Assessment Schedule – NZIC 2009
Chemistry: Describe oxidation-reduction reactions (90311)

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<table>
<tr><th>Q</th><th>Evidence</th><th>Achievement</th><th>Achievement with Merit</th><th>Achievement with Excellence</th></tr>
<tr><td>One
Part A
(a)</td><td><table><tr><td></td><td>Oxidation Number of Mn</td></tr><tr><td>K<u>Mn</u>O$_4$</td><td>+7 or 7</td></tr><tr><td><u>Mn</u>Cl$_2$</td><td>+2 or 2</td></tr><tr><td><u>Mn</u>O$_2$</td><td>+4 or 4</td></tr><tr><td>K$_2$<u>Mn</u>O$_4$</td><td>+6 or 6</td></tr></table></td><td rowspan="3">Three (3) out of five (5)
• 3 out 4 oxidation numbers correct

• One set of ON correctly identifies the oxidation - reduction reaction.

• Observations correct (ie purple solution to colourless / yellow / orange).

• Oxidant and reductant correctly identified.

• Half-equations correctly balanced.(Ignore spectator ions if balanced.).</td><td rowspan="3">Three(3) out five(5)
• All oxidation numbers correct

• Explanation of oxidation – reduction in terms of ON in both equations

• Overall equation correct

• Observations correct (ie purple solution to c’less / yellow / orange) and linked to species.

• Correctly recognises oxidant and reductant and the transfer of electrons.</td><td rowspan="3">• All oxidation numbers correct

AND

• Explanation of oxidation – reduction in terms of ON in both equations

AND

• Complete discussion and role of oxidant and reductant and the number of transferred electrons.</td></tr>
<tr><td>(b)</td><td>$MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + H_2O$
ON of Mn changes from +4 to +2 so has gained 2 electrons, reduction.
ON of Cl changes from -1 to 0 so has lost 1 electron - oxidation
$2AlCl_3 + 3Mn \rightarrow 2Al + 3MnCl_2$
ON of Al changes from +3 to 0 so has gained 3 electrons – reduction
ON of Mn changes from +4 to +2 so has lost 2 electrons – oxidation..</td></tr>
<tr><td>(c)</td><td>$Fe^{2+} \rightarrow Fe^{3+} + e^-$ (oxidation)
$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$ (reduction)
$MnO_4^- + 5Fe^{2+} + 8H^+ \rightarrow Mn^{2+} + 5\ Fe^{3+} + 4H_2O$ (overall)
Purple MnO_4^- solution goes yellow / orange (NOT brown) because of formation of Fe^{3+} OR goes colourless (NOT clear) because of formation of Mn^{2+}.
OR
MnO_4^- is purple and forms colourless Mn^{2+}, while colourless/pale green Fe^{2+} forms Fe^{3+} which is yellow / orange.
MnO_4^- is the reductant and Fe^{2+} is the oxidant. The oxidant Fe^{2+} changes to Fe^{3+} transferring the electron to MnO_4^-. Five Fe^{2+} are required to transfer an electron to MnO_4^- to change it to Mn^{2+}.</td></tr>
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Two	**A** When Cl_2 is bubbled through the NaBr solution the reddish-brown colour is due to the formation of Br_2. Cl_2 the oxidant and Br^- is the reductant. The reactions between halogens are a redox reaction as there is a transfer of electrons eg $Cl_2 + 2e \rightarrow 2Cl^-$ reduction $2Br^- \rightarrow Br_2 + 2e$ oxidation Electrons are transferred between chlorine and bromide **B** When Cl_2 is bubbled through the NaI solution the reddish-brown colour is due to the formation of I_2.(or I_3^-) Cl_2 the oxidant and I^- is the reductant. $Cl_2 + 2e \rightarrow 2Cl^-$ reduction $2I^- \rightarrow I_2 + 2e$ oxidation .Electrons are transferred between chlorine and iodide **C** No reaction as F_2 does not react with Cl_2 as F_2 is a stronger oxidant than Cl_2.	**Two (2) out four (4)** • Balanced equation for either A or B. • One observation linked to species. • Identifies oxidation and reduction for one reaction. • Recognises that a transfer of electrons has taken place.	**Three (3) out (4).** • Balanced equations for A and B. • Links observations A and B. • Identifies oxidation - reduction in A and B.	• Links ALL observations to species involved (A, B and C). • Identifies oxidant and reductant A and B. • Balanced equations. • Justifies oxidation and reduction in terms of electron transfer.
Three **(a)**	**Positive Electrode** • Anode • Chloride ions (anions) move to the anode (+ve electrode) • $2Cl^- \rightarrow Cl_2 + 2e^-$ **Negative Electrode** • Cathode • Lithium ions (cations) move to the cathode (-ve electr). • $Li^+ + e^- \rightarrow Li$ Electron flow from the anode (+) to cathode (-).	**Three (3) out five (5)** • Labels correct.. • Electron flow correct for labels (follow on). • Electrodes correct. • One equation correct.	**Two (2) out three (3).** • All correct	
(b)	**Electrolytic Cell A** Cathode reaction Cu^{2+} 2e →Cu • Anode reaction $2Cl^- \rightarrow Cl_2 + 2e^-$ In this reaction bubbles would be seen to form on the negative /anode electrode and a red brown deposit of copper would form on the positive /cathode. As the reaction proceeds the colour (green/blue-green) of the copper chloride solution would fade.	• Observed change in either cell	• One cell reaction correct with observations linked to species. OR • One observation in each cell correct linked to electrode reaction.	Discussion of observed changes with supporting equations and links to electron transfer.

	Electrolytic Cell B Cathode reaction Cu^{2+} 2e →Cu Anode reaction Cu→ Cu^{2+} 2e The key would become coated in a red-brown deposit of copper and the copper electrode would reduce in size. The solution would not change in colour.			

Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
Two correct at Achieved or higher. 2 x A	Three correct at Achieved with two at Merit 3A x 2M	Three correct at Achieved with one at Merit and one at Excellence. 3A x 1M x 1E