

**QUESTION ONE**

Sodium carbonate peroxide  $2\text{Na}_2\text{CO}_3 \cdot 3\text{H}_2\text{O}_2$  is a form of washing powder that breaks down in water to release  $\text{H}_2\text{O}_2$ . Hydrogen peroxide can act as both an oxidant and reductant.

- (a) Write the half equations for when hydrogen peroxide acts as a reductant and an oxidant.

Reductant: \_\_\_\_\_

Oxidant: \_\_\_\_\_

Sodium hypochlorite  $\text{NaOCl}$ , another washing powder, releases  $\text{OCl}^-$  into solution.

- (b) Write the half equation for the reduction of  $\text{OCl}^-$ .

\_\_\_\_\_

Disproportionation reactions occur when a substance is both oxidised and reduced in the same reaction.

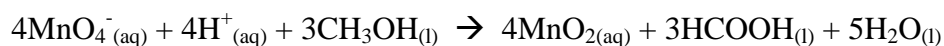
When chlorine gas is bubbled through water, the following reaction occurs:



- (c) Explain why this is a disproportionation reaction.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
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- (d) In a particular reaction, methanol is converted into methanoic acid by potassium permanganate.



By using oxidation numbers, justify which of the species is the oxidant and which is the reductant in this reaction.

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- (e) A chemistry teacher demonstrated a reaction by adding an old one cent coin containing copper metal to concentrated nitric acid in a beaker.

(i) Discuss what would be observed and why, by linking the observations to the species.

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(ii) Write balanced half-equations for the oxidation and reduction reactions, and then write a balanced equation for the overall reaction.

Half-equation \_\_\_\_\_

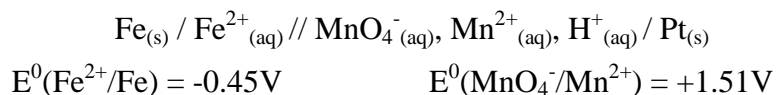
Half-equation \_\_\_\_\_

Balanced equation for overall reaction

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**QUESTION TWO**

A student set up the following spontaneous electrochemical cell:



- (a) Calculate the cell voltage to prove that the cell is spontaneous.
- (b) State the changes in the appearance of the two half cells' solutions as the reaction proceeds.

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- (c) For this electrochemical cell:
- (i) Which species is the cathode \_\_\_\_\_
- (ii) Which species is the anode \_\_\_\_\_
- (iii) The direction of electron flow is **from** \_\_\_\_\_ **to** \_\_\_\_\_
- (iv) The direction of **anion flow** in the salt bridge is \_\_\_\_\_

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- (d) The original electrochemical circuit and voltmeter connections are kept the same except that the  $\text{MnO}_4^{-}, \text{Mn}^{2+}, \text{H}^{+} / \text{Pt}$  half cell is replaced. It is now a  $\text{Zn}^{2+}/\text{Zn}$  half cell with the  $\text{Fe}^{2+}/\text{Fe}$  half cell. The voltmeter now reads  $-0.31\text{V}$ .

Use the information in the above statement to determine the spontaneous reaction.

Include in your answer the appropriate standard cell diagram.

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