General Chemistry I
Worksheet #4b Redox. Chemistry, acid/base chemistry, precipitation reactions and titrations

1. Complete and balance each reaction. Classify each of the reactions by reaction type (acid/base, precipitation or redox).
   
a. \( \_ \_ \text{H}_2\text{C}_2\text{O}_4(\text{aq}) + \_ \_ \text{Na}_2\text{O}(\text{aq}) \rightarrow \)
   type: ____________________________________________________________

   b. \( \_ \_ \text{Pb(NO}_3\text{)}_2(\text{aq}) + \_ \_ \text{Na}_2\text{S}(\text{aq}) \rightarrow \)
   type: ____________________________________________________________

   c. \( \_ \_ \text{HCl}(\text{aq}) + \_ \_ \text{NaOH}(\text{aq}) \rightarrow \)
   type: ____________________________________________________________

   d. \( \_ \_ \text{Cu(s)} + \_ \_ \text{H}^+(\text{aq}) + \_ \_ \text{NO}_3^- \rightarrow \_ \_ \text{Cu}^{2+}(\text{aq}) + \_ \_ \text{NO}_2(\text{g}) + \_ \_ \text{H}_2\text{O}(\text{l}) \)
   type: ____________________________________________________________

2. Give the oxidation number of each element in the following balanced reactions.
   a. \( 4 \text{Al(s)} + 3 \text{O}_2(\text{g}) \rightarrow 2 \text{Al}_2\text{O}_3(\text{s}) \)

   b. \( 2 \text{MnO}_4^-(\text{aq}) + 6 \text{H}^+(\text{aq}) + 5 \text{H}_2\text{C}_2\text{O}_4(\text{aq}) \rightarrow 2 \text{Mn}^{2+}(\text{aq}) + 10 \text{CO}_2(\text{g}) + 8 \text{H}_2\text{O}(\text{l}) \)
3. In number 2, part a (above), circle the oxidizing agent, and put a square around the reducing agent (on the reactant side).

4. **Benzoic acid** is an organic acid (but still, just an acid, don’t let the organic part intimidate you). Its formula is $\text{HC}_7\text{H}_5\text{O}_2$.
   
   a. Break benzoic acid down into its proton and polyatomic anion (yes, include charges!).

   b. Break calcium hydroxide down into its ions (include charges here too!).

   c. Write the reaction that occurs between benzoic acid, $\text{HC}_7\text{O}_2\text{H}_5$, and calcium hydroxide.

5. a. Complete and balance the following reaction. Put a circle around the base and underline the acid.

   $$\underline{\text{_____HIO(aq)}} + \underline{\text{____Ca(OH)_2(aq)}} \rightarrow$$

   b. Write the balanced reaction that takes place when acetic acid reacts with lithium hydroxide.

6. A 25.00 mL sample of vinegar (a dilute solution of acetic acid, $\text{HC}_2\text{H}_3\text{O}_2(aq)$) was titrated with 0.500 M NaOH(aq). The stoichiometric point was reached when 38.1 mL of the base had been added.

   a. Find the concentration of acetic acid in the vinegar. (Hint: writing a balanced chemical equation of the reaction is a good start).

   b. Circle the strong species in the question above (above part a).