WKS 16-2 – Batteries
Chem Honors

Name _____

1) Common Dry Cell: LeClanché Battery (A primary Cell)
   a) Write in the important oxidation numbers in the two half reactions:

      Anode (oxidation): $Zn + 4\ NH_3 \rightarrow [Zn(NH_3)_4]^{2+} + 2e^-$

      Cathode (reduction): $2\ MnO_2 + 2\ NH_4^+ + 2e^- \rightarrow Mn_2O_3 + 2\ NH_3 + H_2O$

   b) What is the electrode at the anode? _____
   c) What is the electrode at the cathode? _____
   d) What is one large concern about the anode?

2) Alkaline Battery
   a) What two improvements did this make on the LeClanché battery?

3) Nickel-Metal Hydride Battery (Ni-MH): A Rechargeable Battery (Secondary Cell)
   a) Write in the oxidation numbers in the two half reactions:

      Anode (oxidation): $MH + OH^- \rightarrow H_2O + M + e^-$

      Cathode (reduction): $NiO(OH) + H_2O + e^- \rightarrow Ni(OH)_2 + OH^-$

   b) How does an external power source recharge the Ni-Cad battery?

4) Lead Storage Battery (Car Battery: Lead-Acid Battery)
   a) Write in the oxidation numbers in the two half reactions:

      Anode (oxidation): $Pb(s) + SO_4^{2-}(aq) \rightarrow PbSO_4(s) + 2e^-$

      Cathode (reduction): $PbO_2(s) + 4\ H^+(aq) + SO_4^{2-} + 2e^- \rightarrow PbSO_4(s) + 2\ H_2O(l)$

   b) What is the electrolyte in the battery? _____
   c) What happens to the lead (Pb) when run? _____
   d) What happens to the lead(IV) oxide (PbO_2)? _____
   e) How much voltage does each cell produce? _____
      How many cells does the typical 12V car battery have? _____
   f) One advantage of the lead storage battery is that it can be recharged many times (it recharges when you are driving). What is one major disadvantage of the lead storage battery?

5) Fuel Cells

   a) What is a fuel cell? _____
   b) What are the two major advantages of fuel cells? _____
   c) Write in the oxidation numbers in the two half reactions:

      Anode (oxidation): $2\ H_2(g) + 4\ OH^-(aq) \rightarrow 4\ H_2O(l) + 4e^-$

      Cathode (reduction): $O_2(g) + 2\ H_2O(l) + 4e^- \rightarrow 4\ OH$

Read the attached article, *Beyond Hydrogen: The New Chemistry of Fuel Cells*, from **Chem Matters**, December 2007

6) Why are fuel cells more efficient than conventional combustion engines?

7) What are two problems associated with hydrogen-based fuel cells?

8) What are the two alternate fuels mentioned, and what are two problems associated with them?