UNL21 Chemistry

Your Teacher for Unilearn Chemistry is **Mary Hill; BA, MSc, DipEd, MEdSt, GradDipArts, GradDip Computer Studies, MRACI**. She is an experienced Chemistry educator and researcher having taught Chemistry in high schools and universities for over 30 years.

Mary will be providing support for your studies in the Unilearn Chemistry course. This support will be provided by means of a tutoring system, whereby you can discuss your difficulties with the course concepts by email or through the online course support classroom.

Please do not hesitate to contact her as you work through the course materials. One phone call or quick email can make a huge difference when you are stuck. Mary's role is to assist you in mastering these concepts so you can move on to University studies confident that you have the knowledge necessary to succeed.

About the Course

The unit is a preparatory chemistry unit designed to help you gain the necessary knowledge to enter into a tertiary degree for careers in the sciences or health sector. The concepts covered in this unit are: the periodic table; gas laws; chemical bonding; rates of reaction; chemical equilibrium; acids and bases; chemical energy; oxidation and reduction; and organic chemistry.

This unit includes individual tutorial support with an experienced high school chemistry teacher. Tutorial support is via email, phone and an online classroom with discussion forums. There is also a Unilearn Student Support Officer available to help you throughout your study.

The unit has flexible enrolment dates to meet your needs. Start your study when you want and complete the unit any time within the 12 month enrolment window. This unit is equivalent to year 11/12 Chemistry. This unit requires a minimum of 220 hours or 18 weeks to complete. The 18-week option is only available to you if you complete the unit in the online classroom.

Aim

The main aim of this course is to assist the learner to obtain the skills and knowledge in Chemistry, the equivalent of the knowledge gained in a typical Australian high school level chemistry course, which would be required for commencing studies in tertiary programs.

The course also aims to:
- Give students an understanding of some of the aspects of chemistry that affect their daily lives
- Communicate chemical ideas effectively using various methods, including written, graphical and diagrammatic forms
- Develop critical thinking skills, especially with relation to issues involving science and technology.

At the end of this course the learner should be able to:

- Use correctly significant figures and scientific notation
- Name correctly a range of inorganic and organic chemicals
- Recall and describe a wide range of qualitative and quantitative chemical relationships, ideas and information
- Understand basic bonding theories and relate the bonding within materials to their structure and properties
- Predict the products of various types of reactions and to write appropriate balanced equations for those reactions.
- Apply algorithms and link concepts to solve both straightforward and complex problems
- Express and interpret chemical information in diagrammatic and graphical form

The student should have acquired the pre-requisite knowledge and confidence to undertake studies which require a higher level of competence in chemical science and be motivated to continue with lifelong learning where skills in chemistry are required.

Structure

UNL21 Chemistry consists of Modules 1, 2 and 3 which together are made up of 25 chapters.
Questions are included within each chapter and Exercises follow each chapter so that the learner can work through them to develop experience in problem solving. Worked Solutions for the questions and exercises are provided in Module 3.

Progress Tests and lab activities are also provided at appropriate points in the course. Students are required to successfully complete eleven (11) of these progress tests and two (2) lab activities to be eligible to sit for the final examination.

Tutorial Support is available from the UNL21 Chemistry Teacher. This support, which can be accessed by the online classroom, mobile phone or email, is designed to help students clarify understanding of concepts, to provide details of solutions to exercises, and to answer other relevant queries.

Pre-requisite knowledge

Normally, candidates for UNL21 Chemistry should be competent in mathematics including algebraic manipulation, solutions of linear equations, the concepts of ratio and proportion and the interpretation and drawing of graphs. Students who feel they need to develop their mathematical skills are referred to UNL31 Introductory Mathematics. An understanding of junior science, especially scientific terminology relating to chemistry, could also be advantageous.

Specimen Examination

The specimen exam or practice final exam is available once you have completed approximately 80% of the course. The Practice test allows students to work through similar problems under exam conditions which allow them to see if they are pacing themselves appropriately to be successful on the final exam. Most students who are successful on the practice exam find they are successful on the final exam as they are prepared for the type of questions and the exam format they will have during the final exam.

Hours of Study

In general the course should be completed in a minimum of 220 hours of study. The actual time required by an individual student to receive a successful result, however, will depend on the background, time available and needs of the learner. A majority of students take 540 hours to complete the course over the 12 months.

Assessment

The chapter questions, the end-of –chapter exercises, the learning checklist after each chapter, the progress tests and the Specimen Examination are designed to help students prepare for the final examination for UNL21 Chemistry. Examinations are prepared and assessed by the UNL21 Chemistry Teacher and monitored by the Unilearn Examinations Committee.

To be eligible to sit for the final, closed book, examination students are required to achieve a mark of 60% or higher each on ALL progress tests. The formal, supervised examination covers the content of Modules 1 and 2. Candidates, who successfully complete the course, are awarded a Statement of Achievement, which lists the percentage mark gained and a grade of Pass, Credit, Distinction or High Distinction. Any candidate who fails to obtain the minimum mark required for a Pass grade in the examination will be eligible to sit for a second examination.

Examinations are not held at set times. Rather, they are arranged through the Unilearn office after the student has successfully completed the required materials with a score of 60% or higher on each.

Practical Components

UNL21 Chemistry consists of eight practical lab activities that provide you with the foundation required for most medical programs. These lab activities account towards your final grade and can be done either in your home, office or even your backyard if required. Lab activities are hosted through our online classroom, so there is no need to go to a campus or book a room anywhere; they have been developed to be conveniently accessible online.

Chemistry consists of the following lab activities:
1. Concentration of Solutions
2. Titration of NaOH against KHP
3. pH change during a titration
4. Relative reactivity of metals
5. Structural isomers of hydrocarbons
6. Geometric isomers of alkenes
7. Equilibrium and Le Chatelier's Principle
8. Temperature and equilibrium constant

The lab activities consist of 20 hours of practical experience in a combination of hands –on and virtual labs

Grading Scheme

Students are required to complete all required materials (progress tests and lab activities) with a score of 60% or above on each in order to be eligible to sit the final exam. A student's final grade is an accumulation of all required content and will be weighted as follows:

Progress Tests - 10%

Lab Activities - 10%
Final Exam - 80%

The final grading scale is as follows:

Pass (P) - 50-64%
Credit (C) - 65-74%
Distinction (D) - 75-84%
High Distinction (HD) - 85% and above

Content

Module 1

Chapter 1 – What is Chemistry
This chapter covers:
- Evidence of a chemical reaction Qualitative and quantitative observations Dimensional analysis
- Random and determinate errors Precision and accuracy Significant figures
- Scientific notation

Chapter 2 – A Particle View of Matter
This chapter covers:
- Models of atoms
- Atomic number and mass number
- Names and symbols of the first 18 elements of the periodic table and other common elements
- The organisation and usefulness for the periodic table
- Electron configurations of the first 18 elements of the periodic table
- The meaning of chemical formulas Pure substances and mixtures Properties of solids, liquids and gases

Chapter 3 – Metals
This chapter covers:
- The metallic bond
- Physical and chemical properties of metals
- The relationship between the properties of metals and the bonding within them

Chapter 4 – Ionic Compounds
This chapter covers:
- The ionic bond
- The physical properties of ionic compounds
- The relationship between the properties of ionic compounds and the bonding within them
- The names and formulas of common ions Rules for assigning oxidation number Calculation of oxidation number
- Formulas and names of ionic compounds
- Balancing equations

Chapter 5 – Molecular Covalent Substances

This chapter includes:
- The molecular covalent bond
- Lewis structures for simple covalent elements and compounds
- The shapes of molecules based on the number of bonded atoms and the number of electron groups
- Polar and non-polar covalent bonds and molecules
- The rules for naming covalent substances
- The names of the first ten straight-chain alkanes
- The physical properties of molecular covalent compounds
- The relationship between the properties of molecular covalent compounds and the bonding within them
- Intramolecular bonding and intermolecular bonding

Chapter 6 – Network Covalent Substances
This chapter covers:
- Carbon, Silicon and Silicon Compounds

Chapter 7 – Intermolecular Forces
This chapter covers:
- Dispersion forces, dipole-dipole forces and hydrogen bonding
- The effect of the shape of the electron cloud on dispersion forces
- A comparison of the physical properties of substances based upon the types of intermolecular forces involved

Chapter 8 – The Structure of Materials – Revision of Atomic Structure and Bonding Theory
This chapter covers a review of:
- Atomic and molecular structure
- The various types of intramolecular and intermolecular bonds and the properties associated with each type of bond
- The names and formulas for a range of ionic and covalent compounds
- The differences between elements and compounds and between pure substances and mixtures

Chapter 9 – Basic Reacting Quantities
This chapter covers:
- Calculations of relative atomic mass and isotopic abundance Conversion between atomic mass units and grams Calculations of molecular mass and molar mass
- Calculations involving moles and number of particles
- Calculations of percent composition, empirical formulas and molecular formulas
- Calculations involving number of moles, mass and molar mass Dilute, concentrated, saturated and unsaturated solutions Calculations based on solubility curves
- Calculations of parts per million, parts per billion.
- Calculations involving number of moles, molarity and volume
- Calculations needed to prepare solutions from solids and from more concentrated solutions

Chapter 10 – Calculations from Chemical Equations
This chapter covers:
- Balanced Equations
- Calculations based on mass, moles, balanced equation, molarity and volume

- Limiting reagents

Chapter 11 – Acids and Bases
This chapter covers:
- Bronsted-Lowry and Lewis definitions of acids and bases
- Typical strong and weak acids and bases Equations for typical acid-base reactions Conjugate acid-base pairs
- pH and pOH calculations for strong acids and bases
- The relationship between pH and pOH at 25o C
- Calculation of the concentration of H+or OH- at 25o pH and/or pOH data

Chapter 12 – Quantitative Analysis
This chapter covers:
- Volumetric and gravimetric analysis
- Volumetric equipment
- Primary standards
- Equivalence point and endpoint
- Calculations including the preparation of primary standards and titrations
- Indicators for titrations
- Back titrations
- Calculations of straightforward gravimetric analyses where the reaction is known and for hypothetical reactions

Chapter 13 – Reacting Quantities Summary
This Chapter covers:
- A review of all previous calculations involving reacting quantities

Module 2

Chapter 14 – Gases of the Atmosphere
This chapter covers:
- The structures and properties of oxygen, nitrogen and carbon dioxide
- Preparations and uses of oxygen, nitrogen and carbon dioxide
- The main greenhouse gases

Chapter 15 – Gas Laws
This chapter covers:
- The Kinetic Theory of gases
- The properties of gases
- Units of pressure, volume and temperature
- Avogadro's Hypothesis, Boyle's Law, Charles's Law, the Ideal Gas Law and Dalton's Law of Partial Pressures and calculations involving these laws the relation between partial pressure and mole fraction Calculations involving collecting a gas over water

Chapter 16 – Oxidation and Reduction
This chapter covers:
- Identifying oxidation-reduction reactions

- Balancing redox reactions using the ionic half equation method
- For a given reaction, identifying which species are oxidised and reduced and the oxidising and reducing agents
- The design and limitations of the electrochemical series

Using the electrochemical series and/or experimental data to determine whether or not a reaction should occur spontaneously

Chapter 17 – Electrochemical Cells
This chapter covers:
- Drawing fully labelled electrochemical cells
- The shorthand representation of an electrochemical cell
- Dry cell batteries and rechargeable batteries

Chapter 18 – Electrolysis
This chapter covers:
- The differences between electrochemical and electrolytic cells
- Drawing fully labelled diagrams for the electrolysis of molten salts and of salts in aqueous solution
- Faraday's First and Second Laws of Electrolysis and calculations based on them
- Some important uses of electrolysis

Chapter 19 – Chemical Periodicity and the Periodic Table
This chapter covers:
- The construction and usefulness of the periodic table
- Electron configurations of elements up to and including Kr
- The difference between the main block elements, transition elements and inner transition elements
- The prediction of properties based upon an element's position in the periodic table

Chapter 20 – Organic Chemistry Part 1 – Hydrocarbons
This chapter covers:
- Alkanes, alkenes, alkynes, dienes and alkyl groups Molecular, structural and semi-structural formulas Physical and chemical properties of hydrocarbons Structural isomers
- IUPAC system of nomenclature for naming hydrocarbons and halogenated hydrocarbons
- Preparations and reactions of hydrocarbons
- Different conditions required for addition and substitution reactions of alkenes with halogens
- Geometric isomers of alkenes

Chapter 21 – Organic Chemistry Part 2 – Other Organic Compounds
This chapter covers:
- Functional groups for alcohols, carboxylic acids and esters
- Preparations and reactions of alcohols, carboxylic acids and esters
- The physical properties of organic compounds as a function of their bonding
- Addition and condensation polymerisation
- Equations for the formation of addition and condensation polymers
- Number of monomer units and average molar mass of polymers The differences between polyesters, polyamides and polypeptides General formula of amino acids
- Differences between proteins, carbohydrates, fats and oils
- Stoichiometric and other calculations involving organic compounds

Chapter 22 – Energy

This chapter contains:

- Heat of reaction, Q, and change in enthalpy, ΔH Exothermic and endothermic reactions
- Hess's Law of Heat Summation
- Formation and combustion reactions
- Calculations of ΔH using enthalpy of formation and average bond energies

Chapter 23 – Rate of Reaction

This chapter covers:

- Ways of following reaction rate experimentally
- Increasing and decreasing reaction rate
- Energy level diagrams showing ΔH and activation energy
- Determination of reaction rate from graphical and/or experimental data
- The rate determining step in a multi-step reaction

Chapter 24 – Equilibrium and Equilibrium Constant

This chapter covers:

- How rate and concentration change as a system approaches equilibrium The difference between equilibrium and steady state systems Characteristics of a system at equilibrium
- Equilibrium constant expressions
- Calculations involving equilibrium constant expressions
- Le Chatelier's Principle

Chapter 25 – Equilibria in Aqueous Solution

This chapter covers:

- Equilibrium constant expressions for the ionisation of weak acids and bases
- Calculations involving equilibrium constant expressions for the ionisation of weak acids and bases
- Ionisation constants for multi-step ionisation reactions
- The common ion effect
- The value of the ionisation constant of water, K_w, at 25o C Relationships between K_w (H+), (OH-), pH and pOH
- Calculation of pH and pOH of both strong and weak acids and bases
- Calculation of pH and pOH using K_w
- Solubility product constant expressions
- Calculations involving the solubility of a salt and K_{sp} Using K_{sp} to predict the formation of a precipitate K_{sp} calculations involving common ions