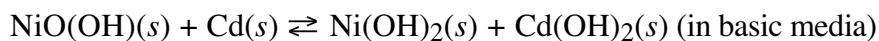
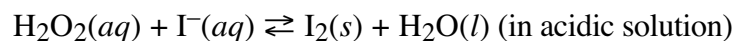


**Problem Set 8** (For Wednesday, March 9)**Recommended Text Problems:** 4.59, 4.62, 11.20, 11.31, 11.36, 11.38, 11.43, 11.48, 11.55, 11.88

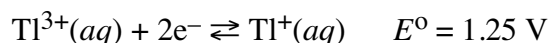
1. For the following reactions, indicate the element oxidized, the element reduced, and write the balanced net reaction.



2. Ammonium perchlorate,  $\text{NH}_4\text{ClO}_4$ , is a solid that spontaneously decomposes above 200 °C into nitrogen gas, chlorine gas, oxygen gas, and water vapor. This reaction is used in the booster propulsion system for the Space Shuttle. Identify the oxidation number changes for each element in  $\text{NH}_4\text{ClO}_4$  in this reaction, and write the balanced net reaction.

3. An electrochemical cell has  $\text{Ag}(s)$  in contact with a 0.05 M solution of  $\text{AgNO}_3(aq)$  on one side, and  $\text{Zn}(s)$  in contact with a  $\text{Zn}^{2+}(aq)$  solution of unknown concentration on the other side. The cell voltage is 1.50 V. What is  $[\text{Zn}^{2+}]$ , and which electrode is the positive one? What is the spontaneous net reaction this cell represents? Next, enough  $\text{NaCl}(s)$  is added to the silver side of the cell to equal the number of moles of  $\text{Ag}^+$  originally present, and  $\text{AgCl}$  precipitates. What is the cell voltage now? You will need to look up the half-reaction potentials as well as the solubility product equilibrium constant for  $\text{AgCl}$ , both in Appendix 5.

4. Which ion of elemental thallium,  $\text{Tl}^+$  or  $\text{Tl}^{3+}$ , is stable in aqueous solution in the presence of  $\text{Tl}(s)$ ? The following standard reduction potentials are relevant:



Write a net reaction involving these three species in a direction that has an equilibrium constant greater than 1, and find the value of the equilibrium constant at 298 K. Which ion is stable?