New Zealand Scholarship Assessment Specifications

General Information

Scholarship Performance Standard	Chemistry
Mode of Assessment	Written examination
For Year	2011

Specific Information

Format of the assessment
There will be up to 6 questions. Questions may be open-ended or structured in a step-wise fashion. They may comprise a number of small questions or just one requiring a 'long answer'. Individual questions may cover the content of more than one Level 3 Chemistry achievement standard. Suggested time for each question will be indicated.

Equipment to bring
A calculator is permitted.

Resources or information supplied
A periodic table, giving element symbols, atomic numbers and molar masses, will be provided.

Symbols, nomenclature, spelling and formatting will follow current IUPAC conventions. These are shown in the reference sheet 'Quantities, Units, Symbols and Nomenclature used in Chemistry'. This is included with the assessment specifications but will not be provided in the examination.

Special notes
In calculations, candidates will be expected to use the molar mass values given with the question or on the periodic table provided.

All working should be shown in calculations. Numerical answers should be rounded to an appropriate number of significant figures. Correct units must be included. Explanations and calculations are expected to be well set out and concise.

Content/Context details
It is possible that content knowledge defined by the Level 2 Chemistry achievement standards may be required. Questions may be asked within a variety of appropriate contexts, some of which may be unfamiliar to the candidates. Some questions may involve extended discussion, where the student needs to judge what is required.
Questions relating to practical work may include discussions of sources of error, reliability of data collected and validity of conclusions drawn.

Quantities, Units, Symbols and Nomenclature used in NCEA Chemistry Examination Papers

NCEA Chemistry examinations will use the following information, which has been based on International Union of Pure and Applied Chemistry (IUPAC) recommendations. Candidates should be encouraged to use this IUPAC terminology, but those who use other terminology will not be penalised if their answers indicate a clear understanding of the chemistry involved.

General Chemistry

Symbols for the physical quantities, ***M***, ***V***, ***H***, ***K***, are written in italics (sloping letters). Any following subscripts will be in upright type.

Symbols / Expressions		**Units in common use**
M,	molar mass, is the mass of one mole of a defined substance and will be used for elements and compounds.	$g\ mol^{-1}$
V,	volume. A looped ℓ is not used in these abbreviations.	L and mL
n,	amount of substance, expressed in moles. It is incorrect to use the term ‘number of moles’. (See details under ‘Amount of Substance’ below.)	mol
c,	*amount concentration*, is expressed as moles per litre, also denoted by the format [ ]. Concentrations may also be written as *mass concentration*, expressed as grams per litre. *Composition of a mixture, commonly expressed as % w/V, % w/w and % V/V, will be used only after giving a clear definition of their meaning (eg grams per 100 mL, grams per 100 g, mL per 100 mL respectively).*	$mol\ L^{-1}$ $g\ L^{-1}$
s,	*(italic s)*, solubility, units as for concentration.	$mol\ L^{-1}$

Amount of Substance

This is a physical quantity, symbol *n (italic n)*, measured in a unit called the mole, which has the abbreviation mol.
The term, ‘number of moles’ is to be avoided. The term, ‘amount of substance in moles’ is preferred. In the same manner, the size of an object can be described in terms of its ‘length in metres’, rather than its ‘number of metres’.

Graph Axes and Table Headings

Labelled as: quantity / unit, e.g. c / $mol\ L^{-1}$. Only values will then be written on the axes or in a table.

Enthalpy changes, ΔH Units commonly used kJ mol^{-1}

$\Delta_r H^{\circ}$, standard enthalpy of reaction when reactants and products are in their standard state (usually the state at 25°C). For example:

$2H_2(g) + O_2(g) \rightarrow 2H_2O(\ell)$ $\Delta_r H^{\circ}(H_2O, \ell) = -570$ kJ mol^{-1}

The term mol^{-1} means per mole of reaction, which is determined by the chemical equation; i.e. 2 mol of H_2 reacting with 1 mol of O_2 to give 2 mol of H_2O.

$\Delta_f H^{\circ}$, standard enthalpy of formation, per mole of product. For example, the standard enthalpy of formation of
liquid water:

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(\ell)$ $\Delta_f H^{\circ}(H_2O, \ell) = -285$ kJ mol^{-1}

$\Delta_c H^{\circ}$ standard enthalpy of combustion, per mole of substance burnt. For example, the standard enthalpy of combustion of hydrogen gas to give liquid water:

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(\ell)$ $\Delta_c H^{\circ}(H_2, g) = -285$ kJ mol^{-1}

Note (i) The superscript ° denotes a defined standard state.

(ii) The alternative superscript $^{\theta}$ (plimsol) is acceptable.

(iii) A space is always left between any value and its unit, as well as between units for composite units.

- $\Delta_{fus}H$, enthalpy of fusion (melting)
- $\Delta_{vap}H$, enthalpy of vaporisation
- $\Delta_{sub}H$, enthalpy of sublimation

Standard Electrode Potential

Electrode potentials are defined as standard electrode potentials, E°.
Units are volts, symbol V.

e.g.

Redox couple	**E° / V**
Zn^{2+} / Zn	–0.76
Fe^{3+} / Fe^{2+}	+0.77\

A half cell is an electrode and the couple it is in contact with. When the oxidant and reductant are in different phases, a vertical line in the cell diagram is used to represent the phase boundary.
For example:
Zn (s) | Zn^{2+} (aq) Oxidant and reductant are in different phases. Metal electrode is part of redox couple.
OR
Fe^{3+} (aq), Fe^{2+} (aq) | Pt Oxidant and reductant are in the same phase. An inert electrode is used.
The vertical line represents a phase boundary.

Equilibrium Constant, K

Constants will be dimensionless, ie have no units, in keeping with current IUPAC conventions. They will include:

- $\boldsymbol{K_c}$ General equilibrium constant in which the equilibrium composition is expressed in terms of concentration of species
- $\boldsymbol{K_a}$ Acid association constant or acidity constant
- $\boldsymbol{K_w}$ Dissociation constant of water

p notation will be restricted to: **p*K*a** for –log10***K***a and **pH** for $-\log_{10}[H_3O^+]$

Chemical Formulae

These denote entities composed of more than one atom (molecules, simple and complex ions, groups of atoms, etc).

eg	Formula	Information conveyed
	H_2O	one water molecule or one mole of water
#	$\frac{1}{2}\,O_2$	half a mole of oxygen molecules
	$Zn_3(PO_4)_2$	one mole of zinc phosphate comprising zinc and phosphate ions in a 3:2 ratio
	$2\,MgSO_4$	two moles of magnesium sulfate
#	$\frac{1}{5}\,KMnO_4$	one-fifth of a mole of potassium permanganate (manganate VII)

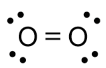
\# Indicates examples that are artificial and are used as a convenient way of calculating amounts of substance in moles.

Lewis Structures

These show the arrangement of valence electrons in molecules. Bonding electrons may be represented using

: or −

For F_2  or 

For O_2  or 

Equations for Chemical Reactions

$H_2(g) + Br_2(g) \rightarrow 2HBr(g)$ forward reaction

$H_2(g) + Br_2(g) \rightleftharpoons 2HBr(g)$ equilibrium

States of Aggregation

These are written in parentheses printed in *italic* type, immediately after the formula or substance and on the same line as chemical formula symbols.

eg ***s*** solid, ℓ liquid, ***g*** gas or vapour

aq aqueous solution (dissolved in water)

HCl*(g)* hydrogen chloride in the gaseous state

Temperature

Celsius temperature °C

Pressure

Units are pascals (Pa), or more commonly kPa. Standard pressure is 10^5 Pa

IUPAC Approved Spelling

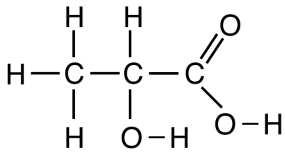
Spelling of the element with atomic number 16 is the IUPAC recommended spelling of **sulfur**. Derived ions have consistent spelling:

e.g. sulfide sulfate sulfite thiosulfate

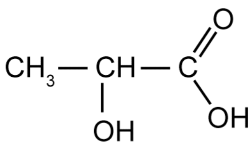
Organic Chemical Formulae

	Information conveyed	Example: lactic acid
empirical formula	Stoichiometric proportions of atoms only. Simplest ratio formula.	CH_2O
molecular formula	Formula of the actual molecule.	$C_3H_6O_3$
structural formula	Shows how atoms are connected. It may be drawn in different ways.	

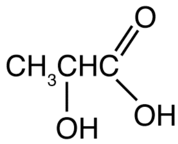
(a) All atoms and bonds are shown.



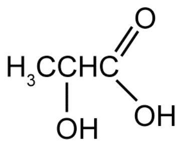
(b) Bonds to hydrogen are not shown



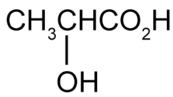
OR



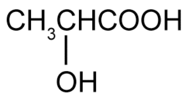
OR



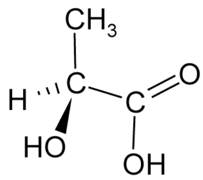
OR
Only bonds to substituents are shown.



OR

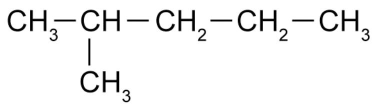
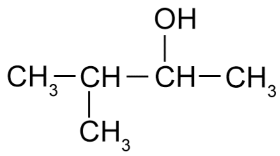
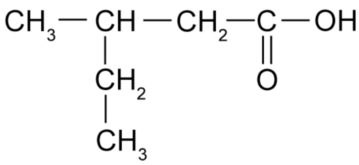
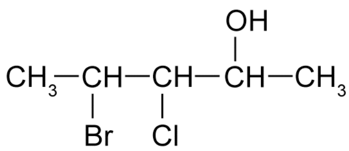
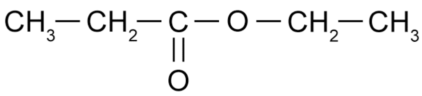


(c) Stereochemistry (3-D arrangement of atoms) is shown.



The structural formulae in (b) are referred to as condensed structural formulae.

Organic Chemical Nomenclature
IUPAC conventions will be followed. There is ongoing discussion on some of the following naming. Candidates will be given full credit for alternative naming if an unambiguous structure is implied. Some examples are:

Structure	**IUPAC name**
	2–methylpentane
	3–methylbutan–2–ol
	3–methylpentanoic acid
	4–bromo–3–chloropentan–2–ol
	ethyl propanoate

References
Packer and Scott, 'Let's Talk Chemistry'.
(information available from scottsoft@optushome.com.au)
P Atkins and L Jones, *Chemistry – Molecules, Matter and Change* (3rd edition), WH Freeman, 1997.