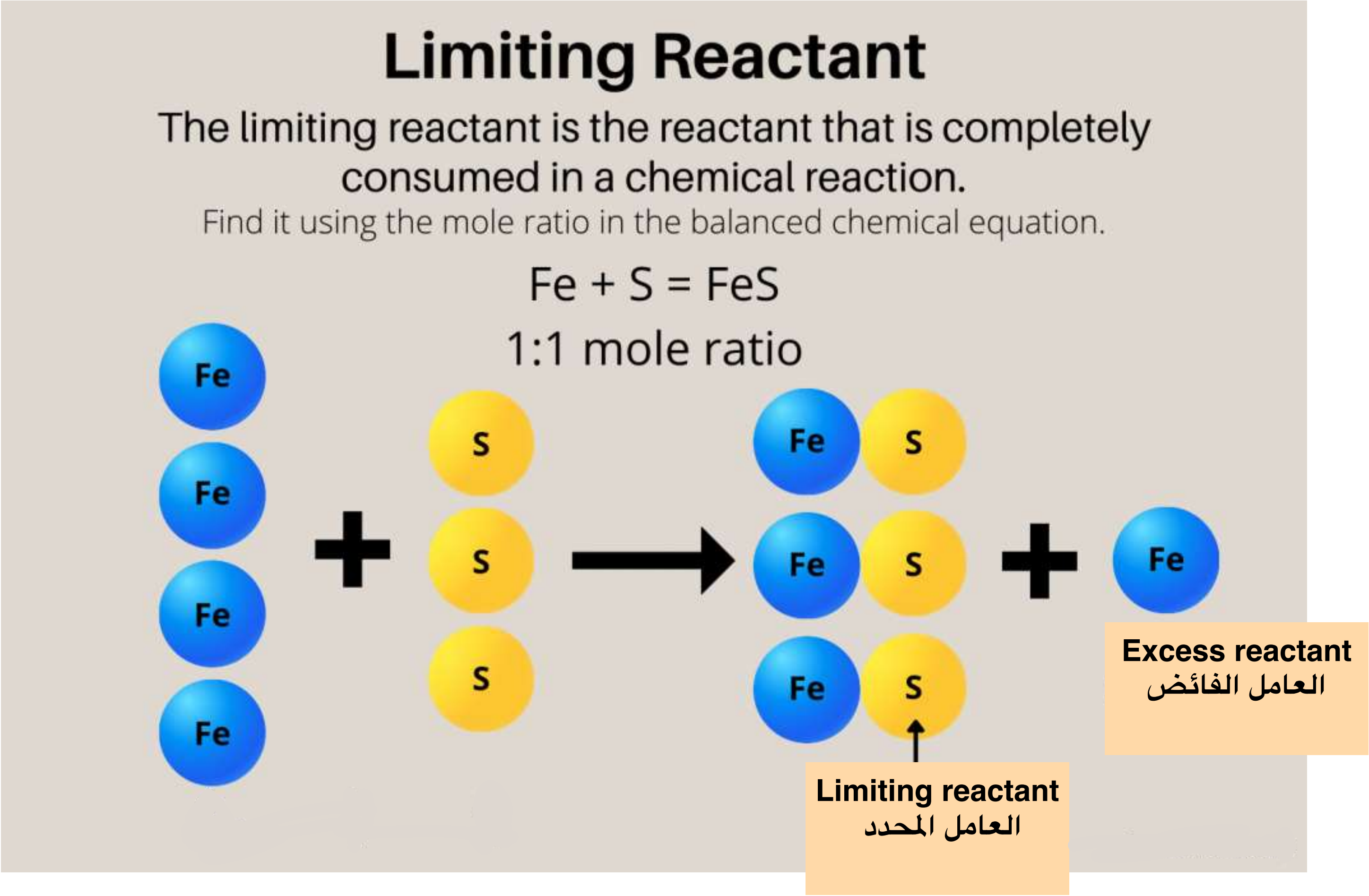
# *Exp 3*

# Limiting Reactant or Limiting Reagent



| LIMITING REACTANT | EXCESS REACTANT |
| --- | --- |
| L.R<br>نرمزلها فقط للشرح | E.R<br>نرمزلها فقط للشرح |
| the limiting reactant is the reactant that gets consumed, completely used up in a chemical reaction. | the reactant that occurs in a quantity greater than needed to completely react with the limiting reactant |
| المحدد للتفاعل | الفائض |
| | Excess reactant<br>نوعين<br>1. reacted Excess reactant<br>الفائض التي تفاعلت<br>2. Un-reacted Excess reactant<br>التي لم تتفاعل |
| | |

# Net Ionic Equation and Complete Ionic Equation

## Molecular Equation or Balanced Equation

$$AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)$$

## Complete Ionic Equation

$$Ag^+(aq) + NO_3^-(aq) + Na^+(aq) + Cl^-(aq) \rightarrow AgCl(s) + Na^+(aq) + NO_3^-(aq)$$

## Net Ionic Equation

$$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$$

لكتابة المعادلة الكيميائية
نبدأ بال molecular equation
ثم ال ionic equation وحذف
الأيونات المتفرجة
واخيراً نحصل على المعادلة الأيونية
النهائية

## أمثلة كيف نكتب معادلة أيونية ومعادلة أيونية نهائية

**1]** Nickel (III)chloride + potassium phosphate -->

Molecular equation $NiCl_3(aq) + K_3PO_4(aq) \longrightarrow NiPO_4(s) + 3\,KCl(aq)$

Total ionic $Ni^{3+}(aq) + 3\,Cl^-(aq) + 3K^+(aq) + PO_4^{3-}(aq) \longrightarrow NiPO_4(s) + 3\,Cl^-(aq) + 3K^+(aq)$

Net ionic $Ni^{3+}(aq) + PO_4^{3-}(aq) \longrightarrow NiPO_4(s)$

**2]** Aluminum + Hydrobromic acid -->

Molecular equation $2\,Al(s) + 6\,HBr(aq) \longrightarrow 2\,AlBr_3(aq) + 3\,H_2(g)$

Total ionic $2\,Al(s) + 6\,H^+(aq) + 6\,Br^-(aq) \longrightarrow 2\,Al^{3+}(aq) + 6\,Br^-(aq) + 3\,H_2(g)$

Net ionic $2\,Al(s) + 6\,H^+(aq) \longrightarrow 2\,Al^{3+}(aq) + + 3\,H_2(g)$

معادلة المواد التي تم تجربتها في المختبر عمليا
+ ارجع لل report sheet وقم بحله مرة أخرى (مهم جدا)

Molecular equation

$$BaCl_2 \cdot 2H_2O(aq) + Na_2SO_4\ (aq) \rightarrow BaSO_{4(s)} + 2NaCl(aq) + 2H_2O(l)$$

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

Net ionic equation

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

**spectator ion** is an ion that exists as a reactant and a product in a chemical equation.

أيونات متفرجة : لا تشترك في التفاعل الكيميائي ولا تتغير شحنتها ونحذفها من طرفي المعادلة

بعض الأمثلة .... مع حلولها

## Practice more and more

**write** net ionic equations

8) $BaCl_2\ (aq) + H_2SO_4\ (aq) \rightarrow$

9) $AlCl_3\ (aq) + KOH\ (aq) \rightarrow$

10) $AgNO_3\ (aq) + CaBr_2\ (aq) \rightarrow$

11) $Mg\ (aq) + AgNO_3\ (aq) \rightarrow$

12) $KOH\ (aq) + H_2SO_4\ (aq) \rightarrow$

13) $Al\ (s) + SnCl_2\ (aq) \rightarrow$

14) $Br_2\ (aq) + KI\ (aq) \rightarrow$

8m) $BaCl_2\ (aq) + H_2SO_4\ (aq) \rightarrow BaSO_4\ (s) + 2HCl\ (aq)$

8i) $Ba^{2+}\ (aq) + SO_4^{2-}\ (aq) \rightarrow BaSO_4\ (s)$

9m) $AlCl_3\ (aq) + 3KOH\ (aq) \rightarrow Al(OH)_3\ (s) + KCl\ (aq)$

9i) $Al^{3+}\ (aq) + 3OH^-\ (aq) \rightarrow Al(OH)_3\ (s)$

10m) $2AgNO_3\ (aq) + CaBr_2\ (aq) \rightarrow 2AgBr\ (s) + Ca(NO_3)_2\ (aq)$

10i) $Ag^+\ (aq) + Br^-\ (aq) \rightarrow AgBr\ (s)$

11m) $Mg\ (s) + 2AgNO_3\ (aq) \rightarrow Mg(NO_3)_2\ (aq) + 2Ag\ (s)$

11i) $Mg\ (s) + 2Ag^+\ (aq) \rightarrow Mg^{2+}\ (aq) + 2Ag\ (s)$

12m) $2KOH\ (aq) + H_2SO_4\ (aq) \rightarrow K_2SO_4\ (aq) + 2H_2O\ (l)$

12i) $OH^-\ (aq) + H^+\ (aq) \rightarrow H_2O\ (l)$

13m) $2Al\ (s) + 3SnCl_2\ (aq) \rightarrow 2AlCl_3\ (aq) + 3Sn\ (s)$

13i) $2Al\ (s) + 3Sn^{2+}\ (aq) \rightarrow 2Al^{3+}\ (aq) + 3Sn\ (s)$

14m) $Br_2\ (aq) + 2KI\ (aq) \rightarrow 2KBr\ (aq) + I_2\ (aq)$

14i) $Br_2\ (aq) + 2I^-\ (aq) \rightarrow 2Br^-\ (aq) + I_2\ (aq)$

ارجع إلى ال manual وقم بحل
المعادلة الموجودة فيه

$Na_3PO_4.12H_2O$ / $BaCl_2.2H_2O$

**<u>limiting reactants طريقة حل المسائل على ال</u>**
**<u>بالتفصيل</u>**
**<u>تتبع الخطوات</u>**
**<u>يجب قراءتها وفهمها</u>**

## ❖ Determining the limiting reactant

- ✓ calculate the amount of product (mol or g) formed from each reactant
- ✓ identify the limiting reactant, it is the reactant that will produce the least amount of product.
- ✓ the other reactant is the one in excess

## ❖ Calculating the amount of the reactant in excess that remains after the reaction

I. calculate the reacted amount of the reactant in excess

II. subtract this amount from the starting (initial) amount of this reactant

## ❖ Writing net ionic equations

1. write the balanced molecular equation
2. write the ionic equation showing the strong electrolytes completely dissociated into cations and anions.
3. cancel the spectator ions on both sides of the ionic equation to get the net ionic equation

القوانين المطلوبة في التجربة

$$m = n \times M$$

$$Moles = \frac{Mass}{Molar\ Mass}$$

## Percent Yield

$$\%\ Yield = \frac{Actual\ Yield}{Theoretical\ Yield} \times 100\%$$

→ Theoretical mass

A (1.12 g) mixture containing $Na_2SO_4$, and $BaCl_2.2H_2O$ was dissolved in water, and then heated to near boiling for 15.0 minutes. After cooling the mixture was filtrated off and 0.113 g of $BaSO_4$ obtained as precipitate. **The obtained filtrate was divided into two parts, the first part drops of 0.050 M $BaCl_2$ were added and nothing was obtained where the second part, drops of 0.50 M $Na_2SO_4$ were added and a cloudy solution was obtained.**

| Compound | Molar mass (g/mol) |
|---|---|
| $Na_2SO_4$ | 142.043 |
| $BaCl_2.2H_2O$ | 244.263 |
| $BaSO_4$ | 233.391 |

وزنة الناتج النهائي يلي منها نبدأ العمل

The percentage of $BaCl_2$ in the original salt mixture is ?

الجزئية هاي من السؤال بتحكيلي من ال limiting reactant
في هذا السؤال التي كونت راسب هي ال ; $Na_2SO_4$,

نتأكد من موازنة المعادلة ✔

$BaCl_2.2H_2O + Na_2SO_4 \longrightarrow BaSO_{4(s)} + 2NaCl + 2H_2O$

$Na_2SO_4$: L.R — $BaSO_4$: (0.113) g

1. moles of $BaSO_4$ = $\frac{mass}{M.m} = \frac{0.113\ g}{233.391\ g/mol} = 4.84 \times 10^{-4}$ moles

* (1:1:1) molar ratio

إذا #moles of $BaSO_4$ = #moles of $Na_2SO_4$ = #moles of $BaCl_2.2H_2O$
ويساوي $= 4.84 \times 10^{-4}$ moles

2. mass of L.R ($Na_2SO_4$) = moles * M.mass
$= 4.84 \times 10^{-4} (142.043) = 0.0687$ g

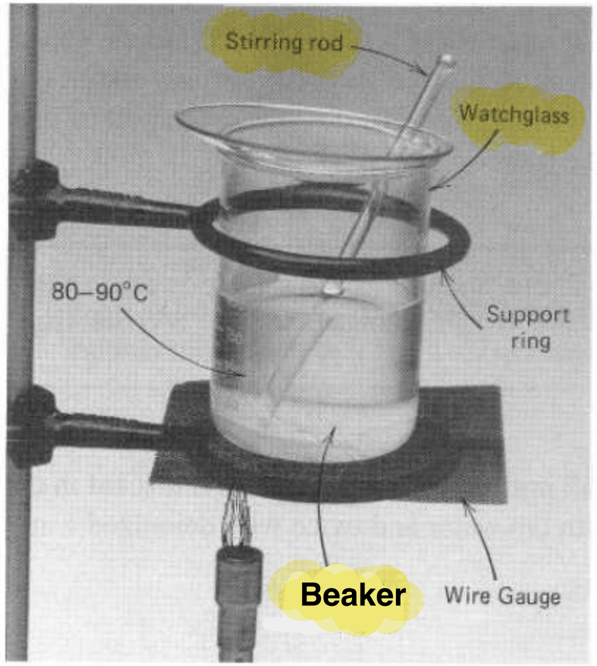
3. mass of E.R ($BaCl_2.2H_2O$) = moles * M.mass
$= 4.84 \times 10^{-4} (244.263) = 0.11826$ g

4. % of L.R($Na_2SO_4$) = $\frac{Actual}{Theoretical} \times 100\% = \frac{0.0687}{1.12} \times 100\% = 6.13\%$

5. % of E.R($BaCl_2.2H_2O$) = $100\% - 6.13\% = 93.86$
$\approx 93.9\%$

المطلوب في السؤال

# الجانب العملي

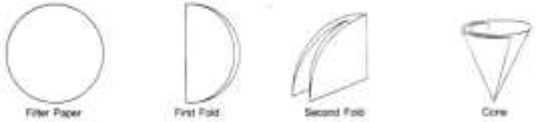


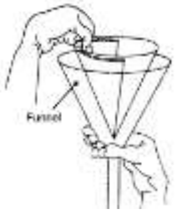

Cool flame: a nonluminous flame with limited amount of gas being burned.

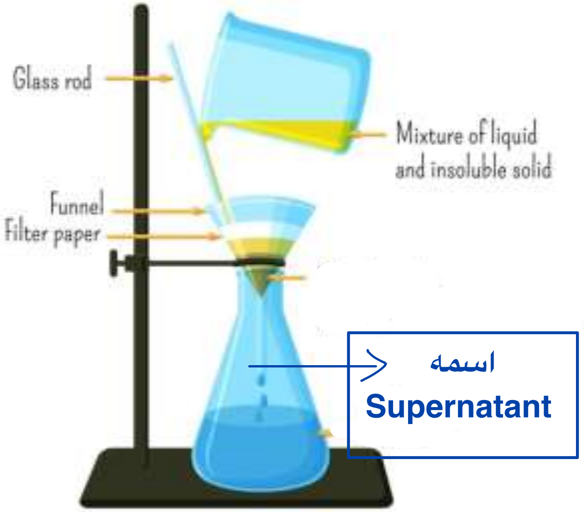
**Digestion** اسم العملية: الهضم

to get larger and purer particles of precipitate الهدف منها

✓ If the precipitate is not digested, some particles may be lost in the filtration ماذا يحدث في حال لم نقوم بعملية الهضم








اسمه
**Supernatant**

Dry

Weigh it

نستخدمه لنستدل عمليا من خلاله على
ال limiting reactant
عن طريق أخذ كمية صغيرة داخل
2 test tubes
ثم إضافة drops من المادتين المتفاعلات على كل test tube

التي ستظهر راسب هي ال limiting reactant

تكون راسب
Limiting reactant

لم يحدث شيء
E.R

**CLEANUP:**

Rinse glassware (الأواني الزجاجية), before and immediately after use, twice with tap water and twice with deionized water and discard in the sink.

You may use soap and a brush to clean the glassware

Two special steps in the Experimental Procedure are incorporated to reduce the loss of the calcium oxalate precipitate. Identify the steps in the procedure and the reason for each step.

الاسئلة الموجودة بالسلايدات مهمه جدا

**Answer**:

Digest the precipitate (ppt) and a fine porosity filter paper is used for filtering the ppt

3. *Part A.6, 7. The drying oven, although thought (and assumed) to be set at 125C, had an inside temperature of 84C.How will this error affect the reported percent by mass of the limiting reactant in the salt mixture . . . too high, too low, or unaffected? Explain.*

**Answer**: *Too high.* An erred mass that is too high infers a greater mass of limiting reactant in the salt mixture. The percent limiting reactant will be reported too high.

# Post Laboratory Questions:

1. *Diborane, $B_2H_6$, can be produced by the following reaction:*

$$NaBH_{4(aq)} + H_2SO_{4(aq)} \rightarrow H_{2(g)} + Na_2SO_{4(aq)} + B_2H_{6(g)}$$

*What is the maximum quantity, in grams, of $B_2H_6$ that can be prepared starting with 250. mL of 0.0875 M $H_2SO_4$ and 1.55g of $NaBH_4$?.*

2. *Part A.2. If the step for digesting the precipitate were omitted, what would be the probable consequence of reporting the "percent limiting reactant" in the salt mixture? Explain.*

**Answer:**

*Too low.* If the $CaC_2O_4$ precipitate were not digested, more would be lost through the filtering process—less product would infer less limiting reactant in the initial sample mixture.

3. *Part A.6, 7. The drying oven, although thought (and assumed) to be set at 125C, had an inside temperature of 84C.How will this error affect the reported percent by mass of the limiting reactant in the salt mixture . . . too high, too low, or unaffected? Explain.*

**Answer:**

*Too high.* An erred mass that is too high infers a greater mass of limiting reactant in the salt mixture. The percent limiting reactant will be reported too high.