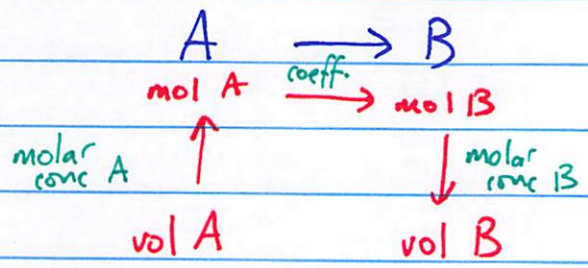
10/8/2018

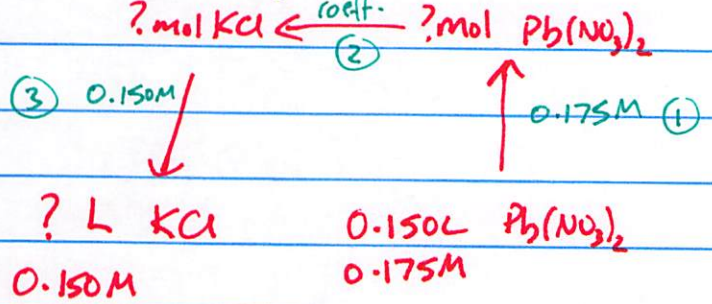
Soln stoichiometry



Ex: What vol (in L) of 0.150 M KCl(aq) will completely react w/ 0.150 L of a 0.175 M $Pb(NO_3)_2$(aq) soln ...

~~$M_1V_1 = M_2V_2$~~

given: $2\,KCl(aq) + Pb(NO_3)_2(aq) \rightarrow PbCl_2(s) + 2\,KNO_3(aq)$



(1) 0.175 M $Pb(NO_3)_2$(aq) means: 0.175 mol $Pb(NO_3)_2$ = 1 L soln

(2) 1 mol $Pb(NO_3)_2$ = 2 mol KCl

(3) 0.150 M KCl(aq) means: 0.150 mol KCl = 1 L KCl soln

$$0.150\,\text{L}\ Pb(NO_3)_2\ \text{soln} \times \frac{0.175\,\text{mol}\ Pb(NO_3)_2}{1\,\text{L}\ Pb(NO_3)_2\ \text{soln}} \times \frac{2\,\text{mol KCl}}{1\,\text{mol}\ Pb(NO_3)_2} \times \frac{1\,\text{L KCl soln}}{0.150\,\text{mol KCl}}$$

.15 ☹

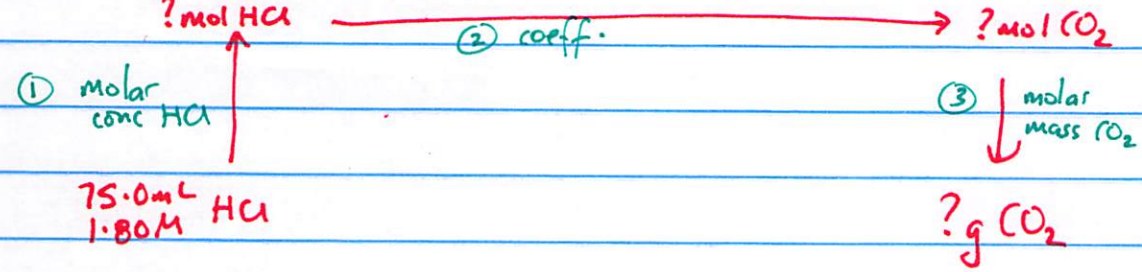
0.150 ☺

$$= 0.350\,\text{L KCl soln}.$$

Ex 2:

given: $2HCl(aq) + CaCO_3(s) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$

PLAN



Q: What mass (in g.) of CO_2 is formed when 75.0mL of 1.80M HCl reacts w/ XS $CaCO_3$?

① $1.80\ mol\ HCl = 1\ L$ ② $2\ mol\ HCl = 1\ mol\ CO_2$

③ CO_2 ③ $44.01\ g\ CO_2 = 1\ mol\ CO_2$

$1 \times C = 1 \times 12.01$

$2 \times O = 2 \times 16.00$

$44.01\ g/mol$

$$75.0\text{mL} \times \frac{1\text{L}}{1000\text{mL}} \times \frac{1.80\text{mol HCl}}{1\text{L}} \times \frac{1\text{mol } CO_2}{2\text{mol HCl}} \times \frac{1\text{mol } CO_2}{44.01\text{g } CO_2}$$

① ② ③

$$= 2.97\text{g } CO_2$$

Electrolytes

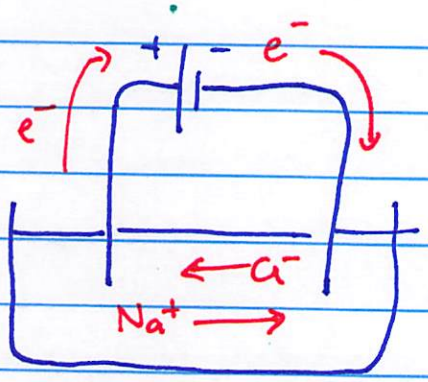
When we add sugar (sucrose, $C_{12}H_{22}O_{11}$) to water, it dissolves, but soln does not conduct electricity.

However, when we add "salt" or NaCl, it dissolves + soln does conduct electricity.

Why?

$$NaCl(s) \xrightarrow{H_2O} NaCl(aq) \longrightarrow Na^+(aq) + Cl^-(aq)$$

charged ions carry elec!



substances that dissolve in H_2O + conduct

"

ELECTROLYTES.

sugar = non-electrolyte (molecule)

strong electrolyte

$$NaCl \xrightarrow{100\%} Na^+ + Cl^-$$

3% only small amt of ions.

$$HF \underset{97\%}{\rightleftharpoons} H^+ + F^-$$

weak electrolyte

TABLE 4.1 Solubility Rules for Ionic Compounds in Water

Compounds Containing the Following Ions Are Generally Soluble	Exceptions
Li^+, Na^+, K^+, and NH_4^+	None
NO_3^- and $C_2H_3O_2^-$	None
Cl^-, Br^-, and I^-	When these ions pair with Ag^+, Hg_2^{2+}, or Pb^{2+}, the resulting compounds are insoluble.
SO_4^{2-}	When SO_4^{2-} pairs with Sr^{2+}, Ba^{2+}, Pb^{2+}, Ag^+, or Ca^{2+}, the resulting compound is insoluble.
Compounds Containing the Following Ions Are Generally Insoluble	**Exceptions**
OH^- and S^{2-}	When these ions pair with Li^+, Na^+, K^+, or NH_4^+, the resulting compounds are soluble.
	When S^{2-} pairs with Ca^{2+}, Sr^{2+}, or Ba^{2+}, the resulting compound is soluble.
	When OH^- pairs with Ca^{2+}, Sr^{2+}, or Ba^{2+}, the resulting compound is slightly soluble.
CO_3^{2-} and PO_4^{3-}	When these ions pair with Li^+, Na^+, K^+, or NH_4^+, the resulting compounds are soluble.

Solubility of ionic cpds

- not all ionic cpds dissolve in H_2O!
  - can use an empirical set of solubility rules

table 4-1

Li_3PO_4	$AgBr$	$CaCO_3$	Na_2SO_4
soluble	insol.	insol.	sol.

Precipitation rxns

precipitate = solid (ppt)

ppt

ex: $2KI(aq) + Pb(NO_3)_2(aq) \longrightarrow PbI_2(s)\downarrow + 2KNO_3(aq)$

not all rxns form ppts:

ex: $KI(aq) + NaCl(aq) \longrightarrow$ no rxn.

KEY: Only insoluble cpds form ppts!