National Certificate of Educational Achievement

2012 Assessment Report

Chemistry Level 2

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

91165 Demonstrate understanding of the properties of selected organic compounds

91166 Demonstrate understanding of chemical reactivity

COMMENTARY

This was the first year for examinations to assess these achievement standards.

Successful candidates ensured that they answered all parts of the question by planning their responses and by using correct chemical terminology.

Candidates who achieved less well used generalisations and there was evidence of rote learned generic answers that were not applied to the specific aspects of questions.

STANDARD REPORTS

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

ACHIEVEMENT

Candidates who were awarded Achievement for this standard demonstrated the required skills and knowledge. They typically:

- drew Lewis structures correctly
- named shapes for molecules given the Lewis structure or correctly stated the number of electron repulsion regions
- stated from a given formula, if a molecule was polar or non-polar, or contained a polar or non-polar bond
- identified particle types and attractive forces between particles for at least one substance
- understood that silicon dioxide had strong covalent bonds that require considerable energy to overcome when melting
- described the conductivity in a substance in terms of relevant mobile charged particles
- described the solubility of a substance in terms of “like dissolves like”
- identified which bonds were broken between atoms in a given chemical equation
- identified that heat was absorbed in endothermic reactions
- could calculate the number of moles in a given reaction.

NOT ACHIEVED

Candidates who were assessed as Not Achieved for this standard lacked some or all of the skills and knowledge required for the award of Achievement. They typically:

- did not include non-bonding electrons in Lewis structures
- confused polar bonds with polar molecules
- did not recognise a double bond as a single region of negative charge
- confused electronegativity with electron repulsion
- referred to repulsion between bonded atoms instead of between regions of negative charge or electrons
- used incorrect terminology to describe solids at the particle level
- stated incorrectly the type of bond in silicon dioxide
- did not relate physical properties of solids to their structure and bonding
- did not know the requirements of conductivity and solubility
- could not carry out thermochemical calculations

- confused the breaking of covalent bonds with the breaking of intermolecular forces when water boils.

ACHIEVEMENT WITH MERIT

In addition to the skills and knowledge required for the award of Achievement, candidates who were awarded Achievement with Merit typically:

- linked correct, named molecule shape to the number, bond angle and nature of negative charge regions
- linked bond polarity to electronegativity difference between bonded atoms
- explained the relationship between the melting point of a substance (silicon dioxide), its constituent particles and the strength of the attractive forces between the particles
- linked the electrical conductivity of substances to the movement of constituent particles
- linked the solubility of substances to the nature of constituent particles
- could carry out at least two steps and showed working for thermochemical calculations.

ACHIEVEMENT WITH EXCELLENCE

In addition to the skills and knowledge required for the award of Achievement with Merit, candidates who were awarded Achievement with Excellence typically:

- compared and contrasted the factors that affect the differing shapes and polarity of similar molecules
- recognised that bond dipoles cancel rather than polar bonds
- justified, explained and recognised a covalent network solid (silicon dioxide) and the relationship between the melting point of a substance, its constituent particles and the strength of the attractive forces between the particles
- compared and contrasted the electrical conductivity and solubility of different substances with reference to bonding and structure
- identified all bonds (including multiple bonds) breaking in a given combustion equation
- explained that intermolecular forces are being broken when water is boiled and that this requires energy
- used units correctly for accurate thermochemical calculations.

OTHER COMMENTS

Many candidates used incorrect terminology in their discussions. The word molecule was used to explain all manner of particles such as “covalent network molecules” or “zinc chloride ionic molecules”.
Incorrect units were frequently used in energy calculations. Candidates need to show working and use an appropriate number of significant figures.

Many candidates referred to O-H bonds breaking when water boils rather than the weak intermolecular forces.

91165 Demonstrate understanding of the properties of selected organic compounds

ACHIEVEMENT

Candidates who were awarded Achievement for this standard demonstrated the required skills and knowledge. They typically:

- stated the colour changes for reactions that occurred

- named organic compounds and drew structural formulae correctly
- stated the correct types of reactions
- identified the reactant and/or products of reactions
- identified acid-base properties of carboxylic acids or amines
- named functional groups
- described substitution or elimination reactions
- recognised that a double bond is a requirement for *cis-trans* isomerism
- identified the major and minor products of the reaction of an asymmetric alkene.

NOT ACHIEVED

Candidates who were assessed as Not Achieved for this standard lacked some or all of the skills and knowledge required for the award of Achievement. They typically:

- drew incorrect structural isomers
- were unable to name organic structures
- confused colour changes for reactions
- were not familiar with the reagent, product and/or conditions for organic reactions
- drew an incorrect polymer structure from a given monomer.

ACHIEVEMENT WITH MERIT

In addition to the skills and knowledge required for the award of Achievement, candidates who were awarded Achievement with Merit typically:

- explained that only a primary alcohol can be oxidised to form a carboxylic acid
- linked reaction type to either observations or products
- wrote equations for reactions that occurred
- explained aspects of a reaction sequence
- explained links between structure and geometric isomerism
- explained the links between the structure of a product formed to the structure of the reactant.

ACHIEVEMENT WITH EXCELLENCE

In addition to the skills and knowledge required for the award of Achievement with Merit, candidates who were awarded Achievement with Excellence typically:

- used experimental observations to justify why one reactant could be used to distinguish between a pair of organic compounds and why another reagent could not be used
- compared and contrasted the similarity and differences between substitution and elimination reactions
- justified the placement of organic compounds within a reaction sequence by making links between structure and reactions
- were able to discriminate between two possible substitution options and explain why one was correct whereas the other was not
- used chemical equations consistently within their answers.

91166 Demonstrate understanding of chemical reactivity

ACHIEVEMENT

Candidates who were awarded Achievement for this standard demonstrated the required skills and knowledge. They typically:

- showed understanding of the factors that affect rate of reaction
- showed understanding that higher temperature relates to increased kinetic energy
- wrote a correct equilibrium expression
- linked the small value of K_c to the high concentration of reactant
- applied principles to predict the effect of changes to an equilibrium system
- gave an equation for an acid or base reacting with water
- identified conjugate acid-base pairs
- identified acids and bases as strong or weak
- associated concentration of hydronium ions with degree of conductivity
- related conductivity of substance to ions in solutions.

NOT ACHIEVED

Candidates who were assessed as Not Achieved for this standard lacked some or all of the skills and knowledge required for the award of Achievement. They typically:

- did not use appropriate key terms
- did not write an equilibrium expression correctly given an equilibrium equation
- did not perform one step correctly in a K_c calculation
- did not correctly predict the effects of changes on equilibrium
- identified exothermic reactions as being favoured by temperature increases
- were unable to rearrange an equation
- did not perform a pH calculation
- wrote symbols for ions incorrectly, often omitting charge or writing the wrong charge
- were unable to identify an aqueous solution using its physical properties.

ACHIEVEMENT WITH MERIT

In addition to the skills and knowledge required for the award of Achievement, candidates who were awarded Achievement with Merit typically:

- explained how reaction rate change was linked to collision frequency change or collisions were more effective in overcoming activation energy at a higher temperature
- were able to carry out a two-step calculation
- explained the effect of changes to an equilibrium system in terms of equilibrium principles
- completed the equations representing the reactions of an amphiprotic species as an acid and a base correctly
- connected conductivity just to the presence of hydronium ions or positive ions
- made links between the acidity or alkalinity of an aqueous solution to the complete or incomplete dissociation of the substance in water.

ACHIEVEMENT WITH EXCELLENCE

In addition to the skills and knowledge required for the award of Achievement with Merit, candidates who were awarded Achievement with Excellence typically:

- analysed how a temperature increase increased the reaction rate in two ways: frequency of collision; and effectiveness of collision
- made clear links between the conditions of a reaction and the rate of reaction and explained the rate using correct terms in relation to the collision theory
- used equilibrium principles to correctly justify changes in the proportion of different species for a specific equilibrium
- discussed the effect of changes to an equilibrium system in terms of equilibrium principles and related them to the appropriate reaction
- justified how changing the temperature changes K_c and the effect on equilibrium
- justified the pH and conductivity of solutions correctly and linked these to correctly written equations
- were able to write chemical equations to show the dissociation of the given substances in water and used them to explain the pH and electrical conductivity.