* لاب أساسيات الكيمياء العامة 108

* الطالب : يزن رياض الخطيب
هندسة مدنية سنة ثانية

^_^

Exp 3] Limiting Reactant. L.R

* L.R: The reactant that consumed firstly in the chemical rxn, and so determine amount of the Product.

* Actual yield: the amount of product that is Product [actually / experimentaly / Practically] in lab.

* Theorical Theoretical yield: Amount of the product that is expected to be produced by Calculation

(٤) The rxn :-

حفظ

$$2Na_3PO_4.12H_2O + 3BaCl_2.2H_2O \xrightarrow{\Delta} Ba_3(PO_4)_2 + 6NaCl + 30H_2O$$

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

244.2 g/mol 380.2 g/mol 602.2 g/mol

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

بالسؤال

نسبه ؟؟

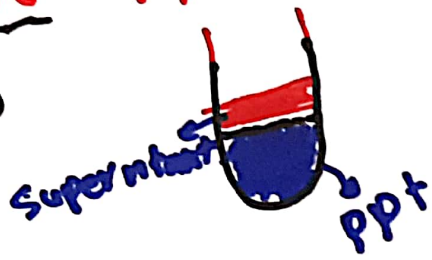
③ The purpose of this exp. :-

1. Determine the L.R. of the exp. rxn :
2. Determine The [Act. Yield, Theo. Yield, % Yeild] of the rxn.

* Supernatant : The clear soln. over ppt. Liquid above a ppt.

* This rxn is endothermic rxn.

* ppt contains :
excess + product (Act. Yi.)



(4) Steps to determine the Theorical Yield:

1. find the l.R. : a) Convert each element to moles.
   b) Divide each element on it's coefficient.
   c) The smallest number is the l.R. .
2. Use only the l.R. in our normal calculation

⑤ ex A 25 g sample of $Na_3PO_4 \cdot 12H_2O$ react with excess $BaCl_2 \cdot H_2O$. If the mass of $Ba_3(PO_4)_2$ (L.R.) Obtained is 17.56 g (Act. Yield). Calculate the % Yield of $Ba_3(PO_4)_2$?

Sol mole PO_4^{-3} = $\frac{25}{380.2}$ = 0.06575 mole

2 mole PO_4^{-3} ⟶ 1 mole $Ba_3(PO_4)_2$

0.0657 PO_4^{-3} ⟶ X = 0.032875 mol

mole = $\frac{M}{M.m}$ ⇒ mass = 19.798 g Theo. Yield

% Yield = $\frac{17.56}{19.798} * 100\%$ = 88.68 %

(6) ex A mixture containing 40 g of $Na_3PO_4 \cdot 12H_2O$ & 30 g of $BaCl_2 \cdot 2H_2O$ is dissolved in water. A ppt of $Ba_3(PO_4)_2$ weighing 22.65 g is produced. calculate % Yield of $Ba_3(PO_4)_2$?

Act. Yield

sol PO_4^{-3}

$\frac{40}{380.2} = 0.105 = \frac{0.105}{2} = 0.0525$ excess

Ba^{+2}

$\frac{30}{244.2} = \frac{0.123}{3} = 0.041$ L.R.

3 mole Ba^{+2} ⟶ 1 mole ⟶ ...

0.123 mole Ba^{+2} ⟶ X

$X = 0.041$ mole

$mole = \frac{mass}{m.m}$

mass $Ba_3(PO_4)_2$ = 24.69 g Theo. Yield

$\Rightarrow$ % Yield $= \frac{22.65}{24.69} \times 100\% = 91.7\%$

ex 10 g of a unknown mixture containing $Na_3PO_4 \cdot 12H_2O$ & $BaCl_2 \cdot 2H_2O$ is dissolved in distilled water. Mass of $Ba_3(PO_4)_2$ ppt is 3.5g. Calc. % of each salt persent in mixture. If $Bacl_2$ is L.R. ?

sol $\frac{3.5}{602.2} = 5.8 * 10^{-3}$ mol

1 ξi → $3 Ba^{+2}$

$5.8 * 10^{-3}$ → X

$X = 0.0174$ mol Ba^{+2}

$mass\ Ba^{+2} = 4.25\ g$ Act.

$mole = \frac{mass}{M.m}$

$\% Ba^{+2} = \frac{4.25}{10} * 100\% = 42.5\%$

$\% PO_4^{-3} = (100 - 42.5)\% = 57.5\%$

8 * Some questions about exp. ^_^ : why ?!

1 Don't boil the solution ?

To minimize the lost of the mass.

2 Using distilled water ?

To provide the reactions of the unkowns.

Act. < Theo.

Yazdin

* Determination of the l.R. :

1 Test for excess PO_4^{-3} OR limiting Ba^{+2} :

* Add 2 drops of 0.5 M $BaCl_2$ to the solu.

If a ppt is formed then PO_4^{-3} is the excess (ex.) & Ba^{+2} is the l.R. (l.R.)

* If a ppt is not formed the PO_4^{-3} is the l.R & Ba^{+2} is the excess.

(10)

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

* Add 2 drops of 0.5 M Na_3PO_4 to the soln. If a ppt is formed then Ba^{+2} is the excess & PO_4^{-3} is the l.R.
* If a ppt. is not formed then Ba^{+2} is the l.R. & PO_4^{-3} is the excess.

(11) *What's the effect of heating the solution on the Particle size of $Ba_3(PO_4)_2$ ppt. ? It makes a coagulation

*What's the effect on the actual Yield of $Ba_3(PO_4)_2$ if:

[1] Using a Coarse paper? dec.

[2] Insufficient washing of the ppt. with water ? inc.

[3] The ppt. wasn't dried completely ? inc.

[4] Washing of ppt. with acid ?
OR = the soln. by acid ? dec.

Yield ∝ Act.

Q1 Given the equation $1A + 3B \rightarrow C + D$ by reacting (1) Mole of A with (2) moles of B, which of the following is true?

1) A is l.R. because of it's higher Molar mass.

2) B is l.R. because of it's higher Molar mass.

3) A is l.R. because you have fewer Moles of A than B

4) B is l.R. because you have fewer Moles of B than A

5) B is l.R. because you need 3 moles of B & you have 2

Sol A] $\frac{1}{1} = 1$

B] $\frac{2}{3} = 0.67$ B is l.R.

Q2] In the l.R. of salt mixture exp. to test for Limiting Ba^{+2} ion: 1) Non of these. supurntant

2) Add few drops of [Barium ion Ba^{+2}] 0.5M to the ppt will appea

3) = = = = [Phosphate ion PO_4^{-3}] 0.5M = = = = .

4) = = = = [Barium ion] 0.5M = = ppt will not =.

5) Heat the mixture solution in the water both for 30 Minutes.

Q3] If 3.28 g unkown mixture containing $Na_3PO_4 \cdot 12H_2O$ & $BaCl_2 \cdot 2H_2O$ is dissolved in distilled water, Mass $Ba_3(PO_4)_2$ ppt is 1.75 g (Act.). Calc. % of $Na_3PO_4 \cdot 12H_2O$ in the mixture if $BaCl_2$ is l.R?

1) 44.19% 2) 35.09 % 3) 65.58 % 4) 57.422

Sol

$\frac{1.75}{602.2} = 2.9 * 10^{-3}$ mole

3 mole Ba^{+2} ⟶ 1 mol ئاي

X ⟶ $2.9 * 10^{-3}$

$X = 8.7 * 10^{-3}$ mole

mass $Ba^{+2} = 2.128$ g

mole = $\frac{mass}{M.m}$

mass PO_4^{-3} = Ba^{+2} l.R

= 3.28 − 2.128

= 1.15 g PO_4^{-3}

% $Na_3PO_4 = \frac{1.15}{3.28} * 100\% = 35.09\%$

Q4] A mixture Containing equal Masses (X) of $Na_3PO_4 \cdot 12H_2O$ & $BaCl_2 \cdot 2H_2O$ is dissolved in water. Appt of $Ba_3(PO_4)_2$ was produced with a mass $0.2X$ (Act.) of the starting Material Then The % Yield of $Ba_3(PO_4)_2$ is :

1) 37.9 % 2) 63.1 % 3) 88.3 % 4) 25.3 %

1/2
1/4

sol

mass Ba^{+2} = mass PO_4^{-3} = X g

Ba^{+2}: $\frac{X}{244.2 * 3} = \frac{X}{732.6}$ أكبر

PO_4^{-3} → l.R.: $\frac{X}{380.2 * 2} = \frac{X}{760.4}$ أصغر smaller

mole $PO_4^{-3} = \frac{X}{380.2}$

$2\ PO_4^{-2} \rightarrow 1\ Zn$

$\frac{X}{380.2} \rightarrow$ mole

mole $= \frac{X}{760.4}$

mass Zn $= 0.791\ X$

% Yield $= \frac{0.2\ X}{0.791\ X} * 100\ \% = 25.3\ \%$

Theo.

Q5| True OR false: * The rxn in the l.R. exp. isn't endothermic. F

is Exothermic

Q6| The Purpose of l.R. exp.:

1) Determine Actually Yield
2) = Theorical Yield
3) = % Yield (Percentage)
4) = l.R. of the exp. rxn.
5) All of these.