Spring 2009 CH 302: Practice Quiz 4 Answer Key

1. In which of the following polyatomic ions does the chromium atom have an even oxidation state?

   I. CrO_4^{2-}

   II. CrO_2^{-}

   III. CrO_2^{2+}

   1. I only
   2. II only
   3. III only
   4. I and II
   5. I and III **Correct**
   6. II and III
   7. I, II and III

Explanation: In each polyatomic ion, oxygen has an oxidation state of -2. The chromium atoms in the chromate, chromite and chromyl ions therefore have oxidation states of +6, +3 and +6 respectively.

2. How many electrons are required to balance the half reaction below?

   $H_2O_2 + __e^- \rightarrow 2\ OH^-$

   1. 1
   2. 2 **Correct**
   3. 3
   4. 4

Explanation: In H_2O_2, the oxidation state of oxygen is -1, and in OH^- it is -2. This is therefore a 2 electron process.

3. Consider the half reactions below:

   $Br_2 + 2e^- \rightarrow 2Br^-$ $E° = +1.07$

   $Fe^{3+} + 3e^- \rightarrow Fe$ $E° = -0.04$

   $Co^{3+} + e^- \rightarrow Co^{2+}$ $E° = +1.80$

   $Zn^{2+} + 2e^- \rightarrow Zn$ $E° = -0.76$

Which species is the weakest **oxidizing** agent?

   1. Zn^{2+} **Correct**
   2. Br^-
   3. Fe^{3+}
   4. Co^{2+}

Explanation: The left hand side of the half reaction with the lowest standard reduction potential is the weakest oxidizng agent. In this case, that species is Zn^{2+}.

4. How many moles of of metallic Tin (Sn) could be produced from Sn^{4+} at a current of 0.2 amperes for 964,853 seconds?

   1. 20 moles Sn
   2. 2 moles Sn
   3. 5 moles Sn
   4. 0.5 moles Sn **Correct**

Explanation: This is a 4 e^- process. $(I \cdot t/n_e \cdot F)$ = moles of product

$(0.2 \cdot 964{,}853/4 \cdot 96{,}485.3) = 0.5$ mol Sn

5. What is the standard cell potential of a battery made from the following two half reactions?

   $Ag^+ + e^- \rightarrow Ag$ $E° = +0.80$

   $Al^{3+} + 3e^- \rightarrow Al$ $E° = -1.66$

   1. 2.46 **Correct**
   2. -2.46
   3. 0.86

4. -0.86

Explanataion: $E°_{cell} = E°_{cathode} - E°_{anode} = 0.80 - ^{-}1.66 = 2.46$

6. Iron can be produced by electrolysis of molten hematite (Fe_2O_3). What species are produced at the cathode and anode respectively?

1. $O_2(g)$, Fe(s)
2. $Fe^{3+}(aq)$, $O^{2-}(aq)$
3. Fe(l), $O_2(g)$ **Correct**
4. Fe(s), $O_2(g)$
5. $O^{2-}(aq)$, $Fe^{3+}(aq)$

Explanation: Oxidation always occurs at the anode, and it is the reduced oxygen found in Fe_2O_3 that must be oxidized to $O_2(g)$. The oxidized Iron found in Fe_2O_3 must be reduced at the cathode into molten aluminum Al(l).

7. In electrochemical cells, the positive terminal is (always/sometimes/never) the cathode and is (always/sometimes/never) the site of reduction.

1. sometimes, never
2. always, never
3. always, always
4. never, sometimes
5. sometimes, sometimes **Correct**
6. sometimes, always
7. never, never

Explanation: In a galvanic cell, the positive terminal is the cathodic terminal. In an electrolytic cell, the positive terminal is the anodic terminal. Therefore the positive terminal is sometimes the cathode and consequently sometimes the site of reduction.

8. The values of E and K are (linearly/exponentially) proportional and (directly/inversely) proportional.

1. linearly, inversely
2. linearly, directly
3. exponentially, inversely
4. exponentially, directly **Correct**

Explanation: $\Delta G = -n \cdot F \cdot E = -R \cdot T \cdot \ln K$