**CHE1031 Lecture 5 HW Key**

Problems must be solved, or written out, in their entirety with all work shown on engineering graph paper. You must label each set in the upper left hand corner with your name, the date and the chapter. Problems must be identified by number and all work must be shown with answers boxed. Be sure your handwriting is legible. An example is posted in the ‘course basics’ section of our Moodle page.

**5.1 Redox agents & half-equations**

1. Label each statement TRUE or FALSE?

1. If something is reduced, it is losing electrons.
2. A reducing agent gets oxidized as it reacts.
3. Oxidizing agents can convert CO into CO2.

2. Indicate whether the following balanced equations involve oxidation-reduction. If they do, identify the elements whose oxidation numbers change.

a. 3SO2 (aq) + 2H(NO3) (aq) + 2H2O (l) 🡪 3H2(SO4) (aq) + 2NO (g)

b. 2H2(SO4) (aq) + 2NaBr (s) 🡪 Br2 (l) + SO2 (g) + Na2(SO4) (aq) + 2H2O (l)

3. Complete and balance these equations using half-equations. Identify oxidizing and reducing agents. (QUIZ a & b ONLY)

1. NO2-1 (aq) + Cr2O7-2 (aq) 🡪 Cr+3 (aq) + NO3-1 (aq)
2. S (s) + H(NO3) (aq) 🡪 H2(SO3) (aq) + N2O (g)
3. Cr2O7-2 (aq) + CH3(OH) (aq) 🡪 HCO2H (aq) + Cr+3 (aq)
4. BrO3-1 (aq) + N2H4 (g) 🡪 Br-1 (aq) + N2 (g)

**5.2 Voltaic cells are redox reactions**

4. You want to create a voltaic cell using these half reactions:

A+2 (aq) + 2e- 🡪 A (s) Ered = - 0.10 V

B+2 (aq) + 2e- 🡪 B (s) Ered = - 1.10 V

You use metals A and B as electrodes in beakers. The electrodes are connected by a wire hooked to a voltmeter.

1. What else do you need to add to create a functional voltaic cell?
2. Which is the cathode?
3. Which direction do electrons move in?
4. What voltage will the voltaic cell generate?

5. The platinum electrode in a standard hydrogen electrode is specially prepared to have a large surface area. Why is this important?

6. A voltaic cell is built using this reaction:

PdCl4-2 (aq) + Cd (s) 🡪 Pd (s) + 4Cl-1 (aq) + Cd+2 (aq)

The cell’s measured standard potential is + 1.03 V.

1. Write the half-reactions.
2. Using data from Appendix E of your text, calculate Ered for the Pd half-reaction.
3. Draw a sketch of the voltaic cell, it’s electrodes and the direction of movement of electrons.

7. Using data in Appendix E of your text, calculate the standard Ecell for each of these reactions.

1. H2 (g) + F2 (g) 🡪 2H+1 (aq) + 2F-1 (aq)
2. Cu+2 (aq) + Ca(s) 🡪 Cu (s) + Ca+2 (aq)
3. 3Fe+2 (aq) 🡪 Fe (s) + 2Fe+3 (aq)
4. 2ClO3-1 (aq) + 10Br-1 (aq) + 12H+1 (aq) 🡪 Cl2 (g) + 5Br2 (l) + 6H2O (l)

**5.3 Batteries**

8. The AA-sized and D-sized alkaline batteries are both 1.5-V batteries that are based on the same electrode reactions. Why/how are they different? What difference does this make in how they are used?

9. What is the advantage of using highly concentrated or solid reactants in a voltaic cell?

10. If an alkaline battery was built with cadmium rather than zinc, how would the Ecell potential be affected?

11. What is the environmental advantage to making nickel-metal-hydride batteries vs. nickel-cadmium batteries?

12. The hydrogen-oxygen fuel cell has a standard electromotive force of 1.23 V. What advantages and disadvantages are there to using this device as a source of power compared to a 1.55 V alkaline battery?

**5.4 Corrosion & electrolysis**

13. When the Statue of Liberty was refurbished, Teflon spacers were placed between the iron skeleton and the copper metal surface. Why? What role did the spacers play?a

14. An iron object is plated with a coating of cobalt to protect against corrosion. Does the cobalt protect iron by cathodic protection? Explain.

15. What is meant by “electrolysis”?

16. What process occurs at the anode in the electrolysis of molten NaCl?

17. The crude copper that is subjected to electrorefining contains tellurium as an impurity. The standard reduction potential between tellurium and its lowest common oxidation state, Te+4, is:

Te+4 (aq) + 4e- 🡪 Te (s) Ered = 0.57 V

Given this information, describe the probable fate of tellurium impurities during electrorefining. Do the impurities fall to the bottom of the refining bath, unchanged, as copper is oxidized? Or do they go into solution? If they go into solution, do they plate out on the cathode?