2023 NCEA Assessment Report

Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Subject: Chemistry
Level: Level 2
Achievement standard(s): 91164, 91165, 91166

General commentary

Candidates who achieved the standard identified key concepts, planned their answers to ensure they answered all parts of the questions, and made references to include comparisons and correct terminology. It was important for candidates to link chemistry concepts back to the substances noted in the question.

Report on individual achievement standard(s)

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

Assessment

The assessment consisted of three questions, and candidates were expected to answer all three questions. The assessment gave ample opportunities to candidates to demonstrate their understanding about concepts with respect to chemical bonds, structures, properties of chemical compounds, and energy changes due to changes in physical and chemical form.

Commentary

Successful candidates were able to demonstrate clear links between bonding, structure, and properties of given substances, as well as carry out accurate energy calculations. Candidates that achieved at merit level or higher were able to plan their answers to ensure they answered all parts of the questions, making references to include comparisons, diagrams, and correct use of terminology and units.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- identified that evaporation was an endothermic process that absorbed energy
- linked symmetry and shape to molecular polarity
- calculated the number of moles given a mass
- identified that solubility is governed by the strength of attractive forces
- drew Lewis diagrams correctly, and named their shapes
- identified by calculation bonds broken in reactants or bonds made in products
- identified the number of bonding / non-bonding electron densities around a molecule and linked this to repulsion theory

- identified that mobile charged particles are necessary for conduction
- identified that an exothermic rection released energy and had a negative enthalpy
- drew enthalpy diagram for an exothermic reaction, with labels for reactants and products.

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

- linked the endothermic process of evaporation to the relative strength of attractive forces between particles and absorption of energy
- carried out the steps of a thermodynamic calculation correctly
- linked regions of electron density and repulsion with regard to a central atom to explain shape and observed bond angles
- explained how electronegativity, symmetry and dipoles were linked to polarity
- linked attractive forces between an ionic solid and a polar or non-polar solvent to the solubility observed
- identified structures, particles and attractive forces for solids
- accounted for conductivity of two different substances by referring to their structure and bonding.

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

- justified the bond angles provided by linking areas of electron density, electron repulsion, number of bonded / non bonded areas, and shape of the molecules
- explained comprehensively molecular polarity linking electronegativity to polar bonds, symmetry, and bond dipoles
- l• inked a change of state with endothermic enthalpy, to absorption of heat energy from skin to breaking of intermolecular bonds and cooling
- discussed comprehensively the solubility of a solute in polar and non-polar solvents using correct chemical terminology
- calculated correctly thermodynamic calculations with correct units, sign, and three significant figures
- discussed the conductivity of substances in differing states using correct chemical terminology
- compared and contrasted chemical substances when this was a requirement.

Candidates who were awarded **Not Achieved** commonly:

- did not clearly distinguish between bonding and particle types in solids
- counted bonds incorrectly in calculations
- showed ambiguity in responses about electronegativity with electron clouds and bond dipoles
- only described charge carriers as electrons
- showed unclear understanding about endothermic and exothermic reactions
- used incorrect formula to calculate moles
- stated that ionic substances were polar (molecules)
- showed unclear understanding about molecular shapes
- omitted valence electrons in Lewis diagrams.

Achievement standard 91165: Demonstrate understanding of the properties of selected organic compounds

Assessment

The assessment consisted of three questions, and candidates were expected to answer all three questions. The assessment gave ample opportunities to candidates to demonstrate their

understanding about concepts with respect to chemical properties and reactions of organic compounds.

Commentary

The ability to identify and explain the type of reaction occurring is a key skill in this standard. Candidates who scored at merit level or higher related their answers back to the organic compound in the question. Core skills such as naming and drawing organic compounds are necessary for success at all levels. Candidates should use the provided bullet points as scaffolding for their answer to ensure all aspects of the question are being covered.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- named and drew some organic compounds using their chemical or physical properties
- identified the correct reaction type
- predicted some reagents and products in a reaction scheme
- classified alcohols as primary, secondary or tertiary
- explained why two products were formed but did not link it to Markovnikov / Zaitsev's rule
- were able to draw a polymer given the monomer
- explained one aspect of addition polymerisation
- discussed the reactivity of the monomer or the polymer
- drew geometric isomers and identified one feature of a geometric isomer
- were able to define or draw structural isomers.

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

- named and drew all organic compounds by using their chemical or physical properties.
- were able to describe a particular reaction type, and link this to the reagent
- predicted most reagents and products in a reaction scheme, and link their observations to the reaction type
- classified alcohols as primary, secondary, or tertiary with reasons
- used Markovnikov / Zaitsev's rule to explain which product was major and which was minor
- linked the symmetry/asymmetry of a molecule to the production of 1 or 2 products
- were able to draw a polymer given the monomer, and explain all aspects of the term addition polymerisation
- explained the reactivity of the monomer and polymer in terms of C=C and C–C
- linked the rigidity of the double bond to the atoms / groups of atoms connected to the C=C being fixed in space
- explained why two different atoms / groups were needed on each C in the double bond for either compound A or D
- defined a structural isomer and link both features to the molecules in question.

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

- consistently drew and named structures and used terminology correctly
- used chemical and physical properties to identify all organic compounds
- predicted all reagents and products in a reaction scheme
- were able to link a reaction type to the observation and conditions
- justified the choice of major / minor products and linked symmetry / asymmetry to the number of products
- consistently referred to the molecules in question in their answers
- discussed all aspects of additional polymerisation, and the reactivity of the monomers and polymers

- linked the rigidity of the double bond to fixing atoms/groups in space, and explained why two different atoms / groups were needed on each C in the double bond for both compounds A and D.

Candidates who were awarded **Not Achieved** commonly:

- incorrectly used terms such as ions or molecules to describe bonding atoms
- referred to an alcohol group as OH^-, hydroxide or OH atom
- omitted to name or draw organic compounds correctly, or drew bonds drawn to incorrect atoms
- were unable to identify the correct reaction type or observations.
- did not predict any reagents and products in a reaction scheme
- did not classify alcohols as primary, secondary, or tertiary
- did not correctly draw elimination or addition products or explain why some elimination reactions produce two products
- showed ambiguity about reason for major / minor in elimination with addition (rich get richer)
- did not demonstrate understanding about aspects of polymerisation
- demonstrated lack of clarity about chain length and reactivity, and distinction between physical and chemical properties
- were unable to draw geometric isomers or identify their features.

Achievement standard 91166: Demonstrate understanding of chemical reactivity

Assessment

The assessment consisted of three questions and candidates were expected to answer all three questions. The assessment gave ample opportunities to candidates to demonstrate their understanding about chemical reactions using the appropriate vocabulary.

Commentary

Candidates who achieved well in this standard displayed strong mathematical and chemical equation-writing skills, as well as considered the example given in the question applied to the chemical concepts they had learned.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- refered to particle collisions and the frequency thereof
- identified whether a reaction rate increased or decreased in response to a given change
- distinguished between strong and weak acids in terms of their dissociation
- referred to “amount” of particles when “concentration” would be more appropriate
- wrote correct K_c expressions
- were unable to state why rates or the positions of chemical equilibria were affected by given changes.
- made mathematical or substitution errors in calculation questions.
- did not use chemical equations to illustrate their answers.

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

- referred to how often successful particle collisions occurred when explaining reaction rates
- linked the properties of acids and bases to the extent to which they dissociated in solution

- demonstrated an understanding of the relationship between pH, the concentration of hydronium ions and the concentration of hydroxide ions
- justified how reaction rate is altered by a catalyst
- demonstrated an understanding of algebraic rearrangement.

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

- linked all parts of the context back to the key concept required to answer the question
- wrote correct chemical equations and used them in support of their arguments
- demonstrated an understanding of the concept of activation energy and its link to reaction rate
- demonstrated an understanding of the difference between acid/base strength and concentration, and linked these to the properties of pH and electrical conductivity
- used the concept of concentration accurately
- were specific about the types of particles under discussion, e.g. reactants, products, H_3O^+, OH^-, ions.

Candidates who were awarded **Not Achieved** commonly:

- completed only some of the questions
- used incorrect mathematical formula to attempt calculation questions
- made errors in writing K_c expressions
- attempted to write some chemical equations
- showed a lack of familiarity with the terms “conjugate acid” and “conjugate base”
- were unable to distinguish between strong and weak acids in terms of their dissociation.
