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90311

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Level 2 Chemistry, 2004

90311 Describe oxidation–reduction reactions

Credits: Four
2.00 pm Wednesday 10 November 2004

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

A Periodic Table is printed on page 2 of this booklet.

You should answer ALL the questions in this booklet.

If you need more space for any answer, use the pages 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.

Achievement Criteria *For Assessor's use only*		
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Describe oxidation–reduction reactions.	Apply oxidation–reduction principles.	Interpret information from oxidation– reduction processes.
Overall Level of Performance		

PERIODIC TABLE OF THE ELEMENTS

1	*2*											*13*	*14*	*15*	*16*	*17*	*18*
																	2 **He** 4.0
3 **Li** 6.9	4 **Be** 9.0							Atomic Number 1 **H** 1.0 Atomic Mass				5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	10 **Ne** 20.2
11 **Na** 23.0	12 **Mg** 24.3	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.0	17 **Cl** 35.5	18 **Ar** 40.0
19 **K** 39.1	20 **Ca** 40.1	21 **Sc** 45.0	22 **Ti** 47.9	23 **V** 50.9	24 **Cr** 52.0	25 **Mn** 54.9	26 **Fe** 55.9	27 **Co** 58.9	28 **Ni** 58.7	29 **Cu** 63.6	30 **Zn** 65.4	31 **Ga** 69.7	32 **Ge** 72.6	33 **As** 74.9	34 **Se** 78.9	35 **Br** 79.9	36 **Kr** 83.8
37 **Rb** 85.5	38 **Sr** 87.6	39 **Y** 88.9	40 **Zr** 91.2	41 **Nb** 92.9	42 **Mo** 95.9	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	71 **Lu** 175.0	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226.0	103 **Lr** 262.1	104 **Rf**	105 **Db**	106 **Sg**	107 **Bh**	108 **Hs**	109 **Mt**									

Lanthanide Series	57 **La** 138.9	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** 146.9	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 159.0	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0
Actinide Series	89 **Ac** 227.0	90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np** 237.1	94 **Pu** 239.1	95 **Am** 241.1	96 **Cm** 247.1	97 **Bk** 249.1	98 **Cf** 251.1	99 **Es** 254.1	100 **Fm** 257.1	101 **Md** 258.1	102 **No** 255

You are advised to spend 45 minutes answering the questions in this booklet.

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QUESTION ONE

(a) Write the oxidation number of the underlined element in each of the following species.

(i) $\underline{\mathbf{Mn}}^{2+}$ _____

(ii) $H_2\underline{\mathbf{O}}_2$ _____

(iii) $\underline{\mathbf{Br}}_2$ _____

(iv) $\underline{\mathbf{S}}O_2$ _____

(v) $\underline{\mathbf{C}}O$ _____

(b) Two oxidation-reduction reactions were carried out and the observations recorded. Use the information provided to answer the questions that follow.

Reaction One

Reactants	Observation
Acidified hydrogen peroxide, $H_2O_2(aq)$ and bromide ions in solution, $Br^-(aq)$.	Both reactant solutions were colourless but when added together an orange colour was observed.

(i) Identify the species oxidised and the species reduced in the above reaction.

Species oxidised _____ Species reduced _____

(ii) Use oxidation-reduction processes to explain why the solution goes orange.

_____

_____

_____

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Reaction Two

Reactants	Observation
Chlorine gas, $Cl_2(g)$, was bubbled into a solution containing iron (II) ions, $Fe^{2+}(aq)$.	The pale green solution changed to a pale orange colour.

(iii) Explain this observation in terms of oxidation–reduction processes.

QUESTION TWO

When sulfur dioxide gas (SO_2) is bubbled into a solution of acidified potassium dichromate solution, a colour change is observed. The **unbalanced** equation for this reaction is given below.

$$Cr_2O_7^{2-} + SO_2 \rightarrow SO_4^{2-} + Cr^{3+}$$

(a) Identify the reductant in this reaction. Justify your answer using oxidation numbers.

Reductant:

Justification:

(b) Write balanced half-equations for the oxidation and reduction reactions that occur.

Oxidation:

Reduction:

(c) Combine the half-equations in (b) to give the balanced equation for this oxidation-reduction reaction.

(d) Describe the observations that would be expected when this reaction occurs.

Explain these expected observations by referring to the species involved in the reaction.

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QUESTION THREE

Iodine (I_2) can be produced from the reaction between potassium iodate (KIO_3) and potassium iodide (KI). The iodide ions (I^-) and iodate ions (IO_3^-) react together to form the iodine (I_2).

(a) Iodide ions (I^-) and iodate ions (IO_3^-) both contain the element iodine (I), but in two different oxidation states. What is the oxidation number of iodine (I) in each species?

(i) I^- _____

(ii) IO_3^- _____

(b) Identify the oxidant and reductant in this reaction.

Oxidant _____

Reductant _____

(c) Complete and balance the half-equations for the reactions of iodide ions (I^-) and iodate ions (IO_3^-) forming iodine (I_2).

I^- : $I^- \rightarrow I_2$

IO_3^- : $IO_3^- \rightarrow I_2$

(d) Combine these two half-equations to give a balanced equation for the reaction.

QUESTION FOUR

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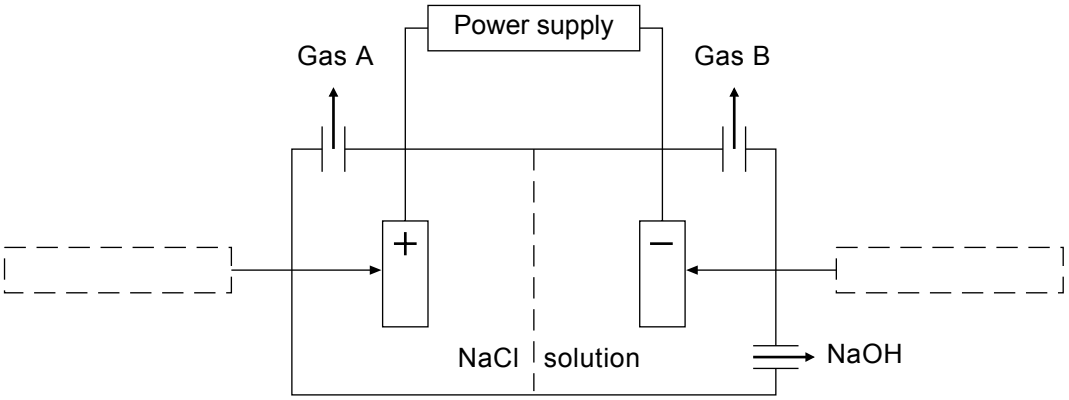
Chlorine is made industrially by the electrolysis of brine, a concentrated solution of sodium chloride. A simplified diagram of the cell is shown below.



(a) **Label** the anode and the cathode clearly in the dashed boxes on the diagram above.

(b) The two half-reactions occurring in the cell are shown below.

Complete and balance the equation for Reaction Two.

Reaction One: $2\ H_2O + 2\ e^- \rightarrow 2\ OH^- + H_2$

Reaction Two: $Cl^- \rightarrow Cl_2$

(c) Gases are produced at each electrode as the electrolysis proceeds.

Identify which gas in the diagram above is chlorine. Circle your answer below.

Gas A **Gas B**

Justify your choice by discussing the reactions that occur during electrolysis, the electrodes where these reactions occur, and the products that are formed.

QUESTION FIVE

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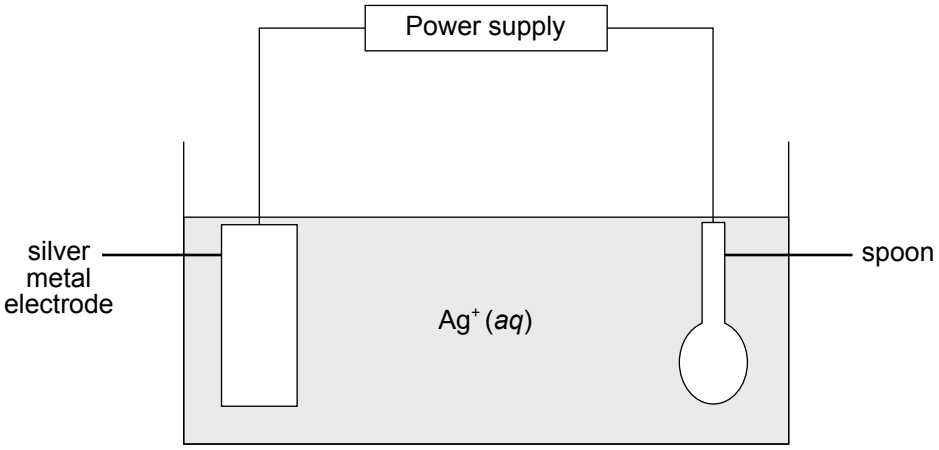
An electrolytic cell can be used for electroplating. Electroplating is a process where a metal object is coated with a thin layer of another metal.

This process is shown in the diagram below. The spoon is electroplated with silver metal and the silver electrode gets smaller.



Using principles of electrolytic cells, discuss how the layer of silver is plated onto the spoon. Include relevant oxidation-reduction half-equations in your discussion.

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

Question number

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