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Chem!stry Class:

Date: / /

Assignment for Electrochemistry

Question 1:

Dilute sulphuric acid is electrolysed using inert electrodes.

Which equation represents the reaction at the **anode** (+ve)?

- A $O_2^{2-} \rightarrow O_2 + 2e^-$
- B $2H^+ + 2e^- \rightarrow H_2$
- C $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$
- D $SO_4^{2-} \rightarrow O_2^{2-} + SO_2 + 2e^-$

Question 2:

Four electrolytes were electrolysed using carbon electrodes.

Which set of data is correct?

	Electrolyte	Product at	
		Anode	Cathode
A	$CuSO_4(aq)$	Oxygen	Copper
B	$NaCl_{(aq)}$	Chlorine	Sodium
C	$NaH_{(l)}$	Sodium	Hydrogen
D	$PbBr_2(l)$	Lead	Bromine

Question 3:

Which particles are responsible for the conduction of electricity through **i) metals** and **ii) electrolytes**?

- A **i) Metals** = Negative ions **ii) Electrolytes** = Positive ions
- B **i) Metals** = Electrons **ii) Electrolytes** = Electrons
- C **i) Metals** = Positive ions **ii) Electrolytes** = Electrons
- D **i) Metals** = Electrons **ii) Electrolytes** = Positive ions and negative ions

Question 4:

Which one of the following best describes what happens during the electrolytic refining of copper?

- A Copper is deposited on the cathode (-ve) and the solution becomes colourless.
- B Copper is removed from the anode (+ve) and deposited at the cathode (-ve). The solution remains blue.
- C The solution becomes increasingly blue as more copper ions are formed at the anode.
- D Copper is transferred from the solution to the anode (+ve) and the solution becomes colourless.

Question 5:

Concentrated aqueous zinc chloride is electrolysed with platinum electrodes. What are the products at the electrodes?

- A Anode (+ve) = Chlorine Cathode (-ve) = Zinc
- B Anode (+ve) = Hydrogen Cathode (-ve) = Oxygen
- C Anode (+ve) = Oxygen Cathode (-ve) = Zinc
- D Anode (+ve) = Zinc Cathode (-ve) = Chlorine

Question 6:

Which one of the following elements requires the smallest number of electrons for one mole of atoms to be liberated during electrolysis?

- A Aluminium.
- B Calcium.
- C Copper.
- D Sodium.

Question 7:

A metal can be obtained by the electrolysis of its molten chloride. The table below shows properties of the metal and its chloride.

Substance	Melting Point	Boiling Point	Density (At Temperature of Electrolysis)
Metal	328 °C	1750 °C	11 g / cm ³
Metal Chloride	534 °C	950 °C	4.5 g / cm ³

In what state will the metal be formed in the electrolysis?

- A As a solid below the molten chloride.
- B As a liquid below the molten chloride.
- C As a solid on the surface of the molten chloride.
- D As a liquid on the surface of the molten chloride.

Question 8:

Aqueous copper(II) sulfate is electrolysed using carbon electrodes. What happens to the electrolyte?

- A It becomes more acidic.
- B It becomes more alkaline.
- C It turns deeper blue.
- D It remains unchanged.

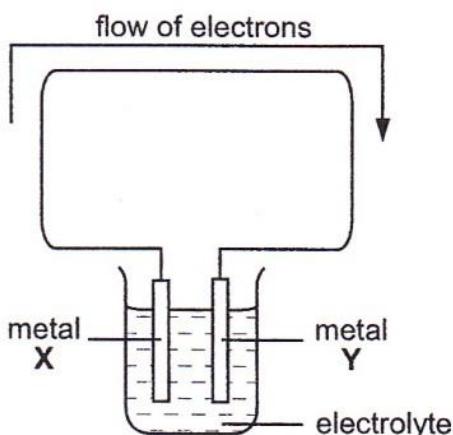
Question 9:

In which line in the table is all of the information correct?

	Reaction at Electrode	Electrode	Product
A	$2X^- \rightarrow X_2 + 2e^-$	Cathode	Metal
B	$X^+ + e^- \rightarrow X$	Anode	Metal
C	$2X^- \rightarrow X_2 + 2e^-$	Anode	Non-metal
D	$X^+ + e^- \rightarrow X$	Cathode	Non-metal

Question 10:

Apparatus was set up as shown.

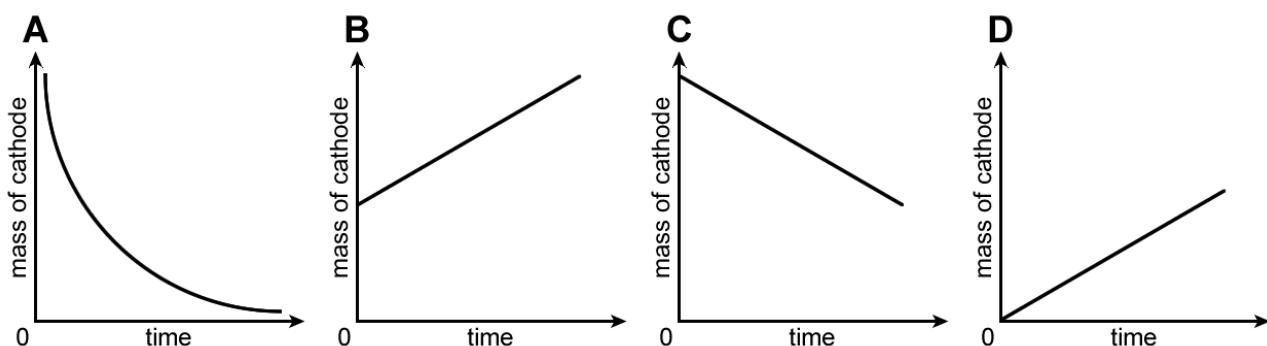


For which pair of metals would electrons flow in the direction shown?

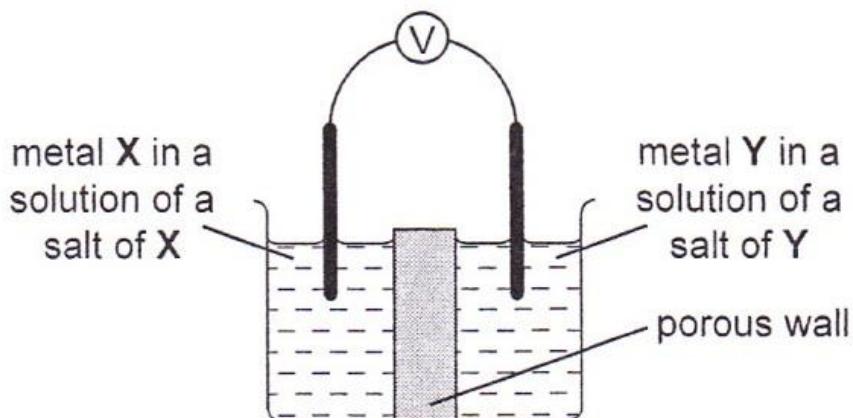
- A Metal X = Copper Metal Y = Zinc
- B Metal X = Iron Metal Y = Aluminium
- C Metal X = Iron Metal Y = Magnesium
- D Metal X = Zinc Metal Y = Silver

Question 11:

Aqueous copper(II) sulfate is electrolysed using copper electrodes. The current is constant and the cathode (-ve) is weighed at regular intervals. Which graph is obtained when the mass of the cathode is plotted against time?

**Question 12:**

Which pair of metals, X and Y, will produce the highest voltage when used as electrodes in a simple cell?



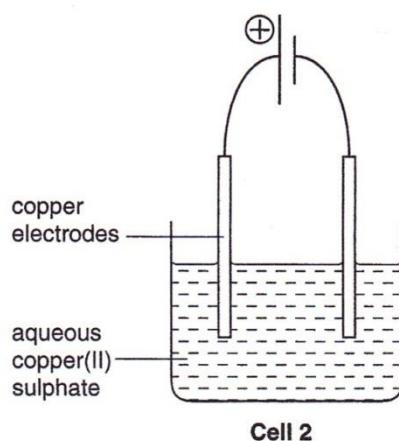
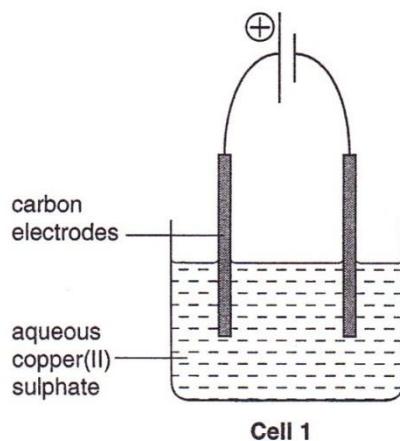
- | | | |
|----------|---------------------|------------------|
| A | Metal X = Copper | Metal Y = Silver |
| B | Metal X = Magnesium | Metal Y = Silver |
| C | Metal X = Magnesium | Metal Y = Zinc |
| D | Metal X = Zinc | Metal Y = Copper |

Write your answers to the multiple-choice questions in the table below:

1.	2.	3.	4.
5.	6.	7.	8.
9.	10.	11.	12.

Question 13:

Aqueous copper(II) sulfate was electrolysed in two cells using different electrodes as shown below.



- a) Write ionic equations, with symbols, for the reactions taking place at the **anodes**.

Anode reaction Cell 1:

Anode reaction Cell 2:

- b) Describe **one** change that you would **see** happen in both cells.

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- c) Describe **one** change that you would **see** happen in Cell 1, but not in Cell 2.

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Question 14:

- a) Consider the following substances:

Lead(II) bromide

Sodium chloride

Sugar

Ethanol

Hydrogen Chloride

Potassium Iodide

Copper

Sulfur

From these substances, name those that:

- i) Conduct electricity in the solid state.

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- ii) Conduct electricity both in the liquid state (*i.e.* when molten) and in aqueous solution.

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- iii) Do not conduct electricity in their natural state, but form conducting solutions when dissolved in water.

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- iv) Do not readily conduct electricity under any of these conditions.

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Note: Each chemical may be used once, more than once, or not at all.

b) An aqueous solution of calcium hydroxide is electrolysed between carbon electrodes.

i) What gas would you expect to be produced at the anode (positive electrode)?

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ii) It is observed that, during the electrolysis, the mass of the anode decreases and a white precipitate forms in the solution around it. Suggest a reason for these observations.

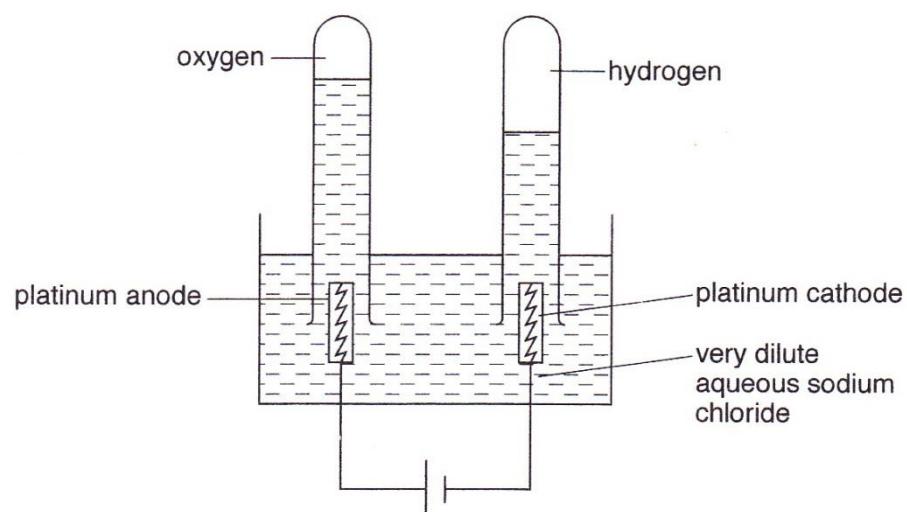
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Question 15:

An experiment is carried out to electrolyse very dilute aqueous sodium chloride.



a) Oxygen forms at the anode.

i) Write half-equations, with state symbols, for the reaction that forms oxygen.

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ii) Is this reaction an oxidation or a reduction reaction? Explain your reasoning.

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b) i) During the reaction, 4.8 cm^3 of oxygen collects at the anode.

Calculate the mass of 4.8 cm^3 of oxygen. Note: The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

- ii) Hydrogen is collected at the cathode during the reaction. What volume of hydrogen forms when 4.8 cm³ of oxygen forms?
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- c) After the electrolysis has been running for some time, the solution becomes more concentrated. What are the products of the electrolysis when the solution becomes more concentrated?

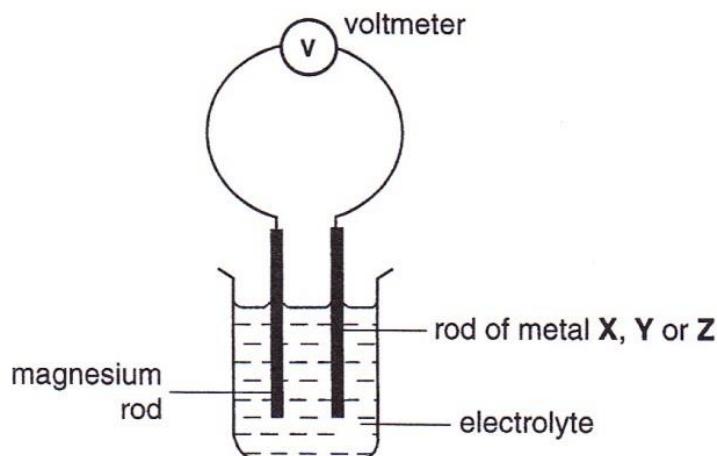
At the Anode:

At the Cathode:

In Solution:

Question 16:

The diagram shows a cell that can be used to produce electrical energy.



- a) Explain why distilled water is not used as the electrolyte.
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- b) The table shows the results when rods of three metals, X, Y, and Z are used in separate experiments. All of the metals are less reactive than magnesium.

Rod 1	Rod 2	Voltmeter Reading / V
Magnesium	X	2.72
Magnesium	Y	0.78
Magnesium	Z	1.10

Place the metals in order of reactivity.

Most Reactive Magnesium **Least Reactive**

Question 17:

Electroplating can be used to coat nickel with a thin layer of silver.

- a) Draw a labelled diagram of the apparatus that can be used to electroplate silver onto nickel.

- b) Write equations, with state symbols, for the reactions at the anode and cathode.

Anode:

Cathode:

- c) Solutions of two salts, **A** and **B**, were electrolysed using carbon electrodes. The following products were collected.

Salt	Products
A	Oxygen and Hydrogen
B	Chlorine and Hydrogen

- i) Suggest the names of the two salts, **A** and **B**.

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- ii) Describe tests to confirm the identities of the three gases collected.

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- Scan the QR code given below to view the answers to this assignment.



http://www.chemist.sg/electro_chem/electrochem_assignment_ans.pdf