• Common Glassware and Equipment :

- - Erlenmeyer Flask : دورق مخروطي
- Beaker : دورق
- Buchner Funnel : قمع بوخنر
- Wash Bottle : قنينة الماء
- Glass Fannel : قمع زجاجي
- Buret : سحاحة
- Medicine Dropper : قطارة دوائية
- Thermometer : ميزان حرارة
- Suction Flask : دورق شفط
- Capillary Tube : انبوب شعيري
- Test Tube : انبوب اختبار
- watch Glass : حصة الزجاج
- spatula : ملعقة مسطحة
- Test Tube wood Holder : ملقط خشبي
- Test Tube Brush : فرشاة انبوب الاختبار
- Crucible Tongs : ملقط اكريد
- Ring stand, Iron Rings : حامل حلقي، حلقات حديد
- wire gauze : سلك الغاز
- Graduated Cylinders : اسطوانة مدرجة
- Clamp Holder : حامل المشبك
- Double Buret clamp : المشبك المزدوج
- Extension clamp : مشبك تمديد
- Graduated pipet : ماصة مدرجة
- volumetric pipet : ماصة عيارية
- Filter paper : ورق ترشيح

Experiment 1: Basic Laboratory Techniques.

- objectives: 1. To light and properly adjust a Bunsen burner
  2. To develop skills For properly operating a laboratory balance.
  3. To develop skills For measuring volumes of liquids and solids.
  4. To determine the density of a metal and an unknown liquid.

- The objectives of laboratory work:
  1. design and build apparatus.
  2. develop techniques, ~~record data and deduce~~
  3. record data and deduce rational theories

- The Bunsen Burner:
  - Robert Bunsen
  * producing a combustible gas-air mixture that yields a hot.

- The natural gas:
  - composed primarily of the hydrocarbon methane, CH_4.

- Lighting the burner:
  - Turn off the burner's gas control.
  - Fully turn on the gas valve at the outlet.
  - close the air holes at the base of the burner and open the gas control slightly.
  - Bring ~~the~~ a lighted match or striker up
  - adjust the gas control until the Flame is pale blue and has two.

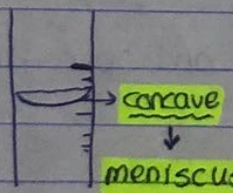
- The Laboratory Balance :
  - * the most common balances :
    - . The triple beam :
    - . The Top - loading .

- Two checks you should make befor using a balance :
  1. make sure that are nothing on the balance.
  2. make sure that you are tare the balance.

* Be sure to record the weight of the objects to the precision that the balance allows : ± 0.01 g for both balances.

- Volumetric Glassware :
  - volumetric measurements :
    - . Graduated cylinders
    - . transfer pipets.
    - . Mohr pipets.
    - . burets.

- Graduated cylinders :
  - measure an approximate volume of a liquid.



  - The bottom of the meniscus is used for all measurements.

- To avoid error :
  - your eye should always be level withthe meniscus when you are measuring the volume.

- Size :
  - 10-mL , 25-mL , 50-ml and 100-mL

- **Pipet :**
  - **Transfer pipet :**
    - is calibrated to deliver (TD), one and only one volume.
  - **Mohr pipet :**
    - graduated so that it can deliver any volume
      - usually to the nearest tenth of a milliliter up to its maximum volume.

- **Size :**

(T.P) 5-ml , 10-ml , 20-ml , and 25-ml

(M.P) 5-ml , 10-ml , 25-ml

- **Remember :**
  - you are not allowed to use your mouth for suction even if you are filling the pipet with water.

- **Burets :**
  - the principal use of the buret is for titrations.

- **The Precise titrations require :**
  1. burets that drain freely.
  2. are very clean
  3. do not leak around the stopcock.

- **Filtration:**
  - The simplest method of separating a solid from a liquid.

* using (Filter paper) ⟶ is available with variety of porosities.

. but the Filtration will be slow.

- **Gravity Filtration:**
  - this technique requires:
    - conical Filter Funnel.
    - glass stirring rod.

* the mixture to be Filtered should be poured along the stirring rod to direct the Flow of the liquid into the Filter paper.

- **Suction Filtration:**
  - is much Faster than gravity Filtration.

but: quantitative recovery of a solid is rarely achieved.

- this technique requires:
  - Buchner Funnel
  - suction Flask
  - rubber stopper or rubber ring.
    - to hold the Funnel tightly in the Flask.
  - glass stirring rod
  - heavy rubber tubing
  - water aspirator

- **Density :**
  - the mass of a substance per unit volume.

$$d = \frac{m}{v} \rightsquigarrow \text{Density} = \frac{\text{mass}}{\text{volume}}$$

* the density of water = 1.0 g/mL or 1.0 g/cm³

Q: Two general chemistry students determiend the density of leal following the procedure given in this experiment. Give one reasons why their experimental values may differ.

... Because of the lake of accuray on the experiment.

Q: if an air bubble adheres to the metal's surface when submerged in water, how does affect the metal's experimental density? (Explain)

... The density of metal's will decrease ; Beraus when the air bubble adheres to the metal's surface the volume of water will increase that cause increasing in metal's volume. density↓ = mass / volume ↑

Q: if several drops of / unknown liquid cling to the pipet's inner wall's (due to dirty pipet), will its reported density be higher or lower then its actual density? (Explain)

... The density will be higher than the actual density : Because when several drops of unknown liquid cling to the pipt's walls, the dirty pipet take some volume, so the volume of unknown liquid will decrease, that cause higher of Density ⇒ Density↑ = mass / volume ↓

Experiment 2: Physical changes, chemical Properties and Reactions.

- Objectives: 1. To observe some physical and chemical properties of a ~~grop~~ group of substances.
2. To observe several changes in matter and to determine if they are physical changes or chemical reactions.

• Physical property:
the property that can be observe without changing the composition of a substance.

ex: melting point, boiling point, color, density.

• Chemical property:
the property can be observe when a substance reacts to produce one or more different substances in a chemical changes.

• melting point: when a solid changes to liquid
* change in Form without a change in chemical identity.

• boiling point: when a liquid changes to gas.

* The inability of some substances to burn is also a chemical property but no chemical change is associated with lake of burning.

• Reactants: The substances that present before a chemical reaction occurs.

• Products: The substances that formed from chemical reaction occurs.

- vaporization : Liquid → gas تبخر
- condensation : gas → Liquid تكاثف
- sublimation : solid → gas تسامي
- deposition : gas → solid تبلور

Q: Describe what did you observe when solid iodine (I_2) was heated. what is the name of this physical change?

- sublimation → physical change.

Q: what observation can you conclude when you heated naphthalene directly and strongly on the Bunsen burner? Is that change physical or chemical?

- vapor gas and liquids and it has a bad smile. . chemical change

Q: what observation can you conclude when you heated NaCl directly and strongly on the Bunsen Burner? Is that change physical or chemical?

- Does not melt and absorb heat, physical change.

chemical property

Q: Complete the Following equations:

a. $2Mg + O_2 \xrightarrow{\Delta} 2MgO$

b. $CuSO_4 \cdot 5H_2O \xrightarrow{\Delta} CuSO_4 + 5H_2O$

c. $Zn + 2HCl \longrightarrow ZnCl_2 + H_2$

d. $Cu^{+2}_{(aq)} + (\text{few drops})\ 2NH_4OH \rightarrow 2NH_4^+ + Cu(OH)_2$ ⇐ sky-blue

e. $Cu^{+2}_{(aq)} + (\text{excess})\ NH_4OH \rightarrow Cu(NH_3)_4^{+2} + H_2O$

f. $Pb^{+2} + Cl^- \rightarrow PbCl_2$.

Experiment 3 : Empirical Formula of Magnesium Oxide.

- Objectives : 1. To determine the empirical Formula of Magnesium oxide.

• Empirical Formula :

↳ The Formula gives the relative number of atoms of each element present in a Formula unit.

* To derive the empirical Formula :

1. determine the number of moles of each of its elements in a sample.
2. calculate the simplest ratio (which must be expressed as whole number).

• Magnesium :

↳ moderately ~~reaction~~ reactive elementary substance.

* magnesium is heated to a high temperature, it reacts with oxygen in the air to Form magnesium oxide.

$$2\,Mg_{(s)} + O_{2(g)} \xrightarrow{\text{heat } \Delta} 2\,MgO_{(s)}$$

* because air contains other gasous elements such as nitrogen.

$$3\,Mg_{(s)} + N_{2(g)} \xrightarrow{\text{heat}} Mg_3N_{2(s)}$$

- $Mg_3N_{2(s)} + 6H_2O_{(l)} + heat \longrightarrow 3Mg(OH)_{2(s)} + 2NH_{3(g)}$
- $Mg(OH)_{2(s)} + heat \longrightarrow MgO_{(s)} + H_2O_{(l)}$

Q: How would your result for the empirical formula be affected by each of the following:

A. The crucible was wet for the initial weighing but was dry for the subsequent weighing's?
- when the crucible was wet for the initial weighing ~~we~~ the mass of it ~~is~~ will be higher than the actual weight, Then when it dry we weight another mass, that cause the mass of MgO will less than the actual mass.

B. Magnesium was only partially converted to oxide.
- when magnesium was only partially converted to oxide the mass of MgO will decrease because the mass of Mg will decrease.

C. A ~~Flash~~ Flake of the final oxide was blown out of the crucible just befor the final weighing, explain.
- the mass will decrease
the mass of MgO will be too low.

D. If you forget to add water to the contents of the crucible, would your experimental percent of magnesiume have been too high or too low? Explain.
- If we forget to add water to the contents of the crucible, the mass of magnesium will be too low because we have a mixture of magnesium oxide and magnesium nitride, so we don't have the mass of magnesium oxide.

2. A compound containing only carbon and hydrogen is analyzed, and is found to contain 74.88% carbon on a mass basis. Calculate the empirical Formula of the compound?

* suppose that we have 100 g of compound

	C	H
mass	74.88 g	100 - 74.88 = 25.12g
molar mass	12 g/mol	1 g/mol
moles	6.24	25.12
÷ less moles	1	≈ 4

∴ the empirical Formula For compound is CH_4

Experiment 4: Formula and Decomposition of a Hydrate.

- objectives: 1. To determine the Formula of a known hydrate.
  2. To determine the composition of an unknown hydrate.

- Hydrate :

are crystalline compounds in which one or more molecules of water are ~~thm~~ combined with each Formula unit of salt of the anhydrate compound.

water hydration often is not bound tightly into the crystalline strucher of the anhydrous compound.
and can usually be driven off by heating a sample.

* if the hydrate is colored, a color change usually results upon heating as the anhydrates salt Forms.

- $CuSO_4 \cdot 5H_2O_{(s)} \xrightarrow{\Delta} CuSO_{4(s)} + 5H_2O_{(g)}$
  Blue → white.

- $CoCl_2 \cdot 6H_2O_{(s)} \xrightarrow{\Delta} CoCl_{2(s)} + 6H_2O_{(g)}$
  Red → Blue

- $NiSO_4 \cdot 7H_2O_{(s)} \xrightarrow{\Delta} NiSO_{4(s)} + 7 \cdot H_2O_{(g)}$
  Green → yellow.

- ~~when we have a sp~~
- when we have sufficient moisture in the present air
  ↳ the hydrate can Form spontaneously ~~Form~~ From the anhydrous salt.

* many hydrates and ~~thire~~ their anhydrous forms are white crystallin salt
  ↳ so that a color change may not occur.

*** the anhydrous ~~must be~~ salt must be cooled in the absence of moisture so that that the hydrate does not re-form befor weighing.

- Desicooler ⇒
  we use desicooler, Because some anhydrous turn into hydrates again in room temperature so we cool it down to calculate the currect mass.

- A sample of unknown hydrate weighing 0.546 g, after heating, it weighs 0.413 g, what is the persent of water in the hydrate?

* mass of water = mass of hydrate - mass of ~~hy~~ anhydrous
  = 0.546 g - 0.413 g
  = 0.133 g H_2O

- percent of water in the hydrate = $\frac{\text{mass of water}}{\text{mass of sample}} \times 100\%$

$= \frac{0.133}{0.546} \times 100\%$

$= 24.35\ \%$

Q: If the unknown hydrate is ~~com~~ incompletely decomposed, what is the effect on the calculated % of water in the unknown (larger or smaller)? Explaine.

- It will be smaller than the actual value, because when the unknown hydrate is incompletely decomposed the mass of anhydrous will be less than the actual the the mass of water also will be less.

Q: if some of unknown hydrate spatters out of the beaker and is unnoticed by the experimenter. what is the effect on the calculated % of water in the unknown (larger or smaller)? Explaine.

- it will be larger than the actual value; because the mass of water will be more than the actual mass of water (we will take From the mass of hydrate)

Q: what is the purpose of the disicooler and how should it be used?

- To absence of moisture From a hydrate sample by putting the Beaker. $BaCl_2$ into it.

Q: ~~A sample of unknown hydrate~~

Q: A 0.938g sample of barium chloride dihydrate is heated and 0.779g of anhydrous residue remains after cooling. what is the calculated Formula (moles H_2O / moles $BaCl_2$) of the hydrate?

- mass of H_2O = 0.938 − 0.779 = 0.159 g
- molar mass of $BaCl_2$ = 208.2
- molar mass of H_2O = 18

- moles. $BaCl_2 = \frac{0.779}{208.2} = 3.74 \times 10^{-3}$ mol
- moles. $H_2O = \frac{0.159}{18} = 8.83 \times 10^{-3}$ mol

Q: How should waste solid be disposed of after performing the procedure?

waste container

• Experiment 5 : Decompsition of Potassium chlorate ($KClO_3$) and unknown.

-objectives : 1. To determine the percentage of oxygen in a sample of potassium chlorate.

2. To determine the percentage of potassium chlorate in a mixture.

• « Stoichiometry » :

↳ The terme that use to refer to all quantitative aspects of chemical composition.

- The ability to perform chemical calculations is very much associated with one's understanding of chemical Formulas and chemical equations.

• A - The thermal decomposition of potasium chlorate

$$KClO_3 \xrightarrow{\Delta} KCl + 3/2\ O_2$$

one mole of $KClO_3$ = 122.6g → 1 mole of KCl = 74.6g
→ 1.5 mole of O_2 = 48g

• when potassium chlorate is completly decomposed
↳ the only solid product is KCl
↳ since O_2 is driven off as a gas.

* The loss in the mass is due to escaped Oxygen.

• when a mixture of potassium chlorate and potassium chloride is heated

↳ $KClO_3 + KCl^* \xrightarrow{heat} KCl^{\#} + 3/2\ O_2 + KCl^*$

• mass loss is due to oxygen ($KClO_3$)

• KCl^* is originally present and uncharge.

• $KCl^{\#}$ produced from decomposition of $KClO_3$.

« ω جيد »

- Manganese dioxide (MnO_2), it used as a catalyst
  1. to speed up the rate at which the decomposition occurs.
  2. it alters the rate of the reaction by providing a lower energy path that leads from reactants to products.
  3. the catalyst is not use up during the the course of the reaction

Q: It was not necessary to weigh the catalyst in this experiment, Explain the reasons.
- Because it is only used to speed up the reaction by providing a lower energy, and the catalyst is not used up during the course of the reaction.

Q: what is the percentage of oxygen in $C_6H_{12}O_6$?
- molar mass of $C_6H_{12}O_6$ = 180 g/mol
- molar mass of oxygen = 16 g/mol

$$\text{percentage of oxygen} = \frac{(6\text{ mol} \times 16)\,O}{\text{molar mass } C_6H_{12}O_6} = \frac{6\times16}{180} \times 100\% = 53.33\%$$

Q: Calculate the mass of oxygen in 30 g of CH_2NH_2COOH?
- molar mass of CH_2NH_2COOH = 75.06
- percentage of oxygen = $\frac{2\times16}{75.06} \times 100\% = 42.6\%$
- mass of O in 30 g of CH_2NH_2COOH = $30 \times (42.6/100) = 12.79$ g

Q: Suppose in the first part of the experiment you did not heat strong enough to decompose the potassium chlorate, how would this affect your result?
- The mass of oxygen will be less than the acutal value, while the mass of potassium chlorate will be higher than the actual value, because not all the oxygen has evaporated.

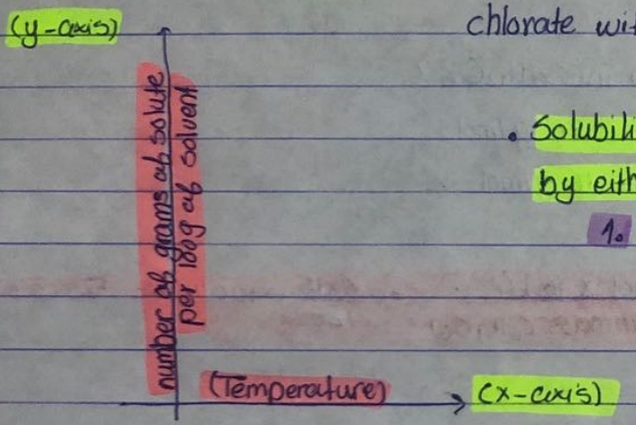
Q: if the Bunsen burner gave a luminous Flame and some soot was deposited on the tube, what effect would this situation have on the calculated % of oxygen?

the combustion reaction is uncomplete

- when some soot deposited on the tube, it added a mass to the Final result, so the calculated % of oxygen will be less than the original %.

• Experiment 6 : Determination of the Solubility Curve of Potassium chlorate ($KClO_3$)

- objectives: 1. To investigate the variation of solubility of potassium chlorate with temperature.



• Solubility Curve may be determined experimentally by either of two methods:

1. analyzing solutions saturated at various Fixed temperature to determine the concentration of dissolved solute.

2. preparing solutions of various known concentrations and observing the temperature at which each solution become saturated.

(2.) more accurate, and the more ~~ten~~ tedious to perform.

• Materials and glassware:

- Potassium chlorate ($KClO_3$).
- thermometer.
- watch glass.
- 5-mL pipet and special stirring r

• The solvent:
  ↳ is the dissolving agent of solution.

• The solute:
  ↳ is the substance that is dissolved.

1. Would the experimental curve as obtained by the method used in B lie above or below the accepted carve if : (explain each answer concisely).

A) some of the water was lost through excessive heating ?

- when some water was lost through excessive heating , the amount of water will decrease , so the concentration of $KClO_3$ is increase Because the mass of water is inverse with concentration then the temperature was increase , the solubility increase .

  * is above the accepted curve.

B) some of the solid were spilled and did not dissolve in the water after being weighed ?

- when some of solid were spilled and did not dissolve in the water after being weighed , the mass of solid in the water was decrease so the concentration was decrease then the temperature decrease the solubility decrease .

  * is below the accepted curve.

C) The First crystals were not observed promptly ?

- if we don't notic the First crystal , the temperature will continue to decrease , so the solubility value will be wrong .

  * is above the accepted curve.

D) The salt tends to give supersaturated solutions ?

- when the solution tends to be supersaturated , the concentration was very higher so we need more time to be saturation . so the solubility will be increase because the temperature and concentration increase .

  * is above the accepted curve.

E) The test tube was contaminated ~~solution~~? with some soluble inert salt?

- if the test tube was contaminated with some soluble inert salt, the amount of dissolved substance will increase then the concentration will be increase, the temperature increase, so the solubility will increase.
  - * is above the accepted curve.

~~2. According to the solubility curve~~

3.

~~Experiment~~ 7 : Limiting Reactant.

- Objectives : 1. To determine the limiting reactant in a salt mixture.
  2. To determine the percent composition of a salt mixture.

- Factors that limit the yield of products in a chemical reaction :
  1. the amounts of starting materials (reactants).
  2. the percent yield of the reaction.

* what is a limiting reactant?

↳ It is the reactant that limits the product that can be formed

$A + B \rightarrow C$

↳ Stoichiometry allows us to compare the amounts of various species involved in a reaction.

- an unknown salt mixture of $Na_3PO_4 \cdot 12H_2O$ and $BaCl_2 \cdot 2H_2O$ is added to water where they form insoluble $Ba_3(PO_4)_2$

$2\ Na_3PO_4 \cdot 12H_2O + 3\ BaCl_2 \cdot 2H_2O \rightarrow Ba_3(PO_4)_2 + 6\ NaCl + 30\ H_2O$

  - * Barium Phosphate is the insoluble product
  - * Sodium chlorate remains in solution.

- The ionic equation can be written:

$6Na^+ + 2PO_4^{-3} + 24H_2O + 3Ba^{+2} + 6Cl^- + 6H_2O \rightarrow Ba_3(PO_4)_2 + 6Na^+ + 6Cl^- + 30H_2O$

- The spectator ions can be cancelled out, leaving the net ionic eqn:

$2PO_4^{-3} + 3Ba^{+2} \rightarrow Ba_3(PO_4)_2(s)$

Two moles of phosphate ion from 2 mol of $Na_3PO_4 \cdot 12H_2O$ (380.2) or 760.4g, reacts with 3 moles of barium ion from 3 mol of $BaCl_2 \cdot 2H_2O$ (244.2) or 732.6g, producing 1 mol of ~~Bet~~ $Ba_3(PO_4)_2$ precipitate (602.0) or 602.0g, if the reaction proceeds to completion.

Q: When 0.990 g of $Na_3PO_4 \cdot 12H_2O$ reacts with excess $BaCl_2 \cdot 2H_2O$, how many moles of $Ba_3(PO_4)_2$ are produced?

$2\,Na_3PO_4 \cdot 12H_2O + 3\,BaCl_2 \cdot 2H_2O \rightarrow Ba_3(PO_4)_2$

- molar mass of $Na_3PO_4 \cdot 12H_2O = 380.2$ g/mol
- moles $Na_3PO_4 = \frac{0.990}{380.2} = 2.6 \times 10^{-3}$ mol
- moles of $Ba_3(PO_4)_2 = 2.6 \times 10^{-3} \times \frac{1 \text{ mol } Ba_3(PO_4)_2}{2 \text{ mol } Na_3PO_4 \cdot 12H_2O}$

$= 1.30 \times 10^{-3}$ mol

Q: The solubility of $Ba_3(PO_4)_2$ is 0.519 mg/L. How many milligrams and moles of $Ba_3(PO_4)_2$ dissolve in 200 mL of solution?

- 0.519 mg —dissolve→ 1000 mL
  ?? ← 200 mL → (0.1038 mg / 200 mL)
- convert mg → g ⇝ / 1000 ⇝ 10.38×10^{-5} g
- moles $= \frac{10.38 \times 10^{-5}}{601.9} = 17.2 \times 10^{-8}$ mol
- molar mass $Ba_3(PO_4)_2$ = 601.9 g/mol.

3. Identify the purpose for washing the precipitate in part A.
- To get rid of all the excess reactant.

4. Answer the Following :

A. Describe how the weight of $Ba_3(PO_4)_2$ precipitate is determine in part A.
- we get it From the difference between the mass of substance befor and after the reaction (mass befer - mass after).

B. Describe how test your unknown salt mixture For the presence of excess $Na_3PO_4 \cdot 12H_2O$?
- to test it, add $BaCl_2 \cdot 2H_2O$ to the system, if Na_3PO_4 was present in the initial solution, a white amorpnous precipitate forms during the reaction with $BaCl_2$

C. what technique is use to flush $Ba_3(PO_4)_2$ precipitate From a beaher? How is it done?
- Gravity Filtration.

5. when 0.421 g of $BaCl_2 \cdot 2H_2O$ and 0.722 g of $Na_3PO_4 \cdot 12H_2O$ mix with water Forming 500 mL of solution, How many grams of $Ba_3(PO_4)_2$ precipitate?

$$2Na_3PO_4 \cdot 12H_2O + 3BaCl_2 \cdot 2H_2O \longrightarrow Ba_3(PO_4)_2$$

- molar mass . $Na_3PO_4 = 380.2$ g/mol
- molar mass . $BaCl_2 \cdot 2H_2O = 244.2$ g/mol
- molar mass . $Ba_3(PO_4)_2 = 601.9$ g/mol

- moles . $Na_3PO_4 \cdot 12H_2O = \frac{0.421}{380.2} = 1.10 \times 10^{-3}$ mol

- moles . $BaCl_2 \cdot 2H_2O = \frac{0.722\,g}{244.2} = 2.96 \times 10^{-3}$ mol

$BaCl_2 \cdot 2H_2O$

• Experiment 8 : Acid - Base Titrations.

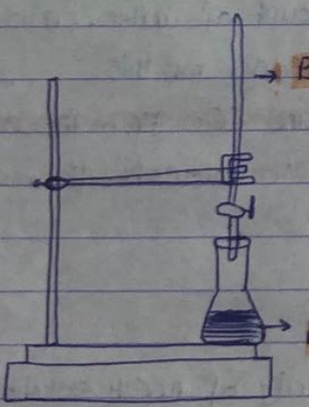
- objectives : 1. To standarize a sodium hydroxide solution.
2. To determine the percentage of acetic acid in a vinegar sample.
3. To determine the molar mass of an unknown acid.

- Titration :
is a type of analysis that allows us to measure the amount of solution required to react completely with another solution.

* Titration is classified as volumetric analysis.

- (titrant) : the solution is placed in a burette
- (analyte) : the solution is placed in another vessel such as an Erlenmeyerflask.

• we use indicator, which changes its color at the endpoint.



→ Buret containing base (or acid)

→ Acid (or base) and indicator.

• the indicator :
↳ Phenolphthalein.

• moles of acid = moles of Base (at endpoint)

$M_a \times V_a = M_b \times V_b$

• M : Molarity
• V : volume.

• Molarity of Base (M_b) = $\frac{\text{moles of base}}{\text{volume of base (L)}}$

* we cannot be prepared solution by weighing out solid NaOH
↳ Because it absorb water and CO_2.

- number of moles of acetic acid in vinegar = number of moles of standard NaOH.
  عدد مولات حمض الأسيتيك في الخل = عدد مولات هيدروكسيد الصوديوم القياسي
- moles of acitec acid = $\frac{\text{mass of acetic acid}}{\text{m.m of acetic acid}}$
- % of acetic acid in vinegar = $\frac{\text{mass of acetic acid}}{\text{mass of vinegar}} \times 100\%$
- mass of vinegar = volume (mL) x density (g/mL)

Q: List the sources of error, which might contribute to inaccurate experimental value for the percentage of acetic acid in the vinegar sample.

1. Misreading valuenes
2. Passing the endpoint
3. Error in calculating concentration
4. Not Paying attention to units during conversion.

Q: A 0.500 M standard solution of NaOH cannot be made up by weighing out solid NaOH and dissolving it in the correct amount of water. Thus, NaOH cannot serve as a primary standard, Suggest two reasons for this.

- Because it absorbs water and CO_2 From the atmosphere and therefore, it's difficult to calculate the exact concentration of NaOH.
- or may be not pure.

Q: How would your ~~calculation~~ calculated molarity of NaOH solution be affected (too high, too low or not change) by each of the following.

A) The burrette is not rinsed with the solution befor it is Filled.

- when we didn't rinse the burette befor we filled it, The ~~suspen substances~~ suspented substances will increase the volume, so the concentration will low

b) you go past the endpoint in the titration
- if we pass the endpoint, the volume will be too high so the concentration will be low.

c) some of acid solution splashes out of the Flask during the titration.
- the volume of the acid will be low, so the concentration of the NaOH will be high.

d) using water to rinse the inner sides of the Flask.
- The concentration will not change, because the moles of acid does not change so the acid will requrined the same volume of the base to reach the endpoint → no change

4.) suggest a reason why the molarity of NaOH solutions may change if the solution is exposed to air for an extended period of time.
- Because the solution may be absorb CO_2 and water vapor and react with them.

5.) suppose that you used oxalic acid, $H_2C_2O_4$ instead of standard HCl solution and you prepare a standard solution of oxalic acid by weighing out individual sample. if you dissolve 3.00g of oxalic acid in 100 mL of water.

A) what would be the molarity of the acid in the solution?

. molarity = $\frac{\text{moles}}{\text{volum}} = \frac{0.033}{100\times10^{-3}}$

$= 0.33\ M$

. molar mass $H_2C_2O_4 = 90.03\ g/mol$

. moles . $H_2C_2O_4 = \frac{3.00}{90.03} = 0.033$

B) what would be the molarity of NaOH solution if 25 mL of the base were required to neutralize 30.00 mL of the standard oxalic acid solution.

$H_2C_2O_4 + 2NaOH \longrightarrow Na_2C_2O_4 + 2H_2O$

moles . $H_2C_2O_4 = M \times V = 0.33 \times 0.03 = 0.0099$ mol

moles . $NaOH = 0.0099 \times 2 = 0.0198$ mol

. Molarity = $\frac{\text{moles}}{\text{volume}} = \frac{0.0198}{0.025} = 0.792\ M.$

- Experiment 9: Oxidation - Reduction Titration.
  - objectives: 1. standardization of $KMnO_4$ solution.
    2. Determination of the molar mass of unknown reducing agent.

- Oxidation reduction reaction:
  - the reactions in which there is a net change in the oxidation numbers of one or more elements in the ~~reaction~~ reacting substances.

* Oxidation and reduction go together
  - if oxidation occurs, there ~~are~~ must be an accompanying reduction.

- ~~Oxid~~
- ~~Ex~~ Oxidizing agent: is one that gains electrons (being reduced).

- reducing agent: is one that loses electrons (being oxidized).

* The common oxidizing agents:
  1. permanganate ion
  2. chromate ion
  3. dichromate ion.

- in our experiment:
  - Oxidizing agent ⇝ potassium permanganate. ($KMnO_4$)
  - Oxalate ion ⇝ reducing agent ($C_2O_4^{-2}$).

$$16\,H^+ + 2\,MnO_4^- + 5\,C_2O_4^{-2} \longrightarrow 2\,Mn^{+2} + 10\,CO_2 + 8\,H_2O$$

- $8H^+ + MnO_4^- + 5e^- \longrightarrow Mn^{+2} + 4\,H_2O$
- $C_2O_4^{-2} \longrightarrow 2CO_2 + 2e^-$

Mn^{+7} (purple) → Mn^{+2} (colorless)

Calculations:

From the above balanced ionicoverall reaction, it is clear that 2mol of $KMnO_4$ react with 5 mol of oxalic acid.

To determine the molarity of $KMnO_4$ solution

At the end point:

$$\#\text{ moles of } KMnO_4 = \frac{2}{5} \times \#\text{ moles of oxalic acid.}$$

$$M_{(KMnO4)} \times V_{(KMnO4)}(\text{liter}) = \frac{2}{5} \times \frac{\text{mass of oxalic acid}}{\text{molar mass of oxalic acid}}$$

To determine the molar mass of an unknown reducing agent

At the end point:

$$\#\text{ moles of } KMnO_4 = \frac{2}{5} \times \#\text{ moles of unknown oxalate salt}$$

$$M_{(KMnO4)} \times VKMnO4(\text{liter}) = \frac{2}{5} \times \left(\frac{\text{mass of unknown oxalate salt}}{\text{molar mass of unknown oxalate salt}}\right)$$

Q: How is oxalic acid versus NaOH different From oxalic acid versus $KMnO_4$ titration?

- in NaOH titration is a acid-base titration, but in $KMnO_4$ titration is a oxidation-Reduction titration.
- and in NaOH titration we need indicator (Phenolphthalin) but in this titration we didn't need to use it, because the $KMnO_4$ is an indicator.

Q: why a brown turbidity is (some times) might be found in titration ($KMnO_4$) solution with oxalic ion.

- Because we didn't stir the solution enugh "slowly" so the precipetate apper (MnO_2)

Q: what type of indicator would you use For the redox titration of Potassium permanganate and Fe^{+2} ion?

- There is no need to use indicator. Because permanganate is the indicator.

• Experiment 13 : Determination of the composition of sodium Bicarbonate by Gas Evolution Analysis.

- objectives : 1. To determine the percentage composition of $NaHCO_3$ sample.

" $2NaHCO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + 2CO_2 + 2H_2O$,

analyzed quantitatively

& by measuring the amount of evolved carbon dioxide.

* is decomposed by acid treatment ⇝ [illegible]

- The weight of pure ~~NaOH~~ $NaHCO_3$ in the original sample is determined From the weight of one of the decomposition products

↓

one of them is gas / (CO_2)

* ~~if we measurement~~

if we measure the volume of CO_2 , temperature , pressure

we can calculate the number of moles

$PV = nRT$ ⇝ $n = PV/RT$ * $R = 0.0821\ L.atm/mol.K$

From the equation ⇝ moles of CO_2 = moles of $NaHCO_3$ in the orginal sample

• CO_2 is collected over water ⇝ $P_{atm} = P_{CO_2} + P_{water\ vapor}$.

* corrected volume of carbon dioxide (mL) = $(V_2 - V_1) - V_{H_2SO_4}$

Q: List the possible sources of errors in this experiment and suggest possible methods to avoid them.

1. water level in both the buret and the leveling bulb is not coincide, so we have to be careful to be coincide.
2. Presence of leaks due to disconstancy of the meniscus at various positions on the leveling bulb, so you should check that.

Q: what is the advantage of using a leveling bulb?

- The opening allows the water in the system to be exposed to the atmospheric pressure in the lab. The leveling bulb is filled with water, and the water moves through the hose to fill the buret. As gas is produced, the water will be pushed out of the buret into the leveling bulb thus preventing excess pressure build up.

Q: Instead of using water in the buret and the leveling bulb, one could use mercury, what are the advantages and disadvantages of the use of mercury?

- Mercury is a highly toxic element and has been banned from use in most applications that require human contact. water does an adequate job in the determining level.

Q: Use the following data obtained in the analysis of a sodium bicarbonate tablet to calculate the mass % $NaHCO_3$ in the tablet.

- mass. tablet = 1.973 g
- V_{CO_2} evolved = 314 mL
- vapor pressure of water = 20 mmHg
- Barometric pressure = 725 mmHg
- m.m $NaHCO_3$ = 83.998 g/mol

* $P_{CO_2} = 725 - 20 = 705$ mmHg $\rightsquigarrow$ /760 = 0.927 atm
* $n = PV/RT = 0.01202$ mol $\rightsquigarrow$ moles CO_2 = moles $NaHCO_3$
* mass. $NaHCO_3 = 0.01202 \times 83.998 = 1.0095$ g $\rightsquigarrow$ % m. $NaHCO_3 = \frac{1.0095}{1.973} = 51.16\%$.

- Experiment 14 : Calorimetry and Heats of Reaction

- objectives : 1. To determine the heat capacity of a calorimeter.
2. ~~To determine the heat~~
2. to use the calorimeter to determine :
a. The specific heat of a metal.
b. The heat of neutralization of a reaction between an acid and Base.

- exothermic : a chemical reaction which releases heat.
↓
- the temperature of the reaction mixture rises
- the potential energy of the chemicals involved in the reaction decreases

* if the temperature of the reaction mixture drops
↳ then heat must be supplied to the mixture ⇝ endothermic

- Total energy (kinetic and potential) ⇝ constant

in exothermic :
- potential energy drops
- kinetic energy increases

- At constant pressure ⇝ $\Delta H = H_F - H_i$

* ΔH = specific heat x mass x ΔT ⇝ $\Delta H = C \times m \times \Delta T$

- specific heat : the amount of heat needed to raise the temperature of 1g of a substance by 1°C

- S.h / water (relatively large) = 4.18 J/g°C or 1 cal/g.°C

- The molar heat, ΔH (cal / mole) = $\frac{\Delta H \text{ (cal)} \times MW \text{ (g/mol)}}{\text{mass}}$

⊛ Heat capacity of the calorimeter.

Heat lost (water) = Heat gained (water + calorimeter)

⊛ ~~Heat~~ specific heat of copper

Heat lost (copper) = Heat gained (calorimeter + water)

⊛ Heat of neutralization.

ΔH = (heat capacity of calorimeter) $\times \Delta T$ + V * D $\times \Delta T$ $\times$ specific heat.

Q: The described procedure has several assumptions that may lead to wrong results. what are these assumptions? How can you improve the results?

- The key to all calorimetry experiments is the assumption that there are no heat exchange between the insulated calorimeter and the room.

Q: If a substantial amount of heat is lost to the surroundings, how will this affect the experimental value of ΔH?

- The calculated of ΔH would increase, because the heat lost to the air will cause the value of ΔT to be smaller.