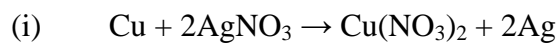


QUESTION ONE

(a) Give the oxidation number of the underlined atom in each species.

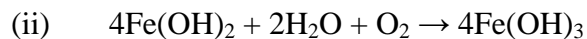


(b) Using oxidation numbers to back up your claims, show the species being oxidised and the species being reduced in each of the reactions below.



Oxidised _____

Reduced _____



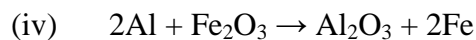
Oxidised _____

Reduced _____



Oxidised _____

Reduced _____



Oxidised _____

Reduced _____

QUESTION TWO

For the following reactions write the full ionic equation for the reaction that is occurring. **Explain** any observed changes by linking them to the species involved in the reactions.

- (a) Potassium iodide solution is added to a mixture of sulfuric acid and potassium permanganate in a test tube and shaken. The mixture changes from purple to brown/orange.

Equation _____

Explanation _____

- (b) Hydrogen peroxide solution is added to a mixture of sulfuric acid and potassium permanganate in a test tube. The mixture changes from purple to colourless and a gas is given off.

Equation _____

Explanation _____

- (c) Chlorine water and iron II nitrate are shaken together in a test tube. The smell of chlorine disappears and the mixture changes from pale green to orange.

Equation _____

Explanation _____

QUESTION THREE

Chromium is a relatively rare metal in the Earth's crust and usually occurs in various forms of the mineral chromite (Cr_2O_3). Chromium is extracted from chromite using carbon as the reducing agent, to form chromium and carbon monoxide.

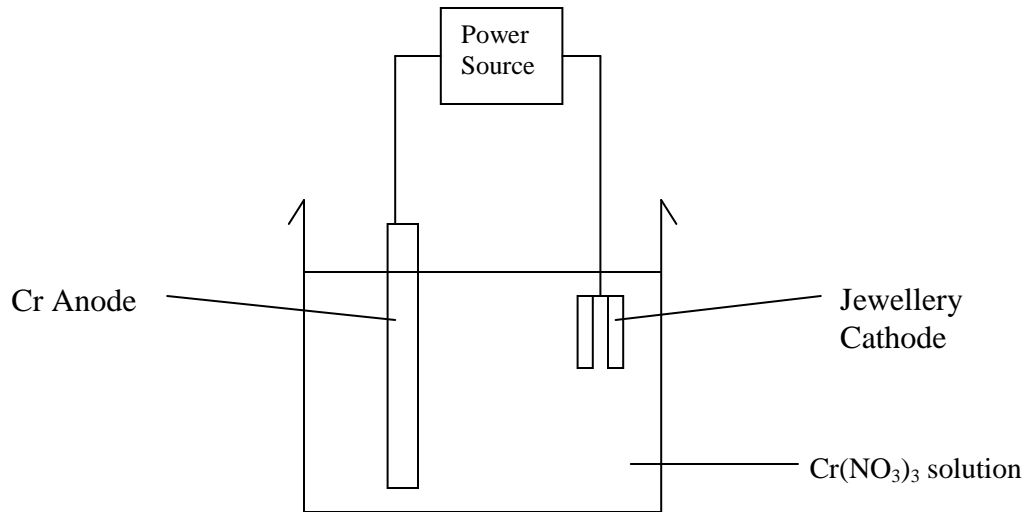
- (a) Write the two half equations and hence the full ionic equation for this process.

- (b) The extraction of chromium in this way is actually very complex, but the last stage of the process involves the reduction of Cr^{3+} to the metal. Write the half equation for this reaction.

- (c) Chromium can most commonly be found as potassium dichromate in the laboratory. Acidified potassium dichromate was used to oxidise ethanol ($\text{C}_2\text{H}_6\text{O}$) to ethanoic acid ($\text{C}_2\text{H}_4\text{O}_2$). The test tube turned from orange to green. Give the two half equations and hence the full ionic equation for this reaction.

QUESTION FOUR

A student set up the following equipment to electroplate some jewellery with chromium.



- (a) On the diagram above, label the positive and the negative electrodes.
- (b) Discuss the reason for connecting the jewellery to the cathode and not the anode.
- _____
- _____
- _____
- _____
- (c) Would the system work better if distilled water was used instead of $\text{Cr}(\text{NO}_3)_3$ solution? Explain.
- _____
- _____
- _____
- _____
- (d) What would be observed in the cell as the reaction proceeded?
- _____
- _____
- _____
- _____

- (e) Would the Cr^{3+} concentration change in the beaker, as the reaction proceeded?

Explain your answer.

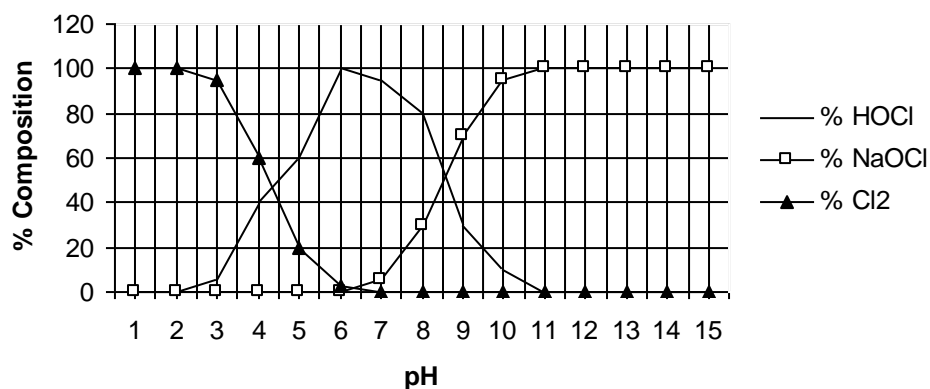
- (f) Write the half equations occurring at each electrode and label as oxidation or reduction.

Cathode _____

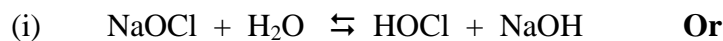
Anode _____

QUESTION FIVE

Composition of Bleach at Different pH's



Bleach delivers its disinfectant properties through the formation of hypochlorous acid (HOCl), which enters the cell of a micro organism and kills it. It may be formed in one of two ways.



With reference to the graph above

- (a) Why is it recommended that you use bleach between pH 6 and pH 8?

- (b) Chlorine gas will attack many metals to form a metal chloride salt. Show by means of electron half equations and a full ionic equation, what effect chlorine gas would have on an iron mixing rod at a wastewater treatment plant.

- (c) Is the chlorine gas acting as an oxidising agent or a reducing agent in (b) above?
