NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

New Zealand Scholarship
Assessment Specifications

General Information

Scholarship Performance Standard	Chemistry
Mode of Assessment	Written examination
For Year	2007

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. Other numerical data will be provided in questions as needed.

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 with the examination.

Special Notes
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 Scholarship Chemistry Examination Papers

The following information 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***, ***s***, ***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. M_r, relative molecular mass, and A_r, relative atomic mass, will not be used.	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 [ ].	mol L^{-1}
	Concentrations may also be written as *mass concentration*, expressed as grams per litre.	g L^{-1}
	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).	
–	***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 in favour of the 'amount of substance'. In the same manner, the size of an object can be described in terms of its 'length', rather than its 'number of metres'.

Graph Axes and Table Headings

Labelled as quantity/unit, eg c / mol L^{-1} and not 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*

- $\Delta_r \boldsymbol{H}^{\mathbf{O}}$, standard enthalpy of reaction when reactants and products are in their standard state (usually the state at 25°C). For example:
  $2H_2(g) + O_2(g) \longrightarrow 2H_2O(\ell)$ $\Delta_r \boldsymbol{H}^{\mathbf{O}}$ $(H_2O, \ell) = -570$ kJ mol^{-1}

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

- $\Delta_f \boldsymbol{H}^{\mathbf{O}}$, standard enthalpy of formation, per mole of product. For example, the standard enthalpy of formation of liquid water:
  $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow 2H_2O(\ell)$ $\Delta_f \boldsymbol{H}^{\mathbf{O}}$ $(H_2O, \ell) = -285$ kJ mol^{-1}

- $\Delta_c \boldsymbol{H}^{\mathbf{O}}$, standard enthalpy of combustion, per mole of substance burnt. For example, the standard enthalpy of combustion of hydrogen gas to give liquid water:
  $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow 2H_2O(\ell)$ $\Delta_c \boldsymbol{H}^{\mathbf{O}}$ $(H_2, g) = -285$ kJ mol^{-1}

Note (i) The superscript $^{\mathbf{O}}$ 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.

- $\Delta_{fus}\boldsymbol{H}$, enthalpy of fusion (melting)

- $\Delta_{vap}\boldsymbol{H}$, enthalpy of vaporisation

- $\Delta_{sub}\boldsymbol{H}$, enthalpy of sublimation

Standard Electrode Potential

Electrode potentials are defined as standard electrode potentials, $\boldsymbol{E}^{\mathbf{O}}$.
Units are volts, symbol V.

eg	Redox couple	$\boldsymbol{E}^{\mathbf{O}}$/V	not $\boldsymbol{E}^{\mathbf{O}}$(V)
	Zn^{2+} / Zn	–0.76	oxidant and reductant in different phases
	Fe^{3+}, Fe^{2+}	+0.77	oxidant and reductant in same phase

A half cell is an electrode and the couple it is in contact with, eg:
Zn (s) / Zn^{2+} (aq) OR
Fe^{3+} (aq), Fe^{2+} (aq) / Pt
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
- $\boldsymbol{K}_s$ Solubility product or solubility constant
- $\boldsymbol{K}_b$ The base hydrolysis constant – this will not be provided.

– p notation will be restricted to: **p*K*$_a$** for $-\log_{10}\boldsymbol{K}_a$
and **pH** for $-\log_{10}([H_3O^+] / 1 \text{ mol L}^{-1})$

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 manganate VII (permanganate)

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

Equations for Chemical Reactions

$H_2(g) + Br_2(g) \longrightarrow 2HBr(g)$		forward reaction
$H_2(g) + Br_2(g) \rightleftharpoons 2HBr(g)$		equilibrium
$H_2(g) + Br_2(g) = 2HBr(g)$		stoichiometric relation

In the examination, only the first two styles will be used and expected to be employed by candidates.

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

Thermodynamic (Kelvin) temperature K

Pressure

Symbol *P*. Units are pascals (Pa), or more commonly kPa.
Standard pressure is 10^5Pa or 1 bar

IUPAC Approved Spelling

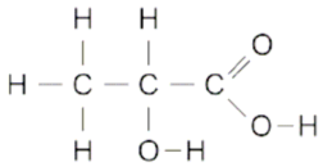
Spelling of the element with atomic number 16 is the original English spelling of **sulfur**. Derived ions have consistent spelling:

eg sulfide sulfate sulfite thiosulfate.

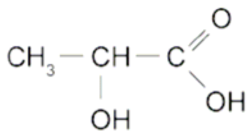
Organic Chemical Formulae

	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.	

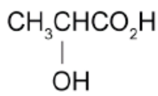
(a) All atoms and bonds are shown.



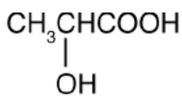
(b) Bonds to hydrogen are not shown



OR
Only bonds to substituents are shown.



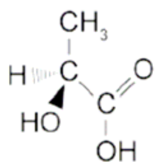
OR



(c) Structure is reduced to one line

$CH_3CH(OH)CO_2H$ OR $CH_3CH(OH)COOH$

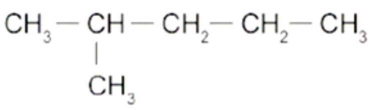
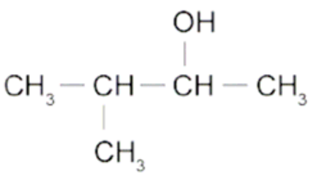
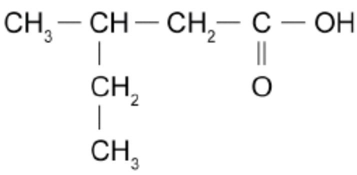
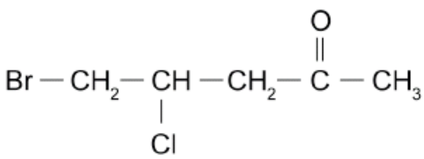
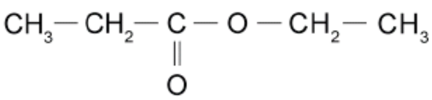
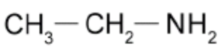
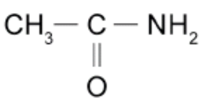
(d) Stereochemistry (3-D arrangement of atoms) is shown.



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
	5-bromo-4-chloropentan-2-one
	ethyl propanoate
	aminoethane or ethylamine
	ethanamide

References

Packer and Scott, 'Let's Talk Chemistry'.
(information available from scottsoft@optushome.com.au)

P Akins and L Jones, *Chemistry – Molecules, Matter and Change* (3rd edition), WH Freeman, 1997.