Aabriti Mehta

Somaiya TRUST

Batch: C2-2 Roll No.: 16010122109
Experiment / assignment / tutorial No.
Grade: AA / AB / BB / BC / CC / CD / DD

Signature of the Faculty In-Charge with date

IA-2

(QI) Water

1) 1.36 g $CaCl_2$ = 50 g $CaCO_3$ $\frac{1.36 \times 100}{111}$ $CaCO_3$ eq
1.36 mg $CaCl_2$ = 50×10^{-3} mg $CaCO_3$
= 1.23 g

Hardness = $\frac{50 \times 10^{-3}}{500} \times 10^6$ = 100 ppm $\frac{1.23 \times 10^6}{500}$ = 2460 ppm

2) 50° Cl = a mg/L
0.070° Cl = 1 mg/L

$a = \frac{50}{0.070}$ = 714.285 = 714.29 mg/L

0.070 °Cl = 0.10° Fr
50° Cl = b° Fr

$b = \frac{50 \times 0.10}{0.070}$ = 71.428 °Fr = 71.43° Fr

3)

$MgSO_4$ = 12 ppm	$12 \times 100/120$ = CaCO3 equivalent 10 ppm	P
$CaCl_2$ = 11.1 ppm	$11.1 \times 100/111$ = 10 ppm	P
$MgCO_3$ = 16.8 ppm	$16.8 \times 100/84$ = 20 ppm	T
$Na(HCO_3)$ = 13 ppm	~~13 x 100/~~ -	N.H

Temporary hardness = 20ppm

4) M/20 EDTA = 0.05 M EDTA
1000 ml, 1M EDTA = 10 g $CaCO_3$
1 mL, 1M EDTA = 100 mg $CaCO_3$

50 ml water sample = 12 ml of 0.05 M EDTA
1000 ml water sample = 20 x 12 ml of 0.05M EDTA
= 240 mL of 0.05M EDTA

1 ml, 1M EDTA = 100 mg $CaCO_3$

240 ml, 0.05M EDTA = $240 \times 0.05 \times 100$

= 1200 ppm

= Total hardness.

∴ Total hardness = 1200 ppm.

5) Vol = 50,000 Lit

			$CaCO_3$ eq	
P	$MgCl_2$	1.9 ppm	$1.9 \times 100/95$ = 2 ppm	L+S
P	$CaSO_4$	6.8 ppm	$6.8 \times 100/136$ = 5 ppm	S
T	$Mg(HCO_3)_2$	7.3 ppm	$7.3 \times 100/146$ = 5 ppm	2L
T	$Ca(HCO_3)_2$	4.05 ppm	$4.05 \times 100/162$ = 2.5 ppm	L

Lime req. $= \frac{74}{100}\left[2 \times 5 + 2.5 + (2)\right] \times \frac{50000}{10^6} \times \frac{100}{\%\ Purity}$

$= \frac{74}{100}\left[14.5\right] \times 5 \times \frac{100}{\%\ Purity}$

$= \frac{5513}{100} = \frac{5365}{100 \times 100}$ [%Purity = 100].

$= 55.13$ kg $= 0.5365$ kg

6) Vol = 25000 Lit

			$CaCO_3$ eq	
P	$CaCl_2$	= 1.11 ppm	$1.11 \times 100/111$ = 1 ppm	S
P	$MgSO_4$	= 6 ppm	$6 \times 100/120$ = 5 ppm	L+S
T	$Mg(HCO_3)_2$	= 7.3 ppm	$7.3 \times 100/146$ = 5 ppm	2L
T	$Ca(HCO_3)_2$	= 4.05 ppm	$4.05 \times 100/162$ = 2.5 ppm	L
	CO_2	= 22 ppm	$7.3 \times 100/36.5$ = 20 ppm	L+S
	HCl	= 7.3 ppm		

Somaiya TRUST

Batch: Roll No.:
Experiment / assignment / tutorial No.
Grade: AA/ AB / BB / BC / CC / CD / DD

Signature of the Faculty In-Charge with date

Soda req. $= \frac{106}{100}\left[1+5+20*\right] \times \frac{100 \times 25000}{10^6 \times \%\text{Purity}}$

$= \frac{106}{100}[26] \times \frac{25}{10 \times 100}$ [%Purity = 100]

$= 0.689$ kg

7) $COD = \frac{(33-12) \times 0.05 \times 8 \times 1000}{50}$

$= 168$ ppm

$y = 50$ ml
$V_b = 33$ ml
$V_t = 12$ ml
$N = 0.05N$

8) Hardness (ppm) $= \frac{1000}{750} \times 7.4 \times \frac{100}{148}$

$= \frac{20}{3}$ ppm

$= \frac{20 \times 0.070}{3}$ °Cl

$= 0.467$ °Cl

9) 1 L of 1N HCl = 50g $CaCO_3$

200L of 0.1N HCl = $200 \times 0.1 \times 50$ g $CaCO_3$

$= 1000$g $CaCO_3$

$= 10^5$ mg/l $CaCO_3$

$= 10^5$ ppm

10) 150 L of 10% NaCl sol^n = 15L of NaCl

Assuming 1N sol^n.

15 L, 1N NaCl $= 15 \times 50$g $CaCO_3$

$= 750$ g $CaCO_3$

$= 7.5 \times 10^4$mg $CaCO_3$

11) 1000 ml of SHW = 1.11 g $CaCl_2$

$= \frac{1.11}{1000} \times \frac{100}{111} \times 1000$ mg $CaCO_3$

1 ml SHW = 100 mg $CaCO_3$

50 ml SHW = 21 ml EDTA

1 ml EDTA = $\frac{50}{21}$ ml SHW

$= \frac{50}{21} \times 100$ mg $CaCO_3$

Total hardness in $CaCO_3$ $= \frac{50}{21} \times 10^{-3} \times \frac{1000}{1000}$

$= 2.38$ ppm

Somaiya TRUST

Batch: Roll No.:
Experiment / assignment / tutorial No.
Grade: AA/ AB / BB / BC / CC / CD / DD

Signature of the Faculty In-Charge with date

(Q2) Energy

1) C=82% H=5% S=3% N=2% Ash=Remaining =100-92 =8%

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

$$= \frac{1}{100}\left[8080 \times 82 + 34500\left(5 - \frac{0}{8}\right) + 2240 \times 3\right]$$

$$= \frac{1}{100}\left[662560 + 172500 + 6720\right]$$

$$= \frac{841780}{100} = 8417.80 \text{ kcal/kg}$$

2) C=90%, H=4%, S=2%, N=1%, Ash=100-97=3%

(0.09×4×587=211.32)

$$NCV = [HCV - 0.09H \times 587]$$

$$HCV = \frac{1}{100}\left[8080 \times 90 + 34500\left(4 - \frac{0}{8}\right) + 2240 \times 2\right]$$

~~[869680]~~ ~~[215200]~~ ~~=212~~ = 8696.80 kcal/kg

8696.80

~~=2152 kcal/kg~~

NCV = 8696800 − 211.32 = 8485480 kcal/kg

3) % moisture = wt of ~~coal~~ coal − wt. of coal after heating ×100
wt. of coal taken

$$= \frac{1.2 - 0.88}{1.2} \times 100$$

$$= \frac{0.32}{1.2} \times 100$$

$$= 26.67\ \%$$

4) % Volatile Matter = $\frac{1.8 - 1.09}{1.8} \times 100 - 10\%$

$= \frac{0.71}{1.8} \times 100 - 10$

$= 39.44 - 10$

$= 29.44\ \%$

5) % Ash = $\frac{0.63}{1.8} \times 100$

$= \frac{0.63}{1.8} \times 100$

$= 35\ \%$

6) $\%C = \frac{4.8 \times 12 \times 100}{1.56 \times 44}$

$= 83.916$

$= 83.92\ \%$

$\%C = \frac{\text{Increase in mass KOH} \times 12 \times 100}{\text{wt coal sample taken} \times 44}$

7) $\%H = \frac{1.2 \times 2 \times 100}{1.56 \times 18}$

$= 8.547$

$= 8.55\%$

$\%H = \frac{\text{Increase in mass } C_aU_2 \times 2 \times 100}{\text{wt of coal sample taken} \times 18}$

8) $\%N = \frac{\text{Vol of acid} \times 1.4 \times \text{Normality}}{\text{wt of Sample}}$

$= \frac{(28-15) \times 1.4 \times 0.05}{2.8}$

$= \frac{13}{40}$

$= 0.325\%$

Somaiya TRUST

Batch: Roll No.:
Experiment / assignment / tutorial No.
Grade: AA / AB / BB / BC / CC / CD / DD

Signature of the Faculty In-Charge with date

9) $\%S = \frac{0.66 \times 32 \times 100}{1.75 \times 233}$

$= 5.179\%$

$= 5.18\%$

$\%S = \frac{\text{wt of } BaSO_4 \text{ residue} \times 32 \times 100}{\text{wt of coal sample taken} \times 233}$

10) $\%$ Amt of oxygen $= 100 - \%(C+H+S+N+\text{ash})$

$= 100 - (85+4+2+1+4)$

$= 100 - 96$

$\%O = 4\%$

Amt of oxygen $= 4\%$ of $5kg$

$= \frac{4}{100} \times 5 = 0.2 kg$

Element	wt	O_2 req
C	4.25	$4.25 \times 32/12 = 11.33$
H	0.2	$0.2 \times 16/2 = 1.6$
S	0.1	$0.1 \times 32/32 = 0.1$
N	0.05	$0.05 \times 32/14 = 0.114$

Total $O_2 = 11.33 + 1.6 + 0.1 + 0.114 = 13.17 kg$

11) wt of air $= \frac{110}{100} \times 4.85 = 5.335 kg$

$32g$ of $O_2 = 22.4 L$

$4.85 kg$ $O_2 = a$

$a = \frac{4.85 \times 22.4}{32 \times 10^{-3}} = 3.395 \times 10^3 L$

Vol of air $= 1.1 \times 3.395 \times 10^3$

$= 3.7345 \times 10^3$

$= 3734.5 L$

Q3) Spectroscopy

1) $A = 2 - \log_{10} \%T$ $\quad \%T = 60\%$

$= 2 - \log_{10} 60$

$= 2 - 1.7781$

$= 0.2219\ A$

2) $\%T = 50\%$

$A = 2 - \log_{10} \%T$

$= 2 - \log_{10} 50$

$= 2 - 1.6989$

$= 0.3011\ A$

3) Absorbance = 0.56 A at 280nm

$l = 0.75cm = 7.5mm$

$\epsilon = 6.4 \times 10^3\ L/mol\ cm$

$A = \epsilon \times C \times L$ $\quad C \rightarrow conc.$

$Conc. = \frac{A}{\epsilon \times L}$

$= \frac{0.56}{0.75 \times 6.4 \times 10^3}$

$= \frac{0.56 \times 10^{-3}}{4.8}$

$= 0.1167 \times 10^{-3}$

$= 1.167 \times 10^{-4}\ mol/L$

$\therefore$ Concentration $= 1.167 \times 10^{-4}\ mol/L$

4) $T = 0.45 = 45\%$ at 230nm

$l = 2cm$

$l_1 = 1cm$

$A = 2 - \log_{10} T = 2 - \log_{10} 45$

$= 2 - 1.6532$

$= 0.3468$

$A = \epsilon . c . l$

$\epsilon = \frac{0.3468}{2c}$

ϵ remains constant

∴ When path length $= l_1 = 1cm$

$A = \epsilon . c . l$

$= \frac{0.3468}{2c} \times c \times 1$

$= 0.1734$ A

∴ Absorbance $= 0.1734$

5) $A = 0.334$ A $\quad l = 1.2cm$

$C = 10^{-3} M$

$\epsilon = \frac{A}{C \times l}$

$= \frac{0.334}{10^{-3} \times 1.2}$

$= \frac{0.334 \times 10^3}{1.2}$

$= 0.2783 \times 10^3$

$= 2.783 \times 10^2$ L/mol cm.

$= 2.783 \times 10^2$ dm^3/mol cm

6) Benzene = C_6H_6

It is a non-linear molecule

∴ Modes of vibration $= 3N - 6$

No. of atoms $= N = 6 + 6 = 12$

∴ Modes of vibration $= 3(12) - 6$

$= 36 - 6$

$= 30$

∴ There are 30 modes of vibration in Benzene.

~~Tout~~

Toluene : C_7H_8

It is non-linear molecule

∴ No. of atoms $= 7 + 8 = 15$

∴ Modes of vibration $= 3N - 6$

$= 3(15) - 6$

$= 45 - 6$

$= 39$

∴ There are 39 modes of vibration in Toluene.