HW10 - Electrochemical Stoichiometry

Question 1 — 1.5 pts

What is the standard cell potential of a battery made from the half reactions below?

$2H^+ + 2e^- \longrightarrow H_2$ E° = 0.00V

$O_2 + 4H^+ + 4e^- \longrightarrow 2H_2O$ E° = +1.23 V

a. -2.46
b. -1.23
c. 2.46
d. 1.23

Question 2 — 1.5 pts

In an electrolytic cell, the negative terminal is the (cathode/anode) and is the site of the (oxidation/reduction) half-reaction.

a. anode, reduction
b. cathode, oxidation
c. cathode, reduction
d. anode, oxidation

Question 3 — 1.5 pts

Consider the galvanic cell:

$Ag(s) | AgCl(s) | Cl^-(aq) || Cl^-(aq) | Hg_2Cl_2(s) | Hg(l)$

What is the smallest possible integer coefficient of Ag(s) in the combined balanced equation?

a. 3
b. 4
c. 1
d. 2

Question 4 — 1.5 pts

Silver is plated on copper by immersing a piece of copper into a solution containing silver (I) ions. In the plating reaction, copper...

a. is oxidized and is the reducing agent.
b. is reduced and is the oxidizing agent.
c. is oxidized and is the oxidizing agent.
d. is reduced and is the reducing agent.

Question 5 — 1.5 pts

What is the E° for the following electrochemical cell where Zn is the cathode?

$Fe | Fe^{2+}$ (1.0 M) || Zn^{2+} (1.0 M) | Zn

$E°_{(Zn)} = -0.76$, $E°_{(Fe)} = -0.44$

a. +0.32
b. -1.20
c. +1.20
d. -0.32

Question 6 — 1.5 pts

Which of the metals in the list below will react with 1M H_2SO_4 to produce hydrogen gas?

$Na^+ + 1e^- \longrightarrow Na$ E° = -2.714

$Cd^{2+} + 2e^- \longrightarrow Cd$ E° = -0.403

$Pb^{2+} + 2e^- \longrightarrow Pb$ E° = -0.126

$Cu^{2+} + 2e^- \longrightarrow Cu$ E° = +0.337

a. Na, Cd, Pb, and Cu
b. Na, Cd, and Pb only
c. Na and Cd only
d. Cu only

Question 7 — 1.5 pts

Consider the voltaic cell:

Pt | Sn^{2+} (0.10 M), Sn^{4+} (0.0010 M) || Ag^+ (0.010 M) | Ag

$Sn^{4+} + 2e^- \longrightarrow Sn^{2+}$ E° = +0.15 V

$Ag^+ + 1e^- \longrightarrow Ag(s)$ E° = +0.80 V

The electrons flow in the external circuit from...

a. Sn to Ag
b. Ag to Pt
c. Sn^{2+} to Ag^+
d. Pt to Ag

Question 8 — 1.5 pts

Using the standard potential tables, what is the largest approximate E° value that can be achieved when two half-cell reactions are combined to form a battery?

a. 3 V
b. -6 V
c. 6 V
d. -3 V

Question 9 — 1.5 pts

Consider the cell:

$Zn(s) | Zn^{2+}(aq) || Cl^-(aq) | AgCl(s) | Ag(s)$

Calculate E°.

a. -1.20 V
b. +0.98 V
c. +1.20 V
d. +0.54 V

Question 10 — 2.0 pts

Which species will oxidize Cr^{2+} ($E°_{red} = -0.407$) but not Mn^{2+} ($E°_{red} = +1.224$)?

a. Pb^{4+} ($E°_{red} = +1.68$)
b. O_3 in acid ($E°_{red} = +2.076$)
c. Zn^{2+} ($E°_{red} = -0.762$)
d. Fe^{2+} ($E°_{red} = -0.771$)
e. V^{3+} ($E°_{red} = -0.255$)

Question 11 — 1.5 pts

If the standard potentials for the couples Cu^{2+}|Cu, Ag^+|Ag, and Fe^{2+}|Fe are +0.34, +0.80, and -0.44 V respectively, which is the strongest reducing agent?

a. Cu^{2+}
b. Fe^{2+}
c. Cu
d. Ag
e. Fe
f. Ag^+

Question 12 — 1.5 pts

For the cell diagram below:

$Cd(s) | CdSO_4(aq) || Hg_2SO_4 | Hg(l)$

What reaction occurs at the cathode?

a. $2Cd(l) + SO_4^{2-}(aq) \longrightarrow CdSO_4(s) + 2e^-$
b. $2Hg(l) + SO_4^{2-}(aq) \longrightarrow Hg_2SO_4(s) + 2e^-$
c. $Hg_2SO_4(s) + 2e^- \longrightarrow 2Hg(l) + SO_4^{2-}(aq)$
d. $CdSO_4(s) + 2e^- \longrightarrow 2Cd(l) + SO_4^{2-}(aq)$

Question 13 — 2.0 pts

Consider the cell diagram below:

$Mg(s) | Mg^{2+}(aq) || Au^+(aq) | Au(s)$

$Mg^{2+} + 2e^- \longrightarrow Mg$ E° = -2.36

$Au^+ + e^- \longrightarrow Au$ E° = +1.69

What is the cathode and what is the cell type?

a. Mg(s); a voltaic cell
b. Au(s); an electrolytic cell
c. Mg(s); an electrolytic cell
d. Au(s); a voltaic cell

Question 14 — 1.5 pts

Consider the half-reactions:

$Mn^{2+} + 2e^- \longrightarrow Mn$ E° = -1.029 V

$Ga^{3+} + 3e^- \longrightarrow Ga$ E° = -0.560 V

$Fe^{2+} + 2e^- \longrightarrow Fe$ E° = -0.409 V

$Sn^{2+} + 2e^- \longrightarrow Sn$ E° = -0.136 V

Using the redox couples to establish a voltaic cell, which reaction would be non-spontaneous?

a. $2Ga + 3Sn^{2+} \longrightarrow 2Ga^{3+} + 3Sn$
b. $Sn^{2+} + Mn \longrightarrow Sn + Mn^{2+}$
c. $Sn^{2+} + Fe \longrightarrow Sn + Fe^{2+}$
d. $2Ga^{3+} + 3Fe \longrightarrow 2Ga + 3Fe^{2+}$
e. $Fe^{2+} + Mn \longrightarrow Mn^{2+} + Fe$

Question 15 — 1.5 pts

Find the standard emf of the given cell diagram:

$Cu(s) | Cu^{2+}(aq) || Au^+(aq) | Au(s)$

$Cu^{2+} + 2e^- \longrightarrow Cu$ E° = +0.34 V

$Au^+ + e^- \longrightarrow Au$ E° = +1.69 V

a. +2.03 V
b. -1.35 V
c. -2.03 V
d. +1.35 V

Question 16 — 2.0 pts

Which species will REDUCE Ag^+ but not Fe^{2+}?

a. Cr
b. K
c. Co^{2+}
d. H_2

Question 17 — 1.5 pts

If the table of standard reduction potentials is ordered with the strongest reducing agents at the top, how are the reduction potentials ordered (from top to bottom)?

a. from most spontaneous to least spontaneous
b. from most common to least common
c. from most negative to most positive
d. from most positive to most negative

Question 18 — 1.5 pts

Which species is the weakest reducing agent in the table of half-reactions?

a. F^-
b. F_2
c. Li^+
d. Li

Question 19 — 1.5 pts

If the two half-reactions below were used to make an electrolytic cell, what species would be consumed at the anode?

$Au^{3+}(aq) + 3e^- \longrightarrow Au(s)$ E° = +1.50

$I_2(s) + 2e^- \longrightarrow 2I^-(aq)$ E° = +0.53

a. $I^-(aq)$
b. $Au^{3+}(aq)$
c. $I_2(s)$
d. Au(s)