Name: KEY Chem 11 Block _____ March 8, 2017

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

Flask	Magnesium		0.5 M Hydrochloric acid		In excess	Limiting
	Mass (g)	Moles	Volume	Moles		
1	2.43	0.100	200 mL	0.1	Mg	HCl
2	1.22	0.0502	200 mL	0.1	–	–
3	0.61	0.025	200 mL	0.1	HCl	Mg

1) Calculate the moles of magnesium for flasks 1-3:

F #1: 2.43 mol of Mg × $\frac{1 \text{ mole}}{24.31 g}$ = 0.099958... = **[0.100 mol of Mg]**

F# 2: 1.22 mol of Mg × $\frac{1 \text{ mol}}{24.31 g}$ = **[0.0502 mol of Mg]**

F#3: **[0.025 mol of Mg]**

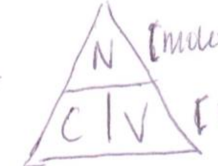
2) Calculate the moles of HCl for flasks 1-3:

$\frac{200 mL}{1000}$ = 0.200 L × 0.5M = **[0.1 moles of HCl]**

in

M = $\frac{\text{moles}}{L}$

Reminder



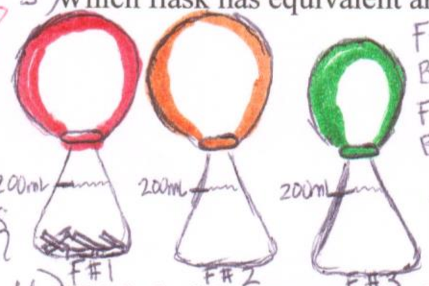
[concentration = molarity (M)]

N = C×V

1Mg : 1 mol H_2

3) Which flask has equivalent amounts of reactants? How do we know?

amount of H_2 ∝ Mg



F#1 and 2
Ballons are same size
F#3
Balloon is smaller

F# 2+3
no Mg
observed after rxn

If equivalent: shouldn't expect to see any xs Mg in flask (Mg fully reacts)

Molar ratio
- 1Mg : 2 HCl
- twice as much HCl compared to Mg

0.1 mol HCl × $\frac{1 \text{ mol of Mg}}{2 \text{ mol of HCl}}$ = **[0.05 mol of Mg]** required to react

↓

[Flask #2]

1:2 ratio

0.05 mol of Mg : 0.1 mol of HCl

4) Which flask has magnesium left over? How much (in moles) is left over?

- from demo, can see **[flask # 1]** has xs Mg; calculated 0.1 mol Mg which is greater than flask #2 and #3

Calculated earlier (#4)

0.1 mol of HCl × $\frac{1 \text{ mol Mg}}{2 \text{ mol HCl}}$ = 0.05 mol of Mg required for rxn

Given 0.100 mol of Mg
− 0.05 mol of Mg required

[0.05 mol of Mg in xs]

5) Which flask has excess HCl? How much is left over?

[Flask #3] has xs HCl

To find required HCl:

0.025 mol of Mg × $\frac{2 \text{ mol HCl}}{1 \text{ mol of Mg}}$ = 0.050 mol of HCl required

left over?

0.1 mol given
0.050 mol required

[0.05 mol of HCl in xs]

Miss Chatrath

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$$N_2 + 3H_2 \rightarrow 2NH_3$$ 1 mol of N_2 : 3 mol of H_2

The equation "says" that each mole of N_2 that wants to react must have exactly 3 moles of H_2 present (no more, no less).

Based on the amounts of reactants mixed, determine the limiting and excess reagent in each of the following cases.

N_2	H_2	Excess reactant	Limiting reactant	Amount left over
1 mole for every mole 3X as much	3.1 moles of N_2 mol of H_2 reacts	H_2	N_2	$1 \text{ mol of } N_2 \times \frac{3 \text{ mol } H_2}{1 \text{ mol } N_2} = 3 \text{ mol of } H_2$ required 3.1 mol H_2 given − 3 mol H_2 required 0.1 mol of H_2 in xs
1 mole for every mole reacting, 1/3	2.9 moles of H_2 mole of N_2 reacts	N_2	H_2	$2.9 \text{ mol of } H_2 \times \frac{1 \text{ mol of } N_2}{3 \text{ mol of } H_2} = 0.97 \text{ mol of } N_2$ required 1 mol N_2 given − 0.97 mol N_2 required 0.03 mol of N_2 in xs
8 moles for every mol of 3x mol of	25 moles N_2 reacting, H_2 reacts	H_2	N_2	$8 \text{ mol of } N_2 \times \frac{3 \text{ mol } H_2}{1 \text{ mol } N_2} = 24 \text{ mol } H_2$ required 25 mol H_2 given − 24 mol H_2 required 1 mol H_2 in xs
32.0g $\times \frac{1 \text{ mol}}{28.02 \text{ g}}$ = 1.14 mol of N_2	32.0g $\times \frac{1 \text{ mol}}{2.02 \text{ g}}$ = 15.8 mol of H_2	H_2	N_2	$1.14 \text{ mol of } N_2 \times \frac{3 \text{ mol } H_2}{1 \text{ mol of } N_2} = 3.42 \text{ mol of } H_2$ required 15.8 mol of H_2 given − 3.42 mol of H_2 required 12.4 mol of H_2 in xs
5.00g $\times \frac{1 \text{ mol}}{28.02 \text{ g}}$ = 0.178 mol of N_2	1.00g $\times \frac{1 \text{ mol}}{2.02 \text{ g}}$ = 0.495 mol of H_2	N_2	H_2	$0.178 \text{ mol of } N_2 \times \frac{3 \text{ mol of } H_2}{1 \text{ mol of } N_2} = 0.534 \text{ mol of } H_2$ required BUT not enough given ∴ H_2 = limiting reagent $0.495 \text{ mol of } H_2 \times \frac{1 \text{ mol } N_2}{3 \text{ mol } H_2} = 0.165 \text{ mol of } N_2$ required 0.178 mol N_2 given 0.165 mol N_2 required 0.013 mol N_2 in xs.

Note: sig figs for last 2 rows differ in student copy

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1. Consider the following reaction:

$$4H_2O + 3CO_2 \rightarrow C_3H_8 + 5O_2$$

If we mix 6.0 moles of C_3H_8 and 20.0 moles of O_2 asking about reverse rxn

a. What will be in excess and how much will be unused?

$C_3H_8 + 5O_2 \rightarrow 4H_2O + 3CO_2$

molar ratio: 1 mole C_3H_8 : 5 mole O_2

6.0 mol of C_3H_8 × $\frac{5 \text{ mol } O_2}{1 \text{ mol } C_3H_8}$ = 30. mol of O_2 required BUT 20.0 mol of O_2 only given

20.0 mol of O_2 × $\frac{1 \text{ mol } C_3H_8}{5 \text{ mol } O_2}$ = 4.00 mol of C_3H_8 required; 6.0 mol of C_3H_8 given − 4.00 mol of C_3H_8 required = 2.0 mol of C_3H_8 in xs

b. How many grams of water will be produced?

Start with limiting reagent: molar ratio: 5 mol O_2 : 4 mol H_2O

20.0 moles of O_2 × $\frac{4 \text{ mol } H_2O}{5 \text{ mol } O_2}$ × $\frac{18.02 \text{ g}}{\text{mol } H_2O}$ = 288.32 g = **288 g of H_2O**

2. Consider the following reaction:

$$6KOH + 3Cl_2 \rightarrow KClO_3 + 5KCl + 3H_2O$$

6 mol KOH : 3 mol Cl_2

If we mix 100.0g of KOH and 100.0g of Cl_2

a. Which one will react completely? (asking for limiting reagent)

100.0 g of KOH × $\frac{1 \text{ mol}}{56.11 \text{ g}}$ = 1.782 mol of KOH vs. 100.0 g of Cl_2 × $\frac{1 \text{ mol}}{70.90 \text{ g}}$ = 1.410 mol of KOH

b. How much of the excess reactant will be left over?

1.782 mol of KOH × $\frac{3 \text{ mol } Cl_2}{6 \text{ mol KOH}}$ = 0.8910 mol of Cl_2 required

1.410 mol Cl_2 given
− 0.8910 mol Cl_2 required
0.519 mol Cl_2 in xs

1.782 mol of KOH × $\frac{3 \text{ mol } Cl_2}{6 \text{ mol KOH}}$ = 0.8910 mol of Cl_2 required — in xs

c. How many grams of $KClO_3$ will be produced?

* start with limiting and what is given

100.0 g of KOH × $\frac{1 \text{ mol of KOH}}{56.11 \text{ g}}$ × $\frac{1 \text{ mol } KClO_3}{6 \text{ mol KOH}}$ × $\frac{122.55 \text{ g}}{\text{mol } KClO_3}$ = **36.40 g of $KClO_3$ will be produced**

1.410 mol of Cl_2 × $\frac{6 \text{ mol KOH}}{3 \text{ mol } Cl_2}$ = 2.82 mol of KOH required BUT not enough ∴ KOH limiting will completely react