VOLUMETRIC ANALYSIS

Equivalent weights of some acids and bases

Acid/Base	Equivalent wt.
Hydrochloric acid (HCl)	36.5
Sulphuric acid (H_2SO_4)	49
Nitric acid (HNO_3)	63
Oxalic acid ($H_2C_2O_4.2H_2O$)	63
Sodium hydroxide (NaOH)	40
Potassium hydroxide (KOH)	56
Sodium carbonate (Na_2CO_3)	53
Potassium carbonate (K_2CO_3)	69

ALKALIMETRY

1. Estimation of Sodium hydroxide using std. HCl

Aim: Determine the mass of sodium hydroxide in the whole of the given solution. You are supplied with a standard solution of HCl containing 3.7 g/L.

Principle

$$NaOH + HCl \longrightarrow NaCl + H_2O$$

Procedure

The given NaOH solution is made upto 100mL in a clean standard flask. 20 mL of the made up solution (NaOH) is pipetted out into a clean conical flask. Add one or two drops phenolphthalein indicator and titrated against Std. HCl from the burette. At the end point the pink colour changes to colourless. The experiment is repeated to get concordant values.

Observations

Sl. No.	Volume of NaOH in mL	Burette Reading		Volume of HCl in mL
		Initial	Final	
1.	20	0		
2.	20	0		
3.	20	0		

Calculations:

Mass per litre of HCl = 3.7 g/L

Equivalent mass of HCl = 36.5

Normality of HCl, $N_1 = \frac{\text{Mass per litre}}{\text{Equivalent mass}} = \frac{3.7}{36.5} = 0.1014$ N

Volume of HCl (V_1) = ………….. mL

Volume of NaOH solution pipetted out, V_2 = 20 mL

Normality of NaOH (N_2) = ?

From normality equation, $N_1V_1 = N_2V_2$,

$N_2 = \frac{N_1V_1}{V_2} = \frac{0.1014 \times \ldots\ldots}{20}$ = **………… N**

Equivalent mass of NaOH = 40

Mass per litre of NaOH solution = Normality x Equivalent mass = ……….. x 40 = ………………. g/L

The mass of NaOH in the whole of the given solution = $\frac{\text{Mass per litre} \times 100}{1000}$

$= \frac{\text{Mass per litre}}{10} = \frac{\dots\dots\dots}{10} =$ **………………….g**

Result

The mass of NaOH in the whole of the given solution = ………………. g

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2. Estimation of Sodium carbonate using std. H_2SO_4

Aim: Determine the mass of sodium carbonate (Na_2CO_3) in the whole of the given solution. You are supplied with a standard solution of sulphuric acid containing 4.8 g/L.

Principle

$$Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + CO_2 + H_2O$$

Procedure

The given Na_2CO_3 solution is made upto 100mL in a clean standard flask. 20 mL of the made up solution (Na_2CO_3) is pipetted out into a clean conical flask. Add two or three drops Methyl orange indicator and titrated against Std. H_2SO_4 solution from the burette. At the end point the golden yellow colour changes to orange red. The experiment is repeated to get concordant values.

Observations

Sl. No.	Volume of Na_2CO_3 in mL	Burette Reading		Volume of H_2SO_4 in mL
		Initial	Final	
1.	20	0		
2.	20	0		
3.	20	0		

Calculations:

Mass per litre of H_2SO_4 = 4.8 g/L

Equivalent mass of H_2SO_4 = 49

Normality of H_2SO_4, $N_1 = \frac{\text{Mass per litre}}{\text{Equivalent mass}} = \frac{4.8}{49} = 0.0979$ N

Volume of H_2SO_4 (V_1) = ………….. mL

Volume of Na_2CO_3 solution pipetted out, V_2 = 20 mL

Normality of Na_2CO_3 (N_2) = ?

From normality equation, $N_1V_1 = N_2V_2$,

$N_2 = \frac{N_1V_1}{V_2} = \frac{0.0979 \times \dots\dots}{20} =$ **………… N**

Equivalent mass of Na_2CO_3 = 53

Mass per litre of Na_2CO_3 solution = Normality x Equivalent mass = ……….. x 53 = ………………. g/L

The mass of Na_2CO_3 in the whole of the given solution $= \frac{\text{Mass per litre} \times 100}{1000}$

$= \frac{\text{Mass per litre}}{10} = \frac{\dots\dots\dots}{10} =$ **………………….g**

Result

The mass of Na_2CO_3 in the whole of the given solution = ………………. g

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ACIDIMETRY

1. Estimation of Oxalic acid using std. KOH

Aim: Determine the mass of oxalic acid in the whole of the given solution. You are supplied with a standard solution of potassium hydroxide containing 5.7 g/L.

Principle

$$2KOH + H_2C_2O_4 \longrightarrow K_2C_2O_4 + 2H_2O$$

Procedure

The given oxalic acid solution is made upto 100mL in a clean standard flask. A clean burette is rinsed with the made up oxalic acid solution upto the zero mark. 20 mL of the KOH solution is pipetted out into a clean conical flask. One or two drops phenolphthalein indicator is added and titrated against oxalic acid solution from the burette. At the end point, the pink colour changes to colourless. The final burette reading is noted. The experiment is repeated to get concordant values.

Observations

Sl. No.	Volume of KOH in mL	Burette Reading		Volume of $H_2C_2O_4$ in mL
		Initial	Final	
1.	20	0		
2.	20	0		
3.	20	0		

Calculations:

Mass per litre of KOH = 5.7 g/L

Equivalent mass of KOH = 56

Normality of KOH, $N_2 = \frac{\text{Mass per litre}}{\text{Equivalent mass}} = \frac{5.7}{56} = 0.1018$ N

Volume of KOH solution pipetted out, V_2 = 20 mL

Volume of $H_2C_2O_4$ (V_1) = ………….. mL

Normality of $H_2C_2O_4$ (N_1) = ?

From normality equation, $N_1V_1 = N_2V_2$,

$N_1 = \frac{N_2V_2}{V_1} = \frac{0.1018 \times 20}{\ldots\ldots\ldots} =$ **………… N**

Equivalent mass of $H_2C_2O_4$ = 63

Mass per litre of $H_2C_2O_4$ solution = Normality x Equivalent mass = ………… x 63 = ……………… g/L

The mass of $H_2C_2O_4$ in the whole of the given solution = $\frac{\text{Mass per litre} \times 100}{1000}$

$= \frac{\text{Mass per litre}}{10} = \frac{\ldots\ldots\ldots}{10} =$ **………………….g**

Result

The mass of $H_2C_2O_4$ in the whole of the given solution = ……………….. g

2. Estimation of Nitric Acid using std. K_2CO_3

Aim: Determine the mass of nitric acid (HNO_3) in the whole of the given solution. You are supplied with a standard solution of potassium carbonate (K_2CO_3) containing 6.8 g/L.

Principle

$$K_2CO_3 + 2\ HNO_3 \longrightarrow 2\ KNO_3 + CO_2 + H_2O$$

Procedure

The given HNO_3 solution is made upto 100mL in a clean standard flask. A clean burette is rinsed with the made up solution and is filled upto the zero mark. 20 mL of K_2CO_3 solution is pipetted out into a clean conical flask. Two or three drops methyl orange indicator is added and titrated against HNO_3 solution from the burette. At the end point the golden yellow colour changes to orange red. The final burette reading is noted. The experiment is repeated to get concordant values.

Observations

Sl. No.	Volume of K_2CO_3 in mL	Burette Reading		Volume of HNO_3 in mL
		Initial	Final	
1.	20	0		
2.	20	0		
3.	20	0		

Calculations:

Mass per litre of K_2CO_3 = 6.8 g/L

Equivalent mass of K_2CO_3 = 69

Normality of K_2CO_3, $N_2 = \frac{\text{Mass per litre}}{\text{Equivalent mass}} = \frac{6.8}{69} = 0.0985$ N

Volume of K_2CO_3 solution pipetted out, V_2 = 20 mL

Volume of HNO_3 (V_1) = ………….. mL

Normality of HNO_3 (N_1) = ?

From normality equation, $N_1V_1 = N_2V_2$,

$N_1 = \frac{N_2V_2}{V_1} = \frac{0.0985 \times 20}{\dots\dots}$ = **……….. N**

Equivalent mass of HNO_3 = 63

Mass per litre of HNO_3 solution = Normality x Equivalent mass = ………… x 63 = ………………. g/L

The mass of HNO_3 in the whole of the given solution = $\frac{\text{Mass per litre} \times 100}{1000}$

$= \frac{\text{Mass per litre}}{10} = \frac{\dots\dots\dots}{10}$ = **…………………. g**

Result

The mass of HNO_3 in the whole of the given solution = **………………. g**

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