



New Zealand Qualifications Authority
Mana Tohu Matauranga O Aotearoa

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Assessment Report

Level 2 Chemistry 2016

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Part A: Commentary

Candidates who gained Merit and Excellence levels of achievement tended to give full and complete answers, demonstrating planning and systematic working in calculations. These candidates interpreted and used graphs to explain and justify known chemical trends; and also utilised language such as 'compare and contrast' and 'elaborate' to demonstrate Excellence level skills.

Candidates are advised to read questions carefully to avoid giving irrelevant or incorrect explanations. Those that gave incomplete answers, or repeated information, or did not include working in their calculations tended to perform less well. In some instances candidates appeared to offer pre-prepared answers but did not adapt their responses to the given context and so were unable to demonstrate their understanding.

Using language, symbols, and conventions appropriately or accurately are important skills at this level.

Part B: Report on Standards

91164: Demonstrate understanding of bonding, structure, properties and energy changes

Candidates who were awarded **Achievement** commonly:

- identified and gave reason for a reaction being exothermic or endothermic
- drew an energy diagram without labels
- calculated an amount of a substance given mass and molar mass
- identified either the type of substance; the type of particle or the attractive forces in different substances
- identified that freely moving charged particles are required for electrical conductivity

- knew that solute-solvent attractions are needed for dissolving to occur
- drew Lewis structures for molecules and stated the name of the molecular shape
- identified the number of negative charge regions or non-bonding pairs and bonding pairs in molecules with given formulae
- stated that different atoms bonding together will have different electronegativity
- identified the relevant bonds broken in a reaction when complete structural formulae were given.

Candidates who were assessed as **Not Achieved** commonly:

- confused the type of solid, the type of particle and the bonding involved in ionic, covalent network and molecular substances
- did not identify the type of particle in substances that allowed electrical conductivity
- could not describe that attractions between both solute and water were needed for a solution to occur
- described ionic compounds as polar molecules
- used 'like dissolves like' as a justification of solubility
- confused electronegativity with negatively charged regions
- were unable to describe why polar bonds form.

Candidates who were awarded **Achievement with Merit** commonly:

- drew a partly labelled energy diagram
- calculated the energy change for a reaction
- explained electrical conductivity in terms of free movement of electrons or ions
- explained aqueous solubility in terms of the relative strength of attractions between solute and solvent particles
- explained shapes and bond angles in terms of the number and nature of negative regions around the central atom
- explained the polarity of molecules in terms of the different electronegativity values of the atoms making up the bonds or the symmetry of the molecules
- calculated the energy change for a given reaction using bond enthalpy values, with minor errors
- identified the number and nature of bonds broken and formed in a given reaction.

Candidates who were awarded **Achievement with Excellence** commonly:

- completed two energy calculations correctly and stated a conclusion
- recognised that energy must be absorbed to break intermolecular bonds
- drew a fully labelled energy diagram
- justified electrical conductivity in terms of the free movement of charged particles
- justified aqueous solubility in terms of the relative strength of attractions between solute and solvent particles
- compared and contrasted shapes and bond angles in terms of the number and nature of negative regions around the central atom
- justified the polarity of molecules in terms of the different electronegativity values of the atoms making up the bonds and the symmetry of the molecules.

Standard-specific comments

Candidates are also expected to use the language in the standard, rather than unexplained terms such as “van der Waals forces” and “like dissolves like”.

Many candidates did not show appropriate working in the bond enthalpy calculation. The use of the headings “bonds broken” and “bonds formed” would be useful.

Candidates should be careful with units in their calculations, for example, the energy released in kJ rather than kJ mol^{-1}

91165: Demonstrate understanding of the properties of selected organic compounds

Candidates who were awarded **Achievement** commonly:

- named, drew and classified selected organic structures
- identified trends from a graph
- recognised that double bonds and different atoms are involved in *cis* or *trans* isomers
- identified acids as proton donors
- identified conditions or observations for substitution and addition reactions
- drew major and minor products from an addition reaction
- drew the correct monomer from a given polymer.

Candidates who were assessed as **Not Achieved** commonly:

- did not use the appropriate chemistry vocabulary
- struggled to name or draw organic structures
- did not include hydrogen atoms on structural formulae
- were unable to identify the nature of the particles involved in reactions
- stated Markovnikov’s Rule as “the rich get richer” without demonstrating any understanding of the chemistry involved
- could not describe polymerisation
- confused addition and substitution reactions.

Candidates who were awarded **Achievement with Merit** commonly:

- explained substitution in terms of atoms or groups of atoms being replaced
- recognised the impact of a non-rotational carbon to carbon double bond in the formation of geometric isomers
- linked the formation of different polymers to the positioning of the double bond
- explained addition polymerisation

- explained major and minor products using Markovnikov's rule
- explained the classification of a tertiary haloalkane
- wrote and balanced acid / base equations
- explained properties of carboxylic acids
- completed reaction schemes without error
- identified the reagents used in various organic reactions such as 'concentrated sulfuric acid for the dehydration of alcohols'
- could name and draw structural isomers for a given molecular formula.

Candidates who were awarded **Achievement with Excellence** commonly:

- explained the factors required for geometric isomerism and applied them to a specific example
- compared and contrasted the reactions of an alkene and alkane with bromine water
- justified why major and minor products form from an addition reaction with an asymmetric alkene
- analysed reactions using chemistry terminology, symbols and accurate language for the compounds in question.

Standard-specific comments

Candidates must use IUPAC naming conventions appropriately.

91166: Demonstrate understanding of chemical reactivity

Candidates who were awarded **Achievement** commonly:

- interpreted a graph to identify a trend
- identified that a powdered metal has a greater surface area than a strip of metal
- linked the basic nature of a carbonate to the production of hydroxide ions or its ability to accept protons
- calculated the pH of a strong acid
- recognised the degree of dissociation of strong and weak acids
- identified that mobile charged particles are required for electrical conductivity
- wrote an equilibrium equation from a K_c expression
- identified the colour change and / or direction favoured by an equilibrium system when the concentration of a reactant or product is changed
- substituted into a K_c expression successfully
- recognised that increasing pressure had no effect on an equilibrium system with equal amounts of gaseous reactants and products.

Candidates who were assessed as **Not Achieved** commonly:

- incorrectly stated that catalysts provided particles with extra energy in chemical reactions
- could not use proton transfer to complete equations to show the amphoteric nature of water
- explained pH in terms of 'acidity' rather than hydronium ion concentration
- identified electrons as the charged particles responsible for the electrical conductivity of ionic solutions
- used single-headed arrows for equilibrium reaction equations.

Candidates who were awarded **Achievement with Merit** commonly:

- linked an increase in the frequency of effective collisions to an increase in reaction rate
- explained that an increase in surface area exposes more particles for collision
- explained that a catalyst increases the rate of a reaction by providing an alternative pathway with a lower activation energy
- calculated pH, $[\text{H}_3\text{O}^+]$, and $[\text{OH}^-]$ for strong acids and bases, and reported answers with the correct units and to an acceptable number of significant figures
- linked the pH of strong and weak acids to the degree of dissociation and $[\text{H}_3\text{O}^+]$ present in the solution
- linked the electrical conductivity of a solution to the relative amount of ions present, although often mistakenly referring to hydronium ions only
- rearranged a K_c expression correctly to determine the concentration of the product
- explained that the position of an equilibrium is unchanged by a change in pressure when there are equal amounts of gaseous reactants and products.

Candidates who were awarded **Achievement with Excellence** commonly:

- linked the change in gradient of a graph to the change in concentration of reactants and the subsequent change in the frequency of effective collisions
- compared and contrasted reactions involving a change in surface area using collision theory
- elaborated on how a catalyst increases the reaction rate by offering an alternative reaction pathway with a lower activation energy, such that a greater proportion of particles now have enough energy to overcome the activation energy
- explained, with support from chemical equations, and using the correct arrows, how the degree of dissociation of a weak acid affects the $[\text{H}_3\text{O}^+]$, and therefore the pH of the solution
- justified the conductivity of solutions regarding the degree of dissociation of an acidic salt and a weak acid, and the subsequent relative concentration of all ions in solution (not only the H_3O^+ ions)
- explained that the very small K_w value indicates that there is very little dissociation of water, so therefore, $[\text{reactant}] > [\text{products}]$
- used Le Chatelier's principle to analyse the effect on the position of an equilibrium when the concentration of a reactant is changed
- justified an equilibrium as exothermic by linking changes in temperature and the K_c value to the relative concentration of reactants and products.

Standard-specific comments

Some candidates needed to give more specific detail when using the collision theory to explain changes to reaction rate. 'More collisions' was commonly used rather than 'more collisions per second' or a 'greater frequency of collisions'. Moreover, when describing the change in concentration of a reactant, candidates typically referred to 'more reactant particles' rather than a 'higher concentration of reactant particles'.

Incorrect arrows in equations were used by some candidates. For example, strong and weak acid dissociation equations often had identical arrows, and the equilibrium equation written from a K_c expression frequently had a single-headed arrow.

Some candidates were confused by the 'good' electrical conductivity of ammonium chloride since they thought that as a weak acid it would only partially dissociate. They did not recognise the ionic nature of ammonium chloride. A common misconception was that only the hydronium ions present in an acidic solution would contribute to its electrical conductivity.

Some candidates struggled to 'give an account of the extent of ionisation of water', even though it was simply a question designed to assess the link between the magnitude of the K_w value and the extent of dissociation.

Some candidates used generic expressions such as 'to oppose the change' or 'to compensate for the change', rather than applying equilibrium principles.

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