— g/L — —

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Chemistry Numericals

→ Equivalence of $CaCO_3$
- Molec. Wt = 100
- Eq. Wt = 50

Conversion factor = $\frac{100}{\text{Molar mass of hardness causing substance}}$

Equivalence of $CaCO_3$ = Amount of HC substance (ppm) × Conversion factor
= Amt of HCS × $\frac{100}{\text{Molar mass / molecular wt of HCS}}$

Temporary Hardness (Carbonate Hardness) = Sum of Temp [CO_3 वाले]

→ EDTA

① SHW contains — $CaCO_3$ in — ml distilled water.

② — ml of sol^n requires — ml of EDTA for tit^n.

③ — ml of Hard Water requires — ml of EDTA, After boiling, filtering it requires — ml of EDTA.

Sol^n ① 1 litre contains — gm = — $\times 10^3$ mg

1000 ml contains — gm = — $\times 10^3$ mg

1 ml ..... = $\frac{— \times 10^3}{10^3}$ = — mg of $CaCO_3$

② — ml EDTA required — ml SHW

— ml EDTA required — × — mg of $CaCO_3$

1 ml ..... — × — mg of $CaCO_3$ = — mg of $CaCO_3$

(x) EDTA (ml)

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③ ___ ml of Normal HW = ___ ml of EDTA

= ___ × ___ mg of $CaCO_3$

1 ml ... = ___ × ___ mg of $CaCO_3$

L_{NHW}

1000 ml = ___ × 1000 = ___ mg/L or ppm

↓ Total

After filtering, Permanent. (Same as above)

→ Lime Soda Method

Lime Requirement = $\frac{74}{100}$ [Temp Ca^{+2} + 2 × Temp Mg^{+2} + Perm. (Mg^{+2} + Fe^{+2} + Al^{+3}) + CO_2 + H^+ + HCl + H_2SO_4 + HCO_3^- + $NaHCO_3$ − $NaAlO_2$ + OH^- All in terms of $CaCO_3$ eq.]

× Vol. of water × $\frac{100}{\%\text{ purity}}$ × $\frac{1}{10^6}$ kg

Soda Requirement = $\frac{106}{100}$ [Perm (Ca^{+2} + Mg^{+2} + Fe^{+2} + Al^{+3}) + H^+ + HCl + H_2SO_4 − HCO_3^- + OH^- + CO_3^{2-} All in terms of $CaCO_3$ eq]

× Vol. of water × $\frac{100}{\%\text{ purity}}$ × $\frac{1}{10^6}$ kg

Temp Ca^{+2} − $(CaHCO_3)_2$, $CaCO_3$, Temp Ca^{+2} H

Temp Mg^{+2} − $(MgHCO_3)_2$, $MgCO_3$, " Mg^{+2} "

Perm Ca^{+2} − $CaCl_2$, $CaSO_4$, $Ca(NO_3)_2$, Ca^{+2}

Merm Mg^{+2} − $MgCl_2$, $MgSO_4$, $Mg(NO_3)_2$, Mg^{+2}

Perm Fe^{+2} − $FeSO_4$, $FeSO_4 \cdot H_2O$, Fe^{+2}

Perm Al^{+3} − $Al_2(SO_4)_3$, Al^{+3}

HCO_3^- − HCO_3^-, $NaHCO_3$, $KHCO_3$

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→ Zeolite Numerical

Hard Water NaCl Sol^n

$$H_{(mg/L)} \times V_{(L)} = W_{(mg)} \times V_{(L)} \times \frac{100}{117}$$

H - Hardness of water
V - Volume of water
W - Weight of NaCl
V - Volume of NaCl

$$H \times 10000 = 3 \times 10^7 \times 200 \times \frac{100}{117}$$

1 L contains 150 g
200 L contains 150 × 200 g
150 × 200 × 1000 mg
3×10^7 mg of NaCl

$$H = \frac{3 \times 10^7 \times 200 \times 100}{117 \times 10000}$$

3% NaCl → 100 mL contains 3 g
1000 mL contains 30 g.

→ COD & BOD Numerical

$$COD = \frac{(V_b - V_s) \times \text{Normality of FAS} \times 8000}{\text{Volume of water sample}}$$

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$$BOD = (DO_b - DO_i) \times \frac{\text{ml after dilution}}{\text{ml befor dilution}}$$

→ Polymer Numericals

$$\bar{M}_n = \frac{\Sigma N_i M_i}{\Sigma N} = \frac{\Sigma W_i}{\Sigma N_i}$$

$$N_i = \frac{W_i}{M_i} \qquad \bar{M}_n = \frac{W_i}{N_i}$$

$$\bar{M}_w = \frac{\Sigma N_i M_i^2}{N_i M_i} \qquad \bar{M}_w = \frac{\Sigma (W_A N_A)}{\Sigma W_A}$$

$$PDI = \frac{\bar{M}_w}{M_n}$$

$0.1^\circ Fr = 0.07^\circ Cl = 1 ppm \,//\, 1 mg/L$

Mod 3

① GCV | NCV

$$GCV/HCV = \frac{1}{100}\left[8080C + 34500\left(H - \frac{O}{8}\right) + 2240S\right]$$

$$NCV/LCV = GCV - \left[\frac{H}{100} \times 9 \times \text{Steam Heat (587)}\right]$$

② Proximate analysis

$$\%\ \text{Moisture} = \frac{W_1 - W_2}{W_1} \times 100$$

$$\%\ \text{Volatile Matter} = \frac{W_2 - W_3}{W_1} \times 100$$

$$\%\ \text{Ash} = \frac{W_4}{W_1} \times 100.$$

③ Ultimate Analysis

i) Determination of %C & %H

$$\%\ \text{Carbon} = \frac{\text{Increase in mass of KOH bulb}}{\text{Mass of coal}} \times \frac{12}{44} \times 100$$

$$\%\ \text{hydrogen} = \frac{\text{Increase in mass of } CaCl_2 \text{ tube}}{\text{Mass of coal}} \times \frac{2}{18} \times 100$$

ii) $\%\ \text{Nitrogen} = \frac{(V_{blank} - V_{sample}) \times N_{KOH} \times 1.4}{\text{Mass of coal}}$

iii) $\%\ \text{Sulphur} = \frac{\text{mass of } BaSO_4 \text{ residue}}{\text{Mass of coal}} \times \frac{32}{233} \times 100$

④ Oxygen requirement for solid coal

Make Table & calculate Total O_2 required

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Element	Multiplication Factor	Quantity (in 1kg)	Amount of O_2
Carbon	12/32		Amt x MF
Hydrogen	16/2		"
Sulphur	32/32		"
Nitrogen	-		-
Ash	-		-
Oxygen	-1		"

Total Amount of Oxygen = Σ All amts

100 kg Air Contains = 23 kg Oxygen

$\frac{}{}$ kg Oxygen = $\frac{}{}$ x $\frac{100}{23}$ kg air

If excess oxygen supplied

Eg 20% excess air supplied = $\frac{}{}$ x $\frac{120}{100}$ kg air

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Mod 4

① Beer - Lamberts Law (UV)

$A = -\log_{10} T$

$A = +\log_{10} \frac{1}{T}$

$A = \varepsilon b C$

$\varepsilon_{New} = \varepsilon_{old} \times M$

A : Absorbance (No Unit)

ε : Molar absorptivity ($dm^3 mol^{-1} cm^{-1}$)

b : length of cell (cm)

C : Concentration (M)

M : Molecular Weight

T : Transmittance (No Unit)

Note : Absorbs 10 %.

∴ Transmittance (T) = 90 % = 0.9

Absorbs 90 %.

∴ Transmittance (T) = 10 % = 0.1

② IR - Theoretical Mode of Vibration

For linear molecule = 3N - 5 [sp] ; N : no. of atoms in a molecule

For Non-linear molecule = 3N - 6 [sp2/sp3]

Eg. Linear : Carbon Monoxide (CO), HCN, C_2H_2, C_2N_2, NO, CS_2, HCl, CCl_4, C_3O_2

Eg. Non-linear : Water (H_2O), Methane (CH_4), Carbon dioxide (CO_2), Sulfur dioxide (SO_2), Nitrous oxide (N_2O), Nitrogen dioxide (NO_2), Ozone (O_3), Hydrogen Sulfide (H_2S)

③ IR - Characteristic Absorption frequency (cm^{-1})

1) Organic Functions

Alcohol	O-H	3200 - 3600
Alkane	C-H	2850 - 3000
	-C-H	1350 - 1480

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Alkene	C=C	1620-1680
Alkyne		2100-2260
Amine	N-H	3300-3500
Aromatic	C=C	1400-1600

2) Carbonyl (C=O)

Carbonyl	C=C	1670-1820
Acid	O-H	2500-3300
Aldehyde	=C-H	2820-2850
Ester	C-O	1000-1300
Ether	C-O	1000-1300
Nitrile	-CN	2210-2260

How to analyze IR Spectrum

① Is Carbonyl present ?

② If Present

- Acid
- Amides
- Ester
- Anhydride
- Aldehydes
- Ketones

If Absent

- Alcohols
- Phenols
- Amines
- Ethers

③ Double Bonds / Aromatic Rings

④ Triple Bonds

⑤ Nitro Groups

⑥ Hydrocarbons