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دفتر :
مختبر أساسيات الكيمياء العامة

Chemistry Lab

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اللجنة الأكاديمية لقسم الهندسة الصناعية

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- Some of Safety rules:

1) Not allowed in lab: Eating, Drinking, open Sandels Short, Skirts.

2) Don't return any excess Chemicals to the reagent Bottles or Bottles of Solid material.

3) Don't use the Chemicals on the Side Shelves, Unless the leacturer told you.

4) Don't use your mouth to fill or taset Cheemicals

5) Use fume hood for rxns with toxic gases.

6) Don't dispose Solides into Sink

7) Don't point the test tube toward u during Leating or toward any person

8) Ware Safety glasses and LabCoat.

- Decreasing in trend of accuracy of tools:

Pipette > Burette > Vol. flask > Grad. Cylinder > Beaker > Er flask (for titration with swirling)

Pipette: used to transfer liquids with high accuracy

Burette: used to transfer liquids with high accuracy

Vol. flask: Used to prepare Slons with high accuracy

Grad. Cylinder: used to transfer liquids with lowr accuracy

Beaker: chemical rxns

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Weighing:

Uncertainity ↓

- if balance has two decimal : 5g ⇒ 5.00g ∓0.01

  one decimal : 5g ⇒ 5.0g ∓0.1

- Volumes, Thermometer, Lengths

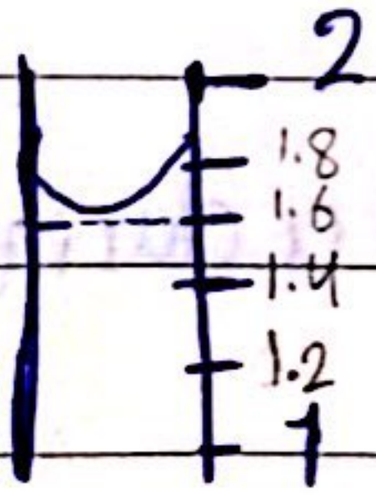
$\rho \frac{Calib}{2} = \frac{0.1}{2} = 0.05$

1.40ml ∓0.05

↑ Should be added

1.10 Cm ∓ 0.05

$\frac{0.1}{2} = 0.05$



1.60ml ∓0.1

Should Be added.

$\frac{0.2}{2} = 0.1$

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Emp. Formula: Simplest whole no. ratio. bet atoms in Cpd.

($Mg_{(s)} + O_{2(g)} \longrightarrow Mg_xO_y$)

- Purpose of exp: Def of the ratio of X:Y

$$\Rightarrow Ratio = \frac{X}{Y}$$

Mg : O

(1) Mass (g)

(2) $moles = \frac{mass}{atomic\ mass}$

(3) Divide on the least moles, The ratio should be a Smallest, whole no.

- Rxns in the exp:

($Mg_{(s)} + O_2 \longrightarrow Mg_xO_y$) (Themain rxn)

- The Side Rxn: $Mg_{(s)} + N_{2(g)} \longrightarrow Mg_3N_2$ (Magnesium nitride)
- How To avoid the Side rxn:

$Mg_3N_2 + H_2O_{(l)} \longrightarrow Mg(OH)_2 + (NH_{3(g)})$ Ammonia

$Mg(OH)_2 \xrightarrow{\Delta} Mg + H_2O_{(g)}$

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- IF Ratio = Mg/O means Ratio of Mg to O
- If water is added but not heated : Mass O ↑inc, ratio ↓de
- NO Sufficient air means : O ↓ dec, So ratio ↑inc
- Formation of the Side products (Mg_3N_2) : O ↓dec, ratio ↑in
- Balance reads erroneously 0.20g higher than the Value → No effect.

- Some questions about exp

(1) Heating Before starting? To remove moisture.

(2) Don't wheight the crucible When it's hot? it gives wrong accu

(3) Don't corer the Crucible Widley? it burns Mg brightly

(4) Adding the water drops? To decompoes Mg_3N_2

(5) if mg_3N_2 decomposed Completly? No effect.

(6) if mg_3N_2 not decomposed Completly? ↑ratio ↓O

(7) Carbon deposited on the crucible? ↓ratio ↑O

(8) Carbon not deposited on the Crucible? No effect.

(9) Magnesium oxidash is not dried Completly? ↑ratio ↑O

(10) Magnesium oxidash is dried Completly? No effect

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(11) Air is sufficient (كافي) to react With all Hg? No effect

(12) nonvolatile (غير طايرة) and Unreactive impurities in the Crucible during (خلال) Oxidation (التأكسد)? ↓ ratio ↑O

(13) nonvolatile (غير طايرة) and Unreactive impurities in the Crucible from the beging (قبل التأكسد.)? No effect.

(14) Volatile during the rxn or in the begning? No effect

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Limiting Reactant: The reactant that is consumed firstly in the chemical rxn, and so determine amount of the product.

Actual yield: The amount of product that is produced actually (expairmently) (practically) in Lab.

Theoritical yield: Amount of the product that is expected to be produced by calculations.

$$\% \text{ yield} = \frac{\text{Act. Yield}}{\text{Theo. Yield}} * 100\%$$

Purpose of the exp:

(1) Def of (LR) of the following rxn:

$$\underset{(A)}{2Na_3PO_4 \cdot 12H_2O} + \underset{(B)}{3BaCl_4 \cdot 2H_2} \rightarrow Ba_3(PO_4)_2 + 6NaCl_2 + 3OH:$$

(2) Def of Act. Yield, Theo. Yield & % Yield of the rxn.

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Supernatant: Clear Sdn over PPt.

This rxn is (endothermic rxn).

Procedures:

(1) Weight 1.0g of the mixtur of the reactants, and add it to Beaker Contains (~200ml dis H2O) heat gently for 10 min, (Without Boiling)

(2) Wait Until the ppt settle down (the Supernatant).

(3) Determine the (LR) by taking an amount of the Supernatant to two beakers.

- Add few drops of reactant (A) to Beaker 1: if turbidity appears, then (A) is (LR) and if not then (A) is excess (not LR).

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- Add few drops of reactant (B) to Beaker 2: if turbidity appears, then (B) is (LR) and if not then (B) is excess (not LR).

(4) Make Suction filtration and dry in Oven then weight the product which is the actual Yield.

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The ppt. Contains : excess + Product (actual yield)

- if the product isn't dried Completely :

Act yield ↑ , % Yield ↑

- Coanse filter paper is Used Will Cause the lost of product : Act yield ↓ , % Yield ↑
- Washing of ppt. with aaid ⇒ Lost of product due to Solubility of product With aeid Act yield ↓ So % Yield ↓.
- Not Sufficient washing of ppt with matar : excess pearsents ⇒ ↑ Act. Yield , ↑ % Yield .

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Identification of Cpds: physical properties:

- physical properties are often used for identification of Cpds

- the most common physical proparites include: Color, density, Solubility, m.b, b.p and the State of matter.

(1) Solubility: maximum mass (usually in grams) of the substance that dissolve in a fixed mass (usually in 100 g) of solvent at a given to.

- A Subestance has different Solubilities in diffrent solvents, reflecting the differences in the molecular compesition of the Solut and Solvent.

- In general: like dissolve in like ⇒

(polar dissolve in polar and nonpolar dissolve in non-polar solvent)

(2) Density : (mentioned Before => $d = \frac{m}{v}$)

- Pipette 10 ml and weight it, then you can calculate the density of the Unknown.

(3) Boiling point : Temp at which Vp at liq is equal to the atm pressure.

- normL (B.p) : Temp at which Vp at liq is equal to 1 atm.
- At (B.p) temp remains constant until the entier volume at the liq has been converted to vapor.

- When air bubbles escape rapidly from the capillary tube, the :

$V_{p(liq)} > atm.p$, temp > B.p

and the temp that is taken will be higher than the true value of B.p.

- When the liq enters the Capillary tube the atm.p > V.p and if temp is taken, it will be lower than B.p (the true value).

- The temp is taken while (not before or after) the liq enters the Capilbary tube, at this moment $(V.p)_{liq} \equiv$ atm. pressure. nearly.

- if some of the unknown aheres (Cling) in th pipette while density procedure is done, mass ↓, density ↓ (it will be lower than the true val

Cations:

1- Calcium ion Ca^{+2}

$Ca(NO_3)_2 + \underset{\text{Sodium oxalate}}{Na_2C_2O_4} \rightarrow \underset{\text{White ppt}}{CaC_2O_4} + 2NaNO_3$

2- Iron (III) ion Fe^{+3}

$Fe(NO_3)_3 + 3KSCN \rightarrow \underset{\text{red solution}}{Fe(SCN)_3} + 3KNO_3$

Potassium thiocyanate

3- Ammonium iron NH_4^+

$NH_4NO_3 + NaOH \rightarrow NH_3 + H_2O$

Sodium hydroxied (Basic)

Gas (with heating change the litmus paper red to blue)

Anions:

1- Hydrogen Carbonate HCO_3^-

$NaHCO_3 + HCl \rightarrow H_2CO_3 + NaCl$

Hydrochloric Acid (Basic)

Buble of Carbon dioxited

2- Sulfate ion SO_4^{+2}

$Na_2SO_4 + BaCl_2 + H^+ \rightarrow BaSO_4 + 2NaCl$

Barium chloride

White ppt

3- Chloride and Bromide ion Cl^- and Br^-

$NaCl + AgNO_3 + HNO_3 \rightarrow AgCl + NaNO_3$

Silver nitried

White ppt

or

NaBr

or AgBr

Pale yellow ppt

- Avogadro's principle: Equal volume of gases under the same temp & pressure contain an equal no. of molecules.

- the molar mass of volatile liq can be determine by using of the ideal gas law:

$$PV = nRT = \frac{m}{M}RT \Rightarrow M = \frac{mRT}{PV}$$

$$\text{Also, } M = \frac{dRT}{P} \text{ . (g/mole)}$$

(d: g/L)

P: atm = 760 torr = 760 Hgmm = 101325 pa

V: volume vapar (L) $\Rightarrow$ (1L = 1000mL = 1000 cm^3 = 1 dm^3)

T: Temp (K)

R: 0.0821 (Latm $mol^{-1} K^{-1}$ = gas constant)

In the exp:

- if the flask isn't dried completly from outside before weighing. ↑m ↑M.m

- If amount of vol. liq isn't enough in the flask. the flask willn't filled completly with vapor but (V) will be considerd as filled but mof vaper ↓ So Mm ↓
- If the balance reads lower than the true value. No effect
- If the 50ml rather than 20ml of vol. liq is used in the exp. No effect
- due to mass of vaper not vol. Liq is considerd

• Determine of Molar Volume of H_2O gas.

- one mole of an ideal gas at STP will occupy a volume = 22.4 L

$(\bar{v})_{stp}$ = 22.4 L/mole

$\bar{v}$: molar volume , stp : Standerd Temp & pressure.

- Stp : t = 0°C , p = 1 atm

In this exp the following rxn will be done :

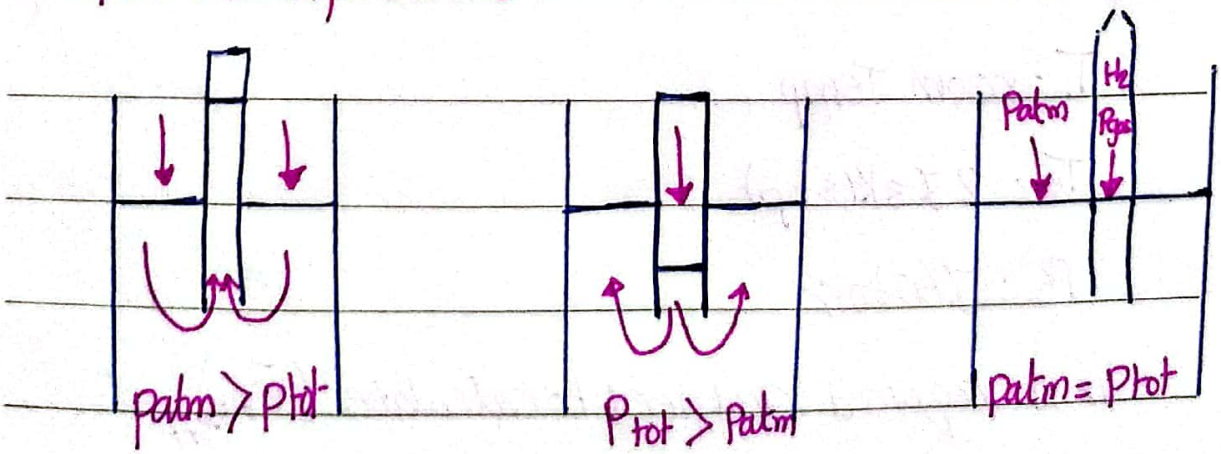
$$Mg + 2HCl \rightarrow MgCl_2 + H_2O$$

H_2 gas will be collected over water, so that the pressure in the container (burette) will be :

$$P_{tot} = P_{gas} + P_{H_2O}$$

$$P_{gas} = P_{H_2} = P_{tot} - P_{H_2O}$$

P_{tot} : atm pressure.



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.Calculations

(1) $Mg + 2HCl \longrightarrow MgCl + H_2O$

(2) $\text{mole mg} = \frac{\text{mass Mg}}{24.31}$ moles of Mg = moles of H_2

(3) $V_{H_2} = V_{uncalb} + V_{calb}$

(4) $P_{H_2} = P_{tot} - P_{H_2O}$ ($p_{tot} = p_{atm} = p_{room}$)

P_{H_2O} depend on temp at H_2O

(5) $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

$P_1 = P_{H_2}$, T_1 = room temp(K) , $V_1 = V_{H_2}$ (point3)

P_2 = 760 torr, $T_1 = T_2$ & V_2 is requierd

(6) $\bar{V}_{H_2}$ at 760 torr $= \frac{V_2}{\text{moles } H_2}$

(7) $(\bar{V}_{H_2})_{stp} = \frac{V_{H_2}}{\text{moles } H_2} \Rightarrow \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

T_1 : room Temp

T_2 : 273K(stp)

P_2 : 760 torr

V_2 is requierd and need to calculate $(\bar{V}_{H_2})_{stp}$

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Collegative properties:

- when non vol. solute is dissolved in certain amount of solvent is changed suchas:
- F.P ↓ B.P ↑ & V.P ↓
- in this exp we will measure the f.p of a solvent (Cyclohexane) then dissolve certain amount of an unknown solute and mesure the f.p again.
- the f.p of the solvent (that will be called slon After solute is dissolved) will be lower than if it were a solvent alone.
- this decreasing in f.p of solvent is called f.p depress and represent by ($\Delta T_f = (f.p_{slon}) - (f.p_{solvent})$)
- f.p: temp at which the solid & liq States are present at eq at the atm pressure.
- As amount of solute in solvent ↑ inc, f.p dec ↓
- As amount of solute in solvent dep ↑ inc
- amount of solute in solvent is represented by diff terms, one of these terms is molality (m)

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- $\Delta T_f \propto m \Rightarrow \Delta T_f = K_f m$

molality = $\frac{\text{moles of Solute}}{\text{mass of solvent}}$ = ... mole/Kg

• now we will determine the molar mass of the solute that is dissolved in solvent and caused the f.p depression.

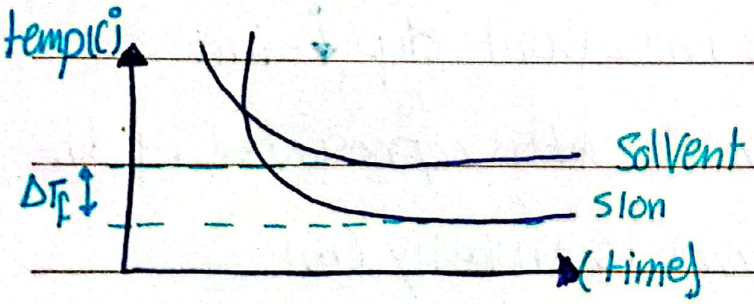
$\Delta T_f = K_f m = K_f \frac{\text{moles of Solute}}{\text{mass of solvent}} = \frac{K_f (\text{mass of solute})}{(\text{MWt}) \text{ mass solvent}}$

$M.W.t = \frac{K_f \cdot \text{mass Solute}}{\Delta T_f \cdot \text{mass solvent}} = \frac{C^\circ Kg\ mol^{-1}\ g}{C^\circ Kg} = g/mol$

K_f : f.p.d Constant for solvent : $C^\circ/m \equiv C^\circ Kg\ mol^{-1}$

- Stirring of solvent/slon during freezing, in Order to prevent the Supercooling

- plot of temp Vs time you can determine ΔT_f.



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Notes :

- if Solute is dissociated ($AB \longrightarrow A + B$)
  Amount ↑ , ΔT_f ↑ , M.Wt ↓
- Assosiation of solutes : ($A + B \longrightarrow C$)
  Amount ↓ , ΔT_f ↓ , MWt ↑
- Not dissolved Completly (the solute)
  ΔT_f ↓ , ∴ MWt ↑
- if thermometer read 20 c° lower than the true value . No effect .

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