

You can use your book and your notes if you wish. You **cannot** work on this assignment with a friend.

Simple Rules for the Solubility of Salts in Water (From Zumdahl, Chemistry, 3e)

1. Most nitrate ( $\text{NO}_3^-$ ) salts are soluble.
2. Most salts containing the alkali metal ions ( $\text{Li}^+$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Cs}^+$ ,  $\text{Rb}^+$ ) and the ammonium ion ( $\text{NH}_4^+$ ) are soluble.
3. Most chloride, bromide and iodide salts are soluble. Notable exceptions are salts containing the ions  $\text{Ag}^+$ ,  $\text{Pb}^{2+}$ , and  $\text{Hg}_2^{2+}$ .
4. Most sulfate salts are soluble. Notable exceptions are  $\text{BaSO}_4$ ,  $\text{PbSO}_4$ ,  $\text{HgSO}_4$ , and  $\text{CaSO}_4$ .
5. Most hydroxide salts are only slightly soluble. The important soluble hydroxides are  $\text{NaOH}$  and  $\text{KOH}$ . The compounds  $\text{Ba}(\text{OH})_2$ ,  $\text{Sr}(\text{OH})_2$ , and  $\text{Ca}(\text{OH})_2$  are marginally soluble.
6. Most sulfide ( $\text{S}^{2-}$ ), carbonate ( $\text{CO}_3^{2-}$ ), chromate ( $\text{CrO}_4^{2-}$ ), and phosphate ( $\text{PO}_4^{3-}$ ) are only slightly soluble.

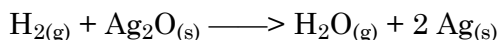
1. a. Determine the concentration of  $\text{Cl}^-$  in 35 mL of a 0.500 M  $\text{MgCl}_2$ .

$$0.500 \text{ M } \text{MgCl}_2 \times \frac{2 \text{ mol } \text{Cl}^-}{1 \text{ mol } \text{MgCl}_2} = 1.00 \text{ M } \text{Cl}^-$$

b. 25.0 mL of a 0.350 M  $\text{NaCl}$  solution are added to 35.0 mL of a 0.500 M  $\text{MgCl}_2$  solution. Assuming the volumes are additive, determine the concentration of  $\text{Cl}^-$  in M.

$$\begin{aligned} 25.0 \text{ mL } \text{NaCl soln} &\times \frac{0.350 \text{ mol } \text{NaCl}}{1000 \text{ mL}} \times \frac{1 \text{ mol } \text{Cl}^-}{1 \text{ mol } \text{NaCl}} = 0.00875 \text{ mol } \text{Cl}^- \\ 35.0 \text{ mL } \text{MgCl}_2 &\times \frac{0.500 \text{ mol } \text{MgCl}_2}{1000 \text{ mL}} \times \frac{2 \text{ mol } \text{Cl}^-}{1 \text{ mol } \text{MgCl}_2} = 0.0350 \text{ mol } \text{Cl}^- \\ \hline &0.04375 \text{ mol } \text{Cl}^- \\ \hline & \frac{0.04375 \text{ mol } \text{Cl}^-}{(.025 + .035)} = 0.7292 \Rightarrow 0.729 \text{ M } \text{Cl}^- \end{aligned}$$

2. Silver oxide can be removed from silver using  $\text{H}_2$ . The following equation describes the reaction.



Is this an oxidation-reduction reaction? What is being oxidized, how many electrons are moved from what element to what element?

Yes, an electron moves from a H atom (in  $\text{H}_2$ ) to an  $\text{Ag}^+$  ion in  $\text{Ag}_2\text{O}$

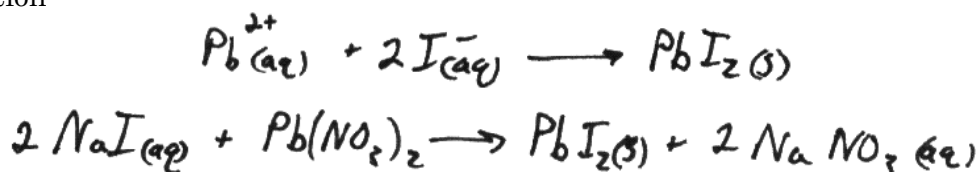
3. 0.3400 g  $\text{Sr}(\text{NO}_3)_2$  are placed in a 250.0-mL volumetric flask. Water is added so that the volume is 250.0 mL. What is the concentration, in M, of the solution?

$$0.3400 \text{ g Sr}(\text{NO}_3)_2 \times \frac{1 \text{ mol Sr}(\text{NO}_3)_2}{211.70 \text{ g Sr}(\text{NO}_3)_2} = 0.001606 \text{ mol Sr}(\text{NO}_3)_2$$

$$M = 0.001606 \text{ mol} / 0.250 \text{ L} = 0.006424 \text{ M}$$

4. Lead ions react with iodide to form lead(II) iodide. How many grams of NaI are required to precipitate all of the lead from 25.0 mL of a 3.5 M lead(II) nitrate solution as lead(II) iodide.

a. balanced equation



b. Grams of NaI

$$25.0 \text{ mL Pb}(\text{NO}_3)_2 \times \frac{3.5 \text{ mol Pb}(\text{NO}_3)_2}{1000 \text{ mL Pb}(\text{NO}_3)_2} \times \frac{2 \text{ mol NaI}}{1 \text{ mol Pb}(\text{NO}_3)_2} \times \frac{149.89 \text{ g}}{1 \text{ mol NaI}} = 26.2307$$

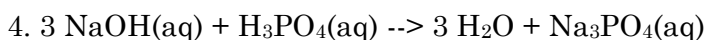
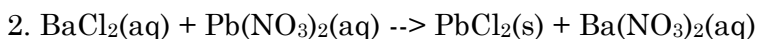
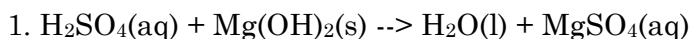
$$= 26 \text{ g NaI}$$

5. 44.30 mL of a 0.100 M NaOH solution are required to neutralize 0.5649 g of an unknown diprotic acid. Determine the molar mass of the diprotic acid?

$$44.30 \text{ mL} \times \frac{0.100 \text{ mol NaOH}}{1000 \text{ mL NaOH soln}} \times \frac{1 \text{ mol acid}}{2 \text{ mol NaOH}} = 0.002215 \text{ mol}$$

$$\frac{0.5649 \text{ g}}{0.002215 \text{ mol}} = 255.034 = 255 \text{ g/mol}$$

6. Identify the products of the following reactions and write balanced chemical equations. If no reaction occurs, write NR.



5. (Hint: a violent reaction that releases gas occurs)

