

Name: _____

Date: _____

Lab # _____

Electrolysis of Water

Introduction: Electrolysis is the separation of a compound into its elements by converting electrical energy into potential energy in an *electrolytic cell*.

Vocabulary (10 pts):

Electrolytic Cell

Voltaic Cell

Anode

Cathode

Spontaneous Reaction

Pre-Lab (30 pts):

Write the *balanced* reaction equation for the decomposition of liquid water (2 pts). (Hint: You have a reference table)

Kinetics:

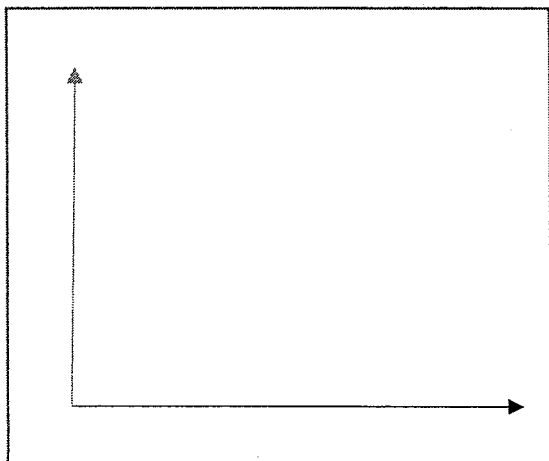
Using your reference table, what is the heat of reaction for this equation: $\Delta H =$ _____ (2 pts)

Is this reaction endothermic or exothermic?
_____ (2 pts)

Put your ΔH into the reaction equation above. Make sure it is on the correct side of the arrow! (2 pts)

Sketch the potential energy diagram for the electrolysis of water. Label the axes and the heat of reaction. (6 pts)

In this lab, H_2SO_4 will be used as a catalyst. Show the path for this on the sketch below. (2 pts)



Redox:

Write the oxidation states for the above reaction. (2 pts)

Bracket and label the oxidation and reduction. (2 pts)

The species being oxidized is: _____ (2 pt)

The species being reduced is: _____ (2 pt)

Write the half reactions for oxidation and reduction below. (4 pts)

Balance the electrons and write the net equation below (2 pts)

Materials:

Hoffmann Apparatus

Water

H₂SO₄

Power Supply

Wooden Splints

Test Tubes

Method:

1. Fill Hoffmann Apparatus with water. Add a small amount of H₂SO₄.
2. Connect the device to a power supply and turn on.
3. Observe the tubes filling with gas. Compare the amount of gas being produced on both sides of the apparatus.
4. Using a test tube, collect a sample of each gas.
5. Conduct a splint test to determine the identity of each gas.

Data and Analysis (30 pts).

1. Compare the amount of gas produced at each electrode.

Consider the balanced equation in the pre-lab, which gas (H₂ or O₂) is produced in greater quantity? _____

On the diagram, label the side where this gas is produced. Is this gas the product of oxidation or reduction? _____

Based on this, **label the electrode on the diagram** as either the anode or the cathode.

Describe the splint test used to test this gas.

Based on the test, which gas was in the tube? _____

Does the gas match your prediction? _____

2. Compare the amount of gas produced at each electrode.

Consider the balanced equation in the pre-lab, which gas (H₂ or O₂) is produced in lesser quantity? _____

On the diagram, label the side where this gas is produced. Is this gas the product of oxidation or reduction? _____

Based on this, **label the electrode on the diagram** as either the anode or the cathode.

Describe the splint test used to test this gas.

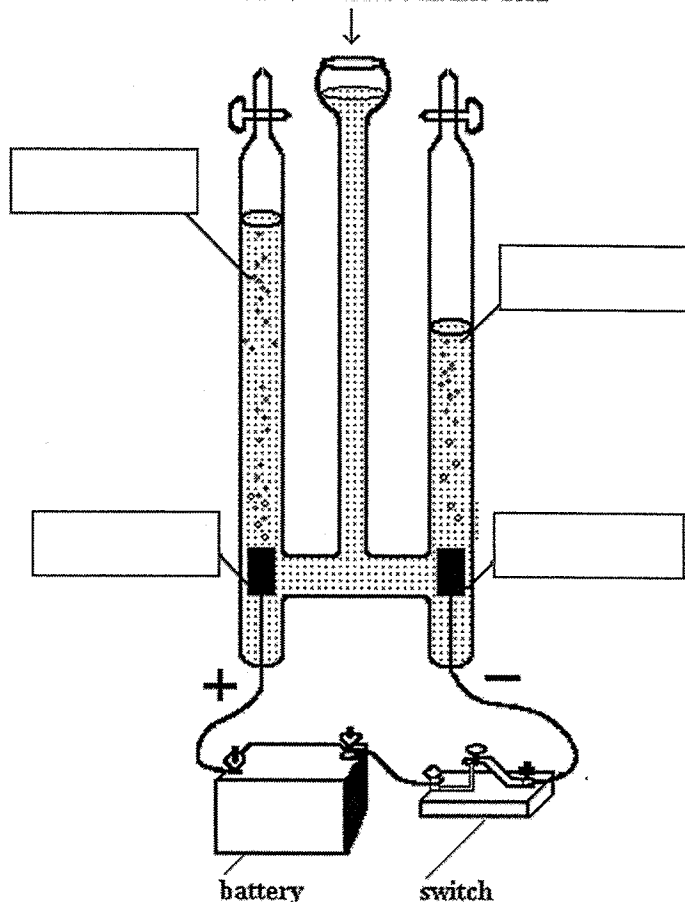
Based on the test, which gas was in the tube? _____

Does the gas match your prediction? _____

3. Label the direction of flow of electrons through the power supply when the switch is closed.

15.5.4 Hofmann voltameter

water + dilute sulfuric acid



Questions (12 pts):

1. What about this reaction makes this an electrolytic cell?
2. What is the purpose of the power supply in an electrolytic cell?
3. Describe the conversion of energy in an electrolytic cell?

Regents Questions

18 pts

1. Where do reduction and oxidation occur in an electrolytic cell?

- A) Both occur at the anode.
- B) Both occur at the cathode.
- C) Reduction occurs at the anode, and oxidation occurs at the cathode.
- D) Reduction occurs at the cathode, and oxidation occurs at the anode.

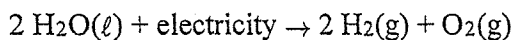
2. Energy is required to produce a chemical change during

- A) chromatography B) electrolysis
- C) boiling D) melting

3. Which energy conversion must occur in an operating electrolytic cell?

- A) electrical energy to chemical energy
- B) electrical energy to nuclear energy
- C) chemical energy to electrical energy
- D) chemical energy to nuclear energy

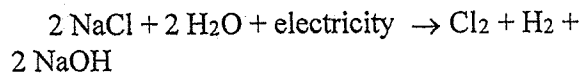
4. Given the cell reaction:



This cell is best described as

- A) an electrolytic cell in which an exothermic reaction occurs
- B) an electrolytic cell in which an endothermic reaction occurs
- C) a voltaic cell in which an exothermic reaction occurs
- D) a voltaic cell in which an endothermic reaction occurs

5. Which statement best describes the reaction represented by the equation below?



- A) The reaction occurs in a chemical cell and releases energy.
- B) The reaction occurs in a chemical cell and absorbs energy.
- C) The reaction occurs in an electrolytic cell and releases energy.
- D) The reaction occurs in an electrolytic cell and absorbs energy.

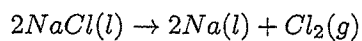
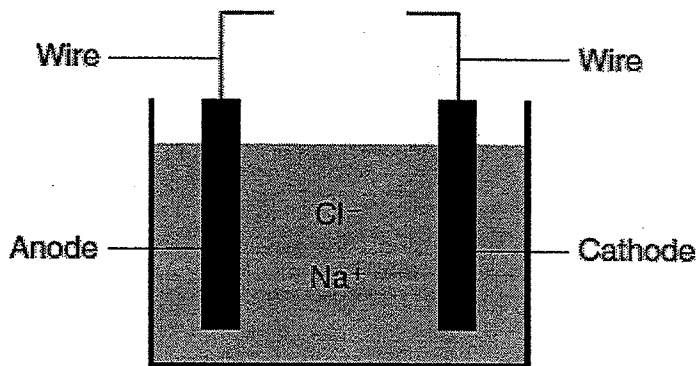
6. Which process occurs at the anode in an electrochemical cell?

- A) the loss of protons
- B) the loss of electrons
- C) the gain of protons
- D) the gain of electrons

Base your answers to questions 7 through 9 on the information below.

Metallic elements are obtained from their ores by reduction. Some metals, such as zinc, lead, iron, and copper, can be obtained by heating their oxides with carbon.

More active metals, such as aluminum, magnesium, and sodium, can not be reduced by carbon. These metals can be obtained by the electrolysis of their molten (melted) ores. The diagram below represents an incomplete cell for the electrolysis of molten NaCl. The equation below represents the reaction that occurs when the completed cell operates.



- _____ 7. Write a balanced half-reaction equation for the reduction of the sodium ions in sodium chloride to sodium atoms.
- _____ 8. Towards which electrode with the chloride ions migrate?
- _____ 9. What is needed to complete this cell?
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