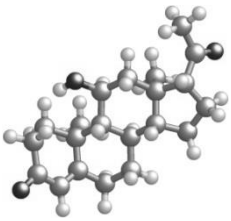

Chem!stry

Name: …… **( )**

Class: ……

Date: …… **/** …… **/** ……

Revision Questions on Energy Changes / Redox / Electrolysis

Question 1:

Calculate the oxidation state of sulphur in each one of the following compounds.

a) H_2S ……

b) SO_2 ……

c) SO_3 ……

d) SO_3^{2-} ……

e) K_2SO_4 ……

f) $S_2O_3^{2-}$ ……

g) $S_4O_6^{2-}$ ……

Question 2:

Chlorine gas can be prepared in the laboratory according to the following chemical reaction.

$$MnO_{2(s)} + 4HCl_{(aq)} \rightarrow MnCl_{2(aq)} + 2H_2O_{(l)} + Cl_{2(g)}$$

a) Complete the table below to show the oxidation states of chlorine and manganese at the start and at the end of the reaction.

Element	Oxidation State at the Start of the Reaction	Oxidation State at the End of the Reaction
Manganese		
Chlorine		

b) What is the **oxidising agent** in this reaction, MnO_2 or HC*l*? Explain your answer.

……

……

c) What is the **reducing agent** in this reaction, MnO_2 or HC*l*? Explain your answer.

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d) State the qualitative test for chlorine gas.

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e) The chlorine gas that is produced by this reaction is damp. Which reagent should be used to dry the chlorine gas, anhydrous calcium oxide or concentrated sulphuric acid? Explain your answer.

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Question 3:

The table below shows some information about two copper ores, *tenorite* and *cuprite*. Both contain copper oxide.

Ore	Formula of Copper Oxide in Ore	Oxidation Number of Copper	Percentage of Copper by Mass
Tenorite		+2	80.0%
Cuprite	Cu_2O		

a) **i)** What is the formula of the copper compound in tenorite?

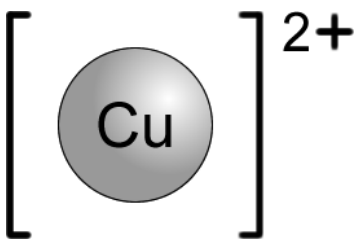
……

ii) What is the oxidation number of copper in cuprite, Cu_2O?

……

iii) Calculate the percentage of copper by mass in cuprite, Cu_2O.

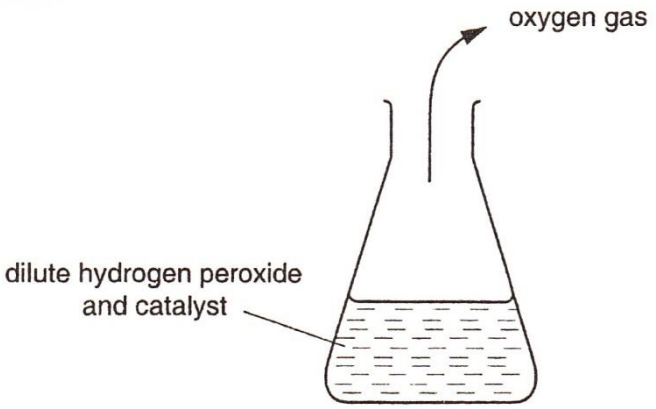
b) Another ore of copper contains copper(II) sulfide. Complete the dot and cross diagram below for copper(II) sulphide showing the outer electrons only.



Copper Ion Sulfide Ion

Question 4:

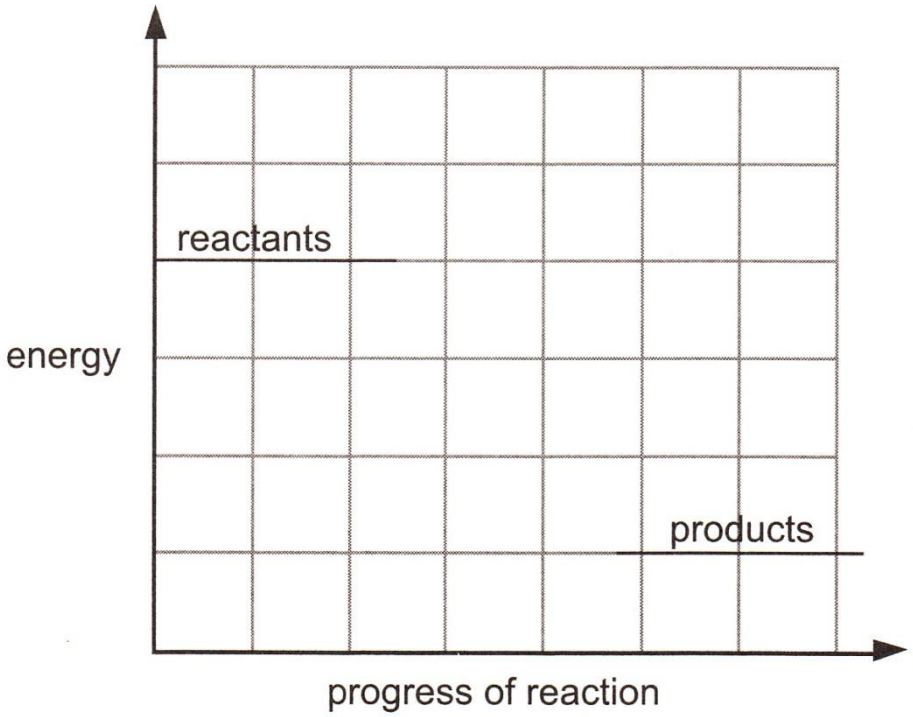
Dilute hydrogen peroxide decomposes to give oxygen and water when a catalyst is added.



a) Balance the equation for the reaction and complete the state symbols.

$$\ldots\ldots H_2O_2 (\quad) \rightarrow \ldots\ldots H_2O (\quad) + \ldots\ldots O_2 (\quad)$$

b) This diagram shows the energy levels of the reactants and products for this reaction.



Complete the diagram by:

- Drawing in the reaction pathway for the reaction.
- Showing the activation energy, E_a, by a single headed arrow.
- Showing the energy change for the reaction, ΔH, by a single headed arrow.

c) The overall energy change for the reaction is exothermic.

i) Explain how the diagram shows this.

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ii) Explain, in terms of bond breaking and bond making, why **this reaction** is exothermic.

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Question 5:

Car manufacturers are developing fuel cells for use in cars.

Fuel cells produce electrical energy from the reaction between a fuel and oxygen. Two possible fuels for use in fuel cells are hydrogen and methanol. The table below gives some data about these two fuels.

Fuel	Melting Point / °C	Boiling Point / °C	Energy Change of Combustion kJ / mol
Hydrogen	–259	–252	256
Methanol	–97.7	64.5	715

a) The table gives values for the energy change of combustion for each fuel in kJ / mol.

i) Calculate the energy output for 1 g of each fuel.

ii) Use the values that you have calculated, and information in the table, to discuss the advantages and disadvantages of using each fuel in cars.

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iii) Hydrogen and methanol have different effects on the environment when used as fuels. Outline **two** environmental differences between the two fuels.

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b) The energy output of a fuel cell can be shown using an energy profile diagram. Draw an energy profile diagram for the combustion of methanol. Your diagram should include labels for the reaction enthalpy change and activation energy.

Question 6:

When copper is extracted from its ore, it contains carbon impurities.

a) Suggest how the carbon impurities get into the copper.

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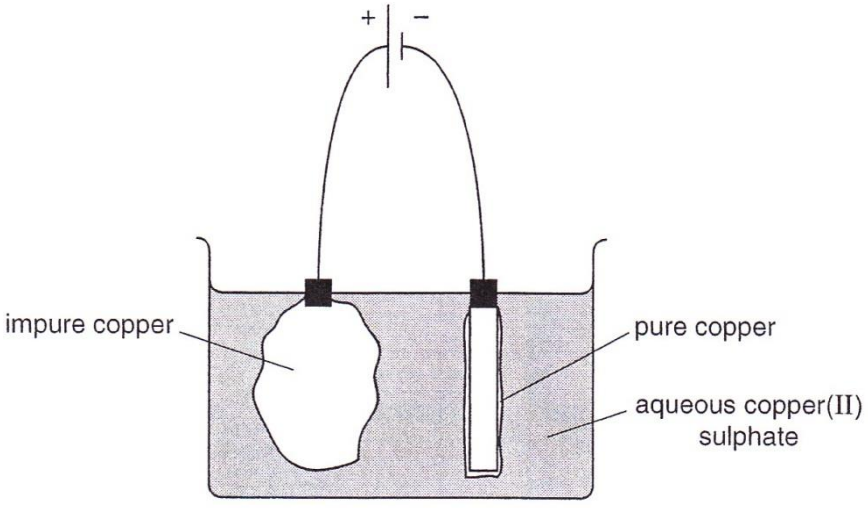
b) Copper for electrical wiring needs to have a very high purity.

Pure copper is made by electrolysis, using aqueous copper(II) sulfate as an electrolyte.



i) Write equations, including state symbols, for the reactions at each electrode.

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ii) What happens to the concentration of the aqueous copper(II) sulfate during the electrolysis? Explain your reasoning.

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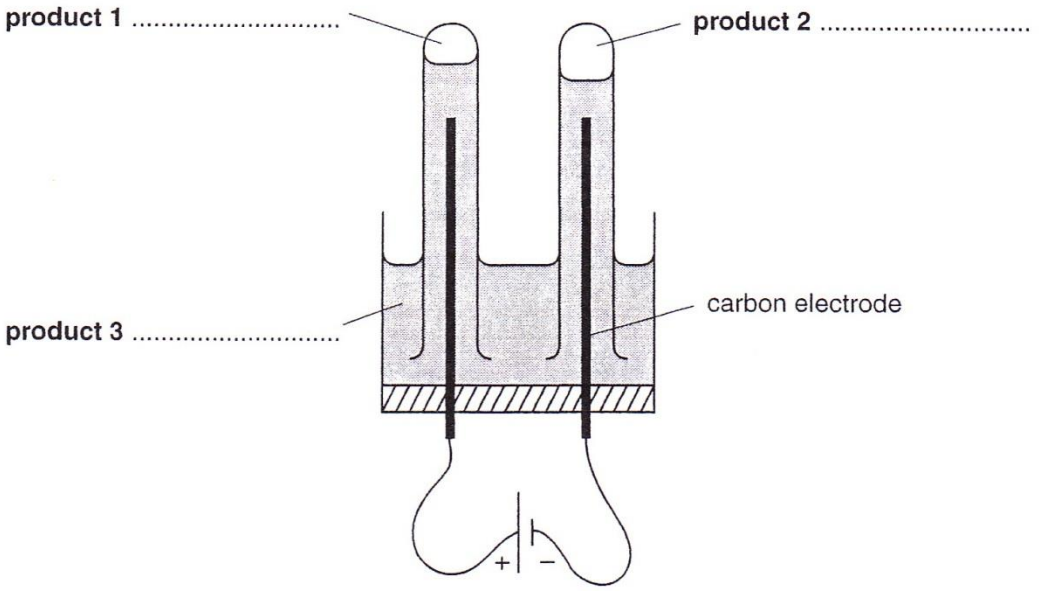
Question 7:

Chlorine is made by electrolysis of concentrated aqueous sodium chloride.

The diagram below shows apparatus that can be used to electrolyse concentrated aqueous sodium chloride.



a) Label the products on the diagram.

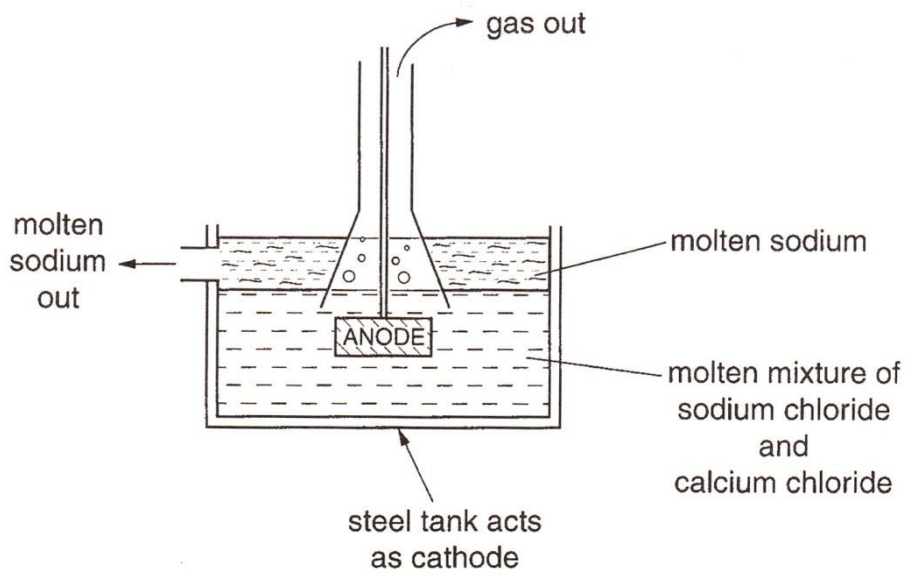
b) Write ionic equations, including state symbols, for the reactions taking place at the anode and the cathode.

Reaction at the anode: ……

Reaction at the cathode: ……

Question 8:

Sodium metal is extracted from molten sodium chloride by electrolysis.



a) **i)** Write an ionic half-equation, with state symbols, to show the reaction that happens at the anode.

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ii) Describe a simple test, and its result, that would identify the gas given off at the anode.

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b) Calcium chloride is added to the sodium chloride to lower the melting point of the mixture.

i) Explain why lowering the melting point of the mixture makes the process cheaper to run.

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ii) The molten sodium contains metallic impurities. Name the main metallic impurity that you would expect to find and explain how it forms.

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c) Sodium chloride can also be electrolysed in aqueous solution. Describe the differences in the products of the electrolysis of concentrated aqueous sodium chloride compared to molten sodium chloride.

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Question 9:

Aqueous copper(II) sulfate is electrolysed using carbon electrodes.

a) Give the formulae of all the ions present in the solution.

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b) A copper coating forms on the cathode, and a gas is evolved at the anode.

i) Write a half-equation for the formation of copper at the cathode.

……

ii) Name the gas formed at the anode and describe a test for this gas.

……

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c) After some time, the blue colour of the aqueous copper(II) sulfate fades, and the pH of the solution decreases. Explain why these changes take place.

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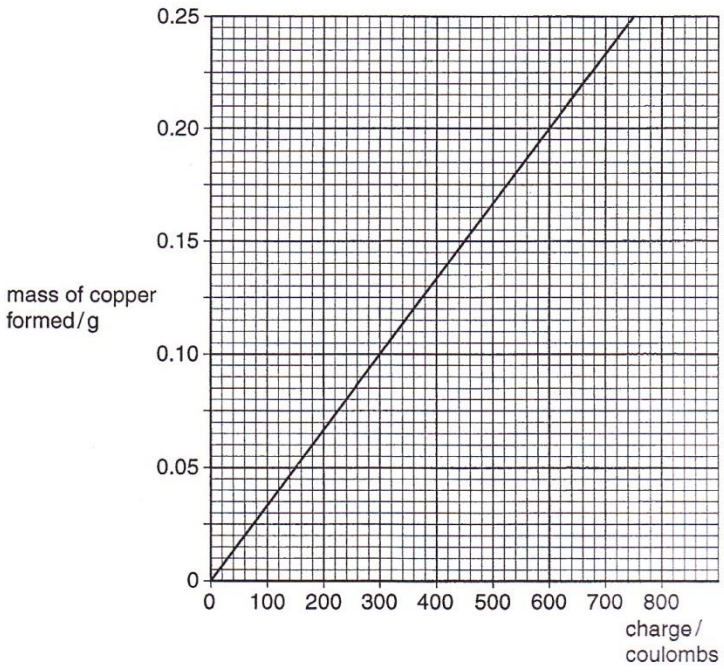
d) A student investigated the relationship between the mass of copper formed and the total charge passed through the solution. This is the graph of the results.



i) What mass of copper is formed when a charge of 600 coulombs is passed through the solution?

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ii) Use the graph to predict the charge needed to form 1 g of copper, and hence predict the charge needed to deposit 1 mole of copper.

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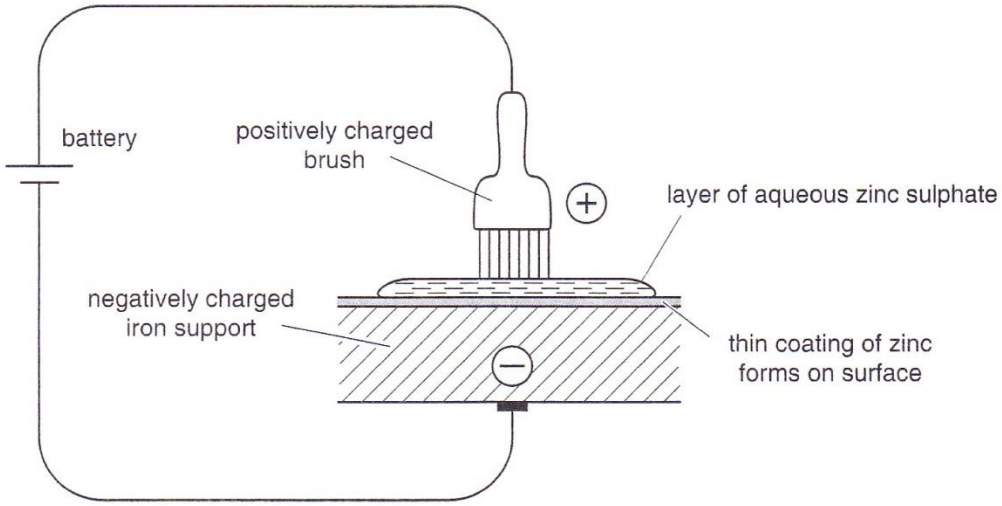
Question 10:

A new type of electroplating is known as “brush electroplating”. It is used to electroplate zinc onto very large iron supports to be used in buildings. The iron supports are too big to be plated in a normal electrolysis tank. During the process, a metal brush spreads a layer of aqueous zinc sulfate over the iron surface. A battery gives the metal brush a positive charge and gives the iron support a negative charge. A layer of zinc forms on the surface of the iron support.



a) The surface of the iron acts as a cathode. Zinc ions from the solution form zinc on the surface of the iron. Write an ionic half-equation, with state symbols, for this reaction.

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b) Two different designs of metal brush are available. One type of brush is made from zinc, one type is made from platinum. As the electrolysis takes place, each brush has a different effect on the concentration of zinc ions in the solution.

i) What will happen to the concentration of the zinc ions during the electrolysis if the brush is made from platinum?

……

ii) What will happen to the concentration of the zinc ions during the electrolysis if the brush is made from zinc?

……

iii) Platinum brushes are much more expensive than zinc brushes. However, zinc brushes need replacing regularly, but platinum brushes do not. Explain why.

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c) During the process, a worker needs to hold the brush. Which of the following materials would be a good choice for the handle of the brush? Give a reason for your answer.

chromium copper graphite iron poly(ethene)

Material: …….

Reason: ……..

d) Explain why iron supports coated with zinc do not rust, even if the zinc coating is damaged.

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- Scan the QR Code below for the answers to this assignment.

http://www.chemist.sg/energy_changes/assignment_redox_electrochem_energy_ans.pdf