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ملخص :

اساسيات كيمياء عملية

للطالبة : سلسبيل خليل

اللجنة الأكاديمية لقسم الهندسة الصناعية

2023

Read the following safety rules before going into the laboratory and abide by them.

Wear safety glasses at all times. Prescription glasses are adequate but contact lenses are not adequate.

1- Always wear your laboratory coat. Do not wear clothing that hinders free movement of your hands or hangs loose outside your laboratory coat.

2- Do not work in a laboratory if no lecturer or technician is present. Read the experimental instructions carefully before starting the work. Especially note any precautions that must be taken.

3- Never eat, drink, or smoke in the laboratory. Never taste chemicals. Wash your hands well before leaving the laboratory. Also, wash your hands or any part of your body immediately with water when it comes in contact with chemicals.

4- Do not use your mouth to fill a pipette. There are special bulbs for this purpose.

5- Note the position of safety equipment like fire extinguishers, eye washers, and first aid boxes. Report all accidents immediately to a staff member or technician.

6- Use the fume hood when handling strong-smelling or irritating chemicals.

7- Be careful about discarding away wastes.Always follow instructions.

Do not dispose of solids into the sink. Do not leave glassware or any other solid materials, including filter papers, in the sink. Put broken glassware into the labeled buckets.

Some waste liquids must be stored into special bottles, not disposed of in the sink. A staff member or technician will help you.

8- Do not leave a lit burner unattended. Always stay clear form the flame.

9- When heating anything in a test tube, do not point the mouth of the test tube towards yourself or towards any other person.

10- Before leaving the laboratory turn off any water taps and burners and dispose of solid waste in the correct container. Also, wash all apparatus used and clean up the bench top.

11- Keep your bench clean and tidy while you are working. Clean up any spills or broken glass immediately. Keep your books and papers away from water, chemicals, and flames. Position your apparatus on the bench so that it is convenient and comfortable to use. Keep unused equipment out of the way, so that you do not knock it over.

12- If you are in any doubt about anything, ask the staff member or technician for advice.

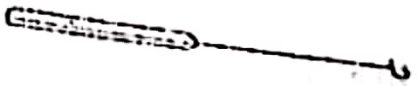
13- Request the assistance of your instructor/technician if and when you suffer a cut or a burn **or face a dangerous** situation.

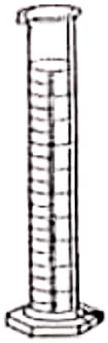
SOME LABORATORY APPARATUS


Beaker


Büchner funnel

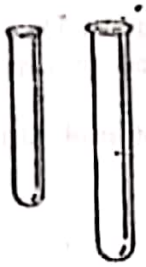

Funnel


Glass rod with platinum wire (for flame testing)


Graduated cylinder


Erlenmeyer flask


Dropping bottle

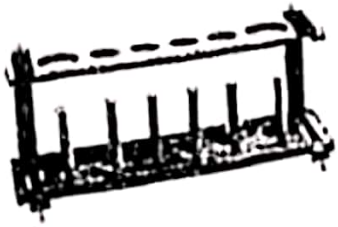

Test tubes


Bunsen burner


Stirring rod


Dropper


Safety glasses (Goggles)


Test tube rack


Plastic wash bottle

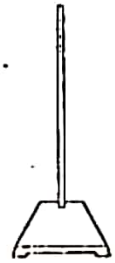

Clamp holder


Volumetric flask


Burette


Tripod


Condenser

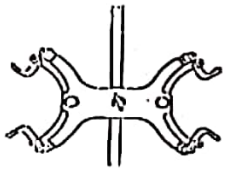

Stand

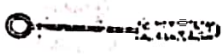

Crucible


Volumetric pipette


Reagent bottle


Pipette filler


Burette clamp


Test tube brush


Metal spatula

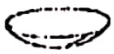

Test tube holder


Ring clamp


Ceramic square


Forceps


Wire gauze


Watch glass


Crucible tongs

Accuracy of tools :- دقة الأدوات

- pipette → الأعلى دقة
- Burette
- volumetric flask
- Graduated cylinder
- Beaker
- Erlenmeyer flask. → الأقل دقة

- pipette / Burette → used to transfer liqued with high accuracy.
- Graduated cylinder → used to transfer liqued with Low accuracy
- volumetric flask → used to prepare soulation with high accuracy
- Erlenmeyer flask → for titration with Swirling
- Beaker → for reactions

II - weighing :-

- Balance :-

A - one decimal (0,0)

Ex *4,0 g ± 0,1

*7,0 g ± 0,1

B - Tow decimal (0,00)

Ex 6,00 g ± 0,01

مرتين 11,05 g ± ,01

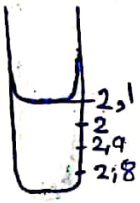
C - Three decimal

Ex 11,005 g ± ,001

6,004 g ± ,001

[2]- Volumes, Length and Thermometer:-

Uncertainly = $\frac{\text{Calibration}}{2}$ ← تدريج

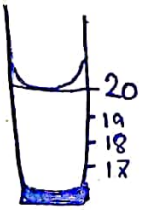


$un = \frac{\text{ا}1}{2} = \underline{\underline{,05}}$ ↘

لضعفها العزادة

$2,1\underline{0} \pm ,05$

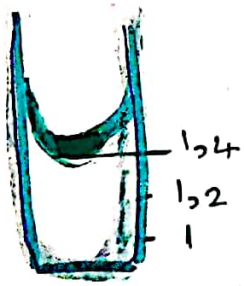
(zero) 0 ← يجب إضافة



$un = \frac{1}{2} = ,5$

$20,0 \pm ,5$

Ex



$un = \frac{,2}{2} = ,1$

$1,40 \pm ,1$

Experiment(2) :-

Empirical Formula of a Compound:-

The Main RXN: $Mg + O_2 \longrightarrow Mg_x O_y$

The Side RXN :- $3\,Mg_{(s)} + N_{2(g)} \longrightarrow Mg_3N_2$ → نايتريد

- يجب التخلص من النايتريدات عن طريق إضافة H_2O

$Mg_3N_2 + 6\,H_2O \longrightarrow 3\,Mg(OH)_2 + 2\,NH_3$ ↑ Ammonia

$Mg(OH)_2 \xrightarrow[\text{تسخين}]{\Delta} MgO + H_2O$

- MgO ↓ أكسيد المغنيسيوم
- H_2O ↓ ماء

Empirical Formula :→ Smallet whole number ratio of atoms in the Compound. (أبسط عدد صحيح بين الجزيئات في المركب)

Experiment (2) :-

- Heating before Starting ⟶ to remove the moisture

- Don't weight the crucible when its hot ⟶ Its give wrong accurate.

- Don't Cover the Crucible widely ⟶ its burns Mg brightly.

- Adding a few water drops ⟶ to decompose Mg_3N_3

What the effect of Mg:O moles ratio if:-

Mg:O

Mg_3N_2 Not deComposed ⟶ increase

Mg_3N_2 deComposed ⟶ No effect

Carbon deposited on the Crucible Surface ⟶ DeCrease

Carbon not deposited on the Crucible Suface ⟶ Noeffect

MgO ash is not dried ⟶ Decrase

MgO ash is dried ⟶ No effect

Air is not Sufficient (to react with Mg) ⟶ increase

Air is Sufficient ⟶ No effect

- Nonolatile and unreactive impuritis in the crucible from the beginning ⟶ No effect.

- Nonolatile and unreactive impuritis in the crucible during oxidation ⟶ Decrease

Rapid oxidation of Mg ⟶ increase

لـ أكسدة سريعة

Ex :- How many grams of Mg Combine with 1,5 g of Chloride was in $MgCl_2$?

المطلوب

Mass Mg ?!

Mass Cl_2 = 1,5

Molar Mass = 35,45 → $MgCl_2$

$$\text{Moles of Cl} = \frac{m}{m.m} = \frac{1,5}{35,45} = ,0423 \text{ mole}$$

$2\,Cl_2 \rightarrow ,0423$

$1\,Mg \rightarrow ?!$

$$\frac{,0423}{2} = \frac{2x}{2}$$

$x = ,02115$ ← moles of Mg

$$n = \frac{\text{Mass}}{m.m} = ,02115 = \frac{m}{24,31}$$

$$m_{Mg} = 0,514\,g$$

Experiment (3) :-

① Limiting reactant (LR) : It is reactant that is consumed first and thus determins of product formed.

| Limiting Reactant | ← هو العامل الذي ينفذ أولاً

② Theoretical yeild :- Maximum amount that can produced with give amount of LR Calculation , | نحن نقوم بحسابها |

③ Actual yeild :- less than theoretical yeild, By lab.

النسبة المئوية من التجربة (حقيقية)

$$yield = \frac{\text{Actual yeild}}{\text{Theoretical yeild}}$$

This RXN is endothermic

ماص للحرارة

راسب PPT < Excess / products

The equation in molecular From

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

نعم ✓

صافي المعادلة الأيونية

$$3Ba^{2+} + 2PO_4^{-3} \longrightarrow Ba_3(PO_4)_{2(s)}$$

A 25 g Sample of $Na_3PO_4 \cdot 12H_2O$ react with excess $BaCl_2H_2O$ if the mass of $Ba_3(PO_4)_2$ obained is 17,56g Calculate the yeild of $Ba_3(PO_4)_2$?

yeild $Ba_3(PO_4)_2$ المطلوب

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

$Na_3PO_4 \cdot 12H_2O$

Na_3PO_4 Moles $Na_3PO_4 = \frac{25}{380,2} = ,6575$

Mass = 25

M.M = 380,2

$2PO_4^{-3} \longrightarrow 1\ Ba_3(PO_4)_2$

$,6575 \longrightarrow X$

$X = ,03287$ → Theortical → $\frac{Mass}{M.M} = n$

$,03287 = \frac{Mass}{602,2}$

Mass = 19,79

Yeild $Ba_3(PO_4)_2 = \%100 \times \frac{\text{Actual Yeild}}{\text{Theoretical Yeild}} = \frac{17,56}{19,79}$ معطى

نقوم بحسابها

Yeild = 88,73%

محدد بـ العامل المحدد

➢ **Determination of the LR :** زيادة / أو المحدد

❑Test for excess PO_4^{-3} or limiting Ba^{+2} :

- Add 2 drops of 0.5M **BaCl** to the solution , If a precipitate **is formed** then PO_4^{-3} is the excess and Ba^{+2} is the LR

If a precipitate **is not formed** the PO_4^{-3} is the LR and Ba^{+2} is the excess .

❑Test for excess Ba^{+2} or limiting PO_4^{-3}:

- Add 2 drops of 0.5M Na_3PO_4 to the solution **if a PPT is formed** then Ba^{+2} is the excess and PO_4^{-3} is the LR

If a PPT is **not formed** then Ba^{+2} is the LR and PO_4^{-3} is the excess زيادة

❑**Q9.** What is the effect of heating the solution on the particle size of $Ba_3(PO_4)_2$ PPT?

Ans. It makes a coagulation

❑**Q9.** What is **the effect** on the actual yield of the $Ba_3(PO_4)_2$:

- Using a coarse paper **(Decrease)**
- Insufficient washing of the PPT **(Increase)**
- Using the Acidic to wash the solution **(Decrease)**
- The PPT wasn't dried completely **(Increase)**

❑**Q10.** **Don't boil** the solution ?

Ans . To minimize the lost of the mass .

❑**Q11.** Using **distilled water** ?

Ans. To provide the reactions of the unknowns .

حفظ

❑**Q12.** The RXN in the LR Exp isn't endothermic ?

Ans. False

❑**Q13.** In a PPT of $Ba_3(PO_4)_2$ the factor that might lead to decrease the percentage yield is ?

Ans . Using a filter paper with coarse porosity

❑**Q(Years).** The purpose of the Limiting Reactant experiment ?

Ans . 1- Determination of the reactant that is consumed firstly in the chemical reaction

2- Determine the actual yield

3- Determine the percentage yield

4- All of the above

❑**Q(Years).** In the limiting reactant experiment , a few drops of $BaCl_2\,2H_2O$ are added and turbidity is appeared , this means ?

Ans. $BaCl_2\,2H_2O$ is the **LR** and Na_2SO_4 is the excess .

Experiment (4) :-

Physical properties :- الخصائص الفيزيائية

- Color
- odor
- رائحة

type → Qualitative (صفات)

Boiling point
Density
Solubility

type → Quantitative (أرقام)

Solution → Solute + Solvent

محلول = مذيب + مذاب

H_2O (water) → Polar (قطبي)

(C_6H_{12}) (cyclohexane) → Non-polar (غير قطبي)

(C_2H_5OH) (Ethanol) → Polar (قطبي)

Solubility → maximum mass usually in gram of the substance (Solute) that dissolve in fixed mass usually 100 g of Solvent at given Temperature.

(Complete dissolving) → S → ذوبان كامل

Partial → SIS → ذوبان جزئي

in Solube → أ → غير ذائب

Solvent	Solute	Result
Polar	Polar	Soluble(Miscible)
Non-Polar	Non-Polar	Soluble(Miscible)
Polar	Salt	Soluble(Miscible)
Non-Polar	Salt	Insoluble(Immiscible)
Polar	Non-Polar	Insoluble(Immiscible)

Ex. Salt are soluble in water but insoluble in gasoline

2-Density : Mass per volume , large density have large mass in small volume , heavy mean high density

$$D = \frac{Mass}{Volume}$$

3-Boiling Point : when a **liquid** is gradually **heated** , there is a **temperature** at which **bubbles** from spontaneously and continue to form until the entire volume of the liquid has been **converted to a gas** . and where the **vapor pressure** is **equal** to the **atmospheric pressure**

➢This **constant** temperature is called the **boiling point** .

عند تسخين سائل ما تبدأ بعض فقاعات البخار في التكون في وسط السائل و هكذا يمكن القول بأن السائل يغلي عندما يصبح ضغط بخاره مساوياً للضغط الجوي الواقع على سطح السائل .

❑**Q.** What physical property measurable in this experiment **distinguishes(** يفرق أو يميز **)** cyclohexane from cyclohexene ?

Ans . Boiling point

❑**Q.** Using apparatus described in this experiment when should the **boiling point** of a liquid **be recorded** ?

Ans . When the bubbles cease(التوقف) to escape and before the liquid re-enters the capillary tube .

❑**Q.** How does atmospheric pressure **affect** the boiling point of a Liquid ?

Ans. Directly

❑**Q.** How does intermolecular forces affect the boiling point of a Liquid ?

Ans. Directly

❑**Q.** Boiling point Solution larger than Boiling point Solvent ?

Ans. Because it has stronger intermolecular forces

❑**Q.** If a several drops of liquid unknown cling to the pipette wall after deliver **Will the density of the unknown be reported too high or too Low** ?

Ans. Too Low , Mass will decrease then Density will decrease .

❑Q. If the Boiling Point is recorded when bubbles are rapidly escaping the capillary tube will it be recorded too high or too low ?

Ans.

$$Reading > True\ Value,$$
$$Temp > True\ Boiling\ Point,$$
$$Vapor\ pressure > Patm$$

❑Q. If the Boiling Point is recorded after the liquids enters the capillary tube (after the heat is removed) will it be recorded too high or too low ?

Ans.

$$Reading < True\ Value,$$
$$Temp < True\ Boiling\ Point,$$
$$Vapor\ pressure < P_{atm}$$

❑Q. If the Boiling Point is recorded when the liquids cease to escape and before the liquids re-enters the capillary tube ?

$$Reading = True\ Value,$$
$$Temp = True\ Boiling\ Point,$$
$$Vapor\ pressure = Patm$$

❑ Q. Can you predict when the **VP= P_{atm}** theoretically ?

Ans. No

$vp \neq Patm$

$vp < Patm$