

# National Certificate of Educational Achievement

## 2013 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

Candidates who achieved well showed evidence of being well prepared, had closely read the questions and had planned their answers.

Answers given by these candidates were to the point, addressed all parts of the questions, used the language of the question, and related back to the question. Candidates who achieved well also used chemistry specific vocabulary, symbols and units.

Candidates who achieved less well used generalisations and frequently repeated statements.

## 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:**

- identified bond angles and molecular shapes from given Lewis structures
- described a molecule as polar or non-polar with one piece of supporting evidence
- recognised that asymmetrical shapes led to polar molecules and symmetrical shapes led to non-polar molecules
- identified the type of substance, particle and attractive force for at least one substance
- identified the type of bonding in different substances and linked it to their physical properties
- identified bonds broken and bonds formed during chemical reactions
- identified exothermic and endothermic reactions given a thermochemical equation
- linked endothermic reactions to absorption of energy
- calculated moles given mass and molar mass without the use of units.

#### 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 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
- did not know the requirements of conductivity and ductility
- could not carry out thermochemical calculations and failed to convert kg to g for mole calculations
- confused breaking covalent bonds with breaking intermolecular forces when a substance evaporates.

## **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
- predicted and correctly explained the shapes of unknown molecules when given the polarity
- used correct units and signs for thermochemical calculations
- recognised the type of forces that have to be broken for a change of state.

## **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 bond angles of similar molecules
- justified polarity and symmetry of known and unknown molecules using correct terminology and diagrams
- compared and contrasted observed physical properties of different substances using structure and bonding principles
- correctly applied stoichiometric principles to carry out comparative energy calculations between two substances.

## **OTHER COMMENTS**

Many candidates used incorrect terminology in discussions of polar molecules. Electronegativity was frequently confused with electron repulsion, and polar bonds were cancelled rather than bond dipoles.

Many candidates failed to link the observed properties for all substances referred to in a question to a full discussion of their structure and bonding. Many focused on only one aspect.

Units and signs were often left off energy calculations and many candidates failed to use an appropriate number of significant figures. Very few candidates correctly converted the kg to g as required for energy calculations.

## **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:**

- drew or named organic molecules
- identified the secondary chloroalkane, supported by a reason
- recognised that a double bond is needed for geometric isomerism
- drew correct polymer structure from a given monomer, and a monomer from a polymer
- stated the chemical properties and physical properties of organic compounds
- identified the functional group in organic compounds
- classified the type of reaction with a supporting reason.

## 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 name organic molecules correctly
- were unable to draw *cis-trans* structures
- were unfamiliar with the solubility of organic compounds
- stated that bromine water decolourised but did not give the initial colour
- confused reaction types.

## ACHIEVEMENT WITH MERIT

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

- clearly explained the structural requirements for constitutional isomerism and geometric isomerism and related these to the structure of molecules
- wrote a method that distinguished organic compounds from others using chemical properties and/or physical properties
- made links between types of reaction, products formed and functional groups.

## 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:

- linked the double bond, which restricts the rotation of the atoms around the double bond, to geometric isomerism
- wrote a valid method that could be carried out to distinguish between five organic compounds using both chemical properties and physical properties
- linked type of reaction, with a reason, to the structural formula of the product and the name of the functional group formed for three reactions of butan-1-ol.

## OTHER COMMENTS

Candidates should be encouraged to show their understanding of the structure of organic molecules by writing structural formulae with the bonds present between carbon atoms in 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:

- identified that powder has greater surface area than chips
- stated collisions were more frequent when powder was used
- gave an account of the effect of temperature and/or catalyst on chemical reactivity
- wrote a correct  $K_c$  expression given an equation, and a correct equation given a  $K_c$  expression
- identified differences in reactant and product amounts in an equilibrium equation
- noted that  $K_c$  decreased as temperature increased

- stated a smaller  $K_c$  value means more reactants than products
- did one correct step in calculating a concentration from a given  $K_c$  value and concentrations of other species present
- recognised that the difference between an acid its conjugate base is a proton
- calculated pH or a concentration correctly
- described dissociation of strong and weak acids.

### **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:**

- were unable do any correct step in a calculation
- did not write symbols for ions correctly, often omitting charge or giving the wrong charge
- often referred to acids as hydrogen (atom) donors
- could not correctly explain the difference between a strong and a weak acid at the particle level.

### **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 changes in factors such as surface area and temperature to the frequency of collisions
- linked catalysts to lowered activation energy by providing an alternative reaction pathway
- compared and contrasted correctly the effect of pressure on two reactions by referring to difference in relative amounts of gaseous particles between the reactant and product sides
- justified why a reaction was classified as exothermic
- calculated the concentration of a species in an equilibrium system correctly with appropriate units
- illustrated a correct explanation of the difference between an acid and its conjugate base with an example
- explained the reactivity or strength of an acid correctly in terms of hydronium ion concentration.

### **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:**

- discussed comprehensively changes in factors such as temperature and a catalyst on reaction rate with links to particles and collision theory
- discussed comprehensively the effect of pressure on a system, with reference to Le Chatelier's principle and numbers of moles of gas particles
- elaborated on the meaning of  $K_c$  magnitude changes and used equilibrium principles to correctly justify why a reaction was exothermic
- compared and contrasted comprehensively the reactivity of two acids in terms of acid strength, hydronium ion concentration (calculated correctly with correct units) and with reference to collision frequency.