INDEX

loo.

OCT ·09· 2019

BASIC LABORATORY

1 objectives

- To light and properly adjust the flame of a Bunsen burner.
- To develop the skill for properly operating a balance.
- To develop the technique of using a pipet.
- To determine the density of an unkown substance.

2 techniques

4 technique 4. Disposing of Chemicals.

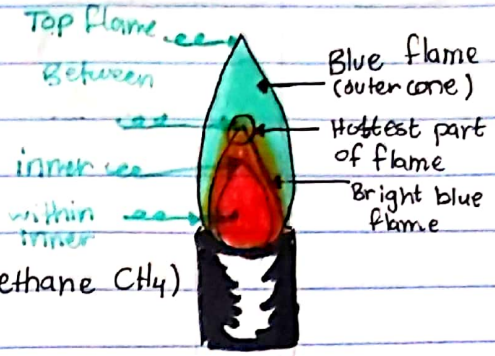
6 technique 6. Measuring Mass.

16a A. Reading and Recording a Meniscus, the volume of aliquid is read at the bottom of its meniscus.

16b B. Pipetting a Liquid. Draw the liquid into the pipet with the aid of a rubber pipet bulb (not the mouth!)

- Control the delivery of the liquid from the pipet with the fore finger (not the thumb).
- Deliver the liquid from the pipet with the tip touching the wall of the receiving flask.
- Do not blow or shake out the last bit of liquid that remains in the tip: this liquid has been included in the calibration of the pipet.

3 Bunsen burner



gas used ⇨ Natural gas.
mixture of hydrocarbons (methane CH_4)

blue, nonluminous flame ⇨ sufficient oxygen

yellow luminous flame ⇨ insufficient supply of oxygen, small carbon particles.
"Incandescence"

4 Balance

Types:-
- Triple-beam
- top-loading
- Analytical

Density:-
- instensive properties.
- mass / volume
- g/cm³ for solids, g/ml for liquid, g/L for gases.

1. Water-Insoluble solid.
   - half-fill graduated cylinder with water and record volume
   - slid the solid into the same g.cy. and difference between the two water levels "this difference ⇨ volume of solid"

PHYSICAL propeties

Oct 16

Techniques

(13) To avoid the problem of bumping (bubbles), place aglass rod and/or several boiling chips.

Introduction

more common physical propeties "color, odor, density, solubility, melting point boiling point".

one Layer (ذوبان كلي)
two = (غير ذائب)
tarbid = (ذوبان جزئي)

∴AND∴

Solubility

• Like dissolve Like, i.e. polar + polar → H_2O + ethanol

NP + NP → benzene + Toluene

تعريف. maximum mass of the substances that dissolves in a fixed mass of solvent at a given temperature.

Density

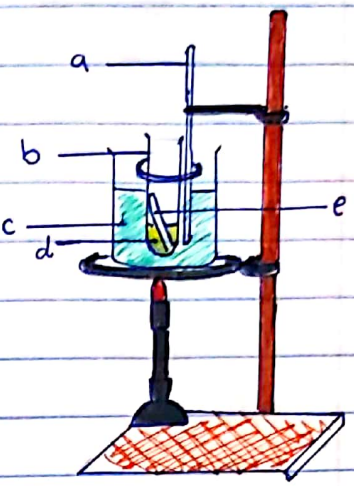
• mass per unit volume substances.

Boiling point

• Two factors affect the value of Boiling point :-

- Molecular weight ↑ → B.p ↑
- Intermolecular forces
  - Dipole Dipole (strong polar) «H_2O-C_2H_5OH»
  - H-bond
  - London Forces (weak) (Non polar) «CCl_4, SF_6, C_6H_6»

a. Thermometer
b. test tube
c. bath water
d. Unkown liquid
e. Capillary tube



* when a rapid and continuous stream bubbles escapes the capillary tube discontinue heating water Bath.

* when the bubbles cease to escape and before the liquid re-enters the capillary tube, record the temperature.

If the boiling point is recorded when bubbles are rapidly escaping the capillary tube, will it be recorded too high OR too low?

« too high »

If the b.p is recored after the liquid enters the capillary tube (after the heat is removed), will it be recorded too high OR too low?

« too low »

CHEMICAL properties

23 OCT

techiques

17a Testing for Oder, Never hold your nose directly over a vessel. Fan some vaper toward your nose.

Introduction

substance: pure element or cpd, having a unique set of chemical and physical properties

Observation of Chemical Reaction

① Evalution of gases (Bubbles, vapor)

e.g.

① $Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2CO_3$

unstable so, decompose to

$CO_{2(g)} + H_2O_{(l)}$

↑ gas without odor

② $NH_4Cl + NaOH \longrightarrow NaCl + NH_4(OH) \longrightarrow NH_{3(g)} + H_2O_{(l)}$

(need warm up), ← gas with odor

يحتاج الى حرارة ليتحول.

② Formation of precipitate (ppt) (solid)

e.g.

$Ba(NO_3)_2 + K_2CrO_4 \longrightarrow 2KNO_3 + BaCrO_{4(s)}$

↑ ppt

$AgNO_3 + NaCl \longrightarrow NaNO_3 + AgCl_{(s)}$

↑ white ppt

③ Temperature → is evolved (Exothermic , $\Delta H = -$)
→ absorbed Endothermic , $\Delta H = +$)

e.g. $C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O + Heat$

$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O + Heat$

④ Color Change

compound dissolved is water :-

Sodium chloride	$NaCl_{(aq)}$
Sodium carbonate	Na_2CO_3
Sodium sulfate	Na_2SO_4
Barium chloride	$BaCl_2$
Zinc sulfate	$ZnSO_4$
Ammonium chloride	NH_4Cl
Water	H_2O

(Reagents) ⇐ soild chemical or solution having a known concentration of solute.

المواد التالية تعتبر كاشف للمواد السابقة :-

Silver nitrate	$AgNO_3$
Barium nitrate	$Ba(NO_3)_2$
Sodium hydroxide	$NaOH$
Sulfuric acid	H_2SO_4

اختصارات المشاهدات ⇐

p → precipitate + color
c → cloudy
nr → no reaction
g → gas , no color
go → gas + odor

Limiting Reactant

23 OCT

Techniques

11b preparing filter paper for a filter funnel :- If a solid is to be separated from liquid using filtering process.

11c Gravity Filtration :- Always keep the funnel stem full with the filtrate.

11e Vacuum Filtration :- used, filter flask, Büchner funnel, filter paper. Once the filter paper is sealed, turn the water fauct attached to the aspirator completely open to create a full suction. Transfer the mixture to the filter and wash the ptt. with an apporpriate liquid. To remove the suction first disconnect the hose from the filter flask, and then turn off the water.

15a Heating in a Drying Oven.

Introduction

$A + B \longrightarrow C + D$

1mol	1mol	1mol	1mol	Stoichiometric
2mol	2mol	2mol	2mol	Mol Ratio
0.5mol	1mol	0.5mol	05mol	Non-stoichiumetic

- Limiting Reactant (L.R) consumed completely تتفاعل بشكل كامل
- Excess Reactant (E.R) تتفاعل
  - reacted « L.R »
  - unreacted « لم تتفاعل »

Experimental تجريبياً

Perecent yield = $\frac{\text{Actual yield}}{\text{Theoretical}} \times 100\%$

Actual الفعلي → Theortical النظري

Theoretical ← Calculation حسابياً

Reaction $BaCl_2 \cdot 2H_2O_{(aq)} + Na_2SO_{4(aq)} \rightarrow 2NaCl_{(aq)} + BaSO_{4(s)} + 2H_2O_{(l)}$

I. Molecular Equation

$Ba^{+2} + 2Cl^- + 2H_2O + 2Na^+ + SO_4^{-2} \rightarrow 2Na^+ + 2Cl^- + BaSO_{4(s)} + H_2O$

II. Complete Ionic Eq.

III. Net Ionic Eq. $Ba^{+2} + SO_4^{-2} \rightarrow BaSO_{4(s)}$

example :-

$2Na_3(PO_4)_2 \cdot 12H_2O_{(aq)} + 3BaCl_2 \cdot 2H_2O_{(aq)} \rightarrow Ba_3(PO_4)_{2(s)} + 6NaCl_{(aq)} + 30H_2O_{(l)}$

Net ionic → $2PO_4^{3-}{}_{(aq)} + 3Ba^{2+}{}_{(aq)} \rightarrow Ba(PO_4)_{2(s)}$

? A 0.942 g sample of the salt mixture is added to water and 0.188 g of $Ba_3(PO_4)_2$ precipitate forms. what is the percent ?

$0.188\ g\ Ba_3(PO_4)_2 * \frac{1\ mol\ Ba_3(PO_4)_2}{601.93\ g} * \frac{3\ mol\ Ba^{2+}}{1\ mol\ Ba_3(PO_4)_2} * \frac{1\ mol\ BaCl_2 \cdot 2H_2O}{1\ mol\ Ba^{2+}} * \frac{244.27\ g\ BaCl_2}{1\ mol\ BaCl_2 \cdot 2H_2O}$

$= 0.229\ g\ BaCl_2 \cdot 2H_2O$

$\Rightarrow \frac{0.229}{0.942} \times 100\% = 24.3\%$ "$BaCl_2 \cdot 2H_2O$"

لإيجاد ما هو « L.R » :-

① كتابة عدد المولات المعطاة في السؤال
② كتابة عدد المولات المعطاة في المعادلة
③ قسمة ① / ②
④ الأقل ناتج قسمة هو L.R
⑤ mole-mole analysis

example

Q1:- 5 moles of A reacts with 20 mole of B calculate the no. of moles of C formed.

$$A + 2B \longrightarrow C$$

	A	2B	C
no of moles	5moles	20mole	?
S.C (عدد المولات الموجودة في المعادلة)	1	2	1
Ratio	5/1 = 5	20/2 = 10	?
	⇩ الأقل L.R		

mole-mole analysis

$$\frac{\text{Ratios of L.R}}{5} = \frac{\text{Ratio product}}{C}$$

$$\frac{5}{1} = \frac{C}{1} \Rightarrow \text{no. moles C} = 5 \text{ moles}$$

Q2: 56g of N_2 reacts with 30g of H_2 to form NH_3. calculate the no. of moles of NH_3 formed.

تحويل من g الى mol

$$N_2 = \frac{56}{28} = 2 \text{ mol}$$

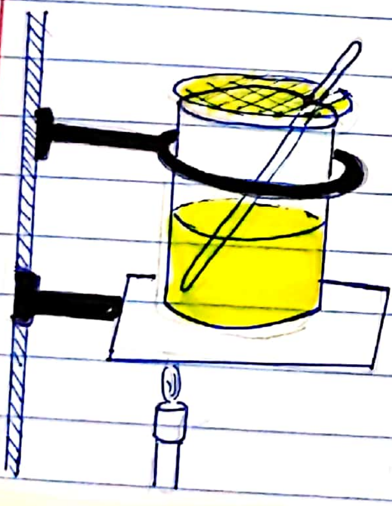
$$H_2 = \frac{30}{2} = 15 \text{ mol}$$, then ...

	N_2	+ $3H_2$	→ $2NH_3$
No. of mole	2	15	?
S.C	1	3	2
ratio	2/1 = (2) ⇩ L.R	15/3 = 5 E.R	?

$$\frac{no.\ N_2}{1} = \frac{no.\ NH_3}{2} \rightarrow \frac{2}{1} = \frac{no.\ NH_3}{2}$$

→ **no. NH_3 = 4 mols**

Experimental

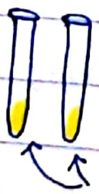


بعد الإضافة و وضع على النار "الفيفة :^^:"
عملية ال heat تسمى " Digesting "

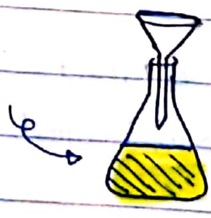
so,

Digesting :- heat under 30min before the boiling , to get alarge and pure particles at cool flame.

* معرفة L.R علية نأخذ المادة بعد 30min ونعمل (simple Filtation)
ونأخذ المادة من (E.F) والتي تسمى " supernatant "



supernatant



① drops of supernatant
② drops of $BaCl_2$ OR Na_2SO_4

المادة التي تعطي عكورة هي ⇐ L.R
تكون نقية هي ⇐ excess. R

ACID AND BASE

wednesday
06

Techniques

7a. Small test tubes are the chemist's choice for handling small volumes

12. Venting Gases, Removing gases from achemical reaction should be accomplished in a fume hood.

17b Testing for Acidity/Basicity, with test paper, insert a clean stirring rod into the solution. For litmus paper
acidic (blue → red)
baseic (red → blue).
* Never place the test paper directly into solution.

Introduction

Stoichometry: a study of a chemical reaction using a balanced equation

Acidic solutions :-
- sour, tart taste
- cause a pricking sensation on the skin
- turn blue litmus red.
- produce hydronium ion H_3O^+
- e.g. sulfuric acid, H_2SO_4, adiprotic acid producing H_3O^+ in two step.
- Hydrochloric acid (HCl), nitric acid (HNO_3), phosphoric acid [inorganic acid]
- Vinegar, citric acid, ascorbic acid, vitamin C [Organic acid]
- $NH_4^+ + H_2O \rightarrow NH_3 + H_3O^+$

$Fe(H_2O)^{3+} + H_2O \rightarrow FeOH^{2+} + H_3O^+$.

Basic solutions

- bitter taste
- slippery to the touch.
- turn red litmus blue.
- produce hydroxide ion (OH^-)
- $NH_3 + H_2O \longrightarrow NH_4^+ + OH^-$

  $NaOH \longrightarrow Na^+ + OH^-$
- using at cleaner, [lye or caustic soda], [calcium hydroxide, slaked lime], [potassium hydroxide, caustic potash] [magnesium hydroxide, milk magnesia].

- $pH = -\log [H_3O^+]$

- كيفية قياس pH :-

  ① Litmus paper

  ② Universal indicator

Acids And Bases

Report sheet →

Part (A)

① the effects Acids (HCl, H_3PO_4, CH_3COOH) For metals (Mg, Zn, Cu)

Names of Acids:-

HCl ↓ Hydrochloric Acid

H_3PO_4 ↓ phosphoric acid

CH_3COOH ↓ Acetic Acid

procedure:-

1> Add 20 drops from Acids in test tube

2> Add metals for each test tube.

3> Recorde the rate of reaction.

the gas released ⇒ H_2

② Effects [concentration] for the Reaction Rate.

Rxn. Rate ↑ ← [ ] ↑ لأن

• • ↑ ← time ↓

1M HCl < 2M HCl < 6M HCl

1M CH_3COOH < 2M CH_3COOH < 6M CH_3COOH

but :- 1M HCl 6 M CH_3COOH ,why?

لأن strong Acid

part (B) :-

1> Rxn $NaOH_{aq}$ + Acid
Hcl

$NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(s)} + H_2O$

Neutral

تحديد وسطية التفاعل (هل هو قاعدي او حمضي؟)

(litmus test) pH meter من خلال ⇐ هو متعادل

⇐ تفاعل حمض قوي مع قاعدة قوية ⇐ ملح + ماء.
(متعادل)

pH = 7

2> Dissolution of NaOH :-

$NaOH \xrightarrow{H_2O} NaOH_{(aq)} + H_2O + Heat$
S.Base

3> Dissolution of Na_2CO_3 :- (salt)

$Na_2CO_3 + H_2O \rightarrow NaOH + HCO_3^-$

Basic Solution

Hydrolysis ⇒ (الإذابة في الماء)

part (C) :- PH

Acid Base
0 7 14

الجدول للحفظ

HCl
CH_3COOH + Indecator بتتبع اللون — الجدول
NaOH
NH_3

Boiled
dis + Indector
Tap

Scanned by CamScanner

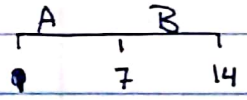
ANTACID

techiques

.16c. Titration a/liquid. , Record the volume "Read the volume in the buret using all certain digits (0.00)

introdution

pH → Acidic solution have pH less than (7)
→ Basic solution have pH greater than (7)



- Antiacid $\xrightarrow[\text{or}]{\text{is}}$ Base
- Acid.s + Base.s → salt + H_2O + Heat

↳ $NaOH + HCl \longrightarrow \underset{(aq)}{NaCl} + \underset{(l)}{H_2O} + Heat$

Net ionic equation: $H^+ + OH^- \longrightarrow H_2O$ $\quad K_w = 10^{-14}$

$$pH = -\log[H^+]$$

- at equivalence ponit ⇒ $[H^+] = [OH^-]$

e.g.

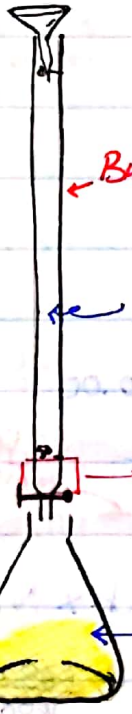
- $Mg(OH)_2 + 2HCl \longrightarrow MgCl_2 + 2H_2O$
- $Al(OH)_3 + 3HCl \longrightarrow AlCl_3 + 3H_2O$

EXP 6

Antiacid

*Experimental

⇒ Name of Method :- Back titration.



حساب الحجم من الاعلى
like :-
Initial . Volume = 0.00
3. digits

Buttette

(50 – 0) درجة

NaOH (0.098M)

غير مدرجة يجب الانتباه اليها .

Erlemayer . F

titrant

(0.01M)

⑤ titration with NaOH
until → Blue

* افضل كتابة دقيقة لقياس ال volume هي (0.00)
↳ (3 digits).

* اذا كان فيه فائض (surplus) نضفه في Beaker ولا ترجعه الى Original Bottel

① mass of Anti acid = (0.1 – 0.15)g

② 30 ml HCl (0.1M)
(Acurate .Voulme) → Buttette . use Another

③ Boil to 2min
↳ Cause ?! to release (CO_2) remove
+ cooling in sink (tap .w)

④ Add the indicator ((Bromophenole Blue))
(5-6 drops)

Acid → Yallow
Base → Blue

في E.F ← يكون الوسط الحمضي فنضيف قطرات indicator ← يصبح اللون اصفر .

* A ⇒ Different between Endpoint and Equivelent point.

Endpoint: ظهور اللون التي تحدد من المختبر

Before the endpoint: « تضاف عدد مولات » وهي مختبرياً مهمة التحديد

« 2 trail »

* Calculation :-

report sheet:-

③ mass of Anti acid =

④ volume HCl Adeled

⑤ Molarity of HCl = 0.1 M

⑥ = NaOH = 0.098 M

⑦ Burette reading inital = 0.00

⑧ = = Final = — (نفرض نطلع هنا اقل من 30 ml)

⑨ volume NaOH = F - I

⑩ # Mole HCl = M HCl × V(L) HCl (حجم جزء التحويل)

= 0.1 × (30)/1000

⑪ # mole NaOH = M NaOH × V(L) NaOH

0.098 × —

⑫ #mole Anti = # M HCl - #M NaOH

⑬ mole per gram = mole Anti / mass Anti (بالبداية) (0.1 - 0.15)

#mole = mass / M.M

= M * V

#mol Acid = #mol Base

HCl → NaOH → Anti acid

-17-

EXP "7"

« Molar Mass of a volatile liquid »

volatile liquid ⇒ Flamable (B.P < 100°C)

* Objective :-

To determine the molar mass [molecular weight) of volatile liquid

* Theory :-

In this experiment the molar mass of a low boiling-point liquid is determined by the [Dumas Method]

Dumas Method the procedure involves vaporizing the liquid into a fixed-volume vessel at a measured temp and barometric -P-

ideal gas equ :-

$$n_{vapor} = \frac{PV}{RT}$$

all this ideal gas but !?...

P → pressure (atm)

V → volume (L)

R → gas constant (L·atm / mol·k)

T → Temperature (k)

then, $n_{vapor} = \frac{mass\ v}{M.M_{com}} \rightarrow M.M = \frac{mass}{n}$

but!?... For real gas { has intermolecular Force + has molecular volume

so,

use 'der Waals eqn'

$$\left(P + \frac{n^2}{V^2}a\right)(V - nb) = nRT$$

Experimental constant

a ⇒ refes to intermolecular forces

b ⇒ " " volume of molecules

Table(3.1)

unit :- b = L/mol

a = $(L^2 \cdot atm)/mol^2$

*Experimental

① clean + dry 125-ml E.F
② Add 6ml of the untown to E.F
③ cover by Al. + rubber
④ with a pin, pierce the Al. Foil several times.
⑤ prepare Boiling (w. Bath)
⑥ AFter 5min from boiling water Bath all untown liquid convent to vapor, at this sured Point, record the temp.

⑦ weight the Flask +Al.foil, with sured drying the F. and remove rubber.

⑧ volume Flask, fill the Flask to the brim and tranfering the .w. to graduated cylinder, record the .V.

⑨ calculation ... ^^

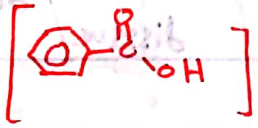
technique لا يوجد داعي لكتابة
لانها مكررة.

EXP "8"

"Recrystallization"

objectives :-

1. select the suitable solvent for recrystallization
2. Recrystallization of a unkown compound (Benzoic acid)



Theory :-

purification by recrystallization depends on the following facts :-

two things!

1. Different solids have different solubilities in a given solvent.
مواد صلبة مختلفة ← لها ذوبان مختلف بنفس المذيب
2. Most solids are more soluble in hot than in cold solvents.
مواد صلبة ← تذوب في مذيب ساخن وتكون أقل ذوباناً عند مذيب بارد

Figure (3.1)

Impurities in a solid 2 kinds:-

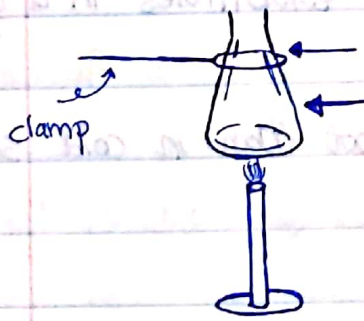
1. Soluble ⇒ remain dissolved in cold saturated solution after ppt. of the desired compd.
2. insoluble ⇒ Removed by gravity filtration of hot solution.

procedure 3-

1. selection of a suitable solvent :-

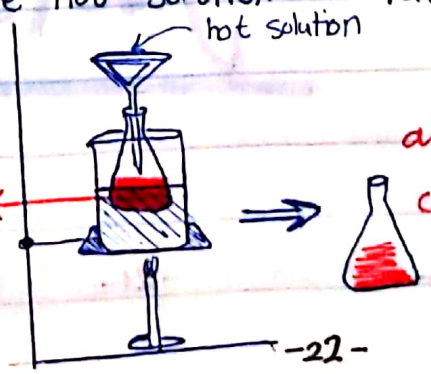
asuitable (ideal solvent) → cold (did not dissolve) / hot (dissolve)

2. preparation of the hot solution and «decolorization»



① Add 1g of crude (% Benzoic acid + % charcoal)
② Add 30ml of ideal solvent (water)
③ boil.

3. Filtration of the hot solution to remove impurities by hot simple filtration.



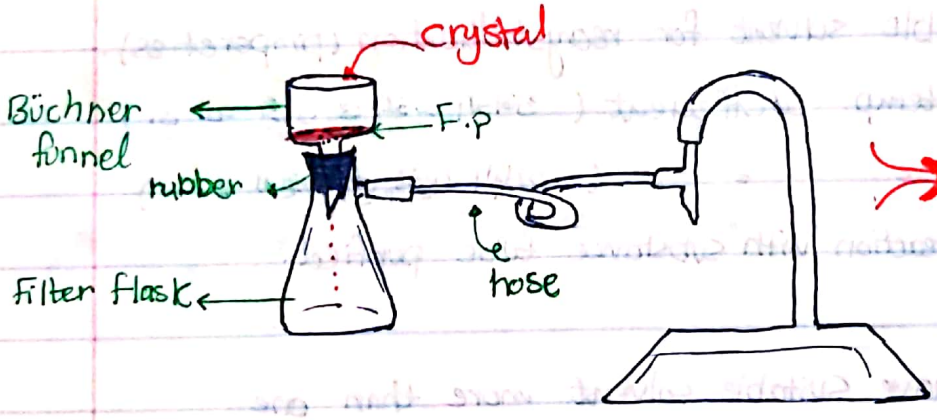
allowed the supernatant to cool down to R.T, until a large amount of crystals has formed

④ Cooling :-

-the mixture finally chilled in ice to complete crystallization

⑤ Collecting and drying of crystals

↳ by suction filtration (cold)



→ dry the F.P + crystal in oven

*Latic energy (L.E)

OR Enthalpy of crystallin solid.

↠ Energy of formation of acrystal for infinitely separations.

e.g. $Na^+_{(g)} + Cl^-_{(g)} \longrightarrow NaCl_{(s)}$ $\Delta H_l = -786$ kg/mol

i.e High L.E energy indicates a high melting point.

* A suitable solvent for recrystallization (properetries):-

① high temp coeffecient (اي انه يذوب في السخين الداضع)

② low = = (= = لا يذوب في السخين البارد)

③ Not reaction with substance tube purified.

∴ If you have suitable solvent more than one

نختار ← الاقل تكلفة (Cheap)، اقل سمية (less toxic)

4/Dec

Exp "9"

Melting point (m.p) ⇒ Identify and purity of solid cpd.

*Objects :-

1. Determing the m.p of pure solid.
2. = = = = impure solid [mix (soluble, In)]
3. Identify an unknown from it's m.p

*Theory :-

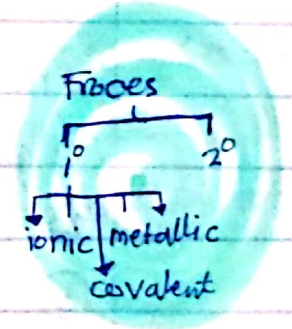
➢ S $\xrightarrow[\text{Freezing}]{\text{heat}}$ l at atmopheric pressure [m.p لا يؤثر على] صبا اختلف .

➢ Factors of that affecting m.p :-

I] Intermolecular Forces (stronger ↑ → m.p ↑)

types of 2° forces -

1. H-bond
2. Dipole - Dipole
3. london Forces



- pure solid has a sharp m.p and will melt within a narrow range of (0.1-1)°C

- soluble impurities affect the m.p of a solid
  - decrease with broad rang of m.p (2-20)°C

- Insoluble impurities such as(glass, sand....)
  - don't affect the m.p (m.p rang).

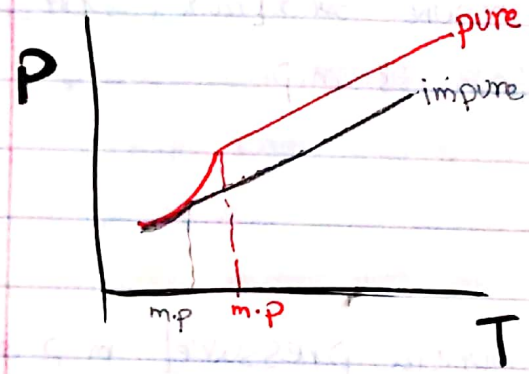


Fig (1.12)

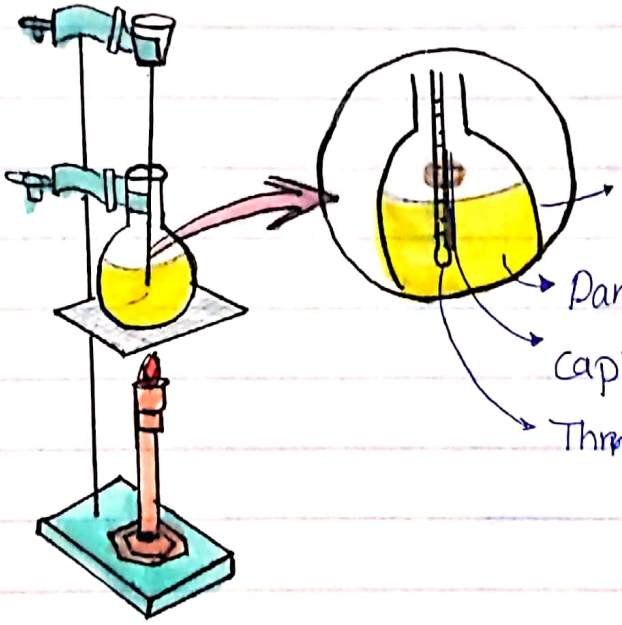
- Q in (62) ⇒ Important

*m.p range is affected :-

1. purity
2. particle size
3. Amount of material cpd
4. Density of packing in the capillary tube
5. Theckness of capillary tube
6. Rate of heating (oil Bath)

*Experimental 8-

set up the Apparatus m.p :-



? why use (paraffin oil) Bath and not a water Bath?

m.p of unknown solid is more than 100°C., so we don't use water bath because it will boil before the melting of the material, but the oil is slow to boil.