EXPERIMENT (1)

VOLUMETRIC GLASSWARE AND BALANCES

Name:	**Group NO.:**

III DATA

	Trial 1	Trial2	Trial 3	Trial4
Initial burette reading, mL				
Final burette reading, mL				
Apparent volume, mL				
Initial weight of flask, g				
Final weight of flask, g				
Weight of water, g				
Temperature, ^{o}C				
Actual volume, mL				
Correction, mL				

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IV. CALCULATION

Note: use significant figures and decimal places in the calculations

(Trial No …………)

1- Apparent Volume (mL) = Final burette reading – Initial burette reading

2- Weight of water(g) =

3- Actual Volume (mL) =

4- Correction (mL) =

ERRORS

• **According to the following rules:**

$z = x + y$ or $z = x - y$ $\Rightarrow$ $\Delta z = \sqrt{\Delta X^2 + \Delta y^2}$

$z = x * y$ or $z = \frac{x}{y}$ $\Rightarrow$ $\Delta z = z * \sqrt{\left(\frac{\Delta X}{x}\right)^2 + \left(\frac{\Delta y}{y}\right)^2}$

Calculate the following errors:

1- Initial (ΔR_i) and final (ΔR_f) burette reading errors =

2- Apparent volume error (ΔA) =

3- Initial (ΔW_i) and final (ΔW_f) weight of the flask errors= Error in the balance =

4- Weight of water error (ΔW) =

5- Temperature error (ΔT) =

6- Actual volume error(ΔAct) =

QUESTIONS

Q1) A 25 mL pipette was found to deliver 24.876 g of water when calibrated against stainless steel weight at 25 ^{o}C. Use the data in Table 2 to calculate the volume delivered by the pipette at this temperature, repeat the calculation at 19 ^{o}C.

Q2) Suggest some sources of error in this experiment.

EXPERIMENT (2)

SAMPLING AND STATISTICAL HANDLING OF DATA

Name:	**Group NO.:**

a) **Homogenous sample**

	Trial 1	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**
Mass of KHP(g)					
Volume of NaOH (mL)					
Molarity of NaOH (M)					
Average molarity of NaOH					
Standard deviation (S_a)					

b) **Heterogeneous sample**

	Trial 1	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**
Mass of mixture(g)					
Volume of NaOH (mL)					
Molarity of NaOH (M)					
Average molarity of NaOH					
Standard deviation (S_t)					

c) Calculation the sampling error (Ss)

a) Homogeneous sample:

1- Molarity of NaOH for trial 1 =

2- Average molarity of NaOH (Ave.x) =

3- The standard deviation of Homogeneous sample (S_a):

Standard deviation (S) = $\sqrt{\frac{\sum(x_i - Ave.x)^2}{n-1}}$

Sa =

b) Heterogeneous sample (HS):

1- Molarity of NaOH for trial 1

2- Average molarity of NaOH =

3- The standard deviation of Heterogeneous sample (S_t):

Sampling error (S_s):

Remember that: $S_t^2 = S_a^2 + S_s^2$

EXPERIMENT (3)
GRAVIMETRIC DETERMINATION OF CHLORIDE

Name:	**Group NO.:**

III DATA

Volume of unknown solution used, mL	
Mass of empty crucible, g	
Mass of crucible + precipitate, g	
Mass of AgCl precipitate, g	

IV CALCULATION

1- Mass of Cl in the volume used, g =

2- Mass of Cl in 1L (g/L) =

V QUESTIONS

Q1) What is the effect of the following phenomena on the chloride determination:

a) Insufficient amount of $AgNO_3$ added.

b) Incomplete transfer of the precipitate.

c) Coprecipitation

d) Washing too little

e) Washing too much.

f) Incomplete drying of precipitate.

g) Photodecomposition of silver chloride.

Q2) What is digestion of a precipitate? Why is it necessary?

Q3) Dilute HNO_3 is used as a wash solvent. Explain?

EXPERIMENT 4

GRAVIMETRIC DETERMINATION OF NICKEL AS BIS(DIMETHYLGLOXIMATO)-NICKEL(II) $NI(DMG)_2$

Name:	Group NO.:

III DATA

Volume of unknown solution used, mL	
Mass of empty crucible, g	
Mass of crucible + $Ni(DMG)_2$, g	
Mass of $Ni(DMG)_2$ precipitate, g	

IV CALCULATION

1- Mass of Ni in the volume used, g =

2- Mass of Ni in 1L (g/L) =

V QUESTIONS

Q1) Why precipitation is carried out in an ammonia solution?

Q2) Why a large excess of DMG should not be added?

Q3) Why ethanol is used for washing?

EXPERIMENT 5

NEUTRALISATION TITRATION IN AQUEOUS MEDIUM

Name:	**Group NO.:**

III DATA

d) a) Standardization of Sodium hydroxide			
Weight of KHP (g)………………………….			
	Trial 1	Trial2	Trial 3
Volume of KHP mL			
Volume of NAOH, mL			
Average vol. of NaOH……………… Molar Conc. NaOH………………….			
b) Determination of Phosphoric acid in commercial acid			
	Volume of H_3PO_4	Volume of NaOH	Indicator
Trial 1			BCG
Trial 2			BCG
Trial 3			Phph
Trial 4			Phph
Molar conc. H_3PO_4………… Average vol. NaOH ……….			BCG
Molar conc. H_3PO_4………… Average vol. NaOH ……….			Phph

III. <u>CALCULATIONS</u>

a) .a Standardization of Sodium hydroxide

- The balanced equation for the reaction is:

- Molarity of KHP(mol/L) =

- Molarity of NaOH (mol/L) =

b) (Determination of Phosphoric acid in commercial acid)

.b1 (Using BCG indicator)

- The balanced equation for the reaction is:

- Molar Conc. of H_3PO_4 (mol/L) =

- Conc. of H_3PO_4 (g/L) =

b2 (Using Phph. indicator)

The balanced equation for the reaction is:

- Molar Conc. of H_3PO_4 (mol/L) =

- Conc. of H_3PO_4 (g/L) =

EXPERIMENT 6
The Neutralizing Capacity of Antacid Tablets

Name:	**Group NO.:**

III DATA

a) Standardization of NaOH solution			
Weight of KHP (g)…………………………			
	Trial 1	Trial2	Trial 3
Volume of KHP, mL			
Volume of NaOH mL			
Average vol. of NaOH……………… Molar Conc. NaOH………………….			
b) Standardization of the HCl solution			
	Trial 1	Trial2	Trial 3
Volume of HCl, mL			
Volume of NaOH, mL			
Average vol. of NaOH……………… Molar Conc. HCl………………….			

c) Determination of Neutralizing capacity of antacid		
	Trial 1	Trial 2
Mass of antacid sample (g)		
Volume of 0.20M HCl (mL)		
Moles of HCl (used to dissolved antacid)		
Volume of NaOH added		

Calculations:

a) <u>Standardization of NaOH against KHP:</u>

- The balanced equation for the reaction is:

- Mass of KHP in g =

- Mole of KHP =

- Molarity of KHP (mol/L) =

- Avg. Molarity of NaOH (mol/L) =

b) <u>Standardization of HCl against NaOH:</u>

- The balanced equation for the reaction is:

- Avg. Molarity of HCl (mol/L) =

c) Determination of Capacity of Antacid:

- Assume one mole of Antacids reacts with one mole of HCl.

➢ Calculation for Trial 1:

1. Total moles of HCl added =

2. Moles of NaOH needed to neutralize excess HCl =

3. Moles of excess HCl =

4. Moles of acid needed to neutralize Antacid=
   (total moles of acid – moles of excess acid)

5. Capacity of Antacid for Trial 1=
   (Moles of acid needed to neutralize Antacid / mass of Antacid)

➢ Calculation for Trial 2:

Repeat the above calculation to find the Capacity of Antacid for Trial 2.

Capacity of Antacid for Trial 2 =

➢ Avg. Capacity of Antacid:

Avg. Capacity of Antacid =

Questions:

1- Why strong bases like NaOH cannot be used to neutralize the acid in the stomach?

2- Why the back titration technique was used in this experiment instead of direct titration?

3- A student is given 0.543g sample of antacid to find it's capacity to be 0.00813 mol/g. The sample was dissolved and treated by 40.00 ml of 0.151 M of HCl, then the solution was titrated with 10.20 ml NaOH. Calculate the concentration of NaOH used .

EXPERIMENT (7)
PRECIPITATION TITRATIONS (ARGENTIMETRY)

Name:	**Group No.:**

III DATA

Standardization of silver nitrate			
Weight of NaCl………………. g			
a) ***Mohr's Method***	Trial 1	Trial 2	Trial 3
Volume of NaCl			
Volume of $AgNO_3$			
Average vol. of $AgNO_3$…………mL Molar conc. $AgNO_3$…………….			
b) ***Fajan's Method***	Trial 1	Trial 2	Trial 3
Volume of NaCl			
Volume of $AgNO_3$			
Average vol. of $AgNO_3$…………mL Molar conc. $AgNO_3$…………….			

Standardization of potassium thiocyanate			
c) ***Volhard's Method***	Trial 1	Trial 2	Trial 3
Volume of $AgNO_3$			
Volume of KSCN			
Average vol. of KSCN…………….mL Molar conc. KSCN…………….			

Determination of a mixture of halides (NaCl + KCl)			
a) ***Mohr's Method***	Trial 1	Trial 2	Trial 3
Volume of unknown			
Volume of $AgNO_3$			
Average vol. of $AgNO_3$…………mL			
b) ***Volhard's Method***		Volume of $AgNO_3$……………..	
	Trial 1	Trial 2	Trial 3
Volume of unknown			
Volume of KSCN			
Average vol. of KSCN…………….mL			

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IV CALCULATIONS

• **Part A. (Mohr's method)**

- Molarity of NaCl (mol/L) =

- Molar Conc. of $AgNO_3$ (mol/L) =

- Weight of $AgNO_3$ (g/L) =

• **Part B. (Fajan's method)**

- Molar Conc. of $AgNO_3$ (mol/L) =

- Weight of $AgNO_3$ (g/L) =

• **Part C. (Volhard's method)** (Use the concentration of $AgNO_3$ from part B)

- Molar Conc. of KSCN (mol/L) =
- Weight of KSCN (g/L) =

- **Part D. (Mixture of halides NaCl and KCl)**

  - Weight of mixture in one liter = <u>6.50 g</u>
  - Weight of mixture in 10 mL (W_1) = <u>0.0650 g</u>

  - **Part D.1 (Mohr's Method)** (Use the concentration of $AgNO_3$ from part A)

  - Moles of the unknown =

  - Weight of NaCl (x) and KCl (y) =

  - Concentration of NaCl and KCl (g/L)=

  - **Part D.2 (Volhard's Methods)** (Use the concentration of $AgNO_3$ from part B)

  - Moles of $AgNO_3$ added =

  - Moles of KSCN =

  - Moles of Unknown =

  - Weight of NaCl (x) and KCl (y) =

  - Concentration of NaCl and KCl (g/L)=

V QUESTIONS

Q1) Why precipitation titrations by the Mohr's method require a neutral solution?

Q2) What is the effect of using acidic solution in the Fajan's method?

Q3) What is the effect of using $K_2Cr_2O_7$ instead of K_2CrO_4 as an indicator on the titration result?

Q4) What is the effect of using basic solution on the results in precipitation titration?

Q5) Why nitrobenzene is added in case of titration of Cl^- by Volhard's method?

EXPERIMENT (8)
REDOX TITRATIONS (DICHROMATE TITRATIONS)

Name:	**Group NO.:**

III DATA

(b) Determination of Fe^{2+} and Fe^{3+} in a mixture		
Molarity of $K_2Cr_2O_7$...........................		
b.1) Determination of Fe^{2+} in the mixture		
	Trial 1	Trial2
Volume of unknown		
Volume of $K_2Cr_2O_7$		
Average vol. of $K_2Cr_2O_7$....................................		
b.2) Determination of Fe^{3+} in the mixture		
Volume of unknown		
Volume of $K_2Cr_2O_7$		
Weight of Fe^{2+} ………………. g / L	Weight of Fe^{3+} ………………. g / L	

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IV. CALCULATIONS

b. Determination of Fe^{2+} and Fe^{3+} in a mixture

b.1 Determination of Fe^{2+} in the mixture

- Molar conc. of Fe^{2+} (mol/L) =

- Weight of Fe^{2+} (g/L) =

b.2 Determination of Fe^{3+} in the mixture

- Moles of Fe^{2+} in the mixture =

- Moles of Fe^{2+} and Fe^{3+} in the mixture =

- Moles of Fe^{3+} in the mixture =

- Molar conc. of Fe^{3+} (mol/L) =

Weight of Fe^{3+} (g/L) =

V. QUESTIONS

Q1) What is the role of H_3PO_4 in determination of Fe^{2+} by titration with $K_2Cr_2O_7$?

Q2) Can you determine iron ores using $K_2Cr_2O_7$?

EXPERIMENT (9)
COMPLEXOMETRIC TITRATIONS (TITRATIONS WITH EDTA)

Name:	**Group NO.:**

III DATA

Standardization of about 0.01M EDTA			
Weight of $ZnSO_4.7H_2O$……………………….g			
	Trial 1	Trial 2	Trial 3
Volume of $ZnSO_4.7H_2O$			
Volume of EDTA			
Average vol. of EDTA……………..mL Molar conc. EDTA……………..mol/L			

Determination of water hardness			
	Volume of H_2O	Volume of EDTA	Note
Trial 1 (V1)			------------
Trial 2 (V1)			
Trial 1 (V2)			In present of NaOH
Trial 2 (V2)			
Average V1 =.. Average V2 =..			
Conc. of $CaCO_3$……………………………mg/L			

Determination of the concentration of Ca and Mg in an unknown solution			
	Volume of unknown	Volume of EDTA	Note
Trial 1 (V1)			------------
Trial 2 (V1)			
Trial 1 (V2)			In present of NaOH
Trial 2 (V2)			
Average V1 =.. Average V2 =..			
ppm Ca……………….…………… ppm Mg……………………………			

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IV. CALCULATIONS

- Part II.A. (Standardization of about 0.01M EDTA solution)

  - Molar conc. of Zn^{2+} (mol / L)

  - Molar Conc. of EDTA (mol / L)

- Part II.B. (Determination of water hardness)

  - Conc. of Ca (ppm)

  - Conc. of Mg (ppm)

  - Total water hardness, as mg $CaCO_3$ /L

- Part II.C. (Determination of the conc. of Ca and Mg in an unknown solution)

  - Conc. of Ca (ppm)

  - Conc. of Mg (ppm)

EXPERIMENT (10)
DETERMINATION OF UNKNOWN BASES BY STANDARDIZED HCI

Name:	**Group NO.:**

II DATA

a) Standardization of hydrochloric acid against sodium carbonate			
	Trial 1	Trial2	Trial 3
Weight of Na_2CO_3, g			
Volume of HCl, mL			
Molar Conc. HCl, mol/L			
Average molar conc. of HCl ………………..			

b) Determination of the composition of the unknown						
	Phph			BCG		
	Trial 1	Trial2	Average	Trial 1	Trial2	Average
Volume, mL						
Wt. of unknown						
The first component of the unknown is ………………. and its percentage ……………..…%						
The second component of the unknown is ……..……. and its percentage ……………..%						

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III. CALCULATIONS

- Molar conc. of HCl (mol / L)

- Percentage of the first component

- Percentage of the second component

- IV. **QUESTIONS**

Q1) If a basic unknown solution was titrated with Phenolphthalein and need 20ml and when it titrated with bromocresol green needs 40ml, the unknown will consist of which type of basic material?

Q2) where you can find the mix of these basic materials in the environments?

1A	2A											3A	4A	5A	6A	7A	8A
1 **H** 1.008																	2 **He** 4.003
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.07	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.88	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.38	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 **La*** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226	89 **Ac†** (227)															

*Lanthanides	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
†Actinides	90 **Th** 232.0	91 **Pa** (231)	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)