Champter 6

(Electrochemistry)

Self Assessment A (Chemistry by Rymond Chang)

NOTE: A table of standard reduction potentials is required to work many of these problems.

1. Complete and balance the following redox equation. When properly balanced using the smallest whole-number coefficients, the coefficient of S is

$$H_2S + HNO_3 \rightarrow S + NO \text{ (acidic solution)}$$

A. 1 B. 2 C. 3 D. 5 E. 6

2. Given the following notation for an electrochemical cell

$$Pt(s) \mid H_2(g) \mid H^+(aq) \parallel Ag^+(aq) \mid Ag(s),$$

what is the balanced overall (net) cell reaction?

A. $2H^+(aq) + 2Ag^+(aq) \rightarrow H_2(g) + 2Ag(s)$
B. $H_2(g) + 2Ag(s) \rightarrow H^+(aq) + 2Ag^+(aq)$
C. $2H^+(aq) + 2Ag(s) \rightarrow H_2(g) + 2Ag^+(aq)$
D. $H_2(g) + Ag^+(aq) \rightarrow H^+(aq) + Ag(s)$
E. $H_2(g) + 2Ag^+(aq) \rightarrow 2H^+(aq) + 2Ag(s)$

3. Calculate the value of $E°_{cell}$ for the following reaction:

$$2Au(s) + 3Ca^{2+}(aq) \rightarrow 2Au^{3+}(aq) + 3Ca(s)$$

A. −4.37 V B. −1.37 V C. −11.6 V D. 1.37 V E. 4.37 V

4. Calculate the standard cell emf for the following cell:

$$Mg \mid Mg^{2+} \parallel NO_3^- \text{ (acid soln)} \mid NO(g) \mid Pt$$

A. 3.33 V B. 1.41 V C. −1.41 V D. 8.46 V E. −8.46 V

5. The overall reaction $2Co^{3+}(aq) + 2Cl^{-}(aq) \rightarrow 2Co^{2+}(aq) + Cl_2(g)$ has the standard cell voltage $E°_{cell} = 0.46\ V$.

Given that $Cl_2(g) + 2e^{-} \rightarrow 2Cl^{-}(aq)$, $E° = 1.36\ V$,

calculate the standard reduction potential for the following the half reaction at 25°C:

$$Co^{3+} + e^{-} \rightarrow Co^{2+}$$

A. 1.82 V B. −0.90 V C. 0.90 V D. −1.82 V E. −1.36 V

6. In the following half equation, which is the oxidizing agent?

$$NO_3^{-}(aq) + 4H^{+}(aq) + 3e^{-} \rightarrow NO(g) + 2H_2O$$

A. NO_3^{-} B. H^{+} C. e^{-} D. NO E. H_2O

7. Which statement is *true* for a spontaneous redox reaction carried out at standard-state conditions?

A. $E°_{red}$ is always negative.
B. $E°_{cell}$ is always positive.
C. $E°_{ox}$ is always positive.
D. $E°_{red}$ is always positive.

8. Consider the following standard reduction potentials in acid solution:

	E°(V)
$Al^{3+} + 3e^{-} \rightarrow Al(s)$	−1.66
$AgBr(s) + e^{-} \rightarrow Ag(s) + Br^{-}$	+0.07
$Sn^{4+} + 2e^{-} \rightarrow Sn^{2+}$	+0.14
$Fe^{3+} + e^{-} \rightarrow Fe^{2+}$	+0.77

The strongest oxidizing agent among those shown above is

A. Fe^{3+}. B. Fe^{2+}. C. Br^{-}. D. Al^{3+}. E. Al.

9. Determine the equilibrium constant, K_{eq}, at 25°C for the reaction

$$2Br^{-}(aq) + I_2(s) \rightleftharpoons Br_2(l) + 2I^{-}(aq)$$

A. 5.7×10^{-19}
B. 18.30

C. 1.7×10^{54}

D. 1.9×10^{18}

E. 5.7×10^{-55}

10. Given the following standard reduction potentials,

$Ag^+(aq) + e^- \rightarrow Ag(s)$ $\quad E° = 0.80\ V$

$AgCN(s) + e^- \rightarrow Ag(s) + CN^-(aq)$ $\quad E° = -0.01\ V$

calculate the solubility product of AgCN at 25°C.

A. 4.3×10^{-14} B. 2.3×10^{13} C. 2.1×10^{-14} D. 5.1×10^{13} E. None of these

11. Calculate the cell emf for the following reaction at 25°C:

$2Ag^+(0.010\ M) + H_2(1\ atm) \rightarrow 2Ag(s) + 2H^+(pH = 10.0)$

A. 1.04 V B. 1.27 V C. 0.92 V D 0.56 V E. 0.80 V

12. How many coulombs of charge are required to cause reduction of 0.20 mole of Cr^{3+} to Cr?

A. 0.60 C B. 3.0 C C. 2.9×10^4 C D. 5.8×10^4 C E. 9.65×10^4 C

13. A current of 0.80 A was applied to an electrolytic cell containing molten $CdCl_2$ for 2.5 hours. Calculate the mass of cadmium metal deposited.

A. 3.2×10^{-7} g B. 1.2×10^{-3} g C. 4.2 g D. 8.4 g E. 16.8 g

14. A current of 2.50 A was passed through an electrolytic cell containing molten $CaCl_2$ for 4.50 hours. How many moles of calcium metal should be deposited?

A. 5.83×10^{-5} mol B. 0.210 mol C. 0.420 mol D. 0.840 mol
E. 1.95×10^9 mol