10/1/2018

Let's apply these concepts to chem eqs.

ex: $CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(g)$

Imagine: $5 \times CH_4$ molecules, and $8 \times O_2$ molecules.
... what's LR?
... how much CO_2 can we make?

$$5 \times CH_4 \times \frac{1\ CO_2}{1\ CH_4} = 5 \text{ molecules } CO_2$$

Excess reactant
XS

$$8 \times O_2 \times \frac{1\ CO_2}{2\ O_2} = \boxed{4 \text{ molecules } CO_2} \text{ theoretical yield}$$

Limiting reactant
LR

Ex: $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$.

Q: How many H_2O molecules can you make from $10 \times C_2H_6 + 21 \times O_2$?

Q: If you only actually make $15 \times H_2O$ molecules, what's % yield?

XS

$$10\ \cancel{C_2H_6} \times \frac{6\ H_2O}{2\ \cancel{C_2H_6}} = 30 \times H_2O$$

LR

theor yield.

$$21\ \cancel{O_2} \times \frac{6\ H_2O}{7\ \cancel{O_2}} = 18 \times H_2O$$

$$\%\ \text{yield} = \frac{\text{actual yield}}{\text{theor. yield}} \times 100 = \frac{15\ H_2O}{18\ H_2O} \times 100 = 83\%$$

Normally we work w/ grams of reactants, not #molecules!

ex: $2Mg(s) + O_2(g) \longrightarrow 2MgO(s)$

if 42.5g Mg reacts w/ 33.8g O_2
- which is the LR?
- what is theor. yield of MgO?

Plan: ① $g\,Mg \xrightarrow[Mg]{\text{molar mass}} mol\,Mg \xrightarrow{\text{coefficients}} mol\,MgO \xrightarrow[MgO]{\text{molar mass}} g\,MgO$

② $g\,O_2 \xrightarrow[O_2]{\text{molar mass}} mol\,O_2 \xrightarrow{\text{coeff.}} mol\,MgO \xrightarrow[MgO]{\text{molar mass}} g\,MgO$

smallest?

Mg	MgO	O_2
$1 \times Mg = 1 \times 24.31$	$1 \times Mg = 24.31$	$2 \times O = 2 \times 16.00$
24.31 g/mol	$1 \times O = 16.00$	32.00 g/mol
	40.31 g/mol	

~~2Mg = 2~~ 2 mol Mg = 2 mol MgO // 1 mol O_2 = 2 mol MgO

① $42.5\,g\,\cancel{Mg} \times \frac{1\,\cancel{mol\,Mg}}{24.31\,\cancel{g\,Mg}} \times \frac{2\,\cancel{mol\,MgO}}{2\,\cancel{mol\,Mg}} \times \frac{40.31\,g\,MgO}{1\,\cancel{mol\,MgO}} = 70.5\,g\,MgO$

LR

theoretical yield

② $\frac{33.8\,\cancel{g\,O_2}}{} \Big| \frac{1\,\cancel{mol\,O_2}}{32.00\,\cancel{g\,O_2}} \Big| \frac{2\,\cancel{mol\,MgO}}{1\,\cancel{mol\,O_2}} \Big| \frac{40.31\,g\,MgO}{1\,\cancel{mol\,MgO}} = 85.2\,g\,MgO$

XS

Suppose we only made 55.9g MgO

Q: What's % yield? $\frac{55.9g}{70.5g} \times 100 = 79.3\%$

(*) Read + do : ex 4.3 + 4.4 on pages 149-150! (*)

Solutions ~ concentration + sol^n stoichiometry

Most rxns in lab + body take place in solution!
- homogeneous mixtures
- largest component = SOLVENT
- smaller component(s) = SOLUTE(s)

} whole thing " ~~sto~~ solution (sol^n)

If solvent is water, the sol^n is called AQUEOUS, (aq)

ex: Brine = $NaCl(s)$ + $H_2O(l)$

$\underbrace{\underset{\text{solute}}{\underset{\text{small}}{NaCl(s)}} + \underset{\text{solvent}}{\underset{\text{larger}}{H_2O(l)}}}_{\text{sol}^n}$

Concentration (conc.)

- Dilute sol^n : small am't solute, relative to solvent
- Concentrated sol^n : large " ——— "

Common quantitative measure of conc is molarity (M) (molar concentration)

$$\underset{(M)}{\text{molarity}} = \frac{\text{am't of solute (mol)}}{\text{vol of solution (L)}}$$

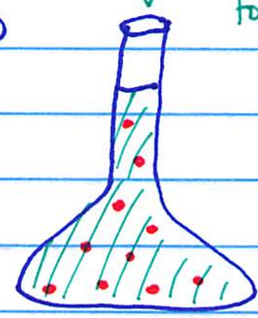
└ note: sol^n, not solvent!

ex: to make 1.0 L of a 1.0 M NaCl(aq)

① 1.0 mol NaCl (58.44 g)

1.0 L volumetric flask

② add H_2O until tot. vol = 1.0 L



same!

molarity = $\frac{1.0\,mol}{1.0\,L} = 1.0 \frac{mol}{L}$ OR 1.0 M

vol. of whole sol^{n}, NOT solvent!

Q: Why not add 1.0 L of H_2O to 1.0 mol of NaCl?