

National Certificate of Educational Achievement

2013 Assessment Report

Chemistry Level 3

- 91390 Demonstrate understanding of thermochemical principles and the properties of particles and substances**
- 91391 Demonstrate understanding of the properties of organic compounds**
- 91392 Demonstrate understanding of equilibrium principles in aqueous systems**

COMMENTARY

Successful candidates are able to adapt a pre-prepared response to match a different styled question that has been asked of them. Some candidates, however, are unable to do this, so cannot adequately answer an unusual question.

It is evident that some candidates are not familiar with the practical component of a typical level three chemistry course. These candidates fail to recognise experimental equipment or fail to have an understanding of what is happening within the practical.

STANDARD REPORTS

91390 Demonstrate understanding of thermochemical principles and the properties of particles and substances

ACHIEVEMENT

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

- defined key terms and used conventions correctly
- drew Lewis structures correctly
- deduced the name, shape and polarity of a molecule
- attributed polarity to whether dipoles cancelled or not
- linked dipoles to the electronegativity of atoms within the molecule
- wrote correct equations
- recognised the types of intermolecular forces and factors that affected these
- calculated energy gained by a solution using $q = mc\Delta T$
- calculated enthalpy using Hess' law
- described factors affecting the spontaneity of a 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:

- restated the data given in the question without any further explanation
- showed no understanding of definitions, key terms, or conventions
- used rote learning indiscriminately
- used inaccurate language such as “bonds cancel” or “electronegativity cancels” when explaining molecular polarity
- did not justify why a bond was polar and could not link this to the overall polarity of a molecule
- were unable to write equations correctly
- applied an incorrect formula to calculations
- described intermolecular forces incorrectly and stated that the intramolecular forces were broken on boiling
- stated that a reaction with a negative ΔH was endothermic.

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 fully a periodic trend
- drew accurate Lewis structures
- named molecular shapes correctly and explained their polarity
- used Hess' law to calculate an enthalpy change
- linked energy input to a change in state and the breaking of intermolecular forces
- recognised the significance of intermolecular forces and used these to justify the relative boiling points of different molecules
- calculated an enthalpy change correctly
- completed a calorimetric calculation partially
- showed understanding for the spontaneity of reactions.

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:

- explained periodic trends in full
- provided clear, well-reasoned explanations for both the shape and polarity of molecules
- completed a multi-step calorimetric calculation
- explained fully the most significant type of intermolecular forces and linked these to the various boiling points
- discussed the spontaneity of the reaction correctly in terms of entropy and enthalpy.

OTHER COMMENTS

Candidates showed a good knowledge of predictable questions such as explaining shapes and polarity of molecules. However, some candidates struggled with less familiar questions.

The majority of candidates did not mention kinetic energy in relation to the boiling point of water.

There were a large number of candidates making careless errors such as missing electron pairs in Lewis structures, or confusing terms.

It was very apparent that large numbers were unfamiliar with practical calorimetry.

91391 Demonstrate understanding of the properties of organic compounds

ACHIEVEMENT

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

- drew and named some structures
- identified some physical properties according to the structure

- stated aspects of reactivity
- contrasted different compounds
- stated a property of enantiomers
- named and/or drew hydrolysis products
- identified reagents and common reaction types
- stated that acyl chlorides had a vigorous reaction with water
- identified oxidation processes and reagents needed
- stated a double bond was formed as a result of an elimination reaction
- identified primary, secondary and tertiary alcohols
- drew a correct dipeptide structure
- stated common laboratory procedures
- recorded observations made in common reactions.

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:

- could not draw or name structures correctly
- were unable to relate physical properties and reactivity to structure
- were unable to distinguish between different functional groups
- drew 3-D structures incorrectly
- drew isomers incorrectly
- mixed-up distillation and reflux processes
- identified butan-1-ol as a basic compound
- could not identify the type of alcohol
- stated amides were basic
- confused reagents in reactions
- showed little understanding of practical work
- drew polymers instead of a dipeptide
- drew dipeptides with incorrect number of bonds in the amide linkage.

ACHIEVEMENT WITH MERIT

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

- drew and named most structures, including the positioning of the functional group
- linked structure to the physical properties and the reactivity of substances
- drew correct 3-D representations
- described what happened in an elimination reaction and identified the major and minor products
- knew that litmus must be damp to work
- drew dipeptides and identified peptide links
- explained distillation adequately
- explained how to test for the different alcohols, however omitted part of the reagent.

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 structure to the reactivity and to the observations consistently
- named molecules that had two different functional groups in them
- explained how different conditions produced different hydrolysis products
- discussed reaction types fully with respect to the structures of both reactants and products
- contrasted and compared structures
- exhibited broad knowledge of reaction sequences
- described fully what happens in an elimination reaction
- justified both major and minor products in terms of symmetry
- wrote equations to explain observations
- described a chemical procedure to identify the different types of alcohol.

OTHER COMMENTS

Successful candidates paid close attention to the question and answered all aspects of the question, e.g. answers that both *compared and contrasted*.

Observations were included when describing a valid method to identify different chemicals.

Care was demonstrated when candidates showed correct atom connectivity, e.g. showing the carbon atom is bonded to the O atom of an OH group, rather than the H atom.

Successful candidates realised that organic liquids do not react with litmus until water is added. They also included the conditions required for the reagent, e.g. concentrated H₂SO₄, instead of just H₂SO₄.

Candidates need to be careful when giving definitions: Some used the term *reflect* instead of *rotate* when explaining a property of enantiomers.

It was obvious that some candidates had not undertaken practical work involving either reflux or distillation.

91392 Demonstrate understanding of equilibrium principles in aqueous systems

ACHIEVEMENT

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

- recognised strong and weak acids/bases and how they dissociated
- discussed mobile ions in relation to conductivity and H₃O⁺ in relation to pH
- were able to write a correct K_a expression and calculate the pH of a weak acid
- recognised that half way to equivalence point is when [acid] = [conjugate base]
- knew a complex ion formed between Ag⁺ and NH₃
- recognised a 2:1 ion ratio in an A₂B compound.

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:

- confused K_s and s
- were unable to write balanced equations
- did not recognise CH_3NH_2 as a base and tended to discuss NH_3 instead
- attributed conductivity to the strength of an acid
- were unable to do simple one-step calculations
- failed to attempt all questions
- did not recognise the significance of the half way to equivalence point.

ACHIEVEMENT WITH MERIT

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

- knew how to use double arrows and single arrows appropriately
- recognised correct species in a solution
- knew that $[\text{Ag}^+] = 2 \times [\text{CrO}_4^{2-}]$ and that $s = [\text{CrO}_4^{2-}]$
- linked a decrease in $[\text{CH}_3\text{COOH}]$ to an increase in $[\text{CH}_3\text{COO}^-]$
- were able to process changes in species during a titration
- set out calculations clearly that were easy to follow
- were able to explain equilibrium changes with respect to species.

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 fully the factors that affect pH and conductivity, supported with the correct equations
- gave a thorough explanation for why $\text{pH} = \text{p}K_a$ at half way to equivalence point and linked this to an equation
- were able to account for all species in solution during a titration
- linked the appropriate species to pH and conductivity and included appropriate equations
- wrote the correct chemical equation for the formation of a complex ion
- used the correct units and three significant figures for calculations
- were able to calculate the pH at any point during a titration.