

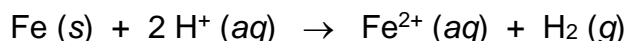
Problem Set 6 – Due by 5 p.m. Monday, 12.2.19

Please answer the following questions on a separate sheet (or sheets) of paper. Be sure to show all your work.

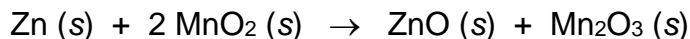
1. Sodium hydroxide (commonly called lye) may be used as a drain cleaner. Suppose that you dissolve 5.00 g of sodium hydroxide pellets in enough water to make 2.0 L of solution. Please predict the solution pH.
2. Your muscles produce lactic acid, $\text{CH}_3\text{CH}(\text{OH})\text{COOH}$ ($K_a = 1.4 \times 10^{-4}$) during exercise.
 - a. Please write the equilibrium for this weak acid reacting with water. Label the acid, base, conjugate acid and conjugate base.
 - b. Please calculate the pH of a 0.075 M solution of lactic acid.
3. In 1999, a battery was designed based on the following cell reaction with a very high oxidation state of iron (nicknamed “super iron”):



- a. Determine the oxidation states for all transition-metal atoms and ions in the cell reaction.
 - b. How many electrons are transferred in this reaction?
4. Acid spontaneously oxidizes iron metal to Fe^{2+} ions, according to the reaction below. Clearly, containers for long-term storage of acid should **not** be made of iron, since the solid iron would dissolve over time.



- a. Write the two half-reactions involved in the process above and calculate the cell potential under standard conditions. How can you tell that the process is spontaneous?
 - b. Which of the following metals could be used in place of iron to successfully store acidic solutions under standard conditions: copper, lead, nickel or tin? Include a calculation of E°_{cell} and a few words to justify your answer.
5. Typical alkaline (zinc—manganese(II) oxide) batteries involve the following overall cell reaction:



- a. Write and balance the oxidation and reduction half-reactions occurring in basic solution.
- b. Which half-reaction occurs at the anode and which occurs at the cathode of the battery?
- c. KOH acts as the electrolyte here. Toward which electrode do the K^+ ions flow?
- d. Refer to Appendix 6 to find the standard half-cell potentials for your half-reactions and calculate E°_{cell} and ΔG° for the overall process. Is it spontaneous under standard conditions?