2015 NCEA Assessment Report

NZQA
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QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

Chemistry Level 3 91390, 91391, 91392

Part A: Commentary

Candidates who discussed organic reactions or interactions between particles in detail, as opposed to using learned phrases or generic terms, gave more coherent responses which showed a deeper understanding.

Successful candidates were able to define and explain terms identified in the Achievement Standards.

The length of a candidate's answer did not relate to the grade. Concise, well-structured responses using appropriate language enabled candidates to exhibit their in-depth understanding.

Part B: Report on standards

1. Assessment Report for 91390: Demonstrate understanding of thermochemical principles and the properties of particles and substances

Achieved	Candidates who were assessed as Achieved commonly: • could identify different periodic trends such as atomic radius or ionisation energy and link them to any of the number of protons, energy level, or electrostatic attraction • wrote electron configuration for atoms correctly • wrote a relevant definition for both ionisation energy and electronegativity • identified that the formation equation for $H_2O(l)$ and combustion of $H_2(g)$ were the same equation • could either draw Lewis diagrams or recognise the shape for given structures • identified the intermolecular bonds present in an alcohol • identified polar and non-polar molecules but failed to explain any links.
Not Achieved	Candidates who were assessed as Not Achieved commonly: • were unclear of definitions • failed to link fundamental concepts such as the number of protons and nuclear charge to either ionisation energy or atomic radii • failed to recognise the products of formation in the combustion of H_2 • thought that $\Delta_c H$ involved the element carbon • were unable to name shapes of molecules and/or drew 3D bonds in their Lewis diagrams • included intramolecular bonds when discussing forces of attraction between molecules • in discussing boiling points, wrote general statements describing intermolecular bonds without relating it to the specific example • confused polar and non-polar molecules • had incomplete answers when explaining shape • discussed effective nuclear charge or electron shielding without defining these concepts • discussed hydrogen bonding as an intramolecular force between O and H • discussed electronegativity rather than ionisation energy.
Achieved with Merit	Candidates who were assessed as Achieved with Merit commonly: • explained periodic trends, but lacked detail, e.g. not linking the increase in electrostatic attraction to an increase in the amount of energy to remove an electron • did not discuss the trend in atomic radii • correctly calculated the enthalpy of formation but made errors with the sign and/or units • recognised that the two alcohols had the same molar mass and therefore the same degree of temporary dipole bonding / hydrogen bonding, but failed to explain why

	the shape of each molecule changed the boiling point, or didn't link it to an increase in the energy required to break the intermolecular bonds • explained a polar or non-polar molecule, linking electronegativity differences to polar bonds, and the symmetry or asymmetry to whether dipoles would cancel or not • explained a structure in detail, stating the number of electron densities, bonding and non-bonding regions, that electron densities repel to give maximum distance, and could identify the parent geometry.
Achieved with Excellence	Candidates who were assessed as Achieved with Excellence commonly: • discussed periodic trends by defining them precisely and linking specific trends to energy level, proton number, amount of nuclear charge and electrostatic attraction • recognised that intermolecular forces are broken when liquids turn into gases and that bond breaking is an endothermic process • calculated the enthalpy of formation, with correct sign and units • discussed shape and polarity correctly linking electron densities, both bonding and non-bonding, repulsion of these densities, parent geometry and the shape to symmetry, and whether dipoles cancelled or not • discussed intermolecular bonding, relating the same molar mass to the same instantaneous dipole attraction. Also that the hydrogen bonding would be similar and that the significant difference was the shape of the molecule. They explained why the linear molecule had a stronger force of attraction and related this to an increase in energy to break these intermolecular bonds.
Standard specific comments	When discussing molecular polarity students should be referring to bond dipoles cancelling, not polar bonds or the effects of the polar bonds. Electronegativity does not explain ionisation energy. All abbreviations, e.g. TDD, should be defined. Lewis diagrams do not have 3D bonds. Students need to be clear as to the difference between a table and a graph, or a formula and an equation. Some students struggled with the change of state question as they failed to link the breaking of intermolecular forces with absorbing energy. Some students struggled with linking shape to the cause of a different boiling point and did not state that you would expect them to be similar due to having the same molar mass.

2. Assessment Report for 91391: Demonstrate understanding of the properties of organic compounds

Achieved	Candidates who were assessed as Achieved commonly: • named some functional groups correctly • drew some organic structures correctly • drew and classified some haloalkane molecules correctly • identified some, or all of the products of the reaction between a haloalkane and alcoholic KOH • identified elimination as the type of reaction between a haloalkane and alcoholic KOH • identified both major and minor products in the reaction between an asymmetrical haloalkane and alcoholic KOH • drew one correct 3D structure of an enantiomer or both mirror images with an error in the way the groups are connected to the carbon atom • drew the repeating unit of a nylon polymer • described one aspect of a condensation polymerisation reaction • recognised why an acid chloride cannot be dissolved in water • recognised acidic hydrolysis and/or could name one product of the hydrolysis reaction • recognised an alkene functional group in a complex triglyceride molecule • describe a test with reaction type or observation to show a molecule is unsaturated • recognised three products of organic reactions or three reagents needed for a

	specific reaction.
Not Achieved	Candidates who were assessed as Not Achieved commonly: • could not recognise and name functional groups correctly • could not draw organic structures correctly, either did not know the functional group, added too many hydrogens onto a carbon, or counted the number of carbon atoms incorrectly • did not recognise that the alcoholic KOH causes elimination of an haloalkane, confusing this with substitution using aqueous KOH • stated incorrectly that an enantiomer needed four different atoms or four different functional groups bonded to a carbon atom • could not name a physical property that would be the same for both enantiomers of a chiral chemical compound, or described a chemical property instead of physical property that was the same for both enantiomers • stated incorrectly that enantiomers were distinguished by the fact that they reflect, deflect, diffract, turn, send, polarised light in different directions • could not draw a nylon polymer correctly by either not forming the amide link or drawing the amide link correctly but drawing one and a half of a repeating unit • did not recognise condensation polymerisation • could not explain why an acid chloride could not be dissolved in water • did not recognise acidic hydrolysis • drew covalent bonds between ions • could not identify the alkene functional group in a complex triglyceride molecule or circled it inaccurately • could not describe the addition reaction test to show that a molecule is unsaturated or confused this test with the substitution reaction test for a saturated molecule where UV light is needed • were unable to draw the products of basic hydrolysis of a triglyceride • did not recognise the reflux procedure and/or could not describe the use of it.
Achieved with Merit	Candidates who were assessed as Achieved with Merit commonly: • drew the structures of and classified haloalkanes correctly • identified three products of the reaction of haloalkanes with alcoholic KOH and clearly described the elimination process • described clearly the formation of major and minor products during the elimination reaction of an asymmetrical haloalkane (Saytzeff's rule) • explained that only an asymmetric haloalkane would form major and minor products • described the structural features, physical similarities and differences of enantiomers clearly • drew the 3D structures of the mirror images of enantiomers accurately • recognised and explained condensation polymerisation clearly through mentioning the di-functionality of the monomers and the release of a small molecule at each reaction site • recognised acidic hydrolysis and could identify one monomer forming • explained the test, type of test and observations of the reaction performed to show that a molecule is unsaturated • could accurately draw the products of basic hydrolysis of a complex triglyceride • recognised that reflux is used for the hydrolysis of a triglyceride and could give the reasons for using it • recognised and accurately wrote, or drew most of the products and reagents of different organic reactions.
Achieved with Excellence	Candidates who were assessed as Achieved with Excellence commonly: • explained the elimination of haloalkanes clearly as the loss of a hydrogen and a halogen from adjacent carbons, including full explanation of Saytzeff's rule for the formation of major and minor products and the asymmetry of molecules, if needed • identified geometric isomers in the formation of the major product of the elimination reaction • drew a condensation polymer accurately and described the condensation process of the formation of the polymer in terms of the di-functionality of the monomers

	• recognised and accurately identified the products of acidic hydrolysis of a triglyceride as the protonated diamine and a dioic acid, instead of a dioyl chloride • recognised and accurately wrote or drew the products and reagents of different organic reactions in an organic sequence, showing their conditions clearly and accurately as well.
Standard specific comments	Some candidates were unable to completely explain elimination reactions (Saytzeff's rule). Some lacked the ability to explain that the halogen and hydrogen atoms must be adjacent to each other. Many candidates were able to clearly state that minor and major products form in elimination reactions however, but were unable to explain this due to asymmetrical molecules. Some candidates could not describe the fact that the diamine and the dioyl chloride were di-functional which caused them to continually react on both sides of the molecule to form a polymer. Hydrolysis, acidic and basic, seems to be a problem for some candidates. Many understood the breaking of, for example, the amide bond, but stated that the original monomers would form again, including sebacoyl chloride if HCl was used in acidic hydrolysis. There is confusion between reflux and distillation, however some candidates realised that reflux was used to increase the rate of the reaction.

3. Assessment Report for 91392: Demonstrate understanding of equilibrium principles in aqueous systems

Achieved	Candidates who were assessed as Achieved commonly: • could write K_a and K_s expressions but made errors in calculations • used equilibrium or reaction arrows correctly, where appropriate • could write dissolving equations, and dissociation or saturation equilibrium equations • recognised that pH is dependent on H_30^+ concentration and that conductivity depends on ion concentrations • identified species in solution • wrote a weak base dissociation equation • wrote the buffer formula or K_a expression correctly • calculated pH correctly • showed an appropriate method for calculating K_s given *s* • could carry out one step correctly of a multistep calculation • recognised that weaker acids have a higher pK_a.
Not Achieved	Candidates who were assessed as Not Achieved commonly: • wrote incorrect equations or ion formulas • gave incorrect products for the dissociation of $CH_3NH_3^+$ with water • could not calculate the pH of a weak acid • did not recognise weak acid or base species • were unable to explain conductivity appropriately • could not complete *Q* (IP), buffer or pH calculations • wrote incorrect K_s expressions • used equilibrium or reaction arrows incorrectly in equations • could not identify species in solution • were unable to relate pK_a value to acid strength.
Achieved with Merit	Candidates who were assessed as Achieved with Merit commonly: • recognised species in solution in order of concentration • recognised weak acid and base species • correctly calculated the pH of a weak acid • correctly calculated K_s given *s* • explained pH and conductivity in terms of [H_3O^+] and concentration of ions but may have not referred to all substances correctly

	• explained an increased solubility of $CaCO_3$ in acidic solution • attempted to calculate *Q* (IP) to prove that a precipitate formed, but made a calculation or rounding error • explained the pH greater than 7 at the equivalence point of a titration was due to weak base species dissociation • calculated the pH of a buffer or evaluated its effectiveness as a buffer • attempted to calculate the pH at the end of a titration, when excess base had been added, but made a calculation or rounding error • linked the equivalence point pH to relative strength of the conjugate base formed.
Achieved with Excellence	Candidates who were assessed as Achieved with Excellence commonly: • correctly performed multistep calculations (K_a, K_s, *Q*, and titration pH) • calculated the pH of a buffer and evaluated its effectiveness • compared and contrasted pH, conductivity and comparison of pH linked to relative strengths of weak acid/weak base conjugate pairs in well-reasoned discussion, using correct terminology • related the pK_a of a weak acid to the strength of its conjugate base and pH at the equivalence point in a titration.
Standard specific comments	Some candidates limited their chance of success due to the poor use of language or terminology within their answers. Some candidates knew how to calculate *Q* (IP), but failed to recognise the effect on concentration of combining volumes. The list of species in solution at the equivalence point was poorly answered with some candidates listing NaF as a species present. Some candidates thought that a buffer could only function if the ratios were 1:1 The pH of the titration 4 mL beyond the equivalence was very challenging, as was the comparison of weak acid/weak conjugate base strengths. Candidates who demonstrated a basic knowledge of aspects of this standard, e.g. ion formation and pH/conductivity, were more likely to succeed.