Chemistry 14B
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Ch 14: Electrochemistry Worksheet

For this worksheet, you should have the sheet with standard reduction potentials of many common half reactions ready at hand. This can be found if you just google "standard reduction potential chart".

1. Which of the following would be the best oxidizing agent? (oxidize others - can be reduced / gain e's)
   a. Cl_2 → Cl^-
   b. Fe → Fe^{2+}
   c. Na → Na^+
   d. Na^+
   e. F^- can't be F^{2-}

2. The following two half reactions are involved in a galvanic cell. At standard conditions, what species are produced at each electrode?
   a. Ag is produced at the cathode and Ni at the anode.
   b. Ag is produced at the cathode and Ni^{2+} at the anode.
   c. Ag^+ is produced at the anode and Ni at the cathode.
   d. Ag^+ is produced at the anode and Ni^{2+} at the cathode.
   e. None of the above

Ag / Ni | Ag^+ / Ni^{2+} — oxidized → anode; cathode

not c b/c need to check E° values in table

3. When the following reaction in basic solution is balanced, what is the sum of the coefficients?

b/c Mn +7 → +4

$$MnO_{4\,(aq)}^- + CN^-_{(aq)} \rightarrow MnO_{2\,(s)} + CNO^-_{(aq)}$$

Mn reduced. C oxidized

(1) $2H_2O + 3e^- + 2MnO_4^- \rightarrow 2MnO_2 + 4OH^-$) 2

(2) $6OH^- + 3CN^- \rightarrow 3CNO^- + 2e^- + 3H_2O$) 3

13

b/c C +2 → +4

$$2MnO_4^- + 3CN^- + H_2O \rightarrow 2MnO_2 + 3CNO^- + 2OH^-$$

$6 + 7 = \boxed{13}$

+ E° so ΔG = −

4. Copper will spontaneously reduce which of the following?
   a. Fe^{2+} and Ag^+
   b. Fe^{2+} Look @ tables
   c. Ag^+
   d. Al^{3+}
   e. Fe^{2+} and Al^{3+}

5. Given the standard potential for the reaction of hydrogen and oxygen:

$$2H_2 + O_2 \rightarrow 2H_2O \qquad E^\circ = +1.23V$$

Calculate the standard potential for the following reaction:

$$H_2O \rightarrow H_2 + 1/2\ O_2$$ just switched sides

-1.23V

6. Determine the standard potential E° of a cell with the following reaction:

$$Fe + Cu^{2+} \rightarrow Fe^{2+} + Cu$$

$Fe \rightarrow Fe^{2+}$ $+0.44$

$Cu^{2+} \rightarrow Cu$ $+0.34$

$+0.78$

0.78V

7. How many electrons are transferred in the following reaction?

$$2\,ClO_3^- + 12\,H^+ + 10\,I^- \rightarrow 5\,I_2 + Cl_2 + 6\,H_2O$$

$10I^- \rightarrow 5I_2$

↑ 10^- charge ↑ ∅

10

$12H^+ + 2ClO_3^- \rightarrow Cl_2 + 6H_2O$

$12 + (-2) = +10$ ← need $10e^-$ to balance charge

∅

8. For the following half cell equations (unbalanced):

$S_2O_{8\,(aq)}^{2-} \rightarrow SO_{4\,(aq)}^{2-}$ $\quad E^o = +2.01V$

$NO_{3\,(aq)}^{-} \rightarrow NO_{(g)}$ $\quad E^o = +0.96V$

a. Predict which element is oxidized and which is reduced and briefly explain your reasoning.

$S_2O_{8\,(aq)}^{2-}$ will be reduced and NO will be oxidized because electrons flow from the more negative to more positive half cell.

b. Assuming basic conditions, write a balanced reaction for what actually happens spontaneously.

$$3\,S_2O_{8\,(aq)}^{2-} + 2\,NO_{(g)} + 8OH^- \rightarrow 6SO_{4\,(aq)}^{2-} + 2NO_{3\,(aq)}^{-} + 4\,H_2O$$

b/c 4⁻ total on other side

$2e^- + S_2O_8^{2-} \rightarrow 2SO_4^{2-}$) 3

$4OH^- + NO \rightarrow NO_3^- + 3e^- + 2H_2O$) 2

$3S_2O_8 + 8OH^- + 2NO \rightarrow 6SO_4^{2-} + 2NO_3^- + 4H_2O$

c. Calculate the cell emf.

$2.01 + (-0.96) = 1.05$

1.05V

d. Draw a schematic representation (cell diagram) for the cell using standard cell convention.