Solubility

Tuesday, September 15, 2020 2:28 PM

Solubility Rules (Tricks)

ALWAYS Soluble

- **N**itrates (NO_3^-)
- **A**cetates ($C_2H_3O_2^-$)
- **G**roup 1 (Li^+, Na^+, etc)
- **S**ulfates (SO_4^{-2})
- **A**mmonium (NH_4^+)
- **G**roup 17 (F^-, Cl^-, Br^-, etc)

Exceptions (2 groups)

1. "PMS"*
   - P → Pb^{+2} (lead)
   - M → Mercury (Hg_2^{+2})
   - S → Silver (Ag^+)

Dilutions

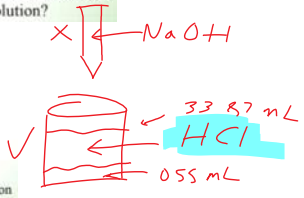
- M(conc) * V(conc) = M(dil) * V(dil) $M_1V_1 = M_2V_2$
- M(stock soln) * V(stock soln) = M(new soln) * V(new soln)
- M= mol/vol
- Steps
  1. Convert grams to moles of Na2CO3(s)
  2. "To completely react" means moles of Na2CO3 must equal moles of H2SO4(aq)
  3. M * V = moles
  4. Rearranged V = moles/M

$MV = moles$

Titration

- Used to determine solubility products'
- Equivalence point
- # of mol of reactant A = # of mol of reactant B
- At equivalence point, M(titrant) * V(titrant) = M(solute) * V(solute)
- Example

You perform an acid-base titration to standardize an HCl solution by placing 50.00 mL of the HCl solution in a flask with a few drops of indicator solution. You put 0.1524 *M* NaOH into the buret, and the initial reading is 0.55 mL. At the end point, the buret reading is 33.87 mL. What is the concentration of the HCl solution?



1. Write the balanced equation.
   $NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$
2. Find the volume of NaOH delivered.
   Volume = $V_{final} - V_{initial}$
   = 33.87 mL − 0.55 mL
   = 33.32 mL = 0.03332 L of 0.1524 *M* NaOH solution
3. Determine moles of NaOH
   0.1524 *M* * 0.03332 L = 5.078×10^{-3} mol NaOH
4. Establish molar ratio
   - From balanced equation the molar ratio of NaOH to HCl is 1:1
   - So, at the end point, moles of NaOH = moles of HCl
     5.078×10^{-3} mol NaOH = 5.078×10^{-3} mol HCl
5. Calculate molarity of HCl solution
   M = moles/L
   5.078×10^{-3} mol HCl * 1/0.05000 L = 0.1016 *M* HCl

$MV = moles$

$5e^{-3}$ NaOH mol $= 5e^{-3}$ HCl mol

moles V

$M = moles/V$

$= 5e^{-3}$ mol HCl / $\left(\frac{50mL}{10^{-3}mL}\right) = 5e^{-3}(0.05)$

$= 0.1$ M HCl

$\frac{50mL}{\text{Given}} \left| \frac{1\ L}{1000\ mL} \right._{\text{conversion}} = \frac{50 \times 1}{100}\ L = 0.05\ L$

Examples

1) How many grams of solute are in solution if you have 20.0 mL of 0.250 M of KOH?

MV $M = 0.250$ M KOH

$V = 20.0\ mL = 0.02\ L$

$20.0\ mL \left| \frac{1\ L}{1000\ mL} \right. = 0.02\ L$

MV = moles → g

Molar Mass

K - 40 g/mol

O - 16 g/mol

H - 1 g/mol

} 57 g/mol KOH

$0.250\ M \times 0.02\ L = 0.005$ moles

$0.05\ mol\ KOH \left| \frac{57\ g}{1\ mol\ KOH} \right. = 0.05 \times 57\ g\ KOH$

$= 0.16\ g\ KOH$

2) What volume of milliQ water would need to be added to 300 mL of 3.2 NaF to make 1.5 M NaF?

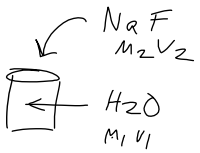
Vol of H_2O ← Unknown

NaF → $M_1 = 3.2$ M

$M_2 = 1.5$ M

$V_1 = 300\ mL = 0.3\ L$

$V_2 = ?$



$M_1V_1 = M_2V_2$

$(3.2)(0.3) = (1.5)x$

$\frac{3.2 \times 0.3}{1.5} = 0.64\ L$