

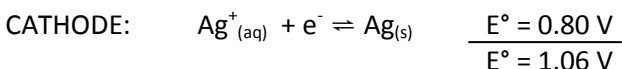
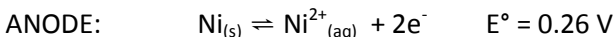
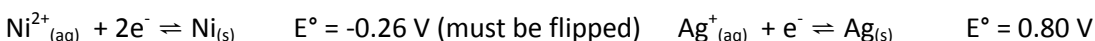
Standard Reduction Potentials Worksheet

1. Calculate the standard cell potential produced by a galvanic cell consisting of a nickel electrode in contact with a solution of Ni^{2+} ions and a silver electrode in contact with a solution of Ag^+ ions. Which is anode and which is the cathode?
2. What is the voltage produced by a galvanic cell consisting of an aluminum electrode in contact with a solution of Al^{3+} ions and an iron electrode in contact with a solution of Fe^{2+} ions. Which is anode and which is the cathode?
3. Calculate the standard cell potential produced by a galvanic cell consisting of a sodium electrode in contact with a solution of Na^+ ions and a copper electrode in contact with a solution of Cu^{2+} ions. Which is anode and which is the cathode?
4. What is the voltage produced by a voltaic cell consisting of a calcium electrode in contact with a solution of Cu^{2+} ions. Which is anode and which is the cathode?
5. An electrochemical cell is constructed using electrodes based on the following half reactions:
$$\text{Pb}^{2+}_{(\text{aq})} + 2\text{e}^- \rightarrow \text{Pb}_{(\text{s})} \qquad \text{Au}^{3+}_{(\text{aq})} + 3\text{e}^- \rightarrow \text{Au}_{(\text{s})}$$
 - a) Which is the anode and which is the cathode in this cell?
 - b) What is the standard cell potential?
6. Calculate the standard cell potential produced by a voltaic cell consisting of a nickel electrode in contact with a solution of Ni^{2+} ions and a copper electrode in contact with a solution of Cu^{2+} ions. Which is anode and which is the cathode?
7. A voltaic cell is constructed using electrodes based on the following half reactions:
$$\text{Mg}^{2+}_{(\text{aq})} + 2\text{e}^- \rightarrow \text{Mg}_{(\text{s})} \qquad \text{Cu}^{2+}_{(\text{aq})} + 2\text{e}^- \rightarrow \text{Cu}_{(\text{s})}$$
 - a) Which is the anode and which is the cathode in this cell?
 - b) What is the standard cell potential?
8. What is the voltage produced by a voltaic cell consisting of a lead electrode in contact with a solution of Pb^{2+} ions and an iron electrode in contact with a solution of Fe^{2+} ? Which is anode and which is the cathode?
9. What is the voltage produced by a voltaic cell consisting of a zinc electrode in contact with a solution of Zn^{2+} ions and a silver electrode in contact with a solution of Ag^+ ions? Which is anode and which is the cathode?
10. Calculate the standard cell potential produced by a voltaic cell consisting of a gold electrode in contact with a solution of Au^{3+} ions and a silver electrode in contact with a solution of Ag^+ ions. Which is the anode and which is the cathode?
11. Use half-reaction potentials to predict whether the following reactions are spontaneous or non-spontaneous in aqueous solutions.
 - a) $\text{Ca}^{2+}_{(\text{aq})} + 2\text{I}^-_{(\text{aq})} \rightarrow \text{Ca}_{(\text{s})} + \text{I}_{2(\text{aq})}$
 - b) $2\text{H}_2\text{S}_{(\text{g})} + \text{O}_{2(\text{g})} \rightarrow 2\text{H}_2\text{O}_{(\text{l})} + 2\text{S}_{(\text{s})}$
 - c) $\text{SO}_{2(\text{g})} + \text{MnO}_{2(\text{s})} \rightarrow \text{Mn}^{2+}_{(\text{aq})} + \text{SO}_4^{2-}_{(\text{aq})}$
 - d) $2\text{H}^+_{(\text{aq})} + 2\text{Br}^-_{(\text{aq})} \rightarrow \text{H}_{2(\text{g})} + \text{Br}_{2(\text{aq})}$
 - e) $\text{Ce}^{4+}_{(\text{aq})} + \text{Fe}^{2+}_{(\text{aq})} \rightarrow \text{Ce}^{3+}_{(\text{aq})} + \text{Fe}^{3+}_{(\text{aq})}$
 - f) $\text{Cr}^{2+}_{(\text{aq})} + \text{Cu}^{2+}_{(\text{aq})} \rightarrow \text{Cr}^{3+}_{(\text{aq})} + \text{Cu}^+_{(\text{aq})}$

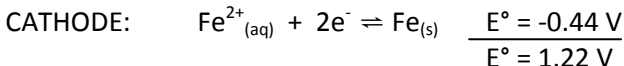
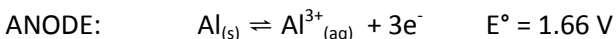
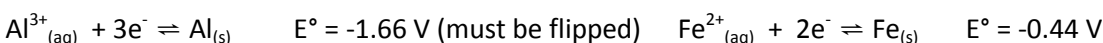
Science 122

Electrochemical Cells Worksheet - Key

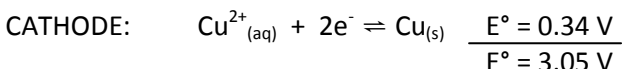
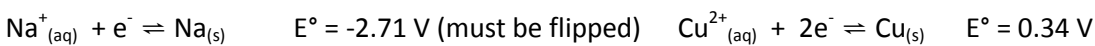
1. Calculate the standard cell potential produced by a galvanic cell consisting of a nickel electrode in contact with a solution of Ni^{2+} ions and a silver electrode in contact with a solution of Ag^+ ions. Which is anode and which is the cathode?



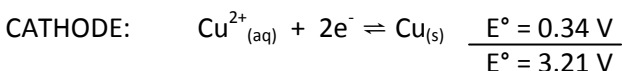
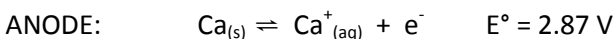
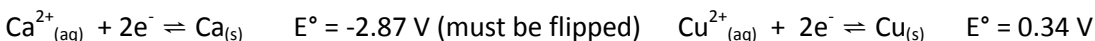
2. What is the voltage produced by a galvanic cell consisting of an aluminum electrode in contact with a solution of Al^{3+} ions and an iron electrode in contact with a solution of Fe^{2+} ions. Which is anode and which is the cathode?



3. Calculate the standard cell potential produced by a galvanic cell consisting of a sodium electrode in contact with a solution of Na^+ ions and a copper electrode in contact with a solution of Cu^{2+} ions. Which is anode and which is the cathode?



4. What is the voltage produced by a voltaic cell consisting of a calcium electrode in contact with a solution of Ca^{2+} ions. Which is anode and which is the cathode?



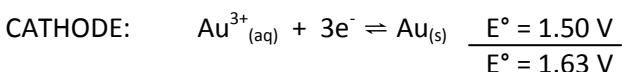
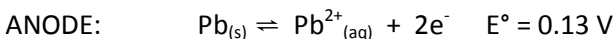
5. An electrochemical cell is constructed using electrodes based on the following half reactions:



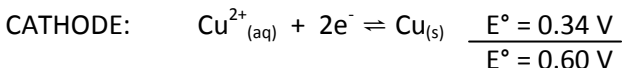
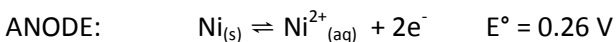
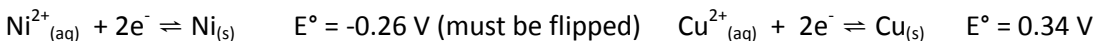
- a) Which is the anode and which is the cathode in this cell?

ANODE: Pb CATHODE: Au

- b) What is the standard cell potential?



6. Calculate the standard cell potential produced by a voltaic cell consisting of a nickel electrode in contact with a solution of Ni^{2+} ions and a copper electrode in contact with a solution of Cu^{2+} ions. Which is anode and which is the cathode?



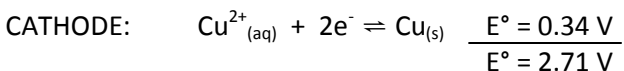
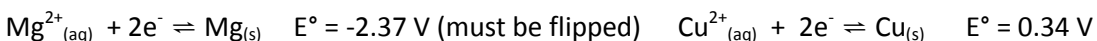
7. A voltaic cell is constructed using electrodes based on the following half reactions:



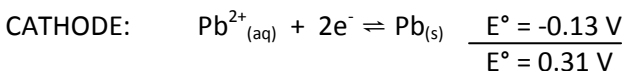
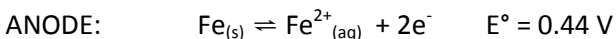
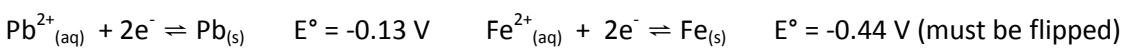
- a) Which is the anode and which is the cathode in this cell?

ANODE: Mg CATHODE: Cu

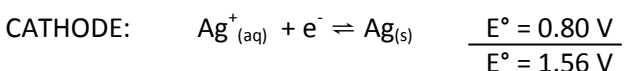
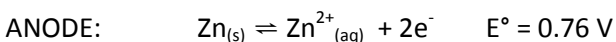
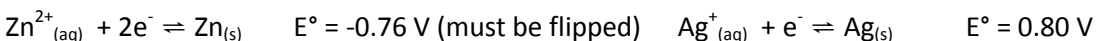
- b) What is the standard cell potential?



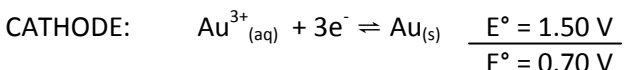
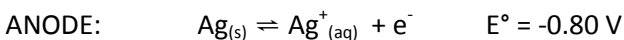
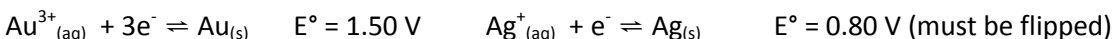
8. What is the voltage produced by a voltaic cell consisting of a lead electrode in contact with a solution of Pb^{2+} ions and an iron electrode in contact with a solution of Fe^{2+} ? Which is anode and which is the cathode?



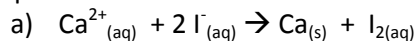
9. What is the voltage produced by a voltaic cell consisting of a zinc electrode in contact with a solution of Zn^{2+} ions and a silver electrode in contact with a solution of Ag^{+} ions? Which is anode and which is the cathode?



10. Calculate the standard cell potential produced by a voltaic cell consisting of a gold electrode in contact with a solution of Au^{3+} ions and a silver electrode in contact with a solution of Ag^{+} ions. Which is the anode and which is the cathode?



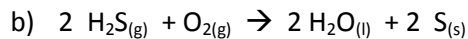
11. Use half-reaction potentials to predict whether the following reactions are spontaneous or non-spontaneous in aqueous solutions.



ANODE: $2 \text{I}^{-}_{(aq)} \rightleftharpoons \text{I}_{2(aq)} + 2\text{e}^{-}$ $E^{\circ} = 0.54 \text{ V}$

CATHODE: $\text{Ca}^{2+}_{(aq)} + 2\text{e}^{-} \rightleftharpoons \text{Ca}_{(s)}$ $\frac{E^{\circ} = -2.87 \text{ V}}{E^{\circ} = -2.33 \text{ V}}$

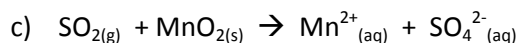
E° is negative, therefore the cell is non-spontaneous.



ANODE: $\text{H}_2\text{S}_{(g)} \rightleftharpoons \text{S}_{(s)} + 2\text{H}^{+}_{(aq)} + 2\text{e}^{-}$ $E^{\circ} = -0.14 \text{ V}$

CATHODE: $\text{O}_{2(g)} + 4\text{H}^{+}_{(aq)} + 4\text{e}^{-} \rightleftharpoons 2 \text{H}_2\text{O}_{(l)}$ $\frac{E^{\circ} = 1.23 \text{ V}}{E^{\circ} = 1.09 \text{ V}}$

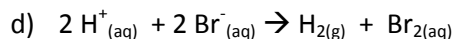
E° is positive, therefore the cell is spontaneous.



ANODE: $\text{SO}_{2(g)} + 2 \text{H}_2\text{O}_{(l)} \rightleftharpoons \text{SO}_4^{2-}_{(aq)} + 4\text{H}^{+}_{(aq)} + 2\text{e}^{-}$ $E^{\circ} = -0.18 \text{ V}$

CATHODE: $\text{MnO}_{2(s)} + 4\text{H}^{+}_{(aq)} + 2\text{e}^{-} \rightleftharpoons \text{Mn}^{2+}_{(aq)} + 2 \text{H}_2\text{O}_{(l)}$ $\frac{E^{\circ} = 1.22 \text{ V}}{E^{\circ} = 1.04 \text{ V}}$

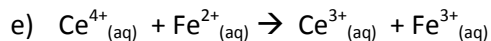
E° is positive, therefore the cell is spontaneous.



ANODE: $2 \text{Br}^{-}_{(aq)} \rightleftharpoons \text{Br}_{2(l)} + 2\text{e}^{-}$ $E^{\circ} = -1.07 \text{ V}$

CATHODE: $2\text{H}^{+}_{(aq)} + 2\text{e}^{-} \rightleftharpoons \text{H}_{2(g)}$ $\frac{E^{\circ} = 0.00 \text{ V}}{E^{\circ} = -1.07 \text{ V}}$

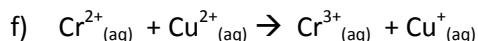
E° is negative, therefore the cell is non-spontaneous.



ANODE: $\text{Fe}^{2+}_{(aq)} \rightleftharpoons \text{Fe}^{3+}_{(aq)} + \text{e}^{-}$ $E^{\circ} = -0.77 \text{ V}$

CATHODE: $\text{Ce}^{4+}_{(aq)} + \text{e}^{-} \rightleftharpoons \text{Ce}^{3+}_{(aq)}$ $\frac{E^{\circ} = 1.61 \text{ V}}{E^{\circ} = -2.38 \text{ V}}$

E° is negative, therefore the cell is non-spontaneous.



ANODE: $\text{Cr}^{2+}_{(aq)} \rightleftharpoons \text{Cr}^{3+}_{(aq)} + \text{e}^{-}$ $E^{\circ} = 0.41 \text{ V}$

CATHODE: $\text{Cu}^{2+}_{(aq)} + \text{e}^{-} \rightleftharpoons \text{Cu}^{+}_{(aq)}$ $\frac{E^{\circ} = 0.15 \text{ V}}{E^{\circ} = 0.56 \text{ V}}$

E° is positive, therefore the cell is spontaneous.