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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
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For Supervisor's use only

Level 3 Chemistry, 2008

90696 Describe oxidation-reduction processes

Credits: Three
9.30 am Friday 28 November 2008

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should answer ALL the questions in this booklet.

A periodic table is provided on the Resource Sheet L3–CHEMR.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–8 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

For Assessor's use only	**Achievement Criteria**				
Achievement		**Achievement with Merit**		**Achievement with Excellence**	
Describe oxidation-reduction processes.		Explain and apply oxidation-reduction processes.		Discuss oxidation-reduction processes.	
Overall Level of Performance					

You are advised to spend 35 minutes answering the questions in this booklet.

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QUESTION ONE

(a) Sodium thiosulfate solution reacts with dilute acid to form a precipitate of sulfur, and sulfur dioxide.

$$S_2O_3^{2-} + 2H^+ \rightarrow S + SO_2 + H_2O$$

(i) Give the oxidation numbers for sulfur in the species below.

$S_2O_3^{2-}$ _____ S _____ SO_2 _____.

(ii) Write balanced half-equations for the oxidation and reduction reactions.

Oxidation _____

Reduction _____

(b) Oxalic acid ($H_2C_2O_4$) reacts with acidified potassium permanganate solution (MnO_4^- / H^+).

(i) Describe what would be observed.

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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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(c) Iodate ions, IO_3^-, react with iodide ions, I^-, in the presence of acid to form iodine, I_2.

Use **oxidation numbers** to identify the oxidant and the reductant in this reaction, and justify your answer.

Oxidant _____ Reductant _____

Justification _____

(d) If a beaker of hydrogen peroxide is left at room temperature for a period of time, small bubbles appear on the bottom and sides of the beaker. **Identify the gas** in the bubbles and **justify your decision** by determining the E_{cell} for spontaneous reaction that occurs, using the $E°$ values given below. Include a balanced equation for the formation of the gas in the bubbles.

$E°\ (H_2O_2 / H_2O) = +1.77\ V$
$E°\ (O_2 / H_2O_2) = +0.68\ V$

QUESTION TWO

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When carrying out a titration using standardised potassium permanganate ($KMnO_4$) solution to determine the amount of Fe^{2+} in a sample, the correct procedure is to acidify the potassium permanganate solution with sulfuric acid. Hydrochloric acid (HCl) should not be used to acidify the potassium permanganate solution because it reacts with some of the species present.

(a) Using the $E°$ values below, identify any reactions that occur when MnO_4^-, Fe^{2+} and HCl mix together in solution. You must calculate $E°_{cell}$ for any reactions you identify.

$E°\ (MnO_4^- / Mn^{2+}) = +1.51$ V
$E°\ (Cl_2 / Cl^-) = +1.36$ V
$E°\ (Fe^{3+} / Fe^{2+}) = +0.77$ V
$E°\ (SO_4^{2-} / SO_2) = +0.20$ V
$E°\ (H^+ / H_2) = +0.00$ V

(b) Discuss how the use of HCl could affect the amount of $KMnO_4$ required to completely react with the Fe^{2+} ions present.

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QUESTION THREE

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A spontaneous reaction occurs when a length of magnesium ribbon is placed in a 1.0 mol L^{-1} solution of lead nitrate, $Pb(NO_3)_2$.

$E°$ (Mg^{2+} / Mg) $= -2.37$ V
$E°$ (Pb^{2+} / Pb) $= -0.13$ V

(a) This reaction is to be used in an electrochemical cell.

(i) Complete the standard cell diagram below for the cell.

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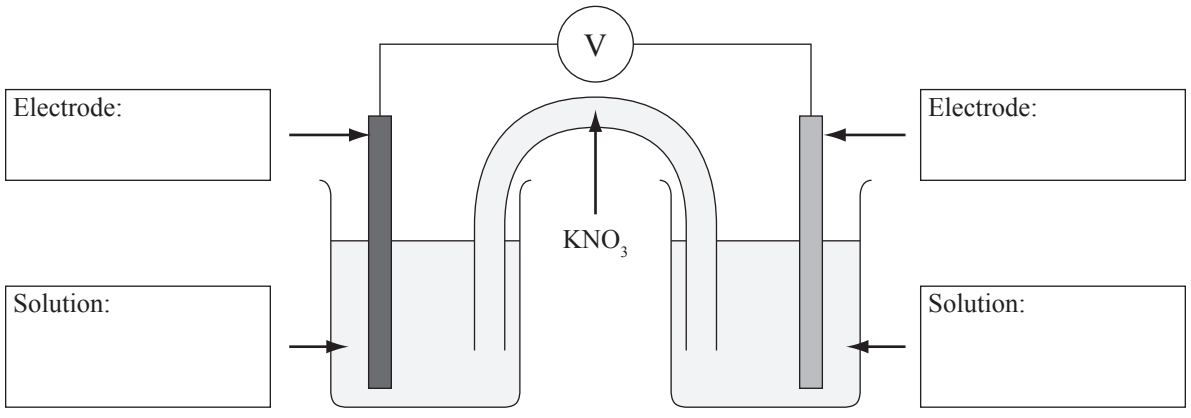
(ii) Calculate the cell voltage.

(b) A student set up the apparatus shown below to measure the cell voltage in (a).

(i) **Identify** the solutions and the electrode substances in the diagram.

(ii) **Indicate** with an arrow the direction of the flow of electrons in the circuit.

(iii) **Label** the anode and cathode.



(c) In the cell in part (b), the voltmeter is removed and replaced with a wire.

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Discuss the movements and chemical reactions of **all** species in the cell in (b) and describe any observations under the following headings:

- Equations for anode and cathode reactions and any observations.
- The movement of ions in the salt bridge and the reasons for it.
- The movement of electrons in the circuit and the reasons for it.

Extra paper for continuation of answers if required.
Clearly number the question.

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