

# CHEMISTRY LEVEL 4C

(CHM 415115)

## NOVEMBER EXAMINATION STUDY GUIDE

### ASSESSMENT PROCEDURES SYLLABUS TOPICS & REVISION SUGGESTIONS

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# INTRODUCTION

To be best prepared for the final examination there are a number of sensible steps that will help you immensely and thus increase your confidence for being able to perform well in the final exam.

These steps include the following points:

- Being fully aware of all the possible topics that are examinable.
- Being familiar with all the information on the "Chemistry Formula Sheet"
- Having a good exam technique.
- Working through *several* exam papers from the last few years.
- Seeking assistance and advice from your teacher at tutorials.
- Knowing which questions are in which criterion.

# EXAMINATION TECHNIQUE

The November exam consists of four booklets each carrying a total of 40 marks giving a grand total of 160 marks.

Apart from the 15 minute initial 'reading time' you have 3 hours (180 minutes) writing time to complete ALL the questions.

We recommend that you allocate 1 minute per mark which will mean that you have a little bit of spare time at the end to do a final check on any answers where you felt unsure.

- In the 15 minute reading time make sure that you read every question carefully and attempt to identify what knowledge or concept the question is testing.
- Use a 'highlighter' pen to emphasise key points that could possibly cause difficulty later on; e.g. electric currents in mA, equilibria involving solids, celsius temperatures where kelvin is needed, .....
- Identify the questions you feel most confident about and always start with these ones.
- Make sure you give all 4 booklets equal time; (i.e. 40-45 minutes each)
- Set your working out neatly, giving proper answers with correct units and appropriate numbers of significant figures.
- Check to see whether your numerical answers sound reasonable.
- Use chemical information when answering description questions; e.g. in corrosion questions, include all relevant chemical equations.
- Use well labelled diagrams wherever appropriate.
- Don't waste time if you find a question isn't working out; go onto another one.
- Never cross anything out unless you know it has been replaced by a better answer. If one of your answers seems unreasonable, make a brief comment to that effect but do not cross it out unless you've identified and fixed your error.
- Check that you haven't missed any pages in each of the four booklets.
- Never walk out of an exam early. Use spare time for checking!!
- Remember your pens, ruler, calculator, .....
- Check that your calculator's batteries are O.K.
- When numerical answers involve lots of zeros, use scientific notation.
- Unless otherwise indicated, express your answers to 3 sig. figs.

# **CRITERIA FOR ASSESSMENT**

## **CRITERION 1**

**Demonstrate personal skills to organize and complete activities.**

## **CRITERION 2**

**Develop, interpret and evaluate experiments.**

## **CRITERION 3**

**Collect, process and communicate information.**

## **CRITERION 4**

**Demonstrate an understanding of the impact of science on society and the environment.**

## **CRITERION 5 \***

**Demonstrate an understanding of the fundamental principles and theories of electrochemistry.**

## **CRITERION 6 \***

**Demonstrate knowledge and understanding of the principles and theories of thermochemistry, reaction kinetics and equilibrium.**

## **CRITERION 7 \***

**Demonstrate knowledge and understanding of the properties and reactions of organic and inorganic matter.**

## **CRITERION 8 \***

**Apply logical processes to solve quantitative chemical problems.**

**( \* = externally assessed criteria)**

# CHEMISTRY (LEVEL 4C) EXAMINATION PAPER FORMAT

1. The examination will involve 15 minutes initial reading time and then 3.00 hours writing time.
2. The FOUR criteria examined in the November external exam are covered in four booklets with mark allocations as shown below:

<b>BOOKLET NUMBER</b>	<b>CRITERION EXAMINED &amp; MARKS</b>
<b>1</b>	<b>C. 5 (40 marks)</b> <b>ELECTROCHEMISTRY</b>
<b>2</b>	<b>C. 6 (40 marks)</b> <b>THERMOCHEMISTRY, RATES &amp; EQUILIBRIUM</b>
<b>3</b>	<b>C. 7 (40 marks)</b> <b>PERIODIC TABLE, GASES &amp; ORGANIC CHEMISTRY</b>
<b>4</b>	<b>C. 8 (40 marks)</b> <b>CALCULATIONS</b>

3. This gives each of the 4 criteria a total of 40 marks and thus a grand total of 160 marks.
4. As you have 180 minutes, allow about 1 minute per mark and this will give you a little extra time at the end for checking and completing questions that were left out.
- \*5. Make sure that you attempt questions from all four booklets. If you leave any book untouched you'll be awarded a "Z" and thus cannot gain any higher than a P.A. award.**

## **MINIMUM REQUIREMENTS FOR AWARDS**

Your final award for Chemistry will be determined by the TQA from the total 12 ratings you achieve (8 ratings from your internal assessment and 4 from your performance in the external 3 hour November examination).

### **EXCEPTIONAL ACHIEVEMENT (E.A.)**

10 "A" & 2 "B" RATINGS  
(with 3 "A" & 1 "B" from the November external exam)

### **HIGH ACHIEVEMENT (H.A.)**

4 "A", 5 "B" & 3 "C" RATINGS  
(with 1 "A", 2 "B" & 1 "C" from the November external exam)

### **COMMENDABLE ACHIEVEMENT (C.A.)**

6 "B" & 5 "C" RATINGS  
(with 2 "B" & 2 "C" from the November external exam)

### **SATISFACTORY ACHIEVEMENT (S.A.)**

10 "C" RATINGS  
(with 3 "C" from the November external exam)

### **PRELIMINARY ACHIEVEMENT (P.A.)**

6 "C" RATINGS

**NOTE: 1 or more "Z" rating means that P.A. is the maximum award attainable.**

# NOVEMBER EXAMINATION TOPICS

## CRITERION 5

### ELECTROCHEMISTRY

- determining oxidation numbers e.g. the ox(Mn) in  $\text{KMnO}_4 = +7$
- oxidation numbers involving metal hydrides where  $\text{ox}(\text{H}) = -1$
- oxidation numbers involving peroxides where  $\text{ox}(\text{O}) = -1$
- comparing the oxidising strengths of (say) chlorine where  $\text{ox}(\text{Cl}) = +1, +3, +5$  and  $+7$ .
- relative oxidising and reducing strengths (Electrochemical Series)
- balancing half equations using  $\text{H}_2\text{O}$ ,  $\text{H}^+$  and electrons.
- balancing net redox equations by finding the oxidation and reduction  $1/2$  equations
- electrochemical series – using  $E^\circ$  to predict spontaneous redox systems
- corrosion:  $1/2$  eqns. protection methods (sacrificial anodes, applied E.M.F., ...)
- differential aeration and the effect of metals 'in contact' on corrosion rates
- electrolysis and electrolytic cells used in industry
- predicting the products of electrolysis (flow chart?)
- Faraday's Law; masses of metals and volumes of gases.
- electrochemical cells – predicting spontaneous redox systems
- determining anode and cathode half-equations.
- establishing the net cell equation
- diagrams of electrochemical cells (labelled).
- direction of electron flow (anode  $\rightarrow$  cathode)
- ion flow through the salt bridge
- polarity of anode and cathode
- $E^\circ$  for cells in standard state
- cells reaching equilibrium / EMFs decreasing with time
- salt bridges; functions, construction and properties.
- shorthand representation for an electrochemical cell

## CRITERION 6

# THERMOCHEMISTRY, RATES & EQUILIBRIUM

- concept of enthalpy as a total heat content
- exothermic and endothermic processes
- bond breaking and forming and the net effect on  $\Delta H$
- enthalpy changes and enthalpy diagrams showing  $\Delta H$
- concept of bond energies
- $\Delta H$  calculated from average bond energies
- heats of combustion in kJ/mole
- calculations of kJ released based upon masses of reactants
- calorimetry experiments using  $E = \{ \text{mass of water} \times \Delta T \times 4.18 \}$  J
- calibration factors for electric calorimeters e.g.  $E = \{ V \times I \times t \}$  J
- writing thermochemical equations
- Hess' Law and calculations of  $\Delta H$  from given data.
- measurement of reaction rates (from data or from slopes of graphs)
- factors affecting reaction rates
- Collision Theory (rates proportional to the number of *effective* collisions)
- activation energy diagrams for exothermic and endothermic reactions
- $E_K$  distribution curves and temperature effects on rates
- catalysis and its effects on  $E_a$ ,  $\Delta H$ , ...
- reaction mechanism and rate determining step
- inhibitors versus "negative" catalysts.
- chemical equilibrium - the dynamic nature of equilibrium and its recognition
- changes to equilibrium (Le Chatelier's Principle)
- graphs showing imposed changes to equilibrium
- industrial applications of equilibrium (e.g. manufacture of sulfuric acid)
- the equilibrium law and expressions for  $K_c$  (non inclusion of solids)
- $K_c$  calculations (most likely in Criterion 8)
- enthalpy and entropy factors determining equilibrium.
- acid base equilibrium based upon  $K_w$  and  $K_a$  for weak acids.
- pH for strong and weak acid solutions and pH for strong bases
- acid/base indicators and their selection for various types of titrations



## CRITERION 7

# INORGANIC CHEMISTRY, THE PERIODIC TABLE & ORGANIC CHEMISTRY

- discovery of the elements and the concept of periodicity
- isotopic variation and determining  $A_r$  from % abundances and mass numbers of isotopes)
- mass spectroscopy as an analytical method
- models for electron arrangement (from Bohr - Quantum)
- electronic configurations e.g. Na = (Ne)  $3s^1$
- comparing sizes of isoelectronic particles eg.  $Ca^{2+}$ ,  $K^+$  and Ar
- periodicity of the elements ( trends within Groups and Periods)
- periodic table with unknown symbols e.g. X = ( )  $ns^2 np^5$  i.e. compounds  $YX_2$
- first ionization energy (trends down a group and across a period)
- trends in successive ionization energies (e.g.  $E_1 \leftrightarrow E_5$ ) for an element such as calcium
- electronegativity and effects of shielding
- ionic and covalent characteristics of compounds
- common gases e.g.  $O_2$   $N_2$   $CO_2$ ,... (their preparation and tests)
- kinetic theory for gases (ideal versus non-ideal gas behaviour)
- review of year 11 organic chemistry (saturation and unsaturation in hydrocarbons)
- tests for unsaturation using bromine (addition and substitution reaction)
- combustion of hydrocarbons (complete and incomplete)
- alkyl halides (substitution reactions with NaOH to form alcohols)
- alcohols and the effects of H-bonding on their B.P.s
- organic functional groups - alcohols, aldehydes, ketones, esters and carboxylic acids
- naming (IUPAC) compounds with functional groups from above list
- writing structural formulae given the IUPAC name.
- oxidation sequences for primary and secondary alcohols.
- writing balanced equations for oxidation of alcohols.
- reaction of OH containing compounds with Na metal
- esterification (reactions and naming of esters)
- hydrogen bonding and its effect on solubility and boiling point
- identification of various functional groups from experimental data.
- aromatic compounds based on benzene (structure and reactions)
- polymers (simple addition polymerization showing polymer name & repeat unit)

## CRITERION 8

### CHEMICAL CALCULATIONS

- empirical formula determinations
- % composition calculations
- calculations involving water of crystallization
- net ionic equations and reacting quantities (e.g. with precipitates forming)
- gas equations (Boyle's Law, Charles' Law and the Combined Gas Equation)
- General Gas Equation  $PV = nRT$
- the values of 'R'
- Kinetic Theory postulates, rates of gaseous diffusion and effusion
- gas mixtures, partial pressures, mole fractions
- general stoichiometry calculations e.g. mass/mass and mass/volume
- solution % content based on density data
- reacting quantities with **limiting and excess reactants**.
- concentrations of solutions; molarity determinations
- percentage purity calculations based on reacting quantities
- "I.C.E." diagrams
- $K_c$  calculations
- pH calculations and degree of dissociation
- $K_a$  calculations and  $[H^+]$  from  $K_a$  data



# EXAMINATION PREPARATION

## STUDY SUGGESTIONS

The following points may form a basis on which to plan a study strategy for the Chemistry exam and ensure your preparation gives you the maximum benefit.

- Your Chemistry Information Sheet is a very valuable document for you and you need to ensure that you are familiar with its content.
- An effective study strategy you might try is to take one major topic at a time such as organic, electrolysis, rates, periodic table, ..... and summarise the key points onto a single A4 page.
- Use sample questions to illustrate methods for answering key problems such as electrolytic plating, acid/base equilibria, limiting reactants,....
- Check through the Criterion 5 – 8 headings that are listed earlier in this booklet and progressively ‘tick’ them off the list as you feel you have reached an adequate knowledge level.
- Collect the previous November Chemistry examination papers together with their answers. These are available from your teacher. These will provide an excellent basis for testing your knowledge level and understanding.
- Take one exam part (e.g. C.5) from last year's paper and attempt to do the questions within the time limit of 45 minutes.
- If there are questions you cannot do, let these direct you to get assistance by seeing your teacher and/or checking to see if you understand the answer given on the “Answers”.
- It is likely that you will be doing “retests” in the last weeks before the final exam period commences. These may be in the form of two separate 1.5 hour ‘mini’ exams one covering C.5 and C.6 and the other, a week or so later covering C.7 and C.8.
- Use the tutorial sessions right up to the time of the exam. Teachers will be available for assistance and to give general advice. Teachers recommend the tutorials as a further way of ensuring good understanding and to achieve effective preparation for the exam.
- There is no real substitute for HARD WORK! Evidence over the years indicates those students who perform best of all are those who are well prepared and have used the general study advice that is given above.

**GOOD LUCK!**



# CHEMISTRY EXAMINATION PREPARATION STUDY TIMETABLE (TERM 4)

We advise you to set up a personal study timetable similar to the one below and plan ahead for retests, tutorials, general revision, etc...

WEEK	ENDING	RETESTS OCCURRING	STUDY TOPICS FOR THIS WEEK
1			
2			
3			
4			
5			
6			
7			
8			Exam week 1
9			Exam week 2