

21 • Electrochemistry

ELECTROLYSIS WORKSHEET

Standard Reduction Potential	E° (volts)
$\text{Cl}_2(\text{g}) + 2\text{e}^- \rightarrow 2\text{Cl}(\text{aq})$	+1.36
$\text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}(\text{l})$	+1.23
$\text{Ag}^+(\text{aq}) + \text{e}^- \rightarrow \text{Ag}(\text{s})$	+0.80
$\text{I}_2(\text{s}) + 2\text{e}^- \rightarrow 2\text{I}^-(\text{aq})$	+0.535
$\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu}(\text{s})$	+0.337
$\text{SO}_4^{2-}(\text{aq}) + 4\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+0.20
$2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g})$ (reference electrode)	0.00
$2\text{H}_2\text{O}(\text{l}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g}) + 2\text{OH}^-(\text{aq})$	-0.828
$\text{Na}^+(\text{aq}) + \text{e}^- \rightarrow \text{Na}(\text{s})$	-2.714
$\text{K}^+(\text{aq}) + \text{e}^- \rightarrow \text{K}(\text{s})$	-2.93

- All of the equations in the chart above are written as _____ (oxidations/reductions).
- The chemicals at the upper left (Cl_2 and O_2) are the most likely to be _____ (oxidized/reduced) and therefore the best _____ (oxidizing agents/reducing agents).
- The chemicals at the lower right (Na and K) are the most likely to be _____ (oxidized/reduced) and therefore the best _____ (oxidizing agents/reducing agents).
- In an electrolytic cell, the (-) electrode is negative because it has _____ (too many/too few) electrons. Chemicals that come into contact with the (-) electrode will _____ (gain/lose) electrons and be _____ (oxidized/reduced). The (-) electrode in electrolysis is called the _____ (cathode/anode).
- Write the change that water goes through at the (-) electrode. _____
- In an electrochemical cell, the (+) electrode is positive because it has _____ (too many/too few) electrons. Chemicals that come into contact with the (+) electrode will _____ (gain/lose) electrons and be _____ (oxidized/reduced). The (+) electrode in electrolysis is called the _____ (cathode/anode).
- Write the change that water goes through at the (+) electrode. _____
- Add these two reactions together (make certain the electrons cancel) and write the overall reaction for the electrolysis of water. _____
- We will perform this electrolysis using an aqueous solution of sodium sulfate. Both the Na^+ and H_2O will be near the (-) electrode. Which chemical is more likely to be reduced? _____
- Both the SO_4^{2-} and H_2O will be near the (+) electrode. Which chemical will be oxidized? _____

11. In the electrolysis of KI(aq)

Both the K^+ and H_2O will be near the (-) electrode. Which chemical is more likely to be reduced? _____

Both the I^- and H_2O will be near the (+) electrode. Which chemical is more likely to be oxidized? _____

Write the reactions at each electrode and the overall reaction:

Cathode:

Anode:

Overall:

12. In the electrolysis of $CuSO_4(aq)$

Both the Cu^{2+} and H_2O will be near the (-) electrode. Which chemical will be reduced? _____

Both the SO_4^{2-} and H_2O will be near the (+) electrode. Which chemical will be oxidized? _____

Write the reactions at each electrode and the overall reaction:

Cathode:

Anode:

Overall:

13. Silver plating occurs when electrolysis of a Ag_2SO_4 solution is used because silver metal is formed at the _____ (cathode/anode).

This is the () (+ / -) electrode. The reaction at this electrode is: _____.

Recall that 1 amp·sec = 1 Coulomb and 96,500 Coulombs = 1 mole e^- 's (Faraday's constant).

If a cell is run for 200. seconds with a current of 0.250 amps, how many grams of Ag^o will be deposited?

14. A current of 10.0 amperes flows for 2.00 hours through an electrolytic cell containing a molten salt of metal X. This results in the decomposition of 0.250 mole of metal X at the cathode. The oxidation state of X in the molten salt is _____ (X^+ , X^{2+} , X^{3+} , X^{4+})

15. Solutions of Ag^+ , Cu^{2+} , Fe^{3+} and Ti^{4+} are electrolyzed with a constant current until 0.10 mol of metal is deposited. Which will require the greatest length of time? _____