

6. Electrochemistry

6.1 Redox processes

Paper 2

Marking Scheme

Q1.

(c)(i)		oxidation number in Mg_3N_2	Both correct for one mark	1
	magnesium	(+)II / 2(+)		
	nitrogen	-III/ 3-		

Q2.

(b)(i)	(+)5 / V	1
(b)(ii)	aluminium / Al	1

Q3.

(a)	compound / molecule / substance that oxidises another / is reduced	1
(c)	Cl / chlorine is both oxidised and reduced	1

Q4.

(b)(i)	species	magnesium in Mg_3N_2	nitrogen in Mg_3N_2	1
	oxidation number	2(+)/ (+)II	3- / -III	
(b)(ii)	<ul style="list-style-type: none"> redox Mg loses electrons / Mg increases ox no / Mg is oxidised N gains electrons / N reduces ox no / N is reduced 			1
(b)(iii)	M1 (enthalpy change / energy change) when one mole of a compound / substance is formed M2 from its elements in their standard states			2
(b)(iv)	M1 correct method to find amount Mg_3N_2 formed in reaction $3.645 \div 24.3$ mol Mg produces $0.15 \div 3$ mol of Mg_3N_2 OR 0.05 mol of Mg_3N_2 M2 use M1 in correct expression to find energy released by 1 mol Mg_3N_2 $23.05 \div$ M1 OR $23.05 \div$ mol Mg_3N_2 OR $23\ 050 \div$ M1 OR $23\ 050 \div$ Mg_3N_2 M3 calculate value from M2 expression correctly $\Delta H = -(M2) = -461(.0)$ kJ mol ⁻¹ OR $-461\ 000$ J mol ⁻¹			3

Q5.

(a)	Br / bromine as the oxidation number of Br decreases / goes from 0 → -1 OR bromine as it causes oxidation number of C (in methanoic acid) to increase / go from (+)2 → (+)4	1
(b)	(solution) turns (from brown / orange / red to) colourless / decolorises OR brown / orange / red fades	1

Q6.

(c)(iii)	M1 S (increases) oxidation number -2 → 0 so oxidation / or is oxidised M2 O (decreases) O.N. 0 → -2 so reduction / is reduced	2
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Q7.

(b)(i)	(+)5/V	1
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Q8.

(d)(i)	$4\text{HI} + \text{O}_2 \rightarrow 2\text{I}_2 + 2\text{H}_2\text{O}$	1
(d)(ii)	M1 I / iodine (increases) oxidation number -1 → 0 so oxidation / is oxidised OR HI / is oxidised as I (increases) oxidation number -1 → 0 M2 O (decreases) oxidation number 0 → -2 so reduction / is reduced	2

Q9.

(a)(i)	$2\text{CuSO}_4(\text{aq}) + 4\text{KI}(\text{aq}) \rightarrow 2\text{CuI}(\text{s}) + (1)\text{I}_2(\text{aq}) + 2\text{K}_2\text{SO}_4(\text{aq})$ M1 correct balancing M2 correct state symbols	2
(a)(ii)	Oxidation state of copper in CuSO_4 (+)2 AND Oxidation state of copper in CuI (+)1	1
(a)(iii)	M1 redox	1
	M2 iodide ions – lost electron(s) AND copper ions – gained electron(s)	1

Q10.

(c)(i)	$3\text{NO}_2 + \text{H}_2\text{O} \rightarrow 2\text{HNO}_3 + \text{NO}$ <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px;">(+4)</div> <div style="border: 1px solid black; padding: 2px;">(+5)</div> <div style="border: 1px solid black; padding: 2px;">(+2)</div> </div> <p>3 correct oxidation numbers – 2 marks 2 correct oxidation numbers – 1 mark</p>	2
(c)(ii)	<p><i>relates the term disproportionation to the reaction described</i></p> <p>M1 <u>nitrogen /N</u> (in nitrogen dioxide) is both gaining electrons and losing electrons during the reaction</p> <p>M2 <i>refer to relevant transfer of electrons when NO₂ reacts to form HNO₃ and NO</i></p> <p>NO₂ to HNO₃ involves loss of electron(s)</p> <p>AND</p> <p>NO₂ to NO involves gain of electron(s)</p>	

Q11.

(b)(i)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 5px;">Chlorine containing species</td> <td style="padding: 5px; text-align: center;">Cl_2</td> <td style="padding: 5px; text-align: center;">HCl</td> <td style="padding: 5px; text-align: center;">HOCl</td> </tr> <tr> <td style="padding: 5px;">Oxidation number of chlorine</td> <td style="padding: 5px; text-align: center;">0</td> <td style="padding: 5px; text-align: center;">-1</td> <td style="padding: 5px; text-align: center;">(+1)</td> </tr> </table> <p>Award 2 marks for 3 correct oxidation numbers Award 1 Mark for 2 correct oxidation numbers</p>	Chlorine containing species	Cl_2	HCl	HOCl	Oxidation number of chlorine	0	-1	(+1)	2
Chlorine containing species	Cl_2	HCl	HOCl							
Oxidation number of chlorine	0	-1	(+1)							
(b)(ii)	disproportionation	1								

Q12.

It oxidises chlorine from -1 to 0	1
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