{H_2O} = 1g/1mL$]

$$n_{H_2O} = \frac{1}{18} \text{ mol}$$

$$M_{H_2O} = \frac{1}{18} \times \frac{1000}{1\,L} \text{ mol}$$

$$= 55.55 \text{ mol/L}$$

Q. What is the molarity of $CO_2(g)$ [Pure] at STP ?

$$1 \text{ mole } CO_2 \longrightarrow 22.4\,L$$

$$M_{CO_2} = \frac{1}{22.4} \text{ mol/L}$$

Ques^n : calculate molarity of NaOH, if 250 mL of aqueous sol^n contains 4g of NaOH.

Sol^n :-

$$M_{NaOH} = \frac{4}{40} \times \frac{1000}{250\,L} \text{ mol} \Rightarrow 0.4 \text{ mol L}^{-1}$$

Ques^n : 500 mL of an aqueous sol^n has molarity 5M, then calculate molarity of 250 ml of the same sol^n.

Sol^n : 5M Ans.

(bcoz it is an Intensive property)

$$M = \frac{n}{500} \times 1000 \Rightarrow \frac{5}{2}$$

$$M = \frac{5}{2 \times 500} \times 1000 = 5M$$

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Sol^{n} :- 500ml → 2.5 mol solute

250ml (1.25 mole) | 250ml (1.25 mole)

→ Molarity = $\frac{1.25 \times 1000}{250} \Rightarrow 5M$

Ques^{n} :- 5 → 200 mL aqueous sol^{n} of NaOH has molarity 2M (NEET 2023) for NaOH.
If 2g of NaOH is added to it, then find final Molarity of NaOH

$2M = \frac{n \times 1000}{200}$

$2 = \frac{m \times 5}{40 \times 8}$

$\Rightarrow m = 16g$

$\frac{16 \times 1000 \times 5}{40 \times 200} \Rightarrow \frac{9}{4} \Rightarrow 2.25 \frac{mol}{L}$

Sol^{n} :- $n_{I_{NaOH}} = \frac{2 \times 200}{1000} \Rightarrow 0.4 mol$

$n_{II} = \frac{2}{40} = 0.05 mol$

$n_{Total} = 0.45 mol$

$M_{NaOH} = \frac{0.45 \times 1000}{200} = 2.25 mol/L$

For DILUTION & EVAPORATION :

$M_1V_1 = M_2V_2$

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Ques^{n} :- How many litres of water should be added to 5L of 4M aqueous sol^{n}, so that its molarity become 2M ?

$$5 \times 4 = 2 \times x$$
$$10 = x$$
$$5L$$

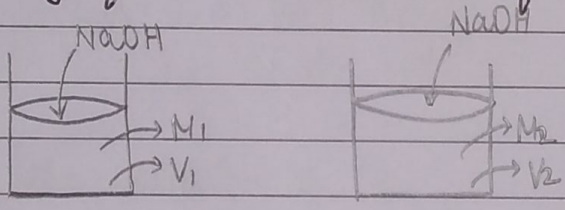
Sol^{n} :- $M_1V_1 = M_2V_2$

$\Rightarrow 5 \times 4 = M_2 \times 2 \times V_2$

$\Rightarrow 10 = V_2$

$\therefore$ $V_2 - V_1 = \Delta V$ = amount of water added = $10 - 5 = 5L$ Ans.

Mixing of 2 aqueous sol^{n} of same solute



$$M_1V_1 + M_2V_2 = M \times (V_1 + V_2)$$

↳ final molarity of solute

Ques^{n} : $M_1 = 2M$ $M_2 = 2.5\,M$ $M = ?$

$V_1 = 250\,mL$ $V_2 = 200\,mL$

Sol^{n} :-

$$\frac{2 \times 250}{1000} + \frac{2.5 \times 200}{1000} = M\left(\frac{450}{1000}\right)$$

$$500 + 500 = 450\,M$$

$$\frac{1000}{450} = M$$

$$\frac{200}{9}$$

$$2.22\ mol\,L^{-1} = M$$

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Ques^{n}-20 pg 19 $1\,Na_2CO_3 \longrightarrow 2Na^{+} + CO_3^{2-}$

2:1 → opt ② has this ratio

10% (w/w) NaOH sol^{n}

10 g solute
100 g solution
→ 10g NaOH in 100g sol^{n}

10% (w/v) NaOH sol^{n}

10 g solute
100 mL sol^{n}
→ 10g NaOH in 100 mL sol^{n}

Ques^{n}: calculate molarity of NaOH in 20% (w/v) sol^{n} of it

Sol^{n}: $\frac{20\text{ g}}{100\text{ mL}} \Rightarrow \frac{200\text{ g}}{1000\text{ mL}}$

$\therefore n = \frac{200}{40} = 5\text{ mol} \Rightarrow M = \frac{n}{V} = \frac{5\text{ mol}}{1\text{ L}}$

$\Rightarrow 5\text{ mol L}^{-1}$

Ques^{n}: calculate molarity of NaOH in 10% (w/w) of its aqueous sol^{n} having $\partial = 1.2\text{ g/mL}$

Sol^{n}:

MY $\frac{10\text{g solute}}{100\text{g sol}^{n}} \Rightarrow \frac{m}{V} = 1.2 \Rightarrow \frac{100}{V} = 1.2$

$\Rightarrow \frac{1000\text{mL}}{12} = V$

Now, $M = \frac{\frac{10}{40} \times 1000}{\frac{1000}{12}}$ $\Rightarrow \frac{10 \times 12}{40} \Rightarrow 3\text{ mol L}^{-1}$ Ans.

SIR 10 g NaOH in 100 g solution

$M_{NaOH} = \frac{10 \times 1.2 \times 1000}{40 \times 100} = 3M$ (10 = x, 1.2 = ∂, 40 = M_B)

$\Rightarrow M = \frac{10 \times \partial}{M_B}$ → molar mass of solute

$d_{sol^{n}} = \frac{\text{mass of sol}^{n}}{\text{Vol. of sol}^{n}}$

$V_{sol^{n}} = \frac{m}{\partial}$

MOLARITY = $\frac{10 \times \%(w/w) \times d}{\text{Molar-Mass of Solute}}$

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Ques^{n}. 28 pg 20 : $M = \frac{n}{V}$

$\Rightarrow 2 = \frac{\text{mass}}{32} \times \frac{1000}{150}$

$\Rightarrow \frac{2 \times 32 \times 15}{100}$

$\Rightarrow \frac{30 \times 32}{100} \Rightarrow 9.6$ grams $\rightarrow$ opt (3) ✓

Ques^{n}. 40 pg 21 : $M_1V_1 + M_2V_2 = M(V_1 + V_2)$

$1 \times 2.5 + 0.5 \times 3 = M(5.5)$

$\frac{2.5 + 1.5}{5.5} = M$

$\frac{8}{11}$ $\frac{40}{55} = M \Rightarrow 0.72 \rightarrow$ opt (3) ✓

Ques^{n}. 44 pg 21 $\frac{98\,g}{100\,mL}$ H_2SO_4 sol^{n} $\quad d = 1.80\ g\ mL^{-1}$

or $\frac{980\,g}{1L}$ H_2SO_4 sol^{n} $\Rightarrow M = \frac{980}{98 \times 1L} \Rightarrow 10M$ (opt 3)

molality = $\frac{\text{moles of solute}}{\text{mass of solvent}}$

MOLALITY (m) :-

↳ UNITS: mol (1st unit) per kg (2nd unit) of solvent

Q. calculate molality of NaOH in 20% W/W aqueous sol^{n} of it.

Sol^{n} :- $\frac{20\,g\ NaOH}{100\,g\ NaOH\ sol^{n}}$ $\Rightarrow$ solvent = sol^{n} − solute = 100g − 20g

$\frac{20}{80} \times \frac{1000}{1} \Rightarrow 250$ mol

molality = $\frac{m \times 1000}{M \times M_A}$ $\quad \frac{1}{4} \Rightarrow \frac{20}{40} \times \frac{1000}{80} \Rightarrow \frac{25}{4}$

$\Rightarrow 6.25\ m$

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→ 148.14 g (through I method)
148.01 g (through II method)

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Ques": calculate the amount of NaOH present in 2kg of its aqueous sol" having molality = 2m

Sol":-

$$\frac{\frac{x}{40}}{(2 - x \times 10^{-3})} = 2$$

$$\Rightarrow \frac{x}{40(2 - x \times 10^{-3})} = 2$$

$$\Rightarrow \frac{x}{40} = 2(2 - x \times 10^{-3})$$

$$\Rightarrow x = 80 \times 2 - 80x \times 10^{-3}$$

$$\Rightarrow x + (80x \times 10^{-3}) = 160\ g$$

$$\Rightarrow x + \frac{80x}{1000} = 160$$

$$\Rightarrow \left(1 + \frac{8}{100}\right)x = 160$$

$$\Rightarrow \left(\frac{108}{100}\right)x = 160$$

$$\Rightarrow x = \frac{160 \times 100}{108} \Rightarrow \frac{4000}{27}$$

$$\Rightarrow 148.14\ g$$

OR

$$\frac{\frac{x}{40} \times 1000}{(2000 - x)} = 2$$

$$\Rightarrow 1000x = 80(2000 - x)$$

$$\Rightarrow 1000x = -80x + 160000$$

$$\Rightarrow 1081x = 160,000$$

$$\Rightarrow x = \frac{160000}{108} = 148.01\ g$$ Ans.

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L-3/03

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Sol^{n} :- 2kg solution

$m = 2m$

↳ 2 mole NaOH in 1000g $H_2O(l)$ – solvent

80g " " 1080g solution

→ 1080g solution contains 80g NaOH

2000g sol^{n} contains $\frac{80}{1080} \times 2000$

$\rightarrow \frac{4000}{27}$

$\rightarrow 148.14\,g$

Relation b/w Molarity (M) & molality (m) :-

$$\frac{1000\,M}{1000\,\partial - M \times M_B} = m$$

M_B → molar mass of solute

∂ → density of sol^{n} (g/ml)

(ठंडा मोती ठंडा दाने मन मेरा बोले molality, molality)

Ques^{n} :- Calculate molality of H_2SO_4 in 5M H_2SO_4 sol^{n}, having $\partial = 1.4\,g\,mL^{-1}$

Sol^{n} :-

$$m = \frac{1000 \times 5}{1000 \times 1.4 - 98 \times 5}$$

$$= \frac{5000}{1400 - 490}$$

$$= \frac{5000}{910} \rightarrow \frac{500}{91} \rightarrow 5.49\ mol\,kg^{-1}$$

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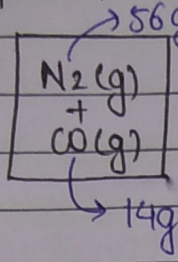
MOLE-FRACTION :-



$$\chi_{N_2} = \frac{n_{N_2}}{n_{N_2} + n_{CO}} \quad ; \quad \chi_{CO} = \frac{n_{CO}}{n_{N_2} + n_{CO}}$$

$\Rightarrow (n_{N_2} + n_{CO} = n_{Total})$

Ques^n :-

* $\chi_{N_2} = \dfrac{\frac{56}{28}}{\frac{56}{28} + \frac{14}{28}} = \dfrac{\frac{56}{28}}{\frac{70}{28}} = \dfrac{56}{70} = \dfrac{8}{10} = 0.8$

* $\chi_{CO} = \dfrac{\frac{14}{28}}{\frac{56}{28} + \frac{14}{28}} = \dfrac{\frac{14}{28}}{\frac{70}{28}} = \dfrac{14}{70} = 0.2$

$\boxed{\chi_{Total} = 1}$ ⇝ In a mixture

Ques^n : 440 g of an aqueous sol^n contains 240 g CH_3COOH (acetic acid) and ~~96~~ 920 g ethanol (C_2H_5OH) calculate mole fractions of CH_3COOH, C_2H_5OH.

$$\frac{\frac{240}{60}}{\frac{240}{60} + \frac{96}{46} + \frac{104}{18}} \sim \frac{4}{4 + \frac{48}{23} + \frac{52}{9}} \Rightarrow \frac{4}{\frac{828 + 408 + 1196}{23 \times 9}}$$

$$\Rightarrow \frac{4 \times 23 \times 9}{828 + 408 + 1196} \Rightarrow \frac{828}{2}$$

Soln :

$$\chi_{CH_3COOH} \Rightarrow \frac{\frac{240}{60}}{\frac{240}{60}+\frac{92}{46}+\frac{108}{18}} \Rightarrow \frac{4}{4+2+6} \Rightarrow \frac{4}{12} \Rightarrow \frac{1}{3}$$ Ans

$$\frac{240}{92}$$
$$332$$

$$\frac{440}{332}$$
$$108$$

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$$\chi_{C_2H_5OH} = \frac{2}{12} \Rightarrow \frac{1}{6}$$ Ans.

Ques: calculate ~~molality~~ mole-fraction of solvent if ~~mole-fraction~~ molality of urea is 4.5 m in aqueous soln.

Soln :-

$$m = \frac{4.5 \text{ moles of urea}}{1 \text{ kg water}}$$ {$NH_2CONH_2 \Rightarrow 60$ g}

~~1000 kg/L~~ ~~1g~~ 1 kg water = ~~1 L~~

$\Rightarrow$ 1 kg = 1000 g ; 4.5 moles urea ⊕ut in 1000 g water

$$\Rightarrow \frac{4.5}{\frac{1000}{18}+4.5} = \frac{4.5}{55.5+4.5} = \frac{4.5}{60} \Rightarrow \frac{45}{600} \Rightarrow 0.075$$ Ans.

$$\chi_{solute} = \frac{m}{m + \frac{1000}{M_{solvent}}}$$

Ques 17
pg 19

$$\frac{1}{1+55.5} \Rightarrow \frac{1}{56.5} \Rightarrow \frac{1000}{565} = 0.01$$ ↳ opt 3)

$$\frac{1}{1+55.5} \Rightarrow \frac{100}{56} \Rightarrow 0.1$$

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Normality (N) = Molarity (M) × n-factor (n_f)

Normality (N) = $\frac{\text{No. of gram equivalent}}{\text{volume of solution (L)}}$

No. of gram equivalents = $\frac{\text{given-mass}}{\text{gram equivalent mass}}$

Equivalent-mass = $\frac{\text{Formula-mass}}{n_f}$

n_f for ions :- (charge No.)
(when in "Sx" charge fixed)

- Na^+ → $n_f = 1$
- Cl^- → $n_f = 1$
- Mg^{2+} → $n_f = 2$
- SO_4^{2-} → $n_f = 2$
- Al^{3+} → $n_f = 3$
- PO_4^{3-} → $n_f = 3$
- NH_4^+ → $n_f = 1$

$Fe^{2+} \longrightarrow Fe^{3+} + e^-$

$\Rightarrow n_f = 1$ (change in oxidation No.)

* for Redox: change in oxidation No. per mole is n_f

n_f for ionic solids :- (~~No~~ Total +ve charge / Total -ve charge)

- $1NaCl \longrightarrow 1Na^+ + 1Cl^-$
  ↳ $n_f = 1$ $\quad 1\times1 \quad 1\times1$
  1×1
- $1Ca(OH)_2 \longrightarrow 1Ca^{2+} + 2OH^-$
  ↳ $n_f = 2$ $\quad 1\times2 \quad 2\times1$
  (1×2)
- $1Al_2(SO_4)_3 \longrightarrow 2Al^{3+} + 3SO_4^{2-}$
  ↳ $n_f = 6$ $\quad 2\times3 \quad 3\times2$
  (1×6)

(no. of moles (coefficient) × n_f)
↳ n-factor of ion

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No. of gram Equivalent = moles x nf

→ No. of g. eq. = $\frac{\text{Weight}}{\text{Equivalent-mass}}$

→ No. of g. eq. = N x V_L (Vol. in Lit.)
(N = Normality)

Na_2O	$MgCO_3$	$Al_2(SO_4)_3$
$2Na^+ + O^{2-}$		
$E_{Na^+} = \frac{23}{1} = 23$	$E_{Mg^{2+}} = \frac{24}{2} = 12$	$E_{Al^{3+}} = \frac{27}{3} = 9$
$+$	$+$	$+$
$E_{O^{2-}} = \frac{16}{2} = 8$	$E_{CO_3^{2-}} = \frac{60}{2} = 30$	$E_{SO_4^{2-}} = \frac{96 \times 3}{2} = 48$
$E_{Na_2O} = \frac{62}{2} = 31$	$E_{MgCO_3} = \frac{84}{2} = 42$	$E_{Al_2(SO_4)_3} = \frac{342}{6} = 57$

* Equivalent mass of an ionic solid (anhydrous) is equal to the sum of equivalent masses of the cation & Anion of the solid.

eg. ✓ $E_{MgO} = 12 + 8 = 20$
✓ $E_{Al_2O_3} = 9 + 8 = 17$
✓ $E_{CaCO_3} = 20 + 30 = 50$

The No. of grams of a metal reacting with —
* 8g of oxygen or
* 1g of hydrogen or
* 30g of carbonate or
* 35.5g of chlorine

is the equivalent mass of the metal.

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eg.

Na_2O		$MgCO_3$		$MgCl_2$		MgO	
46	16	24	60	24	71	24	16
(23)	(8)	(12)	(30)	(12)	(35.5)	(12)	(8)

Quesⁿ– 4g of a metal oxide contains 1.6g of oxygen calculate equivalent mass of the metal oxide

Solⁿ:

$M + \text{Oxygen} \rightarrow M_xO_y$

2.4g 1.6g 4g

Metal	oxygen
2.4	1.6
↓	↓
1.2	0.8
↓	↓
12g ~~20g~~	8g

Metal ⇒ ~~3-1~~ Metal oxide – oxygen
⇒ 4 – 1.6
⇒ 2.4 g Metal

$\frac{2.4}{E_m} = \frac{1.6}{8} = \frac{4}{E_m+8}$

⇒ 20g = equivalent mass (12+8) of metal oxide

* **LAW OF CHEMICAL EQUIVALENCE** :-

* $2Mg + O_2 \longrightarrow 2MgO$ (redox rxⁿ ↳ e⁻ loss/e⁻ gain = n_f)

No. of g-equivalent $(n \times n_f)$ = 2×2 = 1×4 = 2×2

* No. of gram equivalents of each reactants & products are equal in a complete chemical rxⁿ

g. eq. volume (at STP) = $\frac{22.4}{n_f}$

L-4/04

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Ques^{n}: calculate the amount of $CaCO_3$ (in gram) required to react with 200 mL, 0.04 M H_2SO_4 aqueous sol^{n} acc. to law of chemical Equivalence

$$n \times 2 = \frac{0.08 \times 200}{1000}$$

$$\Rightarrow \frac{n_1}{100} = \frac{0.08}{5 \times 2}$$

$$\Rightarrow n = 0.8\,g$$

sol^{n} $\quad \frac{x\,g}{EM} = \frac{W}{50} = \frac{x}{50} = \frac{0.04 \times 2 \times 50}{1000 \times 5}$

$$\Rightarrow x = 0.8\,g$$

$$\Rightarrow \frac{0.08 \times 50}{5}$$

~~Ques^{n}:-~~

★ MIXING of ACID AND BASE :- (when there is Excess acid or Base)

$$N_1V_1 - N_2V_2 = N(V_1 + V_2)$$

↳ Normality of OH^-/H^+ ion

STOICHIOMETRY : calculations based on chemical equations.

Given :- $CH_4 = 32\,g$ $\quad O_2 = 64\,g$

find the ~~not~~ amount of substance that remains unreacted

$$\underset{16g}{CH_4}(g) + 2\overset{64g}{O_2} \rightarrow \overset{44g}{CO_2} + \underset{2\,mole}{2H_2O}$$

$$32g \quad 64g \quad xg \quad y\,mol \rightarrow 2\,mole$$

↳ 44g

↓ limiting reagent

i.e. $64 \times x = 64 \times 44$; $64 \times y = 64 \times 2$

$\Rightarrow x = 44g$ $\quad \Rightarrow y = 2\,mol$

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$32 \times 5 = 160$

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Ques^{n} :- When 1 mol of propane (C_3H_8) is reacted with 48 g of oxygen, calculate the amount of H_2O & CO_2 ~~formed~~ produced in grams

$$\underset{44g}{C_3H_8} + \underset{160g}{5O_2} \longrightarrow \underset{7.92g}{3CO_2} + \underset{4.32g}{4H_2O}$$

$\frac{0.3 \times 44}{5}$ ↓ LR

$\frac{13.2}{5}$ $\quad \frac{48}{160} \Rightarrow 0.3$

$1.64g$ $\quad \frac{40}{10}$

$5 \longrightarrow 3$

$1 \longrightarrow \frac{3}{5}$

$0.3 \longrightarrow \frac{3}{5} \times 0.3 \Rightarrow \frac{0.9 \times 44}{5} \quad \frac{4}{5} \times 0.3$

$\Rightarrow \frac{3.96}{5} \quad \frac{1.2 \times 18}{5}$

$\Rightarrow \frac{39.6}{5} \quad \frac{21.6}{5}$

$\Rightarrow 7.92 \quad 4.32g$

$44g \text{ — } 160g$

$\frac{44}{160} \times 48 \text{ — } 48g$

$\frac{40}{10}$

$13.2g \quad 44.0$

13.2

$30.8g$ unreacted

$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$

$44g \quad 160g \quad 44 \times 3 = 132$

$\frac{44}{160} \times 48 \quad 48$

$\frac{40}{10}$ $\quad 13.2g$

$\frac{132 \times 48}{160} \quad \frac{396}{10} \Rightarrow 39.6$

$\frac{40}{10}$

Good Write

DATE: __/__/____
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1 mol 48g x y

Sol^{n}: $C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$

44g 160g 3×44g 4×18g

g

L.R.

$48\times3\times44 = 160x$; $4\times18\times48 = 160y$

$x = \frac{48\times3\times44}{160}$

$= \frac{33\times12}{10}$

$= \frac{396}{10}$

$= 39.6$ g Ans.

$y = \frac{4\times18\times48}{160}$

$\frac{216}{10} = 21.6$ g Ans.

Good Write

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L.R.
↑

Quesⁿ: 13 pg 19

$2Mg + O_2 \rightarrow 2MgO$

48g Mg — 32g O_2

1g Mg — $\frac{32}{48}$ g O_2

⇒ 1.67 g O_2

0.67g

32g O_2 — 48g Mg

0.56g O_2 — $\frac{24}{32} \times 0.56$ Mg

$\frac{48}{32} \times 0.56$ ⇒ 0.84

⇒ ~~0.42 g~~

0.16g Mg
opt (1)

1.
Quesⁿ: 10g of Ca is allowed to react with 8g of O_2. Find the amount of excess reagent left.

L.R. → $2Ca$, Excess → O_2

$2Ca + O_2 \longrightarrow 2CaO$

80g 32g

$\frac{80 \times 8}{32}$ 1g × 8

⇒ 20g

80g — 32g
10g — 4g

∴ O_2 left ⇒ 8 − 4 = 4g

56 × 2

80g — 112g.
10g — $\frac{112}{8}$ ⇒ 14g

Good Write

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Ques^n: 10 g mixture of (Al+Mg) on reacting with excess of HCl gave 11.2 L H_2 at STP. Calculate the mass of Al & Mg in the mixture.

$$\underset{10\,g}{Al + Mg} + 5HCl \longrightarrow AlCl_3 + \frac{5}{2}H_2 + MgCl_2$$

1 mol — 2.5 mole H_2

0.2 mole

$10 \times 0.2 = x \times 2.5$

$\frac{20}{25} = x$

$\frac{x}{27}$	$\frac{10-x}{24}$
4	5

$\frac{0.2}{2.5} \Rightarrow \frac{200}{25}$

$\Rightarrow 0.08$

$\frac{x}{27} = 0.08$

$10 -$

$\Rightarrow x = 0.08 \times 27$

2.16 g

7.84 g

$\frac{x}{27} = \frac{2}{2.5} \Rightarrow \frac{20 \times 27}{25}$

$\frac{x}{27} = 0.08$

2.16

$10 - \frac{7.84}{1.96}$

$\frac{10.00}{2.16}$

7.84

$\frac{108}{540}$

$\frac{25}{5}$

20

0.2

$\frac{x}{9} = \frac{1-x-10}{12}$

$12x = 9x - 90$

$\frac{x}{9} = \frac{12 - x - 10}{12}$

$\Rightarrow 4x = 6 - 3x \Rightarrow \frac{x}{9} = \frac{2-x}{4}$

Good Write

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Soln :- No. of g. eq. = No. of g-eq. of H_2
of metals

$$\left[\frac{x}{9} + \frac{(10-x)}{12}\right] = \frac{1}{1} \quad \text{Why 1?}$$

$$\Rightarrow \frac{12x + 90 - 9x}{108} = 1$$

$$\Rightarrow 3x + 90 = 108$$

$$\Rightarrow 3x = 18$$

$$\Rightarrow \boxed{x = 6g} \quad \therefore (10-x) = 4g \text{ Ans.}$$

↳ Al-mass ↳ Mg-mass

OR

$$\underset{x\,g}{\overset{(2\times27)g}{2Al}} + 6HCl \longrightarrow 2AlCl_3 + \underset{\frac{3}{2}\times\frac{1}{27}\times x \text{ mole}}{\overset{3}{3H_2(g)}}$$

$$\underset{(10-x)g}{\overset{24g}{Mg}} + 2HCl \longrightarrow MgCl_2 + \underset{\frac{1}{24}\times(10-x)\text{ mol}}{\overset{1}{H_2(g)}}$$

moles of H_2 in 1st sx^n $\Rightarrow$ ~~$x \times 3 = 2 \times 27 \times \frac{3}{2} \times x$~~

$\frac{3 \times x}{2\ 27}$ moles

moles of H_2 in 2nd sx^n $\Rightarrow$ $\frac{10-x}{24}$ moles

Total moles of $H_2 = \frac{11.2}{22.4} = \frac{1}{2}$ (given)

$$\therefore \frac{x}{18} + \frac{10-x}{24} = \frac{1}{2}$$

$$\Rightarrow \frac{x}{9} + \frac{10-x}{12} = 1$$

$$\Rightarrow \frac{4x + 30 - 3x}{36} = 1$$

$$\Rightarrow \boxed{\begin{array}{l} x = 6g \\ \therefore 10-x = 4g \end{array}} \quad \begin{array}{l} \text{— mass of Al in mix.} \\ \text{— mass of Mg in mix.} \end{array}$$

Good Write

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Q.11 : pg 19

$MgCO_3 \longrightarrow MgO + CO_2$

20 g — 8 g

Solⁿ :- 84 g $MgCO_3$ ⟶ 40 g MgO

So, 8 g MgO ⟶ $\frac{84}{40} \times 8$ g $MgCO_3$

$\Rightarrow \frac{336}{15} \Rightarrow 22.40$

$\frac{21 \times 8}{10} \quad \frac{168}{10} \Rightarrow 16.8$ g

$\frac{16.8}{20} \times 100$

84.0 % Ans.

Q.16 pg 19

$M = \frac{x}{63 \times 2} \times \frac{1000}{1} = 2$

$\frac{63}{2} \Rightarrow 31.5$ g.

~~100% conc^{n} HNO_3 ⟶ 31.5 g.~~

~~70% conc^{n} HNO_3 ⟶ 31.5~~

~~70 g HNO_3 ⟶ 100 g~~

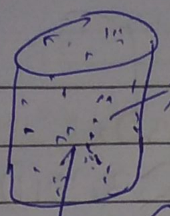
$\Rightarrow$ 70 g pure — 100 g solⁿ

$\Rightarrow$ 31.5 g " — $\frac{100}{70} \times 31.5 \Rightarrow \frac{315}{7} \Rightarrow 45$ g

Ans.

Good Write

OR



→ conc^n sol^n (70%)

70 g HNO_3
100 g sol^n

→ (x g) sol^n of HNO_3; mass of HNO_3 = $\frac{x \times 70}{100}$ g

$$M = \frac{m \times 1000}{M \times V(mL)}$$

$$2 = \frac{\frac{x \times 70}{100} \times 1000}{63 \times 250} \Rightarrow x = 45\,g \text{ Ans.}$$

L-5/05

(27 sept 2022)
→ (Tuesday)

Laws of chemical combination:

① **LAW OF CONSERVATION OF MASS :-**
Total mass in a chemical rx^n is conserved
i.e.
Total mass before rx^n & after rx^n remains constant.

★ Not applicable to Nuclear rx^n.

e.g. Hydrogen + oxygen ⟶ water
4g + 32g ⟶ 36g
$2H_2 + O_2 \longrightarrow 2H_2O$

② **LAW OF DEFINITE PROPORTIONS :-**
- $2H_2 + O_2 \longrightarrow H_2O(l)$
- $2H_2O_2 \longrightarrow 2H_2O(l) + O_2$
- $CH_4 + O_2 \longrightarrow CO_2 + H_2O(l)$

:- The ratio of masses of different elements in a compound is fixed, irrespective of the source of the compound.

★ Not applicable for Non-~~stotio~~ Stochio-metric compound.

★ ③ **LAW OF MULTIPLE PROPORTIONS :-**

H — O: H_2O, H_2O_2
(2g)(16g) 2g → 32g
1 : 2

if 4g 32g, 2g 32g
2 : 1

C — O: CO, CO_2, C_3O_2 (carbon-suboxide)

O = C = C = C = O

Good Write

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H_2O H_2O_2 | CO CO_2 C_3O_2

(2):1 (2):2 | (1):1 (1):2 (3:2 ⇒ (1):2/3)

1:2 | 1:2:2/3

H_2O H_2O_2 | O-ratio ⇒ 3:6:2

$2(H_2O)$ | H_4O_2

4:(2) 2:(2) | 2x(1:1) 1:2 3:2

2:1 | 2:(2) 1:(2) 3:(2)

C-ratio = 2:1:3 = 1/3 : 1/6 : 1/2

N_2O NO N_2O_3 NO_2 N_2O_5

(2):1 (2):2 (2):3 (2):4 (2):5

N-fixed:

O-ratio → 1:2:3:4:5

O-fixed: 1/1 : 1/2 : 1/3 : 1/4 : 1/5

2:1 1:1 2:3 1:2 2:5

60:(30) 30:(30) 20:(30) 15:(30) 12:(30)

N-ratio → 60:30:20:15:12 = 1/2 : 1/1 : 1/3 : 1/4 : 1/5

(4) GAY-LUSSAC'S LAW OF COMBINING GASEOUS VOLUMES

1L 1L 2L

$1H_2(g) + 1Cl_2(g) \rightarrow 2HCl(g)$

$1N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

1L 3L 2L

★ $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

2L 1L (coz liq. so formed)

moles of gas ← n ∝ V → vol. of gas @const T & P

$C(s) + O_2(g) \rightarrow CO_2(g)$

(coz solid) 1L 1L

L.R

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	1	3	2
Ques^{n}:-	N_2 +	$3H_2$ ⟶	$2NH_3$
	6L	10L	x

$3x = 20$

$x = \frac{20}{3} = 6.67L$

My soln

$1L \longrightarrow 3L$

$6L \longrightarrow 18L$ $\quad H_2 \rightarrow L.R$

$3L \longrightarrow 1L$

$10L \longrightarrow \frac{1 \times 10}{3} = \frac{10}{3} L$

$\therefore 6 - \frac{10}{3} = \frac{8}{3} L \rightarrow N_2$ left

Ques^{n}:- 6L of $N_2(g)$ is allowed to react with 10L of $H_2(g)$. Find the volume of NH_3 produced & volume of remaining gas at the end of the rx^{n}.

Sol^{n}:-

$N_2 + 3H_2 \longrightarrow 2NH_3$

1L 3L 2L

$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

6L 10L yL

x ↓

L.R.

$3y = 20$; $x \times 3 = 10 \times 1 \Rightarrow \frac{10}{3} L$ used

Vol. of NH_3 formed $= y = \frac{20}{3} = 6.67L$

$\therefore$ Vol. of N_2 (remaining gas at end) $= 6 - \frac{10}{3} = \frac{8}{3} = 2.67L$

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L.R

Ques. 42 pg 21

$3H_2 + N_2 \longrightarrow 2NH_3$

30L 30L

↓

Excess

3L 1L 2L

30L xL xL

$\Rightarrow 3x = 60$

$\Rightarrow \boxed{x = 20\ L\ NH_3}$

↓ i.e. (∵ 50% formed)

$\boxed{x = 10L}\ NH_3$

$\Rightarrow 3y = 30$

$y = 10L\ N_2$ used

$\Rightarrow 5L$ used

So remaining;

$30 - 10 = 20L\ N_2$

So 15L H_2 left; 25 lit of N_2; 10L of NH_3

EMPIRICAL-FORMULA:-

~~compound~~ ~~Molecular-formula~~ ~~empirical formula~~

compound	Molecular formula (M.F)	Empirical formula (E.F)	$n = \frac{\text{M.F. mass}}{\text{E.F. mass}}$
Acetic-acid	CH_3COOH $C_2H_4O_2$	CH_2O	$\frac{60}{30} = 2$
Glycose	$C_6H_{12}O_6$	CH_2O	$\frac{180}{30} = 6$
Benzene	C_6H_6	CH	$\frac{13 \times 6}{13} = 6$
Ethyne	C_2H_2	CH	$\frac{13 \times 2}{13} = 2$

Good Write

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Urea	$(NH_2)_2CO$	$(NH_2)_2CO$ ↳ (N_2H_4CO)	$1 = \frac{60}{60}$
Oxalic-acid	$(COOH)_2$	$COOH$ ↳ CO_2H	$\frac{2 \times 45}{45} = 2$

Q. calculate mass % of elements present in CH_3COOH.

Sol^n:

% C	% H	% O
$\frac{24}{60} \times 100$	$\frac{4}{60} \times 100$	$\frac{32}{60} \times 100$

%C = 40% %H = 6.67% %O ~~5.33%~~ = 53.33%

Molecular-mass = vapour-density × 2

↓

relative density (No unit)

Ques. An organic compound contains 40% C
6.67% H
53.33% O
calculate its empirical formula, if V.D = 90, calculate its molecular formula

Soln.

40g C	6.67g H	53.33g O
$\frac{40}{12}$	$\frac{6.67}{1}$	$\frac{53.33}{16}$
3.33	6.67	3.33
1	2	1

Empirical formula = CH_2O (30g)

2 × V.D. = molecular-mass

$2 \times 90 = MM = 180g$

$\therefore n = \frac{MM}{E.M} = \frac{180}{30} = 6$ $\therefore C_6H_{12}O_6$ Ans.

Good Write

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Or,

Element	% At mass	least ratio	E.F.
C	40/12 = 3.33	1	
H	6.67/1 = 6.67	2	CH_2O
O	53.33/16 = 3.33	1	

↗ V.∂ × 2 = 90 × 2

$$n = \frac{\text{M.F. mass}}{\text{E.F. mass}} = \frac{180}{30} = 6$$

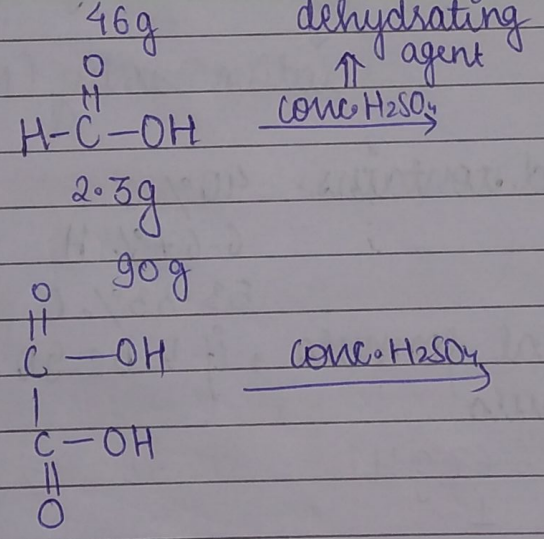
$$\text{M.F.} = (EF)_n$$
$$= C_6H_{12}O_6$$

"Significant figure in π → Infinite" (SF)

100 cm → 1 SF

100.0 cm → 4 SF

Ques. 6 : pg 18



Base — Neutral — Acidic

Now $KOH + CO + CO + CO_2$ (Acid base ⁸x^ⁿ)

↓

CO.

∴ 2.8g Ans = 1.4g + 1.4g

Good Write

50 mL of 16.9% 35.5
↓ 23
product

Ques. 9
pg 19

$AgNO_3(aq) + NaCl(aq) \longrightarrow AgCl(s) + NaNO_3(aq)$

50 mL of 16.9% 50 mL of 5.8%

$\Rightarrow \frac{16.9g}{100mL} \times 50mL$ ∴ $\frac{50 \times 5.8}{100} g$

$\Rightarrow \frac{16.9}{2} g$ $\Rightarrow \frac{5.8 \times 50}{100 \times 58}$

$\Rightarrow \frac{m}{M} = n$ $\Rightarrow 0.05$ mol

$\Rightarrow \frac{16.9}{2 \times 169} \Rightarrow 0.05$ mol

∴ mass of AgCl (m) ⇒ ~~170~~ $MM \times n$ = 107.8 × 0.05 ⇒ 143.3 × 0.05

+ 35.5
143.3

7.165 g
≈ 7g
(opt ①)

Quesⁿ. 30
pg 20 :-

$V_{O_2} = \frac{1 \times 21}{100}$ L { How ??

$n_{O_2} = \frac{21}{22.4 \times 100}$

Quesⁿ. 33
pg 20

$2PH_3(g) \longrightarrow P(s) + 3H_2(g)$
100 mL x

$\Rightarrow \frac{3 \times 100}{2} \Rightarrow 150$ mL

∴ 50 mL Increament

Quesⁿ. 39
pg 21

Se ⟶ 0.5%

x g/mole

$m_{Se} = \frac{x \times 0.5}{100}$

$\Rightarrow 78.4 = \frac{x \times 0.5}{100} \Rightarrow \frac{78.4 \times 100}{0.5} = 1.568 \times 10^4$ Ans

~~56/06~~

$\frac{14}{32} + \frac{28}{64}$: $\frac{46}{92}$: $\frac{92}{46}$

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Q.34 pg 25

$39 \times 2 = (NO_2 + N_2O_4)x$

$78 = (138)x$

$3x = 78$

$x = 29$

138

$NO_2 + N_2O_4 \longrightarrow 100\,g$

$x\,g \quad (100-x)\,g$

MM. g mix. $= 39 \times 2 = 78\,g$

$\Rightarrow \frac{x}{46} + \frac{(100-x)}{92} = \frac{100}{78}$

Ques^n-50 pg 26 Sec-D :-

$C(s) + CO_2 \longrightarrow 2CO\,(g)$

$1L \quad 2L$

$1-x \quad 2x$

$1-x+2x = 1.4$

Ques^n-56 pg 26

for H_2SO_4 $\Rightarrow$ $100\,mL \times \frac{1}{10}\,\frac{mol}{L} \Rightarrow 10\,mmol \times n_f$ (2)

$\Rightarrow 20\,mg\,Eq$

for NaOH $\Rightarrow$ $500 \times \frac{1}{10} \Rightarrow 50\,mg\,Eq$

$50\,mmol \times 1$

$\therefore N_1V_1 - N_2V_2 = N(V_1 + V_2)$

$50 - 20 = N(600)$

$\frac{30}{600} = N$

$\Rightarrow \frac{1}{20} = N_{(OH^-)}$