Chemistry 113.1 Section 1131-1
Introduction to Chemical Techniques
Summer 2023 Syllabus

INSTRUCTOR / SECTION INFORMATION

Section Number: Section **1131-1**. *Note: You must place this section number on all submitted documents.*

Instructor: Babak Gandjian
Office: Remsen Hall Room 206
Office hours: Mon, Tues, Thurs by appointment only
E-mail: bgandjianteach@gmail.com

Lab Hours: Mon, Tue, Thurs 8:15AM-10:30AM
Lab Room: Remsen 156

LABORATORY COURSE COORDINATOR

Coordinator: Dr. Sanjai Pathak

LABORATORY REQUIREMENTS AND POLICIES

Course Objectives: To provide students with the opportunity to develop core competencies in chemistry laboratory skills, as enumerated by the American Chemical Society, including:

- Safe handling of chemicals and proper disposal of waste arising from hazardous chemicals
- Maintaining a laboratory notebook and writing proper laboratory reports
- Use of basic instruments including electronic balances, pH meters, drying ovens, digital data logging devices (e.g. LabQuestVernier)
- Understanding and using stoichiometric calculations and balanced chemical equations
- Using and reading volumetric glassware
- Preparing and diluting standard solutions
- Acquiring and analyzing data, both qualitative and quantitative, and correctly interpreting results, including correct precision, accuracy and units.

Required for Lab:

- Laboratory notebook containing carbonless paper that automatically creates a duplicate copy This notebook must be brought to all laboratory meetings.
- Scientific calculator (need not be graphing calculator)
- The experiment documents for the day-downloadable from the course Blackboard site
- A blue or black pen (notebook entries may not be in pencil !)

NOTE: All lab reports require submission of the ORIGINAL duplicate notebook page(s) from that day's lab.

Attendance/ Tardiness: **Attendance** for every laboratory section is mandatory. **Actually DOING the experiments and analyzing them IS the course**. If a lab is missed (or anticipated to be missed) due to illness or, for example, a death in the family then a **written** excuse must be provided to your laboratory instructor and the laboratory must be made up RIGHT AWAY (only with the proper permission form). Consult your instructor for details on this procedure. If no valid excuse is provided a 0 will be the grade for that lab period. Missing more than 2 lab periods will warrant possible expulsion from the course or a failing grade.
Tardiness- You must be present at the scheduled time for start of lab. Quizzes will be given at the start of the period and no added time will be granted if you are late. Pre-laboratory discussions by the instructors are mandatory for conducting a safe laboratory period, and if you arrive late during or after this discussion you may be dismissed with no 'make-up' option at the discretion of the instructor. Habitual tardiness will not be tolerated whatsoever and will be a basis for grade deductions.

Safety: **Laboratory safety is a priority.** All safety rules listed in the laboratory safety contract, which you sign, must be followed at all times. Penalties range from grade deductions to expulsion for the laboratory for the most serious violations.

Assignments: Laboratory reports are due as follows: Labs done Monday will be due the following Thursday, and Labs done Tuesday and Thursday will be due the following Monday. Reports up to 1 day late are subject to a 20% deduction automatically. More than 2 days late a grade of 0 is assigned.

Academic Dishonesty: Instances of academic dishonesty will not be tolerated and will be treated in accordance with university policy. Examples of academic dishonesty include: copied lab reports; use of data obtained by others; faking data; copying from another student during quizzes, etc.
Please do your own work and build a solid knowledge foundation for yourself.

LABORATORY COURSE GRADE

There are three components to the laboratory course grade:

Laboratory Safety (10%)	**Quizzes (20%)**	**Laboratory Notebook/Laboratory Reports (70%)**

Laboratory Safety (10%): At the first laboratory meeting you will be given a safety presentation and a safety examination.You must pass the safety exam with a 70% or above by the third meeting, or you may not attend laboratory that week until a pass is achieved. At the first meeting you will sign a safety contract. All policies in this contract must be followed in the laboratory at all times.

Each student starts with a safety score of 100 points. Deductions may be made from this 100 points for a variety of safety violations-either individual or group- (see the safety contract) to be determined by the individual instructor. But automatic deductions will be made for the following:

- Failure to wear safety glasses AT ANY TIME during the laboratory period (5 points each violation)
- Improper disposal of any chemicals (for example pouring chemicals into the sink) (5 points each violation)[*If in doubt about how to dispose of a chemical consult the instructor.]*
- Food or drink brought into the lab (5 points each violation)
- Possession in the laboratory of coats, book bags, etc. not needed for lab (USE THE LOCKERS !) (5 points each violation)
- Any violation of the safety contract rules, as deemed appropriate by the laboratory instructor, may result in up to a 5 point deduction for that student.
- General Housekeeping Deduction: The state of cleanliness of the lab-especially the electronic balances-will be evaluated by the course coordinator or designee at random intervals following a laboratory period. If the state of the lab is deemed in violation of safety guidelines, EVERY STUDENT in that lab period will be given a 5 point deduction. If the next inspection reveals a safe lab the 5 point deduction will be lifted. The instructor cannot police the lab every minute. Students bear a responsibility to communicate to fellow students regarding this issue. Watch out for one another and clean up after yourself.
- Any action resulting in harm to a fellow student may be grounds for expulsion for the day (grade of 0) or, depending on the severity, of expulsion from the course.

Quizzes (20%): Quizzes will be given as often as every laboratory period, at the discretion of the instructor. Laboratory quizzes may cover the experiment from the previous week, 'pre-lab' questions regarding the experiment to be performed that day, and/or safety related topics which the instructor deems necessary or important.

NOTE: All assigned quiz grades are at the discretion of the laboratory instructor. The course coordinator will discuss a quiz grade only if there is an issue of a possible incorrect answer on the part of the instructor.

Laboratory Notebooks/ **The Laboratory Notebook** is the only place where written notes, observations or data may be written during the lab period. Some notes

Laboratory Reports (70%): and procedures should also be written in the notebook prior to lab as well. Because all pages are in duplicate, the relevant duplicate sheets must be handed in along with the Laboratory Report. Guidelines for properly recording in the laboratory notebook are posted on the Blackboard site and should be consulted and followed. Before leaving the laboratory for the day, you must request and obtain the instructor's signature (or initials) on the day's entry pages. The duplicate pages submitted with the laboratory report must show this indicator that you did this. Grade deductions may be applied if this is not done.

The **Laboratory Report** must be typed or printed. Script writing is not allowed. Standard programs such as MS Word (for the narrative and some tables) and MS Excel (for data tables and graphs) are available on most College computers and are preferred. 12 experiments will be performed and each will require a written laboratory report. Guidelines for the format of the Laboratory Report will be posted on the Blackboard site.

Daily Laboratory Schedule:

Print out the experiment for lab from Blackboard ahead of time and make sure you read it. Quizzes will be given on the scheduled experiment of the day at the beginning of the period (8:15AM). Arrive early enough (8:05AM) to put away your bag in the locker and hand in the lab report due for that day. Keep your notebook, pen, calculator, and safety goggles on bench. After the quiz, we will discuss the experiment for the day and go over the procedure and safety precautions together. Then you may start on the scheduled experiment. Collect any equipment from the stockroom you may need. During the Lab Period, you should write all observations and measurements you make in your lab notebook. You may need to perform some calculations in the lab. Start to finish up any work and pack up by 10:00AM. Clean up your area and find me so I may inspect your desk and lab notebook before leaving for that day. Please wear your goggles and gloves **at all times**. At home, you should perform any remaining calculations, construct any relevant graphs (Use Excel); answer all questions included in the lab. At the next lab meeting, submit your work to your instructor.

Please time yourself accordingly for all your work. Don't leave stuff for the last minute. Science classes require you to put time and effort into what you learn. If at anytime you have questions or concerns, email me and ask. I will try to answer as soon as possible.

CHEM113.1:SCHEDULEOFEXPERIMENTS

Day#Experiment#: Title of Experiment

1	Check-in.SyllabusandSafety
2	#1: Density
3	#2: HydrateComposition
4	#3:PrecipitationReactions
5	#4StoichiometryofReactionofIronwithCopper(II)
6	#5Qualitativestudyofredoxreactions
7	#6-CopperCycle
8	#7-GasLaws:Molarmassofametal.
9	#8:Dilution(NaOHandKMnO4 dilutions)(pHandspectrophotometry)
10	#9:NaOHprepandstandardizewKHP
11	#10:KMnO4 prepandstandardizewFAS
12	#11:CalorimetryIandII(Calorimeterconstantandsofmetal)
13	#12:Calorimetry:ΔHofacid-baseneutralization
14	Check-out

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FLUSHING, NY 11367-1579
DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY

General Chemistry I (Chemistry 113/501) Syllabus Summer 2023 Prof. R. Greenberg

TENTATIVE Dates	Topic	Chapter	**Tentative Lab Schedule**
7/6	Chemistry: The Study of Change	1	Check-in/Safety Video
7/10	Atoms, Molecules, and Ions	1-2	Exp 1
7/11	Atoms, Molecules, and Ions	2	Exp 2
7/13	Mass Relationships in Chemical Reactions	3	Exp 3
7/17	Mass Relationships in Chemical Reactions	3	Exp 4
7/18	Reactions in Aqueous Solutions	4	Exp 5
7/20	Reactions in Aqueous Solutions	4	Double lecture (TBA)
7/24	EXAM 1 (Ch 1-4)		Exam 1/Lecture
7/25	Gases	5	Exp 6
7/27	Gases	5	Exp 7
7/31	Thermochemistry	6	Exp 8
8/1	Thermochemistry	6	Exp 9
8/4	Quantum Theory and the Electronic Structure of the Atom	7	Exp 10
8/4	Periodic Relationships Among the Elements	8	Double lecture (TBA)
8/7	EXAM 2 (Ch 5-8)		Exam 2/Lecture
8/8	Chemical Bonding I	9	Exp 11
8/10	Chemical Bonding II	10/11	Exp 12/check-out
8/15	FINAL EXAM		Final

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GENERAL CHEMISTRY I (Chemistry 113/501): **Course Information, Summer 2023.**

Required Text

Chang and Overby, ***CHEMISTRY,*** Fourteenth edition McGraw Hill Education, 2022.
26 week access ISBN: 9781266421860
52 week access ISBN: 9781266421273

Purchase the material from the QC bookstore only. The bundled package is the cheapest purchase price available.

Attendance

You are required to attend all examinations, lecture and all recitation sessions. You must obtain a doctor's note or provide other written documentation if you miss an examination, or recitation because of sickness or any other circumstance. This note must be given to your recitation instructor. Grades of unofficial withdraw (WU) will be giving if your total absences in lecture/recitation exceeds 3 times.

You are required to sign an attendance sheet in lecture and recitation. The majority of questions posed on exams will parallel the way the material is presented in lecture. Past performance of students who do not regularly attend lecture is very poor. A grade of WU (unofficial withdraw) will be assigned if you miss 2 exams or have more than 3 absences from lecture.

Examinations

There will be three examinations given in person during lecture, and a comprehensive 2 hour final examination at the end of the course. The final exam may be an ACS exam.

Recitations

Homework problems and general solving techniques are gone over during recitation. Homework should be done **before** coming to recitation. This is your opportunity to ask questions regarding problem solving. Quizzes will be given in recitation.

How to Study

Begin by reading the preface. These pages will describe the various learning aids in the textbook and will give you useful suggestions for studying chemistry.

It is particularly important that you

- **Review each chapter before it is covered in lecture.**

- **Take a good set of lecture notes.**
- **Work out each problem- solving practice exercises as they appearin the text.**

You should realize that because of limited time, many topics cannot be covered completely in lecture. You are expected to use youtextbook to complement your lecture notes.

The Chemistry Department requires a grade of C (not C-) or better to advance to the next course. You must get at least a C in Chem 113 to advance to Chem 114.

What you need to memorize

Your mastery of chemistry depends in large part on your ability to understand concepts and apply your understanding to problem solving. However, you should not neglect the memorization of basic vocabulary, formulas, etc.

In particular you should learn:

- The names and symbols for elements in the main body of the periodic table up to element 89 (actinium).
- The formulas of common ions
- Names of the representative groups in the periodic table
- The rules for naming compounds and the names and formulas of common acids and bases
- Solubility rules/ using them to predict precipitation reactions
- Knowledge of reactions that produce gases
- Basic rules of assigning oxidation numbers
- Knowledge of the electromagnetic spectrum
- Trends of the periodic table
- Molecular geometry associated with VSEPR

Finally, take note of the following…….

- **"Incomplete" grades are NOT given in chemistry courses.**
- **No extra projects will be given to compensate for poor exam grades.**
- There are no make-up exams
- Don't wait for the last few days to inform your instructor of missed labs, quizzes, etc.
- The last day to hand in overdue lab reports is the last day of lab class. Late reports will be severely penalized.
- If you drop the course, you must check out of the laboratory, or you will be charged a substantial monetary fee.

End of chapter problems

It is recommended that you attempt as many review questions and problems as possible. First attempt the problems whose numbers are printed in bold (answers given in the Appendix.). If you fail to answer any of these questions or problems correctly, try the one that immediately follows.

On-Line assignments

An e-book version of the text comes with a log-in code for 2 homework web sites. A hard copy of the text can be purchased for an additional $40.00. Mandatory homework assignments will be posted at the site along with the due date. These assignments will be graded and will constitute 25% of your overall grade. Details will be discussed in lecture.

Grading Breakdown

Semester Exams:	35%
Recitation	10%
Homework	25%
Final exam	30%

You are not allowed to distribute, sell, or purchase any electronically reproduced portions of this course. You cannot sell any written material (now or in the future) obtained from this course including returned/graded exams.

Any violation of the Queens College academic integrity policies will be reported to the department chair and to the committee on course and standing. This includes plagiarism and cheating on exams by web searches, use of unauthorized materials during exams, and chat room use during exams.

REASONABLE ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

Candidates with disabilities needing academic accommodation should: 1) register with and provide documentation to the Special Services Office, Frese Hall, Room 111; 2) bring a letter indicating the need for accommodation and what type. **This should be done during the first week of class.** For more information about services available to Queens College candidates, visit the website, or contact: Special Service Office; Director, Miriam Detres-Hickey, Frese Hall, Room 111; 718-997-5870 (Monday – Thursday 8:00 a.m. to 5:00 p.m. & Friday 8:00 a.m. to 4 pm.).

CUNY POLICY ON ACADEMIC INTEGRITY

Academic Dishonesty is prohibited in The City University of New York and is punishable by penalties, including failing grades, suspension, and expulsion as provided at: https://www.cuny.edu/about/administration/offices/legal-affairs/policies-procedures/academic-integrity-policy/. Please read this document, paying careful attention to the sections on plagiarism and Internet plagiarism. If you are not sure how to cite work you have found on the internet, please review the APA Guidelines provided by the Purdue OWL.

Exams are in-person unless CUNY policy changes. If exams are changed to on-line format, exams will be taken on blackboard and may be proctored using a live zoom feed. You must have a functional camera to be proctored during exams.

Use of chat rooms and internet searches during exams is not allowed and will be considered cheating. Evidence of cheating will be presented to the department Chair and the committee on course and standing.

There are no make-up exams. If a missed exam is excused (pending proper documentation), the grade of the final exam will count for the missed exam grade. You cannot miss 2 exams. You will be given a failing grade if you do not withdraw before the deadline.

My email address is ross.greenberg@qc.cuny.edu Emails will be answered usually within 24 hours. Do not email regarding extensions of homework due dates or extra-credit assignments. These emails will not be responded to.

I cannot assign a grade of P/NC or withdraw you from the course. If you feel this is your best option, you must request this option through the registrar.

Based on previous performance, if you have failed the two lecture exams, you will fail the class.

Lectures, recitation and lab are on Monday, Tuesday and Thursday. Office hour will be on these days.

All class announcements are posted on blackboard and automatically sent to you QC email address. These should be checked daily.

As you move through the material you should construct a review log to use during exam preparation. I do not provide or distribute review materials.

The information for the e.book and online homework site (Aleks) will be released on blackboard.

Absence excuses due to possible Covid exposure and/or contraction of the disease must follow college guidelines. Confirmation by a PCR test (not home administered test), doctors note, and proper clearance to return to class must be submitted to the college and to the department. You are required to maintain the requirements for admittance to campus for all classes. If you miss classes/exams due to failing the requirements for campus access, you will receive a grade of zero for missed work.

Read the posted document on the definition of what a credit-hour is. This class is 4 credit hours requiring 150 mins. of in-class lecture time, 50 mins. of recitation time, and 8 hours of work on your own time per week which includes reading the on-line textbook and Aleks homework. Success in this course requires you meet these standards as a bare minimum.

You are responsible to purchase the Aleks on-line access at the beginning of the semester. Your grade will include 0's for any missed work on the assignments.

The following chapter breakdown is a comprehensive list of what we will cover this semester and what you are expected to have mastered as we complete each chapter. Use this list as a checklist as you prepare for the lecture exams and the cumulative final exam.

Chapter 1: Chemistry: The Study of Change

Conceptual:

- Learn and understand the cyclical nature of the scientific method and its components.
- Understand the concept of significant figures.
- Learn the concepts of the *S.I.* system to derive units.
- Learn the terminology used to describe and classify the different forms of matter.
- Learn terminology used to describe properties of matter.

Functional and mathematical skills:

- Learn and memorize the metric prefixes
- Learn to convert within the metric system and English-metric conversion.
- Learn to apply scientific notation to report numerical information.
- Learn how to apply significant figure rules in calculations.
- Learn how to apply dimensional analysis during calculations.
- Learn temperature units and conversions
- Learn density and its calculations.

Chapter 2: Atoms, Molecules, and Ions

Conceptual:

- Learn the historical contributions of John Dalton, J.J. Thomson, Robert Millikan, Ernest Rutherford, and Niels Bohr.
- Understand the significance of the Law of Conservation of Matter, the Law of Constant Composition, and the Law of Multiple Proportions.
- Learn the properties of the subatomic particles and their role in our understanding of modern atomic structure.
- Learn and understand the general concepts associated with elements and atoms.
- Learn and understand the general concepts associated with compounds and molecules.
- Learn the concepts of the periodic table and how to extrapolate the information contained therein.
- Learn introductory concepts of chemical bonding and bond classification.
- Learn the concepts of ion formation and the use of the periodic table to predict stable ion formation of the representative elements.

Functional and mathematical skills:

- Learn the amu and its conversion as a mass unit
- Learn the nuclide system and the information conveyed by a nuclide
- Learn to construct a Bohr atom model for representative elements.
- Learn to generate formulas of stable ions and ionic compounds.
- Learn the different types of chemical formulas and the information that they provide.
- Learn and memorize the rules of nomenclature: formula to name and name to formula for ionic and binary molecular compounds, acids, and simple hydrocarbons.

Chapter 3: Mass Relationships in Chemical Reactions

Conceptual:

- Learn the concept of average atomic weight.
- Learn the mole concept and its definitions; the counting unit definition and the conceptual mass definition.
- Learn the concepts molecular weight and molar mass.
- Learn the concept of percent composition by mass
- Learn the concept of empirical formula determination and the relationship with molecular formula,
- Understand the information provided by a balanced chemical equation including the recognition of reaction types.
- Understand the concepts of stoichiometry including limiting reagent and percent yield.

Functional and mathematical skills:

- Perform average atomic weight calculations
- Interconvert between the number of particles, moles, and mass
- Perform percent composition by mass calculations and their applications
- Perform calculations to determine empirical and molecular formula by direct and indirect data.
- Learn to balance chemical equations.
- Perform stoichiometry calculations including limiting reagent and percent yield calculations.

Chapter 4: Reactions in Aqueous Solutions:

- Learn to define and identify solutes and solvents.
- Understand classifications of solutes; strong, weak, and non-electrolytes.
- Understand concept of solubility and factors that affect solubility.
- Understand concepts of solution formation; solvation and the solution process.
- Understand methods of classifying solutions quantitatively; saturated, unsaturated, super-saturated, concentrated and dilute solutions.
- Understand concepts of solution concentration, molarity, and the dilution process.
- Understand the concept of stock molarity and effective molarity.
- Understand metathesis reactions and identify metathesis products.
- Understand the information contained in complete balanced molecular, ionic, and net ionic equations.
- Understand the concept of strong and weak acids and bases; the Arrhenius definition.
- Understand/ memorize the solubility rules of ionic solutes.
- Understand the concept of a redox reaction and the concept/definition of an oxidation state, oxidizing and reducing agents and their identification.
- Understand the concepts of solution stoichiometry.

Functional and mathematical skills:

- Identify and classify solutes and solvents.
- Identify precipitates, gases, and weak/non electrolytes that form during metathesis reactions.
- Write complete balanced molecular, ionic, and net ionic equations.
- Interpret solubility curves.
- Perform all molarity/dilution calculations.
- Assign oxidation states to species in redox reactions.

- Identify species undergoing oxidation, reduction, oxidizing and reducing agents.
- Identify and balance redox reactions.
- Perform all forms of solution stoichiometry calculations and stoichiometry of metathesis reactions.

Chapter 5: Gases

Conceptual:

- Define/understand the empirical properties of gases.
- Understand all concepts of pressure; Atmospheric pressure, confined gases, barometers and manometers
- Understand the different units of pressure.
- Learn aspects of the empirical gas laws; Boyles, Charles', Gay-Lussac's, Combined, and Avogadro's and the relevant conditions where each law applies.
- Understand the concept of an ideal gas
- Understand the ideal gas equation and its variations
- Understand stoichiometic concepts applied to gas reactions.
- Understand gas laws and processes relating to gas mixtures
- Understand the Kinetic molecular theory of gases and the Boltzmann distribution of kinetic energy; average kinetic energy and root mean square speed.
- Understand the concept of diffusion and effusion.
- Understand the concept of rate.

Functional and mathematical skills:

- Interconvert pressure units
- Calculations involving barometers, open and closed ended manometers
- Calculate the change in condition of gases using empirical laws
- Calculations involving the ideal gas equation; empirical properties, molar mass, density, and stoichiometry. (unit requirements due to R)
- Calculate total and partial pressures of gas mixtures.
- Calculations involving Raoult's law; mol fraction.
- Calculations of effusion rates and molar mass based on effusion data.

Chapter 6: Thermochemistry

Conceptual:

- Learn terminology of thermochemistry.
- Understand concepts of kinetic and potential energy
- Understand concepts of molecular kinetic energy and potential energy of attracting particles.
- Understand aspects of work, heat flow, and thermal equilibrium.
- Understand the first law of thermodynamics.
- Understand concepts of Internal energy and Enthalpy.
- Understand concepts of exothermic and endothermic processes.
- Understand concept of state functions.
- Understand concepts of constant volume and constant pressure processes.
- Understand concepts of heat capacity and specific heat.
- Understand concepts of calorimetry.
- Understand concepts of Hess' Law.

- Understand concepts of $\Delta H°_{f}$, $\Delta H°_{comb}$, and $\Delta H°_{rxn}$.

Functional and mathematical skills:

- Convert energy units
- Calculate KE, PE, PV work, ΔE and ΔH
- Calculations of calorimetry- Bomb calorimeter, constant pressure calorimeter, heat capacity, and specific heat.
- Calculations of in-phase temperature changes.
- Write heat of formation and heat of combustion reactions
- Perform algebraic and equation-manipulation Hess' law calculations.

Chapter 7: Quantum Theory and the Electronic Structure of the Atom
Chapter 8: Periodic Relationships Among the Elements

Conceptual:

- Learn concepts of electromagnetic radiation- wave and particle theory.
- Understand quantized energy
- Understand the link between atomic line spectrum and the Bohr Model
- Understand concepts of ground state and excited state atoms
- Understand the wave behavior of matter.
- Understand aspects of the Quantum mechanics model of atomic structure
- Understand aspects of the four quantum numbers n, ℓ, m_ℓ, m_s
- Understand terms shell, subshell, and orbital
- Understand aspects of atomic orbitals including shapes, radial electron density
- Aufbau energy ranking of subshells.
- Understand electron configuration exceptions to the Aufbau.
- Understand the link of electron configurations to the periodic table.
- Understand and interpret trends in the periodic table for atomic and ionic radius, ionization energy, electron affinity
- Understand concepts of shielding and effective nuclear charge
- Understand reactivity trends of groups on the periodic table.

Functional and mathematical skills:

- Wavelength, frequency, and photon energy calculations
- Use Bohr (Rydberg) equation to calculate energy and wavelengths of electron transitions in the hydrogen atom.
- Calculate De Broglie wavelength of matter
- Assign complete set of quantum numbers to ground state electrons
- Construct and interpret electron configurations for neutral ground state atoms, ions, and excited atoms. Convert configurations into Bohr model sketches.
- Construct abbreviated electron configurations.
- Sketch orbital shapes
- Rank/order atoms with respect to atomic and ionic radius, ionization energy, electron affinity
- Justify atomic and ionic radius, ionization energy, electron affinity orders with concepts of shielding and effective nuclear charge.
- Compare and justify reactivity trend of elements

Chapter 9: Chemical Bonding I
Chapter 10 Chemical Bonding I
Conceptual:

- Understand aspects and contrast ionic and covalent bonding.
- Learn use of Lewis Dot symbols.
- Learn classifications of covalent bonds.
- Understand concepts of electronegativity.
- Understand concepts of bond polarity and dipole moments.
- Understand aspects of Lewis Dot structures.
- Understand aspects of formal charge, resonance, and preferred structures.
- Understand aspects of bond lengths and bond enthalpies

Functional and mathematical skills:

- Assign and use electronegativity differences to identify ionc, polar, and non-polar covalent bonds.
- Use Lewis Dot symbols to represent ionic reactions.
- Draw Lewis dot structures; octet rule, preferred structures, and ions.
- Draw resonance structures.
- Calculate formal charge on atoms in a Lewis Dot structure.
- Use Lewis Dot structures to estimate ΔH_{rxn} from bond enthalpies.
- Compare bond lengths.

Chapter 10: Chemical Bonding II
Chapter 11: Chemical Bonding II

Conceptual:

- Learn aspects of VSEPR and the concept of molecular geometry
- Learn the standard and variation shapes of VSEPR.
- Understand the effects of free electrons and multiple bonds on molecular geometries.
- Understand the concepts of molecular polarity and the link to VSEPR.
- Understand aspects of hybrid orbitals and Atomic Orbital Theory
- Understand σ and π bonding

Functional and mathematical skills:

- Determine molecular geometry from Lewis Dot structures.
- Assign bond angles according to VSEPR shape
- Assign molecular polarity to molecules.
- Identify hybrid orbitals used in molecules
- Assign Atomic Orbital Theory bonding patterns in molecules.