Chemistry 1050 Curriculum Outline

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Chemistry (3rd Canadian Edition) A Molecular Approach

The lecture and tutorial materials required for this course include:

- *Chemistry (3rd Canadian Edition) A Molecular Approach by* Nivaldo J. Tro Travis D. Fridgen Lawton E. Shaw
- *Mastering Chemistry* Access Code (for all online assignments, included with textbook from bookstore)
- *Learning Catalytics* Access Code (, included with textbook from bookstore)

<u>Chemistry Textbook Bundles:</u>
There are several special packages that can be purchased at the MUN bookstore which include textbooks from chemistry and certain physics and biology courses. If you are taking Chemistry and biology and/or physics then consider these packages as they are better pricing than purchasing them individually.

Be careful about the choices you make with respect to the purchase of course materials since you don't want to have to spend more than necessary. **If you have questions, please feel free to speak with your instructor upon the start of the semester.**

Course Philosophy

The main objective of this course to provide students with a general understanding of chemistry that will be built upon in Chemistry 1051 and eventually in more senior chemistry courses such as those in the traditional subdivisions of chemistry: analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, and physical chemistry. This course will also partially provide you with a solid chemical background required for biology, engineering, pharmacy, medicine, physics, environmental or earth science, human kinetics, etc.

Student Review Material Chapters 1 to 4

Chemistry 1050 students should have a solid grasp of the review topics listed below and are responsible for their own review of these. Students are strongly advised to conduct a serious review/study of the material in chapters 1 through 4 in the first week of classes.

Review topics in Chapters 1 through 4

1. **Basic chemical concepts**
   Students should be familiar with SI units, uncertainty in scientific measurement, use of significant figures, the mole concept and the Avogadro constant in calculations. Students

must be able to balance simple chemical equations using the "balancing by inspection" method (p.102-105).

2. **The naming of inorganic compounds and ions**
Students should know how to name binary compounds, ionic compounds containing polyatomic ions, binary and oxoacids, strong bases, and hydrates (Chapter 3). Students should know the formulas (and charges) of common polyatomic ions such as sulfate (SO_4^{2-}) and the charges on the cations of the alkali metals, alkaline earth metals, aluminum, silver, cadmium and zinc.

3. **Chemical equations and solutions:**
Students should be able to write and balance chemical equations. You should be familiar with the solubility rules and be able to predict whether or not precipitates form and the phase of products using the solubility rules (TABLE 4.2 page 108). You should know what a redox reaction is and be able to identify them, writing oxidation states. Students should also be able to calculate concentration (in mol L^{-1}) and understand dilution (pages 136-137). You should also be able to determine empirical and molecular formulae using experimental data such as through combustion analysis (ie. section 3.8).

4. **Chemical reactions and stoichiometry.**
Stoichiometry is probably the most important topic for students to understand coming into this course as you will see stoichiometry right away in Ch. 5 and 6. (sections 4.7 – 4.9, pages 125-138) should be reviewed and understood. Students must be able to solve stoichiometry problems including those involving limiting reagents. Do stoichiometry problems from the end of the chapter to ensure you know these important concepts and skills.

Topics covered in Chemistry 1050 in Chapters 5 to 11 are listed below.

Chapter 5. Gases (p. 149)

5.1	Breathing: Putting Pressure to Work	p. 149
5.2	Pressure: The Result of Molecular Collisions Pressure Units (p.151), The Manometer: A Way to Measure Pressure in the Laboratory (p. 152)	p. 150-153
5.3	The Gas Laws: Boyle's Law, Charles's Law, and Avogadro's Law Boyle's Law: Volume and Pressure (p.154), Charles's Law: Volume and Temperature (p. 156), Avogadro's Law: Volume and Amount (in Moles) (p. 159)	p. 154-159
5.4	The Ideal Gas Law	p. 160
5.5	Applications of the Idea Gas Law: Molar Volume, Density, and Molar Mass of a Gas Molar Volume at Standard Temperature and Pressure (p. 162), Density of a Gas (p. 163), Molar Mass of a Gas (p. 164)	p. 162-165
5.6	Mixtures of Gases and Partial Pressures Collecting Gases over Water (p. 169)	p. 166-171
5.7	Gases in Chemical Reactions: Stoichiometry Revisited Molar Volume and Stoichiometry (p. 173)	p. 171-173

5.8	Kinetic Molecular Theory: A Model for Gases Kinetic Molecular Theory and the Ideal Gas Law (p. 176) Temperature and Molecular Velocities (p. 177)	p. 174-181
5.9	Mean Free Path, Diffusion, and Effusion of Gases	p. 180-181
5.10	Real Gases: The Effects of Size and Intermolecular Forces The Effect of the Finite Volume of Gas Particles (p. 182), The Effect of Intermolecular Forces (p. 183), Van der Waals Equation (p. 184), Real Gases (p. 184)	p. 181-185

Chapter 6. Thermochemistry (p. 197)

6.1	Chemical Hand Warmers (Suggested reading)	p. 197
6.2	The Nature of Energy: Key Definitions Units of Energy (p. 200)	p. 198-200
6.3	The First Law of Thermodynamics: There is No Free Lunch Internal Energy *U* (p. 201)	p. 200-204
6.4	Quantifying Heat and Work Heat *q* (p. 205), Work *w*: Pressure-Volume (*PV* Work) (p. 209)	p. 205-211
6.5	Measuring $\Delta_r U$ for Chemical Reactions: Constant-Volume Calorimetry **Note:** Conversion of $\Delta_{comb}U$ to $\Delta_{comb}H$ from bomb calorimeter measurements ***is required***. Students are required to know the difference between intensive and extensive properties and hence the difference between $\Delta_r H$ (and $\Delta_r U$) as an intensive molar quantity in kJ mol^{-1} of substance and an extensive quantity in kJ mol^{-1} of reaction.	p. 212-214
6.6	Enthalpy *H*: The Heat Evolved in a Chemical Reaction at Constant Pressure $H = U + PV$ Exothermic and Endothermic Processes: A Molecular View (p. 217), Stoichiometry Involving $\Delta_r H$: Thermochemical Equations (p. 218)	p. 214-219
6.7	Constant-Pressure Calorimetry: Measuring $\Delta_r H$	p. 220-221
6.8	Relationships Involving $\Delta_r H$	p. 221-224
6.9	Determining Enthalpies of Reaction $\Delta_r H$ from Standard Enthalpies of Formation $\Delta_f H^o$ Standard States and Standard Enthalpy Changes $\Delta_r H^o$ (p. 224), Calculating the Standard Enthalpy Change for a Reaction (p. 226)	p. 224-229

Chapter 7. The Quantum-Mechanical Model of the Atom (p. 242)

7.1	Quantum Mechanics: The Theory That Explains the Behaviour of the Absolutely Small	p. 243
7.2	The Nature of Light The Wave Nature of Light (p.244), The Electromagnetic Spectrum (p. 246), Interference and Diffraction (p. 247), The Particle Nature of Light (p. 250). *These topics will be covered conceptually, meaning you need to understand these concepts, but you will not be asked to solve quantitative problems on the photoelectric effect.*	p. 243-254
7.3	Atomic Spectroscopy and the Bohr Model CHEMISTRY IN YOUR DAY: Atomic Spectroscopy, a Bar Code	p. 254-260

for Atoms (p. 258)

7.4 The Wave Nature of Matter: The de Broglie Wavelength, the Uncertainty Principle, and Indeterminacy — p. 260-265
The de Broglie Wavelength (p. 261), The Uncertainty Principle *(conceptually,no quantitative problems)* (p.262), Indeterminacy and Probability Distribution*,* Maps (p. 264).

7.5 Quantum Mechanics and the Atom — p. 265-270
Solutions to the Schrodinger Equation for the Particle in the Box:
Quantum numbers (p.265)
Solutions to the Schrödinger Equation for the Hydrogen Atom (Quantum Numbers) (p. 268)

7.6 The Shapes of Atomic Orbitals — p.270-278
s orbitals ($l = 0$) (p. 270), *p* orbitals ($l = 1$) (p. 273), *d* orbitals ($l = 2$) (p. 274), *f* orbitals ($l = 3$) (p. 274), The Phase of Orbitals (p. 275), The Hydrogen-Like Wave Function (p. 276).
It is very important to understand the radial probability diagrams for the atomic orbitals. The size, the node distributions etc, all impact the physical and chemical properties of the atom.

7.7 Electron Configurations: How Electrons Occupy Orbitals — p. 278-290
Electron Spin and the Pauli Exclusion Principle (p. 279), Sublevel Energy Splitting in Multielectron Atoms (p. 280), Electron Configurations for Multielectron Atoms (p. 284), Electron Configurations for Transition Metals (p. 286), Electron Configurations and Magnetic Properties of Ions (p.288)

Chapter 8. Periodic Properties of the Elements (p. 298)

8.1 Nerve Signal Transmission (suggested reading) — p. 299

8.2 The Development of the Periodic Table — p. 299

8.3 Electron Configurations, Valence Electrons, and the Periodic Table — p. 301-305
Orbital Blocks in the Periodic Table (p. 302), Writing an Electron Configuration for an Element from Its Position in the Periodic Table (p. 303), The *d*-block and *f*-block Elements (p. 304)

8.4 The Explanatory Power of the Quantum-Mechanical Model — p. 305-306

8.5 Periodic Trends in the Size of Atoms and Effective Nuclear Charge — p. 306-313
Effective Nuclear Charge (p. 308), Slater's Rules (p. 310), Atomic Radii of *d*-block Elements (p. 312)

8.6 Ionic Radii — p. 313-316

8.7 Ionization Energy — p. 316-320
Trends in First Ionization Energy (p. 316), Exceptions to Trends in First Ionization Energy (p. 318), Ionization Energies of Transition Metals (p. 319), Trends in Second and Successive Ionization Energies (p. 319)

8.8 Electron Affinities and Metallic Character p. 320-322
Electron Affinity (p. 321), Metallic Character (p. 321)
8.9 Examples of Periodic Chemical Behaviour p. 322-327
The Alkali Metals (p. 323), The Halogens (p. 325), The Noble Gases (p. 326)
Your instructors will present material not in the textbook, such the periodic trend in reactions of alkali earth metals with water and halogens compared to alkali metal reactivity, and the reactions of metal and non-metal oxides with water.

Chapter 9. Chemical Bonding I: Lewis Theory (p. 334)

9.2 Types of Chemical Bonds p. 335-337
9.3 Representing Valence Electrons with Dots p. 337-338
9.4 Lewis Structures: An Introduction to Ionic and Covalent Bonding p.338-343
Drawing Lewis Structures for Molecular Compounds (p. 338) *(also included are drawing Lewis structures for amino acids and DNA bases, you may want to read Sections 22.4 and 22.6),* Writing Lewis Structures for Polyatomic Ions (p. 341) *Comparison of covalent compounds to network covalent compounds: Sections 23.3 and 23.5 (Silicates and allotropes of carbon).* Ionic Bonding and Electron Transfer (p. 342)

9.5 The Ionic Bonding Model p. 343-348
The Born-Haber Cycle. (p. 344) *The Born-Haber Cycle is not a required topic but may be covered by your instructor during lectures.*
Trends in Lattice Energies: Ion Size (p. 345), Trends in Lattice Energies: Ion Charge (p. 346), Ionic Bonding: Models and Reality (p. 347)
9.6 Covalent Bond Energies, Lengths, and Vibrations p. 348-354
Bond Energy (p. 348), Using Average Bond Energies to Estimate Enthalpy Changes for Reactions (p. 349), Bond Lengths (p. 351), Bond Vibrations (p. 352)
9.7 Electronegativity and Bond Polarity p. 354-359
Electronegativity (p. 355), Bond Polarity, Dipole Moment, and Percent Ionic Character (p. 356)
9.8 Resonance and Formal Charge p. 359-363
Resonance (p. 359), Formal Charge (p. 361), *Zwitterions of amino acids.*
9.9 Exceptions to the Octet Rule: Drawing Lewis Structures for Odd-Electron Species and Incomplete Octets p. 364-366
Odd-Electron Species (p. 364), Incomplete Octets p. 364 *(and Section 23.4)*
9.10 Lewis Structures for Hypercoordinate Compounds p. 366-369
CHEMISTRY IN THE ENVIRONMENT: The Lewis Structure of Ozone (p. 369)

Chapter 10. Chemical Bonding II: Molecular Shapes, Valence Bond Theory, and Molecular Obital Theory (p. 377)

10.2 VSEPR Theory: The Five Basic Shapes p. 378-382
Two Electron Groups: Linear Geometry (p. 379), Three Electron

Chapter 11 Liquids, Solids and Intermolecular Forces (p. 433)