NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 2, 2003

Chemistry: Describe oxidation-reduction reactions (90311)

National Statistics

Assessment Report

Assessment Schedule

Chemistry: Describe oxidation-reduction reactions (90311)

National Statistics

Number of Results	Percentage achieved			
	Not Achieved	Achieved	Merit	Excellence
8,645	40.6%	32.1%	18.5%	8.8%

Assessment Report

General Comments

Every candidate for a National Certificate of Educational Achievement examination paper is expected to:

- read the question and do what the question asks
- allow adequate time to complete answers
- be accurate: check and/or proofread
- use appropriate technical terms
- bring the correct equipment
- write and/or draw clearly
- use pen if work is to be eligible for reconsideration.

In general candidates displayed a high level of understanding for this standard. In particular the majority of candidates understood how to:
(i) balance an oxidation–reduction equation and how to balance half equations,
(ii) identify oxidants and reductants,
(iii) determine the oxidation numbers of nominated species.

In order to show an understanding of *Describe oxidation–reduction reactions,* candidates must be able to use chemical language accurately. Candidates who were able to do this usually were then able to link information and show understanding. However, a significant number of candidates were limited in the level of achievement gained due to poor use of chemical language. Common essential chemical terms such as atom, molecule, ion and element, must be thoroughly understood by candidates, as these were often used inaccurately. For example, the following statements were common:
(i) '*the O molecule in the NaOCl'* rather than '*the O atom in the NaOCl'*.
(ii) '*oxygen atoms dissolve the carbon'*, rather than '*oxygen atoms react with the carbon'.*

Other areas in which candidates need to focus their attention in order to improve their level of achievement include:
(i) the application of *oxidation numbers* as many made simple errors in the use of oxidation numbers. For example, this statement was common:
'*the oxidation number of Cl^- is –2*' from $2Cl^- \longrightarrow Cl_2 + 2e^-$ was common.
(ii) an increased awareness to distinguish between the charge of an ion and the oxidation numbers of the atoms in the ion – the oxidation number of Cl in OCl^{-1} is not Cl^{+1}.
(iii) the significance of the ability of halogens to act as oxidants.
(iv) the properties of nominated species in terms of colour.
(v) the principles of electrolytic cells.

Candidates must continue to be made aware that they are not to use pencil or twink, and need to be precise when labelling diagrams.

Assessment Schedule

Chemistry: Describe oxidation-reduction reactions (90311)

Evidence Statement

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
ONE	(a) It is reduced as the oxidation number of Mn decreases from +7 to +2.	Reduction	Reduction identified Mn(+7) to Mn(+2)	
	(b) oxidant is MnO_4^- and reductant is Fe^{2+}	Both correctly identified		
	(c) Oxidation: $Fe^{2+} \longrightarrow Fe^{3+} + e^-$ Reduction: $MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$ (d) $MnO_4^- + 8H^+ + 5Fe^{2+} \longrightarrow Mn^{2+} + 4H_2O + 5Fe^{3+}$	One half equation correctly balanced	Both half equations correctly balanced and identified correctly as oxidation or reduction **OR** Overall Balanced Equation **with** incorrectly identified oxidation or reduction	Overall equation correctly balanced
	(e) The permanganate (purple colour) would turn colourless (Mn^{2+}) or maybe slightly orange due to the formation of Fe^{3+}. (The Fe^{2+} solution is very pale green so hardly affects the observations)	The colour of one species correctly identified. **OR** Purple to Colourless	Colour change appropriately stated with relevant links to species.	
	(f) $Cl_2 + Br^-$ – reaction does occur and solution will go from colourless to orange. Equation is $Cl_2 + 2Br^- \longrightarrow 2Cl^- + Br_2$ No reaction for Cl^- and I_2	Reaction (i) Yes : Reaction (ii) No **OR** Reaction (i): Yes : correct observation / balanced equation	Reaction (i): Yes : correct observation : balanced equation **OR** Reaction (i): Yes : correct observation / balanced equation **And** Reaction (ii): NO	All answers correct. This includes no observation and no equation for the combination of Cl^- and I_2

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
TWO	(a) (i) +4 (ii) +6	Both numbers correct. + sign not needed		
	(b) $SO_2 + 2H_2O \longrightarrow SO_4^{2-} + 4H^+ + 2e^-$ $I_2 + 2e^- \longrightarrow 2I^-$ (c) $SO_2 + I_2 + 2H_2O \longrightarrow SO_4^{2-} + 4H^+ + 2I^-$	One product identified and half equation correctly balanced	A correctly balanced redox equation, one incorrectly identified. Product may be included	Both products correctly identified and final equation correctly balanced.
	(d) The solution changes from orange to green, as dichromate reacts to form Cr^{3+}	Correct colour change stated OR One species and its correct colour	Colours correctly linked to appropriate species.	
THREE	(a) (i) Anode (+) and cathode (–) labelled	One electrode correctly labelled		
	(ii) Movement of ions shown – anions to anode and cations to cathode	Either anions shown moving to anode or cations to cathode		
	(b) (i) at the positive electrode $2O^{2-} \longrightarrow O_2 + 4e^-$ or $2O^{2-} + C \longrightarrow CO_2 + 4e^-$ (ii) at the negative electrode $Al^{3+} + 3e^- \longrightarrow Al$	One half equation correctly balanced (electrodes can be reversed)	Both half equations correctly balanced and at correct electrodes	
	(c) $C + O_2 \longrightarrow CO_2$ Explanation: The electrode must be replaced because C reacts to form the carbon dioxide gas so slowly corrodes away.	Equation correct **OR** Explanation correct	Equation and explanation correct	

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
FOUR	(a) (i) +1 (ii) –1 (iii) 0	2 correct		
	(b) (i) $2Cl^- \longrightarrow Cl_2 + 2e^-$ (ii) $2OCl^- + 4H^+ + 2e^- \longrightarrow Cl_2 + 2H_2O$	One equation correct		
	(c) Reaction of Cl^- is oxidation. There is a loss of electrons **or** an increase in the oxidation number of chlorine (–1 to 0).	Reaction of chloride identified.	Correct reaction identified with appropriate explanation	
	(d) Oxygen is oxidised. The oxidation number increases from –2 to 0, or the oxide loses 2 electrons. Chlorine is reduced as oxidation number goes from +1 to –1, or Cl^{+1} gains 2 electrons.		Both elements correctly identified	Both elements correctly identified, **and** both elements with valid explanations.
	(e) The OCl^- decomposes into $H_2O$and Cl^- during killing but the OCl^- decomposes into O_2 and Cl^- when left after killing. H^+ with Cl^- present reacts with OCl^- to produce Cl_2 which is hazardous.		**Either** products of decomposition are salt and water is not entirely true as the products are salt and oxygen **OR** In the presence of acid the redox reaction is likely to occur to form chlorine, which is a poisonous gas.	**Either** OCl^- : decomposes : H_2O:Cl^- during killing **BUT** Ocl^- : decomposes : O_2:Cl^- : after killing **OR** HCl : OCl^- : Cl_2 : Hazardous

Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
EIGHT of the Achievement opportunities	Achievement ***plus*** SIX of the Merit opportunities	Merit ***plus*** THREE of the Excellence opportunities