Use the following table of standard reduction potentials to assist in answering the questions.

Li^{+}	✹	Li	-3.0V
Na+	✹	Na	-2.7V
Al^{+3}	✹	Al	-1.7V
Zn^{+2}	✹	Zn	-0.7V
Fe^{+3}	✹	Fe	-0.1V
H^{+}	✹	H_2	0.0V
Cu^{+2}	✹	Cu	0.3V
NO_3^{-}	✹	NO	1.0V
Cl_2	✹	$2Cl^{-}$	1.4V
MnO_4-	✹	Mn^{+2}	1.5V
Au^{+}	✹	Au	1.7V
F_2	✹	$2\ F^{-}$	2.9V

1. Consider the formation of copper fluoride. Using the half cell reactions written above, what is the final reaction?
   a. copper ion is oxidized and fluorine gas is reduced
   b. copper ion is reduced and fluorine ion is oxidized
   c. copper ion is reduced and fluorine gas is reduced
   d. copper is oxidized and fluorine gas is reduced
   e. copper is reduced and fluorine gas is oxidized

To form copper fluoride, CuF2, copper has to lose electrons to become the copper ion, an oxidation. Fluorine gas has to gain electrons to become fluorine ion, a reduction.

2. What is the sum of the coefficients when the following reaction is balanced in base?
$MnO_4^{-} + Na_2SO_3 \rightarrow MnO_2 + Na_2SO_4$
   a. 4
   b. 13
   c. 27
   d. 7

The balanced reaction in base is:
$2\ MnO_4^{-} + 3\ Na_2SO_3 + H_2O \rightarrow 2\ MnO_2 + 3\ Na_2SO_4 + 2\ OH^{-}$

3. Which of the following statements is true for a cell with E = 1.2 V?
   a. The sign of ΔG is negative.
   b. The sign at the cathode is positive.
   c. Reduction occurs at the anode.
   d. The sign at the anode is positive.

Because E is positive, the cell is electrolytic. The reaction is non-spontaneous, and ΔG is positive. The sign at the cathode is negative, and the sign at the anode is positive. Reduction always occurs at the cathode.

4. Consider the table of half cell reactions above. Which of the following statements is true?
   a. As written, the reactions occur at ion concentrations of .1 M.
   b. Sodium is a strong reducing agent.
   c. The table provides standard potentials for oxidation.
   d. Manganese ion is a strong reducing agent.

In the table, the reactions are written as reductions, and the standard potential for reduction of the half-reaction is provided. The reactions occur at ion concentrations of 1 M. Half reactions with negative standard potentials occur with stronger reducing agents. Half reactions with positive standard potentials occur with stronger oxidizing agents.

5. Calculate the standard cell potential of a voltaic cell given the following half reactions:
Zn^{2+} (aq) + $2e^-$ → Zn (s) $E^o_{1/2}$ = -0.8 V
Cu^{2+} (aq) + $2e^-$ → Cu (s) $E^o_{1/2}$ = 0.3 V

a. -0.11 V
b. -0.5 V
c. 0.11 V
d. 0.5 V

E^o_{cell}= $E^o_{1/2}$ cathode - $E^o_{1/2}$ anode
= 0.3 V - (-0.8V) = 11V
A voltaic cell (galvanic cell/battery) has a positive E^o_{cell}, meaning that the reaction is spontaneous

6. Consider a cell with the half reactions below and a copper ion concentration of 1M and lithium ion 2M . What is potential of the cell?
Cu^{2+} (aq) + $2e^-$ → Cu (s) $E^o_{1/2}$ = 0.3 V
$2Li^+$ (aq) + $2e^-$ → 2Li $E^o_{1/2}$ = -3.0 V

a. 5.8V
b. 6V
c. 6.02V
d. 0V

E^o_{cell}= $E^o_{1/2}$ cathode - $E^o_{1/2}$ anode = 0.3 V - (-0.3V) = 6V
Cu^{2+} + 2Li → Cu(s) + $2Li^+$ (aq)
E_{cell}= E^o_{cell} - (0.05916 logQ)/n
E_{cell} = 6V - (0.05916 log$[Li^+]^2/[Cu^{2+}]$)/2
E_{cell} = 6V - (0.05916 log$[2]^2$/1)/2 = 6V - (0.05916*0.6)/2 = 6 - .02 = 5.8V

7. Rank the following from weakest to strongest reducing agents: K^+, Cl_2, Zn, Zn^{2+}
Zn^{+2} → Zn $E^o_{1/2}$ = -0.7V
Cl_2→ $2Cl^-$ $E^o_{1/2}$ = 1.4V
K^+ (aq) + e^-→ K(s) $E^o_{1/2}$ = -2.92V

1. K^+< Zn < Zn^{2+}< Cl_2
2. K^+< Zn^{2+}< Zn < Cl_2
3. Cl_2< Zn^{+2}< Zn < K^+
4. Cl_2< Zn < Zn^{+2}< K^+

The strongest reducing agent will have the most negative E. The ranking goes as:
1.4V < 0.7V < -0.7V < -2.92V

8. How many grams of Au were used in the reduction reaction of Au^+ to Au if $9.65x10^3$ C are used?

a. 7.9 g
b. 0.79 g
c. 79 g
d. 790 g

($9.65x10^3$ C)(1 mole Au^+ / $9.65x10^4$ C/mol)(1 mole Au/1mol Au^+)(79 g/1mol Au) = 7.9 g Au