(Assignment-4) (Unit-4)

1- Determine base of the following:

(i) $(345)_{10} = (531)_x$

$345 = 531$

$10^2\ 10^1\ 10^0 \quad x^2\ x^1\ x^0$

$\Rightarrow 3\times10^2 + 4\times10^1 \times 5\times10^0 = 5x^2 + 3x^1 + 1x^0$

$\Rightarrow 300 + 40 + 5 = 5x^2 + 3x^1 + 1$

$5x^2 + 3x^1 - 344 = 0$ — (A)

Suppose we take $x = 8$ then put into eq (A)

$5(8)^2 + 3(8) - 344 = 0$

$5\times64 + 24 - 344 = 0$

$344 - 344 = 0$

$0 = 0$ NOW

$(345)_{10} = (531)_8$

(ii) $(2374)_{16} = (9076)_x$

$\Rightarrow 2\times16^3 + 3\times16^2 + 7\times16^1 + 4\times16^0 = 9x^3 + 0x^2 + 7x + 6$

$8192 + 768 + 112 + 4 = 9x^3 + 7x + 6$

$9076 = 9x^3 + 7x - 6$

$9x^3 + 7x - 9070 = 0$ — (A)

Assume $x = 10$; put $x = 10$ in eq (A)

$9(10^3) + 7(10) - 9070 = 0$

$9000 + 70 - 9070 = 0$

$0 = 0$

then $(2374)_{16} = (9076)_{10}$

DATE / /
PAGE NO.

(iii) Subract using 10's Complement :

$(9754)_{10} - (364)_{10}$

Suppose A = 9754 B = 364

find A - B = ? using 10's Complement

find 10's Comp. of B = 364

10's Comp of a no is 1 add to

9's Comp no. 9999

9's Comp of 364 is 364

9635

then add 1 +1

9636

Now add 9335 with A

9754

+9636

19390

Carry ↗ ∴ than

$(9754)_{10} - (364)_{10} = (9390)_{10}$

(iv) Subtract using 1's Comp. $(10111)_2 - (110011)_2$

we have A = 10111 and B = 110011

6x° First we obtain 1's Comp of B = 110011

then we add A and 1's Comp of B

A = 110111

1's Comp of B + 001100

0 100011 ← Final Answer

Zero final carry

then we invert the Final answer.

Since the final ans is in 1's Comp form we have to invert it to obtain the true ans.

thus 100011 $\xrightarrow{\text{Invert}}$ 011100 = $(28)_{10}$

Hence the answer is $[-(28)_{10}]$ Ans

DATE / /
PAGE NO.

(v) $(2CCD)_{16} = (\ )_8 = (\ )_5$

In Hexadecimal → $(\ )_2$

0 0 1 0 1 1 0 0 1 1 0 0 1 1 0 1

↓ ↓ ↓ ↓ ↓ ↓

0 2 6 3 1 5 ⇒ $(026315)_8$

$(026315)_8 \rightarrow (\ )_5$

$\Rightarrow 0\times8^5 + 2\times8^4 + 6\times8^3 + 3\times8^2 + 1\times8^1 + 5\times8^0$

$\Rightarrow (11469)_{10}$

$(11469)_{10} \rightarrow (\ )_5$

5	11469	
5	2293	4 ← LSB
5	458	3
5	91	3
5	18	1
	3 -	3 ← MSB

$\Rightarrow (337334)_5$

2. State De Morgan's Law?

Answer: De Morgans Law → there are two de-Morgans law.

1. Two Sparate term NoRed together is the same as two term inverted (Complement) and AND'ed i'e $(A+B)' = A' \cdot B'$
2. two Seperate term Nand'ed together is same as the two term inverted (Complemen and OR' ed. i'e

$$(A \cdot B)' = A' + B'$$

DATE / /
PAGE NO.

1. $A'B'C' + A'BC' + AB'C' + ABC'$

$\Rightarrow A'C'(B'+B) + AC'(B'+B)$

$\Rightarrow A'C'(1) + AC'(1) \quad \because B'+B=1$

$\Rightarrow C'(A'+A) \quad \because A'+A=1$

$\Rightarrow C'$ Answer

2. $(A+B+C)(A+B'+C')(A+B+C')(A+B'+C)$

$\Rightarrow (AA+AB'+AC'+BA+BB'+BC'+AC+B'C+C'C)$
$\cdot (AA+AB'+AC+AB+B'B+BC+AC'+B'C'+C'C)$

$\Rightarrow (A+AB'+AC'+AB+BC'+AC+B'C)\cdot(A+AB'+AC+AB+BC+AC'+B'C)$

$\Rightarrow (A(1+B')+AC'+AB+BC'+AC+B'C)\cdot(A(1+B')+AC+AB+BC+AC'+B'C')$

$\Rightarrow (A(1+B)+AB+BC'+AC+B'C)(A(1+C)+AB+BC+AC'+B'C')$

$\Rightarrow (A(1+B)+BC'+AC+B'C)(AC1+B)+BC+AC'+B'C')$

$\Rightarrow (A(1+C)+BC'+B'C)(A(1+C')+BC+B'C')$

$\Rightarrow (A+BC'+B'C)(A+BC+B'C')$

$\Rightarrow (AA+ABC+AB'C'+ABC'+BCBC'+BCB'C+AB'C+BCB'C+B'CB'C')$

$\Rightarrow (A+ABC+AB'C'+ABC'+AB'C)$

$\Rightarrow (A+ABC+AB'C+AB'C'+ABC')$

$\Rightarrow (A+AC(B+B')+AC'(B'+B))$

$\Rightarrow (A+AC+AC')$

$\Rightarrow (A+A(C+C'))$

$\Rightarrow (A+A)$

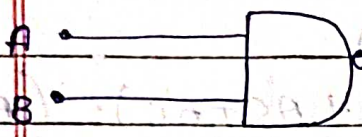
$\Rightarrow A$ Answer

DATE / /
PAGE NO.

3. What are universal gates? why are they called so?

Answer → A universal gate is a gate which can implement any boolean fun^{n}. without need of any other gate. the NAND and NOR are called universal gates.

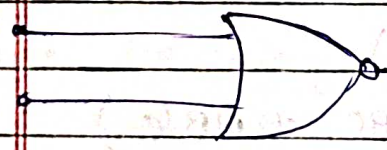
- NAND gate → This is NOT-AND Gate. the output of NAND gate is high (1) if any of the input is low.



Truth Table

A	B	$Y = \overline{A \cdot B}$
0	0	1
0	1	1
1	0	1
1	1	0

- NOR gate → This is NOT-OR gate. the output of NOR gate is low if any one of the Input is high.



Truth Table

A	B	$\overline{A+B}$
0	0	1
0	1	0
0	0	0
1	1	0

Draw the logic dia of EX-OR gate using universal gate?

Sol. EX-OR using NAND Gate

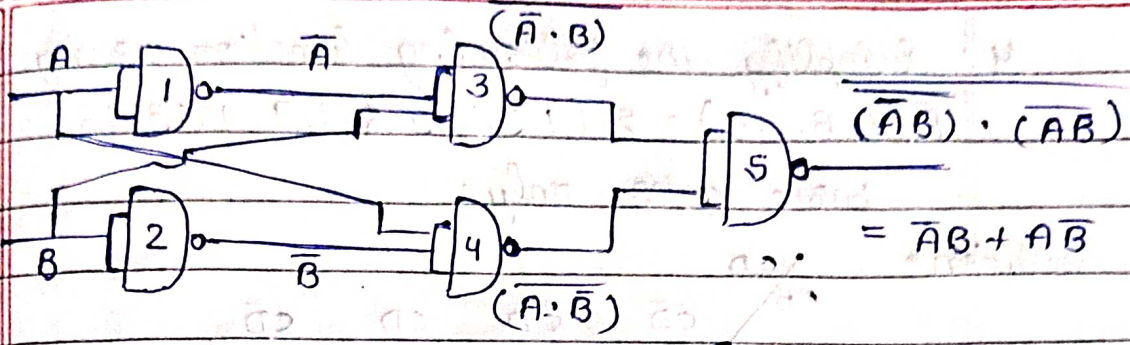
Method Ist

$$Y = \bar{A}B + A\bar{B}$$

$$Y = \overline{\bar{A}B + A\bar{B}} \quad [\because \bar{\bar{A}} = A]$$

$$\Rightarrow \overline{(\bar{A}B) \cdot (A\bar{B})}$$

DATE / /
PAGE NO.



Ex-OR Gate Using NOR Gate:-

$$Y = \bar{A}B + A\bar{B} + A\cdot\bar{A} + B\cdot\bar{B}$$

$$= \bar{A}(A+\bar{B}) + \bar{B}(A+B)$$

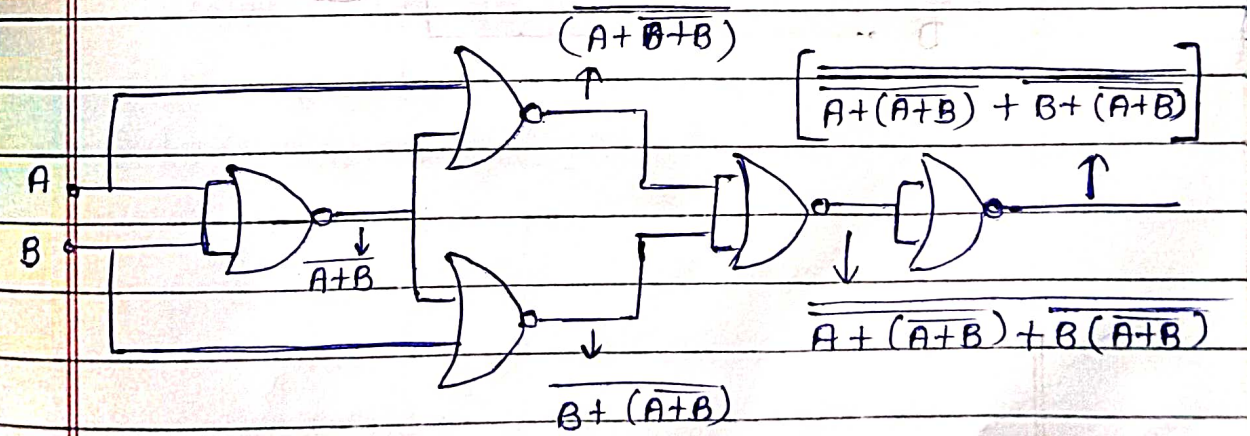
$$\Rightarrow \overline{\bar{A}\cdot(A+B) + \bar{B}(A+B)}$$

$$\Rightarrow \overline{[\bar{A}(A+B)]\cdot[\bar{B}(A+B)]}$$

$$\Rightarrow \overline{[\bar{A}+\overline{A+B}]\cdot[\bar{B}+\overline{(A+B)}]}$$

$$\Rightarrow \overline{[A+\overline{A+B}]} + \overline{[B+\overline{(\bar{A}+B)}]}$$

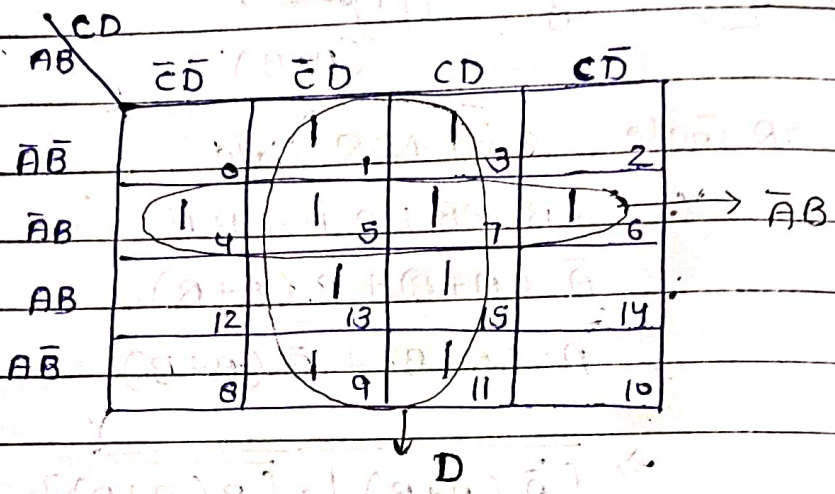
$$\Rightarrow \overline{\overline{[A+(\overline{B+B})]} + \overline{[B+(\overline{A+B})]}}$$



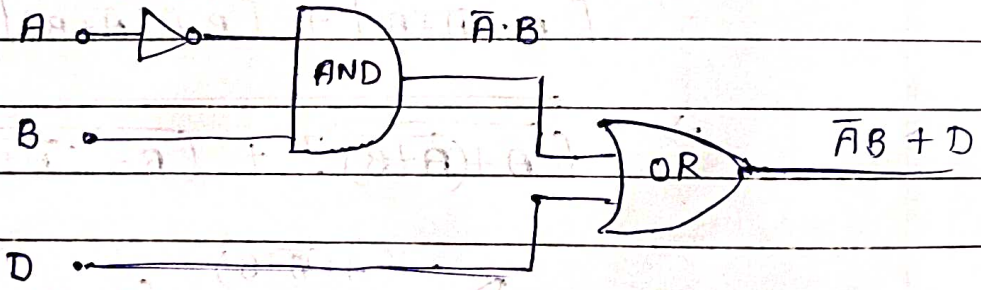
DATE / /
PAGE NO.

4- Simplify the following function using K-Map
$F(A,B,C,D) = \Sigma(1,3,4,5,6,7,9,11,13,15)$.
— basic gates only.

Solution →



$F(A,B,C,D) = \bar{A} \cdot B + D$

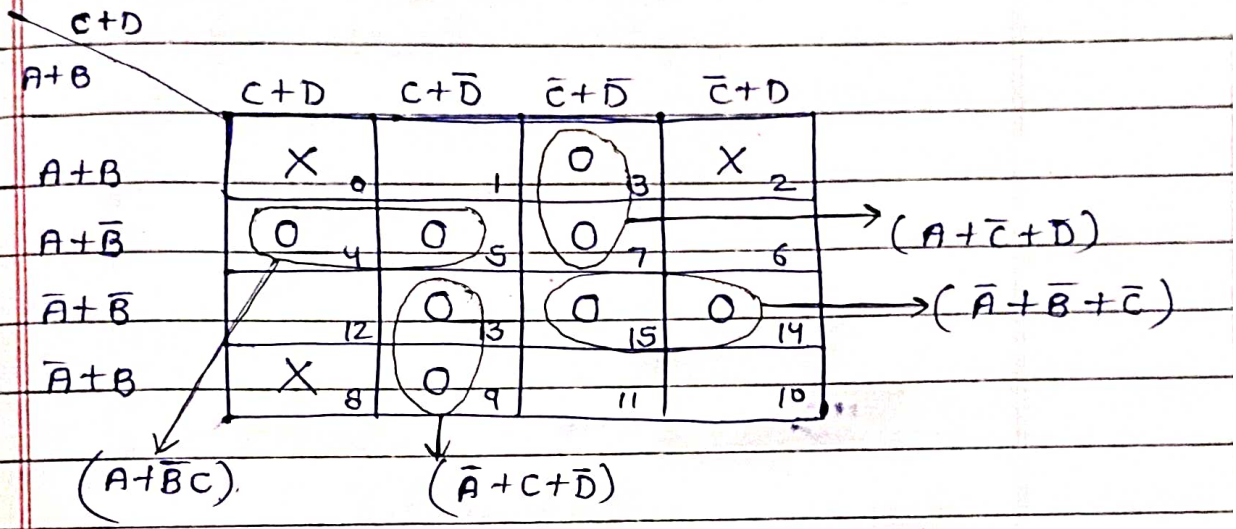


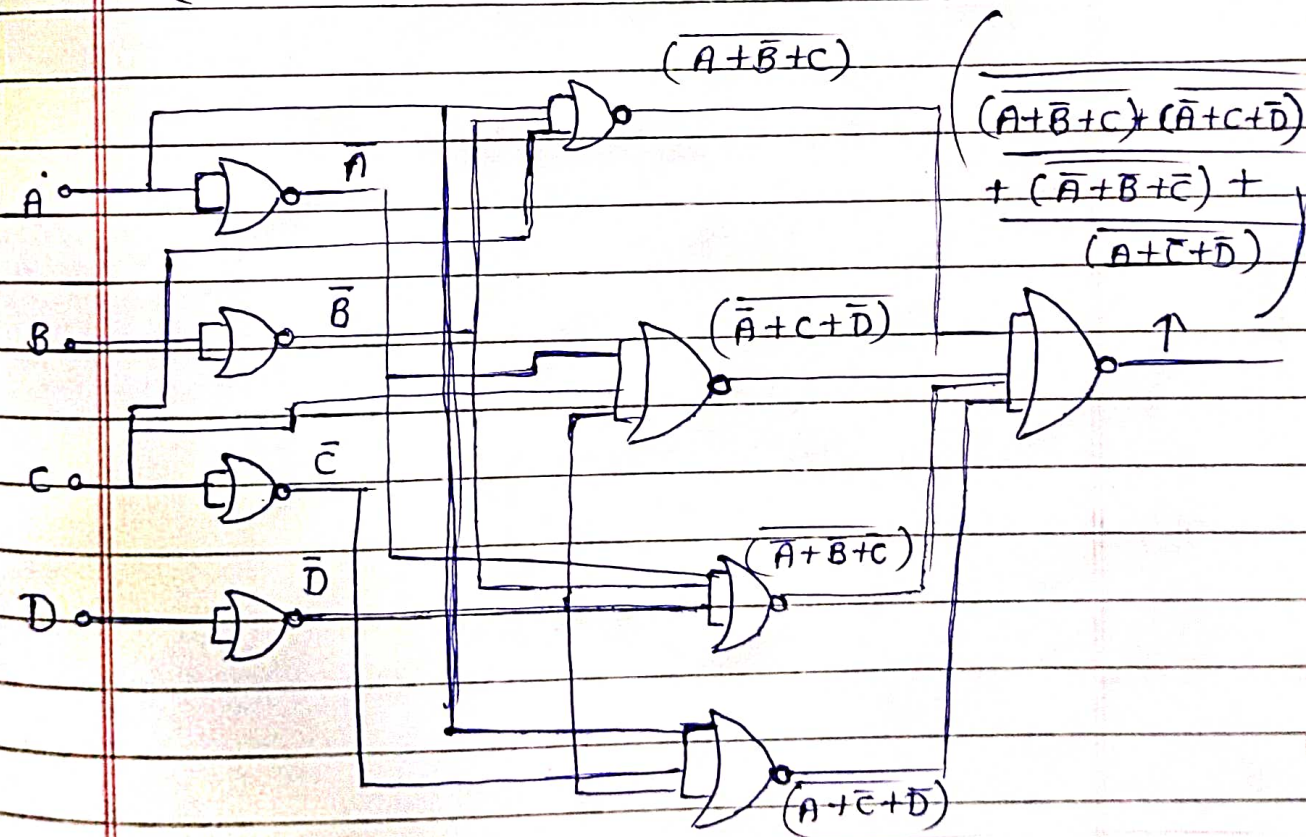
DATE / /
PAGE NO.

5. Minimize Using K-Map and realize Using NOR Gate only.

$F(A,B,C,D) = \Sigma(1,3,4,5,6,7,9,13,14,15) \cdot d(0,2,8)$

Solution: this is Pos Condition. So there are Maxterm then. $A=0$ & $\bar{A}=1$





$F = (A+\bar{B}+C)\cdot(\bar{A}+C+D)\cdot(\bar{A}+\bar{B}+\bar{C})\cdot(A+\bar{C}+\bar{B})$

Answer

(Assignment - 4) (Unit - 4)

1. A Sample of water was found to contain 40.5 mg/l = $Ca(HCO_3)_2$ = 46.5 mg/l = $Mg(HCO_3)_2$, 32.1 mg/l = $CaSO_4$, 27.6 mg/l = $MgSO_4$, 22.45 mg/l = $CaCl_2$, 19.0 mg/l = $MgCl_2$. Calculate the temp. hardness of water Sample?

Answer:

Impurity	Quantity	Eq. wt	Hardness
$Ca(HCO_3)$	40.5	81	$\Rightarrow 40.5 \times \frac{50}{81} = 25$
$Mg(HCO_3)_2$	45.5	73	$\Rightarrow 46.5 \times 50/73 = 31.8$
$CaSO_4$	32.1	68	$\Rightarrow 32.1 \times 50/68 = 23.6$
$MgSO_4$	27.6	60	$\Rightarrow 27.6 \times 50/60 = 23$
$CaCl_2$	22.5	55.5	$\Rightarrow 22.5 \times 50/55.5 = 20.27$
$MgCl_2$	19.0	47.5	$\Rightarrow 19 \times \frac{50}{47.5} = 20$

Temporay Hardness
due to $(Mg(HCO_3)_2 + Ca(HCO_3)_2$
$\Rightarrow 25 + 31.8 = 56.8$ ppM

Permanent Hardness
due to $(CaSO_4 + MgSO_4 + CaCl_2 + MgCl_2)$
$\Rightarrow 23.60 + 23 + 20.27 + 20$
$\Rightarrow 86.87$ ppM

Total Hardness = Tempary + Permanent
$\Rightarrow 56.8 + 86.87$
$\Rightarrow 143.67$ ppM Answer

2- what do you mean by term permutil? Explain zeolite process for water softening? Numerical. A zeolite softener ----- Samples

Answer The word permutil means boiling stone. Zeolites are hydrated sodium alumina silicates. They have porous structure with molecular formula $Na_2O \cdot Al_2O_3 \cdot x\,SiO_2 \cdot y\,H_2O$ (x = 2 to 10 + Y = 2 to 6).

Represented as Na_2Ze (Ze = thumsoluble framework : Na = loosely held sodium ions)

- Water softing

$$Na_2Ze + Ca^{+2} \longrightarrow 2Na^{+} + CaZe$$

(Zealite) (Calcium Salts) (Released Salts in water) (Calcium Zeolite)

$$Na_2Ze + Mg^{+2} \longrightarrow 2Na^{+} + MgZe$$

(Zealite) (Magnesium Salts) (Released in water) (Magnesium Zeolite)

Imp.	Quaulity	Eq wt	$CaCO_3$ Eq^n (Mg/L)	L or S
Ca^{+2}	160	20	$160 \times 50/20 = 400$	S
Co_2	48	22	$48 \times 50/22 = 150$	L+S
HCO_3^-	66	61	$264 \times 50/61 = 216.39$	L
H^+	264	1	$20 \times 50/1 = 100$	L-S
CO_3^{-2}	90	30	$45 \times 50/30 = 75$	L+S
OH^-	45	17	$68 \times 50/17 = 200$	L+S
$NaAlO_2$	10	82	$10 \times 50/82 = 6.09$	- L ~~+~~ S
Nacl	4.7	-	No Hardness	-

$$\text{Lime} = \frac{74}{100}\left[Mg^{+2} + CO_2 + HCO_3^- + H^+ - NaAlO_2\right] \times \frac{100}{\%\ \text{Purity}} \times \frac{\text{Vol. wise}}{106}$$

$$\Rightarrow \frac{74}{100}\left[200 + 150 + 216.39 + 100 - 6.09\right] \times \frac{100}{74} \times \frac{125000}{106}$$

$$\Rightarrow 107.53\ \text{Kg}$$

$$\text{Soda} = \frac{106}{100}\left[Ca^{+2} + Mg^{+2} - HCO_3^- + CO_3^{-2} + OH^-\right] \times \frac{100}{\%\ \text{Purity}} \times \frac{\text{Vol of water}}{106}$$

$$\Rightarrow \frac{106}{100}\left[400 + 200 - 216.39 + 200 + 75\right] \times \frac{100}{94} \times \frac{125000}{106}$$

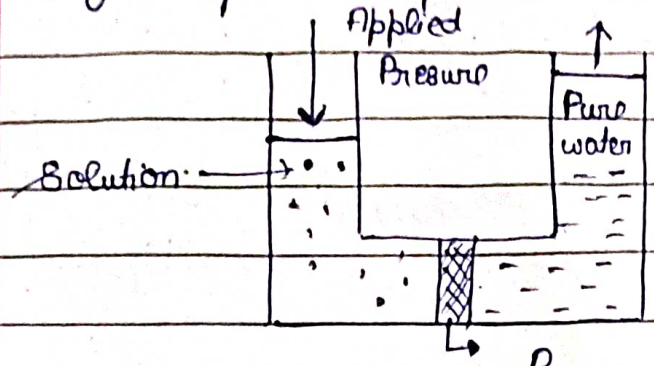
$$\Rightarrow 97.39\ \text{Kg}$$

3- Write a short note on Reverse Osmosis?

Answer:- Osmosis → is a prouss to dwionize water by pushing it under pressur though a semi permeable member from the lower Concentration to the higher Concentration.

Reverse Osmosis → Presure higher than osmotic presewre is applied from the higher Concentration side, so that solvent moves from higher Concentration to lower Concentration. Reverse Osmosis or super flutation is a water purification process that uses a pautially Permeable membane to remove ions unwanted molecules &

Larger particles form clucking water



4- Calculate the minimum weight of air required for complete combustion of 1Kg of fuel containing C = 90% —— rest.

Solution→

C = 90% of 1Kg

$= \frac{90}{100} \times 1000g = 900g.$

H = 3.5% of 1Kg = 35g

O = 3% of 1Kg = 30g

S = 5g

H_2O = 10g

N = 5g

$$\text{Net } O_2 \Rightarrow \left[\frac{32}{12}C + 8H + S - O\right]$$

$$\Rightarrow \frac{32}{12} \times 900 + 8 \times 35 + 5 - 30]$$

$$\Rightarrow 2400 + 280 + 5 - 30$$

$$\Rightarrow 2655g.$$

$$\text{Weight of air required} = \text{Net } O_2 \times \frac{100}{23}$$

$$\Rightarrow \frac{2655 \times 100}{23}$$

$$\Rightarrow 11543.47g \quad \underline{\text{Answer}}$$

5- A Sample of Coal Contains C = 93%, H = 6%, Ash = 1%. The following was data was obtained when the above coal was tested in Bomb's Calon- of Bomb ---------- Steam as = 580 cal/g

Solution:-

$$HCV \Rightarrow \frac{(w+10)(t_2-t_1) - (Ca+Cp)}{x}$$

$$\Rightarrow \frac{(2200+550)(2.42)(60+10)}{0.92}$$

$$\Rightarrow 7168.48 \text{ Cal/gm}$$

LCV = GCV - 0.09 × %H × latent heat of Steam

$$\Rightarrow 7168.4782 - 0.09 \times 6 \times 580$$

$$\Rightarrow 6856.28 \text{ Cal/gm.}$$ Answer