

## Sample Worksheet

(Note: This is an example which can be modified depending on the educational level being targeted)

### Vocabulary

Become familiar with the following terms:

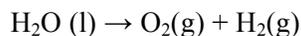
|                   |               |                 |                 |               |
|-------------------|---------------|-----------------|-----------------|---------------|
| Anode             | Cathode       | Reduction       | Oxidation       | Electrolyte   |
| Electrolytic Cell | Voltage       | Current         | Metal           | Semiconductor |
| Insulator         | Potential     | Potentiostat    | Mobile Carriers | Electrons     |
| Holes             | Recombination | Conduction Band | Valence Band    | Band-gap      |

### Problems

1. Oxidation occurs at the \_\_\_\_\_.

2. Reduction occurs at the \_\_\_\_\_.

3. Balance the following equation:



4. Write the two half-reactions for the above reaction:

Oxidation Reaction: \_\_\_\_\_

Reduction Reaction: \_\_\_\_\_

5. Calculate the Electrochemical Cell Potential for this reaction.

6. The value of the cell potential indicates that the reaction is:

Spontaneous or NOT Spontaneous

7. Rank the following in order of increasing conductivity.

Metals, Insulators, Semiconductors

8. Explain your answer from the question above.

9. How many grams of  $\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$  are need to make 25.0 mL of a 0.040 M aqueous solution?

10. How many grams of  $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$  are need to make 50.0 mL of a 0.040 M aqueous solution?

## Answers

1. Anode
2. Cathode
3.  $2 \text{H}_2\text{O}(l) \rightarrow \text{O}_2(g) + 2\text{H}_2(g)$
4. Half Reactions
  - a. Oxidation reaction:  $2 \text{H}_2\text{O}(l) \rightarrow \text{O}_2(g) + 4 \text{H}^+(aq) + 4\text{e}^-$
  - b. Reduction reaction:  $4 \text{H}^+(aq) + 4 \text{e}^- \rightarrow 2 \text{H}_2(g)$
5.  $E_{\text{cell}}^{\circ} = E_{\text{cathode}}^{\circ} - E_{\text{anode}}^{\circ} = 0V - 1.23V = -1.23V$
6. Not spontaneous (*Could also have a  $\Delta G$  calculation here*)
7. Insulators < Semiconductors < Metals
8. Insulators have a large band gap where the conduction band is separated from the valence band, which electrons cannot be promoted across thus producing no conductivity. Metals have conduction bands that overlap with valence bands and thus are not separated. Therefore there is not an energy gap or band gap allowing electrons to flow freely producing high conductivity. Semiconductors have conduction bands and valence bands that are separated but the band gap is not as large as with an insulator. Semiconductors can be doped to decrease the size of the band gap allowing electrons to be promoted across the band gap with some sort of applied energy. Thus the conductivity lies between that of an insulator and a metal.
9. MW=241.60 g/mol  
Answer: 0.24 g
10. MW= 404.00 g/mol  
Answer: 0.81 g