Chemistry 204: Quiz #8

1. Which of the following is the best oxidizing agent?

   a) Cl_2 b) Fe c) Na d) Na^+ e) $F^–$

2. Consider a galvanic cell at 25°C made by placing a tin electrode in 500.0 mL of 1.00*M* Sn^{2+}(*aq*) in one side and a lead electrode in 500.0 mL of 1.00*M* Pb^{2+}(*aq*) in the other side. Determine the concentration of Sn^{2+}(*aq*) when the cell is "dead".

   a) 0.629 *M* b) 0.808 *M* c) 1.19 *M* d) 1.37 *M* e) 2.00*M*

3. Each of the following cells has 1.0 x $10^{–7}$ *M* Cu^{2+}(*aq*) in one side. Which of the following cells has the **lowest** potential?

   a) A cell made with copper and zinc such that the "copper side" has a copper electrode and 1.0 x $10^{–7}$ *M* Cu^{2+}(a*q*), and the "zinc side" has a zinc electrode and 1.0 *M* Zn^{2+}(a*q*).
   b) A cell made with copper and silver such that the "copper side" has a copper electrode and 1.0 x $10^{–7}$ *M* Cu^{2+}(a*q*), and the "silver side" has a silver electrode and 1.0 *M* Ag^+(a*q*).
   c) A copper concentration cell which has two copper electrodes, 1.0 *M* Cu^{2+}(a*q*) in one side, and 1.0 x $10^{–7}$ *M* Cu^{2+}(a*q*) in the other side.
   d) A cell made with copper and cadmium such that the "copper side" has a copper electrode and 1.0 x $10^{–7}$ *M* Cu^{2+}(a*q*), and the "cadmium side" has a cadmium electrode and 1.0 *M* Cd^{2+}(a*q*).
   e) At least two of the above (a-d) have the same lowest potential.

4. Consider the reaction between Ni(*s*) and HCl(*aq*). If we react an excess of nickel metal in a solution of hydrochloric acid, what is the ratio of $[H^+]/[Ni^{2+}]$ when the system reaches equilibrium?

   a) 1.6 x $10^{–8}$ b) 1.3 x $10^{–4}$ c) 7.8 x 10^3 d) 6.07 x 10^7 e) Cannot be determined.

5, 6. Recall the demonstration in which we placed a piece of copper metal in an aqueous solution of silver nitrate. Suppose instead we placed a 6.000 g piece of copper in a beaker with 100.0 mL of 0.1000*M* $Au(NO_3)_3$(*aq*).

5. Determine the concentration of Cu^{2+}(a*q*) at equilibrium.

   a) 1.2 x $10^{–7}$ *M* b) 3.5 x $10^{–4}$ *M* c) 0.050*M* d) 0.10*M* e) 0.15*M*

6. Determine the concentration of Cu^+(a*q*) at equilibrium.

   a) 1.2 x $10^{–7}$ *M* b) 3.5 x $10^{–4}$ *M* c) 0.050*M* d) 0.10*M* e) 0.15*M*

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7, 8. Consider a galvanic cell at 25°C made by placing a zinc electrode in 500.0 mL of 0.100*M* $ZnCl_2$(*aq*) in one side, and a copper electrode in 500.0 mL of 0.0100*M* $CuSO_4$(*aq*) in the other side.

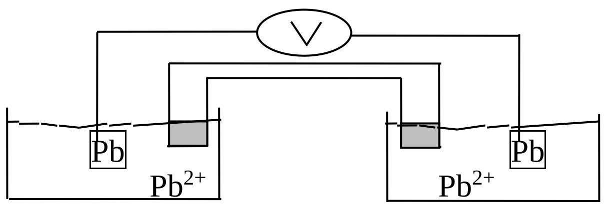
7. Determine the potential of the cell.

a) 1.04 V b) 1.07 V c) 1.10 V d) 1.13 V e) 1.16 V

8. Calculate [Cu^{2+}(a*q*)] after this cell was allowed to produce an average current of 1.00 amp for 3 minutes and 14 seconds.

a) 0.0040*M* b) 0.0060*M* c) 0.0080*M* d) 0.0120*M* e) 0.0140*M*

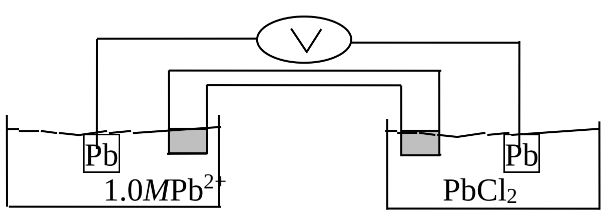
9. A concentration cell is one for which we have the same components in each side of the cell. For this problem, consider a lead concentration cell as shown below:



a. Answer the following questions concerning this cell:

- What is the value of ε° for this cell? Why?
- How do we make a concentration cell like the one above that has a potential? What is the driving force for the cell?
- To have a cell potential of at least 0.1V, what must be true about the relative concentrations of the Pb^{2+} in each side? Provide **quantitative support**.
- Write the half-reaction that occurs in each side of the cell and explain how they correspond to the relative concentration of Pb^{2+} in each side.

b. Suppose we have the following cell, in which we have lead (Pb) electrodes, 1.0*M* Pb^{2+} in one side, and an excess of $PbCl_2$(s) in equilibrium with its ions in the other side:



You measure the cell potential and find it to be 0.053V. Determine:

- The concentration of Pb^{2+} in the right side of the cell. (in molarity).
- The K_{sp} value for $PbCl_2$.
- The standard reduction potential of $PbCl_2(s) + 2e^- \rightarrow Pb(s) + 2Cl^-(aq)$

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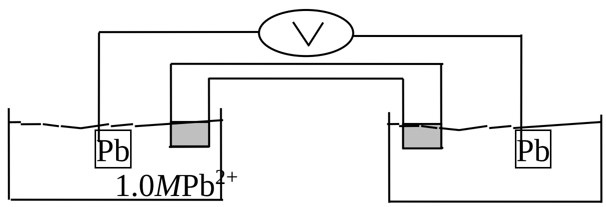
9. c. We saw in lecture, the videos, and the textbook that concentration affects the potential of a cell. If we increase the concentration of the reactant and decrease the concentration of the product, our knowledge of equilibrium tells us that the potential will be increased. Because we cannot get a lower concentration than 0*M*, consider the following cell in which we have lead (Pb) electrodes, 1.0*M* Pb^{2+} in one side, and distilled water in the other side:



Given that to measure a potential we need a flow of electrons through the wire from one side of the cell to the other, **determine the maximum measured potential** of this cell. Assume the volume of each side is 1.00L. **Show all work.**

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KEY:

MC: 1. a, 2. d, 3. c, 4. e, 5. e, 6. b, 7. b. 8. c

9. a. See lectures, videos, and textbook; b. $[Pb^{2+}] = 0.016085\ M$, $K_{sp} = 1.6648 \times 10^{-5}$, $\varepsilon° = -0.27$; c. $\varepsilon = 0.70$ V