ACADIA UNIVERSITY

COURSE OUTLINE

CHEM 1033 CINT: Introductory Chemistry 1

Contact Information

Cathy Murimboh: catherine.murimboh@acadiau.ca
Office: ELL 211
Office hours: (by appointment) in person or via MS Teams

Textbook (optional)

Chemistry: A Molecular Approach (3rd Canadian Edition)
Tro, Nivaldo J., Travis Fridgen, and Lawton Shaw
Pearson Canada, 2019
ISBN: 0134894820

Alternate Textbooks:

1. Principles of General Chemistry v1.0 (Averill and Eldredge) [HTML]
2. Chemistry Virtual Textbook (Stephen Lower, Simon Fraser University) [HTML]
3. Any first-year chemistry textbook

Assessment

Self-Check Questions	5%	On ACORN
Assignments	10%	On ACORN (best 10 assignments)
Timed Tests	15%	On ACORN
Midterm	25%	Proctored in-person
Final Exam	45%	Proctored in-person
Total	**100%**	

The midterm and final exam will be proctored in-person and will be hand-written (with part-marks for work shown). The exams are closed-book, but students are provided with cover pages containing a Periodic Table, list of constants, and a list of formulae. The dates and times of the exams will be arranged between the student and course instructor. Students not living near Wolfville can arrange to write exams with a proctor near them from a list approved by Acadia University. After the proctor has been scheduled, students must email openacadiaexams@acadiau.ca to request the exam. For more information, please see Open Acadia's exam policies for online courses: https://www2.acadiau.ca/online/current-students/exams.html

Online Learning

This course is self-paced, so there are no deadlines or due dates for quizzes and assignments; however, it is highly recommended that you complete the units and lessons in chronological order, as the content from each unit often builds upon that from the previous unit. **The midterm is to be written after completion of Unit 6 (Lewis Structures)**. The final exam is cumulative, but more focus is placed on questions from units 7-11.

Lessons and Self-Check Questions:
There are 11 units in the course, each consisting of several lessons. Lessons contain recorded lecture videos to watch, as well as a few self-check questions to help you test your understanding of the material. There are no penalties for incorrect attempts on self-check questions, and you can re-do the questions as many times as you want in order to learn the material. To start a lesson, just click on the desired topic, and then click 'Attempt Quiz Now' (the videos are embedded in the quiz).

Assignments:
The assignments test understanding of the material from the unit with minimal penalty for incorrect responses. You have 10 attempts per question with a 10% deduction for each incorrect attempt. You can work on the assignments at your own pace, as the system will save your progress and you can resume it at any time. It is highly recommended that you try the “Introduction to ACORN Assignments” quiz before starting the first assignment in order to familiarize yourself with formatting your answers for the various question types.

Timed tests
The timed test for each unit is graded like a typical test in that you only get one attempt, and won't receive any immediate feedback. The allotted time for each test is usually 1-2 hours, depending on the size of the unit. The test will submit automatically when the set time has expired, after which time you cannot make any more changes. The timed tests are open-book.

Supplementary Materials:
Each unit also contains the PowerPoint notes from the lecture videos, as well as some summary slides that review key concepts, equations, and things to memorize from the lessons. Most units also contain extra practice problems and reference data.

Practice Assignments
For additional practice problems, you can re-try old assignments and timed tests (not for credit). Most calculation-based questions will randomize the numbers, so you won’t get exactly the same values as in your first attempt.

Course Description

An introductory treatment of the fundamentals of chemistry: atoms, molecules, ions, chemical equations, stoichiometry, enthalpy, nuclear reactions, electronic structure and periodic properties of the elements, chemical bonding, and molecular structure, acids and bases, and gases. Assessment will be by assignments and examination.

Learning Outcomes

Unit 1 - Fundamentals:

- name compounds
- balance and interpret chemical reactions
- convert between mass, moles, and number of chemical entities
- predict the solubility of ionic compounds using the solubility rules
- determine empirical and molecular formulae from experimental data
- perform unit conversions, making proper use of prefixes and significant figures

Unit 2 - Atomic Theory:

- convert between energy, wavelength, and frequency
- understand wave-particle duality of light and matter
- calculate the de Broglie wavelength for matter
- calculate the kinetic energy, speed, or binding energy of an ejected electron in the photoelectric effect
- explain the Bohr model of the atom, and calculate electron transitions (energy, wavelength, frequency, energy levels) using the Rydberg equation
- understand the meaning of and selection rules for the quantum numbers n, l, m_l, and m_s.
- draw the shapes and orientations of s, p, and d orbitals (including phases) in 2-D
- relate the atomic orbitals with their associated quantum numbers
- identify the number of angular and radial nodes in s, p and d orbitals

Unit 3 – Periodic Trends:

- write electron configurations for various elements and ions, including exceptions to the filling rules (Cr, Mo, Cu, Ag, Au)
- describe and use the three filling rules for energy level diagrams
- draw partial orbital diagrams
- determine whether an atom or ion is paramagnetic or diamagnetic
- identify core and valence electrons in a given atom
- describe periodic trends in effective nuclear charge (Z_{eff}), atomic and ionic radii, ionization energy, and electron gain energy

Unit 4 – Nuclear Chemistry:

- identify types of radioactive decay
- balance nuclear reactions
- calculate the age of a given object using data from radiocarbon dating
- explain nuclear fission, fusion, and transmutation
- calculate mass and energy changes in a nuclear reaction
- calculate nuclear binding energy and explain its significance to the stability of nuclides

Unit 5 – Molecular Orbital Theory:

- describe constructive and destructive interference of atomic orbitals (AOs) to form bonding and antibonding molecular orbitals (MOs)
- identify shapes of MOs
- for homonuclear diatomic molecules up to Z=10 (i.e. H_2 to F_2):
  - choose correct diagram (i.e. with or without s-p mixing)
  - label AOs and MOs, and fill in e^-s
  - calculate bond order, and use it predict relative stability, bond strength, and bond length of different molecules
  - predict magnetic properties of the molecule (i.e. paramagnetic or diamagnetic)

Unit 6 – Lewis Structures:

- for a variety of molecules, draw the best Lewis structure based on formal charge, including resonance structures
- identify exceptions to the octet rule
- based on the Lewis structure, identify:
    - the electron group geometry
    - the VSEPR notation (class)
    - the molecular shape
    - ideal bond angles, and if real bond angles deviate from ideal

Unit 7 – Intermolecular Forces:

- classify bonds (pure covalent, polar covalent or ionic) based on differences in electronegativity of the bonded atoms
- determine if a molecule is polar (i.e. has a net dipole) or nonpolar (i.e. no net dipole)
- identify intermolecular forces present for a given molecule and indicate which is most significant
- predict miscibility of liquids with other substances based on polarity
- predict trends in boiling point, viscosity, surface tension, and vapour pressure
- explain capillary action and predict the appearance of a meniscus in a capillary tube (concave or convex)

Unit 8 – Hybridization:

- draw the Lewis structure of a molecule and identify the hybridization on the central atom
- identify the number of each type of bond (pi, sigma) in a molecule
- identify bond angles
- identify types of orbital overlap (sigma and pi)

Unit 9 – Acids and Bases

- identify Arrhenius, Bronsted-Lowry and Lewis acids and bases
- define acidic, neutral and basic solutions
- identify strong and weak acids and bases
- identify conjugate acid-base pairs and their relative strengths
- interconvert between $[H_3O^+]$, $[OH^-]$, pH and pOH
- calculate pH, pOH, $[H_3O^+]$, $[OH^-]$ for strong and weak acids and bases
- use relative K_a, K_b, pK_a, pK_b values to rank acids and bases by strength

Unit 10 – Salts, Buffers and Titrations

- characterize a salt solution as acidic or basic
- calculate the pH of a salt solution using an ICE table
- write net ionic equations for neutralization reactions
- use the Henderson-Hasselbalch equation to calculate pH for a buffer before and after addition of strong acid or strong base
- explain how to identify and prepare a buffer solution
- calculate pH at various points in a titration for strong acid-strong base, strong base-strong acid, weak acid-strong base and weak base-strong acid titrations
- recognize titration types based on sketches of titration curves

Unit 11 – Gases

- explain the empirical gas laws (Boyle's Law, Charles' Law, Avagadro's Law)
- convert between units for pressure and temperature
- find an unknown variable (P, V, n, or T) after a change in conditions using the general gas equation
- use the ideal gas equation to find an unknown variable (P, V, n, or T)
- use the ideal gas equation in conjunction with the stoichiometry of a chemical equation to find the amount of a gaseous product produced or reactant consumed
- use the ideal gas equation to find the molar mass or density of a gas
- use Dalton's Law of Partial Pressures to find total pressure, mole fraction of one gas, or partial pressure of one gas in a mixture of gases
- explain when and why real gases deviate from ideal behaviour

Accessible Learning Services

If you are a student with documentation for accommodations or if you anticipate needing supports or accommodations, please contact Marissa McIsaac, Manager, at 902-585-1823, or accessible.learning@acadiau.ca. Accessible Learning Services is in Rhodes Hall, rooms 111-115.

Equity and Diversity

Acadia University is committed to becoming a culturally safe and anti-oppressive community. This can only be achieved where there are simultaneous efforts to eliminate all forms of discrimination and harassment from our campus community, including the elimination of all discrimination, harassment and violence based on one's identity, including but not limited to, gender, race, class, ethnicity, sexual orientation, disability, gender identity, gender expression, and Indigeneity.

The Equity, Diversity and Inclusion Officer is available to **students, staff, and faculty**. The fundamental objective of the Equity Office is to **prevent discrimination, sexual harassment, and personal harassment** from occurring, in part by managing Acadia's Policy Against Harassment and Discrimination. For more information, as well as for resources for students who believe they may have experienced or witnessed discrimination, sexual harassment, or personal harassment please contact Acadia's Equity, Diversity and Inclusion Officer, Polly Leonard, MSW, RSW (she/her/hers) at equity@ACADIAU.CA, and check out the website.

Academic Integrity

It is your responsibility to acquaint yourself with the university policy on academic integrity. Academic dishonesty such as cheating and plagiarism are not tolerated. Any form of academic dishonesty in examinations, tests, or assignments is subject to serious academic penalty. The full description of the penalties is outlined in the 2022/2023 Academic Calendar.

- Cheating is copying or the use of unauthorized aids or the intentional falsification or invention of information in any academic exercise
- Plagiarism is the act of presenting the ideas or words of another as one's own. Students are required to acknowledge and document the sources of ideas that they use in their written work.
- Self-plagiarism is also a form of plagiarism. It is the presentation of the same work in more than one course without the permission of the instructors involved.
- One who knowingly helps another to commit an act of academic dishonesty is equally guilty.
- Penalties are levied in relation to the degree of the relevant infraction. They range from failure on that piece of work, to failure in the course, to dismissal from the university.