National Certificate of Educational Achievement

2014 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

Candidates who discussed interactions between particles in detail as opposed to using generic terms, showed a clearer understanding.

Candidates who appeared familiar with practical chemistry discussed observations and links to particles with more clarity.

Successful candidates were able to define terms concisely and use them appropriately in all three standards.

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 commonly:

- wrote correct electronic configurations and stated trends in the periodic table
- were able to identify the main intermolecular forces between molecules
- recognised that boiling points are dependent on the strength of the intermolecular forces involved
- processed a simple calculation, but may have left out units or forgotten the mole factor
- described the different regions on a heating curve
- drew a Lewis structure correctly, including square brackets and the charge of the ion
- identified the shape of the ion
- recognised, and in general terms described, what entropy is.

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 commonly:

- were inaccurate with electron configurations and did not know the correct order of filling in the number of electrons that each orbital should contain
- forgot to include square brackets and the charge around the Lewis structure of an ion
- were unable to determine the significance of the different parts of the heating curve
- confused ionisation energy with electronegativity
- described the process of dissolving incorrectly as a solid changing into a liquid
- stated that the loss of an electron would increase the attraction of the nucleus for the remaining electrons due to a greater proton : electron ratio
- confused entropy with enthalpy.

ACHIEVEMENT WITH MERIT

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

- were able to write electron configurations correctly and link these to the trends in the periodic table
- linked clearly, the trend in decreasing electronegativity down a group to the addition of electron shells, and hence a decrease in electrostatic attraction between the nucleus and the valence shell
- recognised that an atom and its ion have the same nuclear charge
- identified the main intermolecular forces within a substance and were able to link this to the substances boiling point
- linked the shape of the heating curve to two processes that were occurring
- linked entropy to the dispersal of matter
- were able to explain entropy with respect to the system, but failed to recognise a complementary change in the surroundings.

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 commonly:

- linked clearly the trend in decreasing electronegativity down a group to the addition of electron shells a greater distance from the nucleus and hence a decrease in electrostatic attraction between the nucleus and valence shell
- discussed all the intermolecular forces correctly in a range of molecules and recognised that more than one intermolecular force may contribute to a boiling point
- recognised that an increase in the temperature results in an increase in the kinetic energy of the particles
- explained fully the entropy in both a system and its surroundings, describing what entropy was and how it could change
- were able to contrast how the enthalpy of formation of ethanol was different if it formed a gas rather than a liquid. They were specific and stated that the value would be less negative and then gave an explanation as to why this was so
- linked clearly the decrease in ionic radius from atom to cation, to the loss of an electron shell and consequently the decrease in repulsion between electron shells, and that the nuclear charge did not change
- linked the size of the atom/ion, the electronegativity and the ionisation energy to the nuclear charge, distance from the nucleus and electron-electron repulsion.

OTHER COMMENTS

Candidates used terms such as ‘effective nuclear charge’ and ‘electron shielding’ loosely and sometimes incorrectly. An explanation of the changing forces between the charged regions or particles and the impact on the periodic trend would show a clearer understanding of the concept.

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 commonly:

- drew or named some organic structures correctly
- identified the correct functional group for a triglyceride or type of molecule produced in a hydrolysis reaction
- chose water or damp litmus as a suitable reagent to distinguish between organic molecules
- identified carbon dioxide as the gas formed from a neutralisation reaction of sodium hydrogen-carbonate
- described a process that evaporated and re-condensed a mixture to produce a desired organic compound
- drew a monomer structure with a correct functional group identified
- drew one correct monomer for either the acidic or basic hydrolysis of the polymer, with errors in the amino/carboxyl groups
- understood components of the reaction scheme, but linked $SOCl_2$ to a haloalkane and NH_3 to an amine
- recognise the need for an acid or base catalyst for hydrolysis
- chose an appropriate reagent to distinguish between compounds
- could state the reasons for using specific reagents and equipment in an organic synthesis and purification.

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 commonly:

- could not accurately circle an ester functional group or link
- mis-named organic molecules, including esters
- added an extra hydrogen atom to the middle carbon of propan-1,2,3-triol
- did not recognise that the elimination of an alcohol produces an alkene
- could not correctly identify the gas formed when an acid reacts with a hydrogen-carbonate
- mis-identified distillation as reflux
- mis-interpreted Question 2 (a) as a procedure to form the pairs of molecules, instead of a test to distinguish between them
- described a physical property (smell) rather than a chemical test when using reagents
- were able to draw the correct functional group of a molecule, but not its correct structure
- were unable to correctly draw the major and minor products in their correct places
- drew a repeating unit of a polymer instead of the monomer required
- drew inaccurate structures or could not name basic organic molecules
- were not specific in their explanations of either elimination or hydrolysis
- thought that hydrolysis with HCl yielded an acid chloride

- were inaccurate with the placement of bonds in structural formulae
- could not describe observations accurately.

ACHIEVEMENT WITH MERIT

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

- drew accurate structures for *cis-trans* isomers, molecules and carboxylate anions
- gave an explanation that an elimination reaction is a loss of water
- provided a complete explanation for distinguishing between pairs of organic molecules
- understood the purpose of the practical steps involved in organic synthesis
- could accurately draw the structure of a monomer and its acidic / alkaline hydrolysis forms
- understood the need for acidic / alkaline conditions for hydrolysis but failed to be specific in terms of the reagents / conditions required
- drew and named correctly a majority of the structures in an organic sequence
- described clearly elimination reactions and the reasons for major and minor products
- could draw accurate structures for both triglyceride and polyamide hydrolysis linked to the correct reaction conditions
- were consistent with their chain length, drawing and the placement of functional groups in reaction schemes.

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 commonly:

- explained an elimination reaction as a loss of water from adjacent carbons
- demonstrated good use of literacy skills when comparing and contrasting
- understood that the use of heat will affect a result when using Tollens' or Benedict's reagent
- demonstrated their experience with practical organic chemistry by explaining the purpose of organic steps and observations
- could complete a full organic sequence with correct names and structures
- demonstrated understanding of the reagents (HCl / NaOH) and the conditions (aqueous and heat) required for a hydrolysis reaction to occur
- recognised that *cis-trans* isomers were two different compounds formed in the elimination reaction
- recognised that both functional groups were protonated for the acid hydrolysis of a polyamide.

OTHER COMMENTS

Many candidates understood an application of Saytzeff's rule but were unable to adequately explain how it created major / minor products.

Candidates that appeared to have had practical experience of organic synthesis were often more successful.

Some candidates, although understanding hydrolysis under acidic / alkaline 'conditions', failed to be specific in stating what these conditions were.

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 commonly:

- used equilibrium arrows appropriately
- wrote correct acid-base or solubility equations
- described a relationship between the degree of dissociation, pK_a, K_a, H_3O^+ and pH
- wrote an appropriate formula and completed one step of the calculation
- wrote a correct solubility equation and K_s expression
- compared Q and K_s to make a valid conclusion
- recognised the effect of pH on the solubility of a substance
- recognised a buffer region on a titration curve
- calculated –OH, H_3O^+, or K_b from the pH
- recognised that conductivity was caused by the presence of ions.

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 commonly:

- wrote or applied formulae incorrectly in calculations
- did not include charges on ions
- were unable to write a balanced symbol equation
- confused the relationships between the degree of dissociation, pK_a, K_a, H_3O^+ and pH
- could not recognise all species in a solution or the effect of pH on the solubility of a substance
- wrote answers that ignored the information given to them in the question
- did not recognise that HBr was a strong acid
- did not recognise the reason for the conductivity of a solution.

ACHIEVEMENT WITH MERIT

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

- wrote correct equilibrium equations and partially explained the relative species concentrations
- explained the relationships between the degree of dissociation, pK_a, K_a, H_3O^+ and pH
- used a correct process to calculate the mass of a substance in a buffer, with minor errors
- calculated correctly the solubility and the concentration of the species involved
- used the correct process to predict precipitation, with minor errors
- gave partial explanations for the effect of pH on the solubility of a substance
- explained why the pH remained relatively constant in the buffer region of a titration
- used the correct process to calculate the pH of a buffer, with minor errors

- gave partial explanations for the species present at different parts of a titration.

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 commonly:

- justified completely the concentration of all species in a weak acid solution
- calculated correctly the mass of a substance in a buffer with no errors, using appropriate significant figures and the correct units
- predicted precipitations correctly and used appropriate significant figures in the calculations
- explained fully the effect of pH on the solubility of a substance, supported with correct equations
- calculated correctly the pH of a buffer
- compared fully the species present in different parts of a titration and justified the difference in the conductivity, supported by relevant equations.

OTHER COMMENTS

Many candidates had difficulty with the cube root calculation.