Homework 10

Electrochemical Stoichiometry

Question 1 1.5 pts

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

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

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

- -2.46
- 1.23
- 2.46
- -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.

- cathode, reduction
- cathode, oxidation
- anode, oxidation
- anode, reduction

Question 3

1.5 pts

Consider the galvanic cell:

$Ag(s) \mid AgCl(s) \mid Cl^-(aq) \parallel Cl^-(aq) \mid Hg_2Cl_2(s) \mid Hg(l)$

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

- 1
- 2
- 3
- 4

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...

- is oxidized and is the reducing agent.
- is oxidized and is the oxidizing agent.
- is reduced and is the oxidizing agent.
- 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?

$Fe \mid Fe^{2+}$ (1.0 M) $\parallel Zn^{2+}$ (1.0 M) $\mid Zn$

$E^\circ_{(Zn)} = -0.76$, $E^\circ_{(Fe)} = -0.44$

- +1.20
- +0.32
-

-0.32

-1.20

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

Na and Cd only

Cu only

Na, Cd, and Pb only

Na, Cd, Pb, and Cu

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...

Pt to Ag

Ag to Pt

Sn^{2+} to Ag^+

Sn 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?

- 6 V
- -6 V
- -3 V
- 3 V

Question 9

1.5 pts

Consider the cell:

$Zn(s) \mid Zn^{2+}(aq) \parallel Cl^{-}(aq) \mid AgCl(s) \mid Ag(s)$

Calculate E°.

- -1.20 V
- +0.54 V
- +0.98 V
- +1.20 V

Question 10

2 pts

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

- Pb^{4+} ($E°_{red}$ = +1.68)
- V^{3+} ($E°_{red}$ = -0.255)
- O_3 in acid ($E°_{red}$ = +2.076)
- Fe^{2+} ($E°_{red}$ = -0.771)

- Zn^{2+} ($E°_{red}$ = -0.762)

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?

- Fe
- Cu^{2+}
- Ag
- Ag^{+}
- Cu
- Fe^{2+}

Question 12

1.5 pts

For the cell diagram below:

$Cd(s) \mid CdSO_4(aq) \parallel Hg_2SO_4 \mid Hg(l)$

What reaction occurs at the cathode?

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

Question 13

2 pts

Consider the cell diagram below:

$Mg(s) \mid Mg^{2+}(aq) \parallel Au^{+}(aq) \mid Au(s)$

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

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

What is the cathode and what is the cell type?

- Au(s); an electrolytic cell
- Mg(s); an electrolytic cell
- Mg(s); a voltaic cell
- Au(s); a voltaic cell

Question 14

1.5 pts

Consider the half-reactions:

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

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

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

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

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

- $Sn^{2+} + Fe \longrightarrow Sn + Fe^{2+}$
- $Fe^{2+} + Mn \longrightarrow Mn^{2+} + Fe$
- $2Ga^{3+} + 3Fe \longrightarrow 2Ga + 3Fe^{2+}$
- $2Ga + 3Sn^{2+} \longrightarrow 2Ga^{3+} + 3Sn$
- $Sn^{2+} + Mn \longrightarrow Sn + Mn^{2+}$

Question 15

1.5 pts

Find the standard emf of the given cell diagram:

$Cu(s) \mid Cu^{2+}(aq) \parallel Au^{+}(aq) \mid Au(s)$

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

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

- +1.35 V
- -2.03 V
- +2.03 V
- -1.35 V

Question 16 **2 pts**

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

- Cr
- K
- Co^{2+}
- 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)?

- from most spontaneous to least spontaneous
- from most common to least common
- from most positive to most negative
- from most negative to most positive

Question 18 **1.5 pts**

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

- F^-
- Li^+
- Li
- F_2

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?

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

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

- $Au^{3+}(aq)$
- $I_2(s)$
- $I^-(aq)$
- Au(s)

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