JOHN JAY COLLEGE OF CRIMINAL JUSTICE / CUNY

860 Eleventh Avenue, New York, NY 10019

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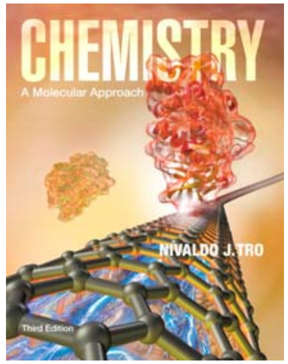
GENERAL CHEMISTRY I (CHE 103) FALL 2013 SYLLABUS

	Professor	*Office (NB)*	*Phone*	*E-mail*	*Office Hours*	*Room/Lab*	-01 (4801)	-02 (4836)	-03 (4803)	-04 (4800)
Lecture– 01-04	Francis X. Sheehan	5.66.16	212-237-8951	FSheehan@jjay.cuny.edu	Faculty are very	L2.85	M&W-3	M&W-3	M&W-3	M&W-3
Recitation – 01	Lauren Gunderson	4.70.07	212-237-8894	LGunderson@jjay.cuny.edu	accessible by email	L2.81	M-2			
Laboratory – 01	Elliot Quinteros	4.62.02	212-237-1437	EQuinteros@jjay.cuny.edu	and in person, meeting	3.66	F-3/4			
Recitation – 02	Helen Chan	4.70.07	646-781-5686	HChan@jjay.cuny.edu	with and without	L2.81		M-2		
Laboratory – 02	Helen Chan	4.70.07	646-781-5686	HChan@jjay.cuny.edu	appointments on	3.70		F-3/4		
Recitation – 03	Rosalie Lipovetsky	3.62	use email →	RLipovetsky@jjay.cuny.edu	teaching days.	L2.82			M-2	
Laboratory – 03	Pia Austria	4.70.07	212-237-8894	PAustria@jjay.cuny.edu	See handout for more	3.70			W-1/2	
Recitation – 04	Anastasiya. Baranova	3.61	use email →	anastasiya.baranova@jjay.cuny.edu	specific dates/times.	L2.82				M-2
Laboratory – 04	Anastasiya. Baranova	3.61	use email →	anastasiya.baranova@jjay.cuny.edu		3.66				W-1/2
							-05 (4802)	**-06** (4834)	**-07** (4804)	**-08** (4833)
Lecture– 05-08	Francis X. Sheehan	5.66.16	212-237-8951	FSheehan@jjay.cuny.edu	Faculty are very	L2.85	M&W-2	M&W-2	M&W-2	M&W-2
Recitation – 05	Lauren Gunderson	4.70.07	212-237-8894	LGunderson@jjay.cuny.edu	accessible by email	L2.81	M-1			
Laboratory – 05	Lauren Gunderson	4.70.07	212-237-8894	LGunderson@jjay.cuny.edu	and in person, meeting	3.66	M-3/4			
Recitation – 06	Elliot Quinteros	4.62.02	212-237-1437	EQuinteros@jjay.cuny.edu	with and without	L2.81		M-1		
Laboratory – 06	Helen Chan	4.70.07	646-781-5686	HChan@jjay.cuny.edu	appointments on	3.70		M-3/4		
Recitation – 07	Anastasiya. Baranova	3.61	use email →	anastasiya.baranova@jjay.cuny.edu	teaching days.	L2.82			M-1	
Laboratory – 07	Lauren Gunderson	4.70.07	212-237-8894	LGunderson@jjay.cuny.edu	See handout for more	3.66			W-3/4	
Recitation – 08	Rosalie Lipovetsky	3.62	use email →	RLipovetsky@jjay.cuny.edu	specific dates/times.	L2.82				M-1
Laboratory – 08	Pia Austria	4.70.07	212-237-8894	PAustria@jjay.cuny.edu		3.70				W-3/4
							-09 (4835)			
Lecture– 09	Francis X. Sheehan	5.66.16	212-237-8951	FSheehan@jjay.cuny.edu		3.80	M&W-1			
Recitation – 09	Pia Austria	4.70.07	212-237-8894	PAustria@jjay.cuny.edu	See above.	3.80	M-2			
Laboratory – 09	Angela Vuong	3.82.04	212-621-3740	AVuong@jjay.cuny.edu		3.66	F-1/2			

Period	***Time***
1	**8:00AM**
2	**9:25AM**
3	**10:50AM**
4	**12:15PM**
5	**2:50PM**
6	**4:15PM**
7	**5:40PM**
8	**7:05PM**
9	**8:30PM**



ISBN-13: 9780321813619

COURSE DESCRIPTION AND OBJECTIVES: This is the first of a two-semester course primarily intended for Forensic Science and Fire Science majors, as well as others interested in developing a strong knowledge base of general chemistry principles. It provides students with a better understanding of the chemical world around us and is a prerequisite for more advanced chemistry courses. The course introduces the basic properties and reactions of elements and compounds which will be further explored in greater detail in the second semester. The accompanying laboratory stresses principles of qualitative and semi-quantitative experimentation. The laboratory exercises are designed to foster a better understanding of chemical principles and ensure the necessary foundation skills are developed to work in a scientific laboratory safely and effectively. 3 hours lecture,1.5 hours recitation, 3 hours laboratory. 5 credits.

REQUIRED LECTURE AND RECITATION READING/MISC MATERIAL:

Lecture Text Bundle (Books a la Carte is an unbound, three-hole punch version of the textbook that is less expensive than the hardcover book and comes bundled with the required online homework software and eText. The textbook chapter under discussion must be brought to class: **(It is important ordering is done by ISBN#. Order ISBN- 13:9780321813619.)**

Tro, Chemistry, A Molecular Approach (3rd ed.), Books a la Carte Plus MasteringChemistry with eText – Access Card Package, Boston: Pearson Education Inc., 2014.

Scientific Calculator

One of the TI-30 scientific calculators shown in this syllabus, available at most electronic and department stores, is required to be brought to class each day. (TI-34 and TI-36 calculators are not TI-30 calculators and, therefore, are prohibited.) The calculator must be in the TI-30 group, such as TI-30XA, TI-30XS, TI-30X IIS.

Turning Technologies Response Card NXT (RCXR-03)

Note: You need not purchase this “clicker.” You may borrow one from the college through the Science Department at no charge provided you agree in writing to return it on or before Department Exam Day (or within 10 days of dropping the course, whichever occurs first) and agree to replace it with an identical model if it is lost, stolen or damaged. Its estimate cost is $40.00. Failure to timely return either the borrowed clicker in good condition or a purchased replacement clicker will result in an SC “Science Stop” on your registration, financial aid, ability to obtain a transcript, etc. The stop can be removed by returning the clicker to Chemistry Courses Coordinator Francis Sheehan (05.66.16) or his specified designee and having the Loan Agreement you signed to obtain the device canceled in your presence. Allow at least one week for the stop to be removed.

LEARNING OUTCOMES – COURSE

Reasoning
- Apply critical thinking skills to introductory problem solving exercises in chemistry.
- Use analytical reasoning skills in course exercises of increasing complexity/difficulty.
- Understand the creative aspects of historical discoveries in chemistry.
- Analyze data and perform basic aspects of statistical analysis.
- Recognize statements of statistical validity of data.
- Understand the significance of reaction rate laws and equilibrium process in experimental data.

Knowledge
- Illustrate a basic understanding of the process of scientific investigation including experimental design, data collection and analysis, and uncertainty and error in measurement.
- Understand how the history of scientific investigation relates to core chemical concepts.
- Demonstrate an understanding of basic mathematical principles in chemistry; modern atomic and molecular theory; properties and reactions of elements and compounds; physical and chemical properties of solids, liquids, and gases including reaction stoichiometry; and molar/concentration relationships.

Practical skills
- Illustrate a basic understanding of laboratory safety; scientific measurement; chemical reactions and formulas; chemical identification; solutions and dilutions; and primary instrumentation.
- Understand the role of personal background and bias in historical scientific investigations.

Communication
- Write coherent laboratory reports.

LEARNING OUTCOMES – DETAILED BY CHAPTER

CHAPTER 1 Learning Outcomes: Students will be able to:

1.1 Atoms and Molecules
- Define atoms, molecules, and the science of chemistry.
- Represent simple molecules (carbon monoxide, carbon dioxide, water, hydrogen peroxide) using spheres as atoms.

1.2 The Scientific Approach to Knowledge
- Define and distinguish between a hypothesis, a scientific law, and a theory.
- Understand the role of experiments in testing hypotheses.
- State and understand the law of mass conservation as an example of scientific law.
- Understand that scientific theories are built from strong experimental evidence and that the term “theory” in science is used much differently than in pop culture.

1.3 The Classification of Matter
- Define matter and distinguish between the three main states of matter: solid, liquid, gas.
- Define and understand the difference between crystalline and amorphous solids.
- Define mixture, pure substance, element, compound, heterogeneous, and homogeneous.
- Differentiate between mixtures and pure substances; elements and compounds; and heterogeneous and homogeneous mixtures.
- Use the scheme on page 7 to classify matter.
- Define and understand the methods of separating mixtures: decantation, distillation, and filtration.

1.4 Physical and Chemical Changes and Physical and Chemical Properties
- Define, recognize, and understand the difference between physical and chemical changes.

1.5 Energy: A Fundamental Part of Physical and Chemical Change
- Define energy, work, kinetic energy, potential energy, and thermal energy.
- State and understand the law of conservation of energy.

1.6 The Units of Measurement

- Understand the importance of reporting correct units with measurements.
- Know the differences between the three most common sets of units: English system, metric system, and International System (SI).
- Know the SI base units for length, mass, time, and temperature.
- Know the three most common temperature scales (Fahrenheit, Celsius, and Kelvin), the freezing and boiling points of water on each scale, and the relationships between the scales.
- Calculate temperature conversions between each scale.
- Know and use the SI prefix multipliers for powers of ten.
- Know and calculate using the derived units of volume and density.

1.7 The Reliability of a Measurement

- Understand that all measurements have some degree of uncertainty and that the last digit in a measurement is estimated.
- Know how to determine the number of significant figures in a measurement using a set of rules.
- Know how to determine the number of significant figures after calculations.
- Distinguish between accuracy and precision.

1.8 Solving Chemical Problems

- Understand dimensional analysis and know how to use conversion factors.
- Understand the problem-solving strategy: sort, strategize, solve, and check.
- Convert from one unit to another.
- Make order-of-magnitude estimations without using a calculator.
- Rearrange algebraic equations to solve for unknown variables.

Impediments to avoid to achieve CHAPTER 1 Learning Outcomes:

• confusing mass and weight
• having difficulty with algebraic manipulation and difficulty converting temperatures between Celsius and Fahrenheit scales is particularly problematic
• equating density with mass
• being unfamiliar with the prefixes used in the metric system or not using them properly (e.g. 1 pm = 1×10^{-12} m vs. 1 m = 1×10^{12} pm)
• using precision and accuracy interchangeably
• not appreciating that in chemistry, measurement yields numbers determined with certain precision and in certain units; both depending on the type of the measuring device
• not finding exact numbers in calculations
• confusing significant figures and decimal places in arithmetic manipulations
• rounding off too soon in calculations or reporting the result to as many figures as the calculator produces
• not understanding the use of a conversion factor of exactly one
• in dimensional analysis problems not seeing that a physical quantity is a multiplication of value and units and, therefore, not performing algebraic operations on both the number and units

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CHAPTER 2 Learning Outcomes: Students will be able to:

2.1 Imaging and Moving Individual Atoms

- Describe scanning tunneling microscopy (STM) and how atoms are imaged on surfaces.
- Define atom and element.

2.2 Early Ideas about the Building Blocks of Matter

- Describe the earliest definitions of atoms and matter (Greeks).
- Know that greater emphasis on observation and the development of the scientific method led to the scientific revolution.

2.3 Modern Atomic Theory and the Laws That Led to It

- State and understand the law of conservation of mass (also from Section 1.2).
- State and understand the law of definite proportions.
- State and understand the law of multiple proportions.
- Know the four postulates of Dalton's atomic theory.

2.4 The Discovery of the Electron

- Describe J. J. Thomson's experiments with the cathode ray tube and understand how they provide evidence for the electron.
- Describe Robert Millikan's oil-drop experiment and understand how it enables measurement of the charge of an electron.

2.5 The Structure of the Atom

- Define radioactivity, nucleus, proton, and neutron.
- Understand Thomson's plum-pudding model and how Ernest Rutherford's gold-foil experiment refuted it by giving evidence for a nuclear structure of the atom.

2.6 Subatomic Particles: Protons, Neutrons, and Electrons in Atoms

- Define atomic mass unit, atomic number, and chemical symbol.
- Recognize chemical symbols and atomic numbers on the periodic table.
- Define isotope, mass number, and natural abundance.
- Determine the number of protons and neutrons in an isotope using the chemical symbol and the mass number.
- Define ion, anion, and cation.
- Understand how ions are formed from elements.

2.7 Finding Patterns: The Periodic Law and the Periodic Table

- Define the periodic law.
- Know that elements with similar properties are placed into columns (called groups) in the periodic table.
- Define and distinguish between metals, nonmetals, and metalloids.
- Identify main-group and transition elements on the periodic table.
- Know the general properties of elements in some specific groups: noble gases, alkali metals, alkaline earth metals, and halogens.
- Know and understand the rationale for elements that form ions with predictable charges.

2.8 Atomic Mass: The Average Mass of an Element's Atoms

- Calculate atomic mass from isotope masses and natural abundances.
- Define mass spectrometry and understand how it can be used to measure mass and relative abundance.

2.9 Molar Mass: Counting Atoms by Weighing Them

- Understand the relationship between mass and count of objects such as atoms.
- Define mole and Avogadro's number.
- Calculate and interconvert between number of moles and atoms.
- Calculate and interconvert between number of moles and mass.

<u>Impediments to avoid to achieve CHAPTER 2 Learning Outcomes</u>:

- not understanding the concept of amu
- failing to recognize the importance of the periodic table as a tool for organizing and remembering chemical facts
- not relating the charges on common monoatomic ions to their position in the periodic table
- underestimating the importance of chapter 2

<u>CHAPTER 3 Learning Outcomes</u>: Students will be able to:

3.1 Hydrogen, Oxygen, and Water

- Know some chemical and physical properties of H_2, O_2, and H_2O.
- Know and understand that compounds, e.g. NaCl, are different from the elements, e.g. Na and Cl_2, from which they are composed.

3.2 Chemical Bonds

- Define and understand the difference between ionic and covalent bonds.
- Describe and understand the formation of an ionic compound from its elements.
- Describe and understand the sharing of electrons in a covalent bond.

3.3 Representing Compounds: Chemical Formulas and Molecular Models

- Define and understand empirical formula, molecular formula, and structural formula.
- Write the empirical formula, molecular formula, and structural formula for simple molecules.

- Recognize and understand the differences between ball-and-stick models and space-filling models.
- Recognize and identify characteristic colors for elements in molecular models.

3.4 An Atomic-Level View of Elements and Compounds
- Identify elements as atomic or molecular.
- Differentiate between atomic or molecular elements and ionic or molecular compounds.
- Know and understand that ionic compounds are composed of formula units and not discrete molecules.
- Know and understand that covalent compounds tend to exist as discrete molecules.
- Know and understand that a polyatomic ion is composed of atoms that are covalently bound to each other.

3.5 Ionic Compounds: Formulas and Names
- Know that ionic compounds are ubiquitous in the Earth's crust as minerals.
- Know and understand the rules for writing formulas for ionic compounds.
- Write formulas for ionic compounds using the charges of the ions and the principle of electrical neutrality.
- Know and understand the rules for naming ionic compounds.
- Write names from formulas and formulas from names of ionic compounds.

3.6 Molecular Compounds: Formulas and Names
- Know and understand the rules for naming molecular compounds.
- Write names from formulas and formulas from names of molecular compounds.
- Write names and formulas for binary acids and oxyacids.

3.7 Summary of Inorganic Nomenclature

3.8 Formula Mass and the Mole Concept for Compounds
- Define formula mass (a.k.a. molecular weight, molecular mass) and molar mass for a compound.
- Understand and calculate the molar mass of a compound.
- Calculate and interconvert between mass, moles, and molecules of a compound.

3.9 Composition of Compounds
- Define and understand mass percent (mass percent composition).
- Calculate mass percent from a chemical formula.
- Use mass percent as a conversion factor.
- Use chemical formulas as conversion factors in mole calculations.

3.10 Determining a Chemical Formula from Experimental Data
- Convert masses into moles and calculate mole ratios to determine empirical formulas.
- Determine empirical formulas from experimental data.
- Determine molecular formulas from empirical formulas and molecular masses.
- Understand combustion analysis.
- Determine an empirical formula from combustion analysis.

3.11 Writing and Balancing Chemical Equations
- Define reactants, products, chemical reaction, and chemical equation.
- Understand how a chemical reaction can be represented by a chemical equation.
- Use coefficients to balance all atoms in a chemical equation.
- Write balanced chemical reactions.

3.12 Organic Compounds
- Define organic compounds.
- Define and understand the differences between alkanes, alkenes, and alkynes.
- Know the names and formulas of the first ten alkanes.
- Identify the common organic functional groups.

Impediments to avoid to achieve CHAPTER 3 Learning Outcomes:

- confusing the subscripts in a chemical formula with the coefficients in front of the formula in a balanced reaction equation
- thinking that polyatomic ions can easily dissociate into smaller ions
- having difficulty grasping the meaning of a mole as a "collective," a mole of a substance contains a fixed number (6.022×10^{23}) of "building blocks" (atoms for most elements, molecules for molecular substances, formula units for ionic substances) in the same fashion as a dozen means 12 (eggs, people, items, etc.)
- not understanding that mass of 1 mole of substance X can be significantly different from the mass of 1 mole of substance Y
- not appreciating that the coefficients in an empirical formula are not exact whole numbers because of experimental or round-off errors and not understanding the existence of experimental error
- not seeing the difference between empirical and molecular formulas
- not realizing that an ionic compound can consist of nonmetals only, e.g., $(NH_4)_2SO_4$
- confusing the guidelines for naming ionic compounds with those for naming binary molecular compounds

CHAPTER 4 Learning Outcomes: Students will be able to:

4.1 Climate Change and the Combustion of Fossil Fuels

- Define and understand the greenhouse effect and greenhouse gases.
- Understand the role of carbon dioxide from fossil fuel combustion with respect to global warming.

4.2 Reaction Stoichiometry: How Much Carbon Dioxide?

- Define and understand stoichiometry, the numerical relationships among chemical amounts in a balanced chemical reaction.
- Understand and use a balanced chemical reaction to calculate the mole relationships between components.
- Calculate the mass of a reactant needed to produce a certain mass of product.
- Calculate the mass of a product formed from a certain mass of reactant.

4.3 Limiting Reactant, Theoretical Yield, and Percent Yield

- Define limiting reactant and theoretical yield.
- Predict a limiting reactant using initial reactant masses and the theoretical yield.
- Calculate and determine a theoretical yield and a percent yield.
- Understand and describe the role of gasoline additives in the combustion of vehicle fuels.

4.4 Solution Concentration and Solution Stoichiometry

- Define solution, solvent, solute, aqueous solution, and molarity.
- Calculate the molarity of a solution.
- Use molarity as a conversion factor in calculating numbers of moles and volumes of solution.
- Calculate the concentration after a solution has been diluted.
- Calculate reaction component amounts using volume, moles, concentration, and stoichiometry.

4.5 Types of Aqueous Solutions and Solubility

- Understand the interactions between water as a solvent and different solutes dissolved in it.
- Define and understand electrolyte, strong electrolyte, weak electrolyte, and nonelectrolyte.
- Define strong and weak acids.
- Understand what is meant by soluble and insoluble.
- Know the solubility trends for compounds made from common anions and cations.

4.6 Precipitation Reactions

- Define precipitate and precipitation reaction.
- Use the solubility trends to predict how the ions from soluble compounds combine to form precipitates.

4.7 Representing Aqueous Reactions: Molecular, Ionic, and Complete Ionic Equations

- Write and describe a molecular equation that shows complete electrically neutral formulas for each compound in a reaction.
- Write and describe a complete ionic equation that shows all the individual ions present in a reaction.
- Define and identify spectator ions.
- Write and describe a net ionic equation that shows only the species that actually change during a reaction.

4.8 Acid-Base and Gas-Evolution Reactions

- Define acid-base reaction (neutralization) and gas-evolution reaction.
- Understand the Arrhenius definitions for acids and bases.
- Recognize diprotic and polyprotic acids from chemical formulas.
- Know the lists of strong acids and bases.
- Describe what happens in an acid–base reaction.
- Understand the equivalence point of a titration, and use solution stoichiometry and equivalence point to calculate the concentration of an unknown in a titration.
- Recognize gas-evolution reactions and predict the identity of evolved gases.

4.9 Oxidation–Reduction Reactions

- Define oxidation, reduction, and oxidation-reduction (redox) reactions.
- Assign oxidation states to atoms in a chemical formula.
- Identify the elements undergoing oxidation and reduction in a redox reaction.
- Understand that combustion is a common redox reaction.

<u>Impediments to avoid to achieve CHAPTER 4 Learning Outcomes:</u>

- forgetting molarity is moles of solute per liter of solution, not per liter of solvent
- using moles instead of molarity in $M_{initial}V_{initial} = M_{final}V_{final}$
- disregarding rules for significant figures when calculating or using molarities
- not understanding that the reagent that gives the smallest amount of product is the limiting reactant
- thinking a percent yield in excess of 100% is a good thing
- not understanding the difference between the amount of material present in the laboratory (or given in the problem) and the number of moles required by stoichiometry
- thinking that water is a good conductor
- having a problem with the arbitrary difference between strong and weak electrolytes
- thinking that nonelectrolytes produce no ions in aqueous solution at all
- not being able to tell the difference between dissolution and dissociation
- confusing the symbols $\rightleftharpoons$ (equilibrium) and ⇔ (resonance)
- not seeing that the net ionic equation for the reaction between strong acids and strong bases is always $H^+_{(aq)} + OH^-_{(aq)} \rightleftharpoons H_2O_{(\ell)}$
- trying to split polyatomic ions into smaller ions when they write net ionic equations
- thinking that a compound consisting of nonmetals only must be molecular (counter-example: $(NH_4)_2SO_4$ which is ionic!)
- not realizing that insoluble really means poorly soluble
- not appreciating the difference between equivalence point and end point
- thinking that an oxidation necessarily involves a reaction with oxygen and/or addition of an atom of oxygen to the formula
- thinking that all atoms of the same element must have the same oxidation number and that this number is uniquely related to the atom's location in the periodic table
- not realizing the equivalence point of a titration is the point where the stoichiometrically correct number of moles of each reactant is present and the end point of a titration is the point where the indicator changes and that they are not the same even though we choose an indicator that will change as close to the equivalence point as possible

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<u>**CHAPTER 5 Learning Outcomes**</u>: Students will be able to:

5.1 Breathing: Putting Pressure to Work

- Define pressure and understand how differences in pressure lead to the act of breathing.

5.2 Pressure: The Result of Molecular Collisions

- Understand pressure from a molecular point of view.
- Understand examples of pressure: wind and pressure imbalance on the eardrum.
- Understand why pressure can be measured in mm of Hg, and convert between the different pressure units.
- Understand the origin of the two numbers for blood pressure.

5.3 The Simple Gas Laws: Boyle's Law, Charles's Law, and Avogadro's Law

- Know and be able to rationalize Boyle's law, the inverse relationship between volume and pressure.
- Use the inverse mathematical relationship between pressure and volume to solve initial and final states problems at constant temperature and amount.
- Know and be able to rationalize Charles's law, the direct relationship between volume and temperature.
- Use the direct mathematical relationship between volume and temperature to solve initial and final states problems at constant pressure and amount.
- Know and be able to rationalize Avogadro's law, the direct relationship between volume and amount (moles).
- Use the direct mathematical relationship between volume and amount to solve initial and final states problems at constant pressure and temperature.

5.4 The Ideal Gas Law

- Know and understand how the ideal gas law combines the three simple gas laws into one equation.
- Calculate using the ideal gas law and the gas constant, *R*, with the appropriate value and units.

5.5 Applications of the Ideal Gas Law: Molar Volume, Density, and Molar Mass of a Gas

- Define standard temperature and pressure and molar volume of an ideal gas.
- Know and understand the relationship between molar volume, molar mass, and density.
- Calculate using density, molar mass, and molar volume.

5.6 Mixtures of Gases and Partial Pressures

- Define and understand partial pressure of a gaseous component in a mixture.
- Define and determine mole fraction of a component in a mixture.
- Know and understand that Dalton's law of partial pressures relates to mole fraction of a gas to the partial pressure of the gas.
- Understand how the total pressure affects the partial pressures of gases in blood, especially during deep-sea diving.
- Know and understand the technique of collecting gases over water.

5.7 Gases in Chemical Reactions: Stoichiometry Revisited

- Understand how stoichiometry applies to gases via the number of moles in the ideal gas law.
- Understand how stoichiometry relates to molar volume.

5.8 Kinetic Molecular Theory: A Model for Gases

- Define kinetic molecular theory for gases.
- Understand each of the three postulates/assumptions of the kinetic molecular theory.
- Understand how the kinetic molecular theory explains Boyle's, Charles's, Avogadro's, and Dalton's laws.
- Follow the derivation of the ideal gas law from the kinetic molecular theory.
- Understand that all gases at the same temperature have the same kinetic energy, and understand the relationship between speed and molar mass.
- Understand the graphical representation of the distribution of molecular speeds.

5.9 Mean Free Path, Diffusion, and Effusion of Gases

- Define and understand *mean free path*.
- Define diffusion and effusion and understand how they are related to the kinetic molecular theory.

5.10 Real Gases: The Effects of Size and Intermolecular Forces

- Understand that the ideal gas law is an approximation that works well under certain circumstances and not so well at low temperature and/or high pressure.
- Understand that nonideal behavior arises from the finite volume of gas particles and the intermolecular forces between particles.
- Recognize and identify the components of the van der Waals equation.

Impediments to avoid to achieve CHAPTER 5 Learning Outcomes:

- forgetting to use temperature in Kelvin in gas problems
- because there are several systems of units, using ideal gas constants with units inconsistent with values
- confusing the standard conditions for gas behavior (STP) with the standard conditions in thermodynamics
- not recognizing that ideal gas behavior should discussed as just that, ideal, and not recognizing that real gases do not behave ideally, especially at high pressures and/or low temperatures
- expecting a change in the gas particle distribution upon temperature changes at constant V
- confusing effusion and diffusion

CHAPTER 6 Learning Outcomes: Students will be able to:

6.1 Chemical Hand Warmers

- Define thermochemistry.
- Understand the idea of heat exchange as a flow of energy.

6.2 The Nature of Energy: Key Definitions

- Define energy, work, heat, kinetic energy, thermal energy, potential energy, and chemical energy.
- Understand the difference between kinetic and potential energy and know why thermal energy and chemical energy are examples of each, respectively.
- Know the law of conservation of energy.
- Understand the difference between the system and the surroundings.
- Know and convert between the common units of energy: joule, calorie, kilocalorie, kilowatt-hour.

6.3 The First Law of Thermodynamics: There Is No Free Lunch

- Define and understand thermodynamics and the first law of thermodynamics.
- Understand why a perpetual motion machine violates the first law of thermodynamics.
- Define and understand internal energy and state function.
- Understand the flow of energy, as work or heat, from the standpoint of the system and the surroundings.
- Understand that energy lost by the surroundings is equal to the energy gained by the system and vice versa.
- Understand the mathematical definition of the first law of thermodynamics in terms of the change in internal energy, heat, and work.
- Understand the sign conventions for heat, work, and the change in internal energy.

6.4 Quantifying Heat and Work

- Define and understand thermal equilibrium.
- Define and understand heat capacity, specific heat capacity, and molar heat capacity.
- Understand the equation that relates heat flow to the amount of substance, the specific heat capacity, and the temperature change.
- Calculate using the equation relating heat flow and temperature change in terms of both the system and the surroundings.
- Define and understand pressure-volume work.
- Understand and use the equation for work in terms of the pressure and volume change.

6.5 Measuring ΔE for Chemical Reactions: Constant-Volume Calorimetry

- Understand how constant-volume calorimetry is used to measure the exchange of energy between system and surroundings in terms of the heat flow.
- Calculate the heat released from reactions in a bomb calorimeter.

6.6 Enthalpy: The Heat Evolved in a Chemical Reaction at Constant Pressure

- Define enthalpy in terms of internal energy, pressure, and volume.
- Understand that the change in enthalpy for a reaction or process is equal to the heat flow under constant pressure.
- Define and understand endothermic and exothermic reactions.
- Understand the molecular view of endothermic and exothermic reactions.
- Define enthalpy of reaction.
- Understand and calculate enthalpy changes with respect to the stoichiometry of chemical equations.

6.7 Constant-Pressure Calorimetry: Meassuring ΔH_{rxn}

- Describe and understand the coffee-cup calorimeter and how it can measure the enthalpy change for a chemical reaction or physical process.
- Understand and calculate enthalpy changes for reactions in a coffee-cup calorimeter.
- Understand the difference between constant-volume and constant-pressure calorimetry.

6.8 Relationships Involving ΔH_{rxn}

- Know, understand, and calculate using reaction enthalpies: multiplying a chemical equation by a factor, reversing a chemical equation, and summing a series of chemical equations.
- Understand the use of Hess's law to calculate the enthalpy change for a reaction from a series of steps.

6.9 Determining Enthalpies of Reaction from Standard Enthalpies of Formation

- Define and understand standard state and standard enthalpy of formation.
- Write thermochemical equations for the formation of compounds.
- Understand the equation for calculating the enthalpy of reaction from enthalpies of formation as an illustration of Hess's law.
- Calculate the enthalpy of reaction using enthalpies of formation of products and reactants.

6.10 Energy Use and the Environment

- Know about energy consumption in the U.S.: sources and uses.
- Know about environmental problems associated with fossil fuel combustion.
- Understand and perform calculations involving the combustion of fossil fuels and the formation of carbon dioxide.
- Know about potential alternative fuels, especially renewable energy sources.

Impediments to avoid to achieve CHAPTER 6 Learning Outcomes:

- confusing power and energy
- confusing heat with temperature
- failing to note that the first law of thermodynamics is the law of conservation of energy
- having difficulty determining what constitutes the system and what constitutes the surroundings
- overcoming the problematic sign conventions (+ and -) used in thermodynamics
- not realizing that a chemical reaction carried out in an open container occurs at constant pressure
- thinking that heat is a state function since enthalpy is a state function and $\Delta H = q_p$
- not being able to tell the difference between enthalpy of a reaction ΔH_{rxn} (in kJ) and molar enthalpy (per one mole of one of the reacting species, in kJ/mol)
- not realizing that Hess' law is a consequence of the fact that enthalpy is a state function
- not knowing where a list of standard enthalpy values can be found in the text (Appendix II)
- having difficulties with calculating a value of $\Delta H_f°$ for a compound not listed in Appendix II from $\Delta H°_{rxn}$ and the available $\Delta H_f°$ values
- thinking that any reaction in which a given compound is formed, regardless of the type of reactants, should be called a formation reaction
- neglecting to notice that a formation reaction leads to a formation of 1 mole of a compound

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CHAPTER 7 Learning Outcomes: Students will be able to:

7.1 Schrödinger's Cat

- Know that the behavior of macroscopic objects like baseballs is strikingly different from the behavior of microscopic objects like electrons.
- Know that the quantum-mechanical model provides the basis for the organization of the periodic table and our understanding of chemical bonding.

7.2 The Nature of Light

- Define and understand electromagnetic radiation.
- Define and understand amplitude, wavelength, and frequency.
- Use the speed of light to convert between wavelength and frequency.
- Know the electromagnetic spectrum and its different forms of radiation.
- Know and understand interference and diffraction and how they demonstrate the wave nature of light.
- Know and explain the photoelectric effect and how it demonstrates the particle nature of light.
- Use equations to interconvert energy, wavelength, and frequency of electromagnetic radiation.

7.3 Atomic Spectroscopy and the Bohr Model

- Define and understand atomic spectroscopy and emission spectrum.
- Understand how the Bohr model explains the emission spectrum of hydrogen.

7.4 The Wave Nature of Matter: The de Broglie Wavelength, the Uncertainty Principle, and Indeterminacy

- Know that electrons and photons behave in similar ways: both can act as particles and as waves.
- Know that photons and electrons, even when viewed as streams of particles, still display diffraction and interference patterns in a double-slit experiment.
- Use de Broglie's relation to interconvert wavelength, mass, and velocity.
- Know the complementarity of position and velocity through Heisenberg's uncertainty principle.
- Know the similarities and differences in classical and quantum-mechanical concepts of trajectory.
- Differentiate between deterministic and indeterminacy.

7.5 Quantum Mechanics and the Atom

- Define orbital and wave function.
- Know that the Schrödinger equation is the ultimate source of energies and orbitals for electrons in atoms.
- Know the properties and allowed values of the principal quantum number, *n*.
- Know the properties, allowed values, and letter designations of the angular momentum quantum number, *l*.
- Know the properties and allowed values of the magnetic quantum number, m_l.
- Know and understand how atomic spectroscopy defines the energy levels of electrons in the hydrogen atom.
- Calculate the energies and wavelengths of emitted and absorbed photons for hydrogen.

7.6 The Shapes of Atomic Orbitals

- Define probability density and radial distribution function.
- Define and understand node.
- Identify the number of nodes in a radial distribution function for an *s* orbital.
- Know the shapes of *s*, *p*, *d*, and *f* orbitals and the relationships to quantum numbers.
- Know that the shape of an atom is dictated by the combined shapes of the collection of orbitals for that atom.
- Define and understand phase.

Impediments to avoid to achieve CHAPTER 7 Learning Outcomes:

- having difficulty converting between angstroms, nanometers, etc. and meters
- having difficulty switching from the language of certainties to the language of probabilities
- being put off by the mathematics, vocabulary, foreign names, and an apparent intangibility of the information
- being unaware that the quantum theory laid foundations for such areas as spectroscopy and nanotechnology, just to mention a few
- confusing Bohr's orbits with orbitals; most spellcheckers do not recognize the word "orbital"
- mistakenly thinking that spectral lines represent energy levels
- having difficulty associating a given line in an emission (or absorption) spectrum with a transition between two energy levels
- drawing 2, 6, 10, and 14 "boxes" in orbital diagrams for s, p, d, and f orbitals, respectively

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CHAPTER 8 Learning Outcomes: Students will be able to:

8.1 Nerve Signal Transmission

- Know that the ions of sodium and potassium, two Group 1A elements, play major roles in nerve-signal transmission.
- Know that the sodium-potassium pumps in cell membranes can distinguish between Na^+ and K^+ because of each ion's radius, one of the most prevalent periodic trends.

8.2 The Development of the Periodic Table

- Know that the rapid discovery of new elements in the 19th century resulted in several scientists' efforts to categorize all known elements.
- Know that Mendeleev organized the modern form of the periodic table in order to group together elements with similar characteristics.
- Know and understand that the periodic law summarizes the behavior of the elements—arranging them by atomic number results in strong correlation with elemental properties.

8.3 Electron Configurations: How Electrons Occupy Orbitals

- Know and understand that an electron configuration shows the number of electrons that occupy particular orbitals in atoms and is the basis for chemical reactivity.
- Know that the spin quantum number, m_s, can have values of +1/2 and –1/2.
- Know the Pauli exclusion principle: No two electrons in an atom can have the same four quantum numbers. Consequently, a maximum of two electrons can occupy a given orbital, and if two electrons occupy the same orbital, they have opposite spins.
- Understand that the sublevels within a given principal energy level are, from lowest energy to highest, $s < p < d < f$.
- Understand the general principles of electron shielding and orbital penetration.
- Write electron configurations.

8.4 Electron Configurations, Valence Electrons, and the Periodic Table

- Define valence and core electrons.
- Know the *s*, *p*, *d*, and *f* blocks of the periodic table.
- Use the periodic table to predict electron configurations.

8.5 The Explanatory Power of the Quantum-Mechanical Model
- Understand that many of the chemical properties of elements are due to the number of valence electrons and that elements in the same group have the same number of valence electrons.

8.6 Periodic Trends in the Size of Atoms and Effective Nuclear Charge
- Know the definitions and differences among van der Waals, covalent, and atomic radii.
- Know and predict trends in atomic radius down a group (larger radius) and to the right across a period (smaller radius).
- Use the ideas of screening and effective nuclear charge to explain the trends for atomic radius.
- Know that the radii of transition elements remain approximately constant across each period.

8.7 Ions: Electron Configurations, Magnetic Properties, Ionic Radii, and Ionization Energy
- Know how to write electron configurations for ions. For anions, extra electrons are simply filled in. For cations, electrons are removed from the highest sublevel of the highest principal energy level.
- Identify and distinguish between paramagnetic and diamagnetic atoms/ions.
- Know the relationship between the radius of a neutral atom and its ions: cations are smaller while anions are larger than the corresponding neutral atom.
- Know and predict trends in first ionization energy down a group (smaller ionization energy) and to the right across a period (larger ionization energy).
- Use the ideas of screening and effective nuclear charge to explain the trends for ionization energy.
- Understand trends in second and successive ionization energies with respect to the noble-gas core.

8.8 Electron Affinities and Metallic Character
- Define and understand the basic trend for electron affinity: It generally gets less exothermic down a group and more exothermic to the right across a period.
- Know the periodic trends in metallic character: It increases down a group and decreases to the right across a period.

8.9 Some Examples of Periodic Chemical Behavior: The Alkali Metals, the Halogens, and the Noble Gases
- Know the names, periodic trends, and representative chemical reactions of the elements of a few groups: Group 1A (alkali metals), Group 2A (alkaline earth metals), Group 7A (halogens), and Group 8A (noble gases).

<u>Impediments to avoid to achieve CHAPTER 8 Learning Outcomes:</u>
- having difficulty with the concepts of shielding and effective nuclear charge, and not recognizing that, as you move to the right in a period, shielding does not increase appreciably but the nuclear charge does, so the effective nuclear charge increases steadily as you move to the right along the period
- confusing why, within a period, atomic radii decrease with increasing atomic number
- not understanding slight irregularities in periodic trends for elements in each row after each ns subshell becomes filled, and after np and (n – 1)d subshells become half-filled
- having problems with the signs of electron affinities; in particular, why group 1A metals have negative (exothermic) electronegativities
- confusing the placement of hydrogen on the periodic table, and recognizing that, despite its common placement in column 1A, hydrogen is a nonmetal
- confusing behavior of elements in aqueous phase with periodic properties determined in gas phase (ionization energy, electron affinity) or in solid phase (ionic radius)
- confusing isoelectronic species with those with the same number of valence electrons

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<u>CHAPTER 9 Learning Outcomes</u>: Students will be able to:

9.1 Bonding Models and AIDS Drugs
- Know that X-ray crystallography was used to characterize the structure of HIV-protease, a biomolecule critical to the reproduction of HIV.
- Know that Lewis structures are simple predictors of how atoms combine to form ionic compounds and molecules.

9.2 Types of Chemical Bonds
- Know and understand that chemical bonds form because they lower the potential energy between the charged particles in the constituent atoms.
- Define and understand ionic bond, covalent bond, and metallic bonding.

9.3 Representing Valence Electrons with Dots
- Know that valence electrons can be represented with dots around an element symbol.
- Identify and draw atoms with their valence electrons represented as dots.
- Know that Lewis theory involves the sharing or transfer of electrons.
- Define and know the octet rule.

9.4 Ionic Bonding: Lewis Structures and Lattice Energies
- Draw Lewis structures of ionic compounds containing main-group elements.
- Understand that the formation of an ionic compound from neutral atoms is exothermic—the amount of energy released is largely due to lattice energy.
- Know that the Born-Haber cycle is a way of accounting for the energetics of each of the steps in the formation of an ionic compound from its constituent elements.
- Use a Born-Haber cycle to calculate the lattice energy of an ionic compound.
- Know that lattice energy decreases for larger ions and increases with increasing charge.
- Understand why ionic solids are poor electrical conductors while ionic liquids and aqueous solutions of ionic compounds are good electrical conductors.

9.5 Covalent Bonding: Lewis Structures

- Know that most nonmetal atoms prefer to be surrounded by eight valence electrons, but hydrogen requires only two.
- Understand that in Lewis theory, a pair of electrons, one from each of two atoms, forms a bond or bonding pair that helps each atom achieve an octet. The two atoms can also share two pairs of electrons (a double bond) or three pairs of electrons (triple bond).
- Identify and draw covalent compounds with single, double, and triple bonds between constituent atoms.

9.6 Electronegativity and Bond Polarity

- Know and understand that a pair of electrons does not have to be shared equally between two atoms. Unequal sharing results in a polar covalent bond.
- Define electronegativity and know its periodic trends.
- Understand that bonds can range from a nonpolar covalent bond to a polar covalent bond to an ionic bond depending on the difference in electronegativity between the two atoms.
- Define dipole moment and percent ionic character.

9.7 Lewis Structures of Molecular Compounds and Polyatomic Ions

- Draw Lewis structures for molecular compounds and polyatomic ions.

9.8 Resonance and Formal Charge

- Define resonance structures and understand how Lewis structures represent the individual and the hybrid structures.
- Define formal charge and understand how to calculate it for the atoms in a Lewis structure.

9.9 Exceptions to the Octet Rule: Odd-Electron Species, Incomplete Octets, and Expanded Octets

- Draw Lewis structures for odd-electron species.
- Draw Lewis structures for molecules containing atoms with incomplete octets.
- Draw Lewis structures for molecules containing atoms with expanded octets.
- Understand why the second-period elements cannot have expanded octets.

9.10 Bond Energies and Bond Lengths

- Define bond energy.
- Estimate reaction enthalpies using average bond energies for all bonds broken and formed in a chemical reaction.
- Understand the inverse relationship between bond length and bond strength.

9.11 Bonding in Metals: The Electron Sea Model

- Understand how the electron sea model accounts for the general macroscopic properties of metals.

Impediments to avoid to achieve CHAPTER 9 Learning Outcomes:

- thinking that a triple bond is three times as strong as a single bond, and not recognizing that the second and third bonds (π bonds) are weaker than the first (σ bond)
- confusing formal charges with real charges on atoms
- using the resonance arrow ↔ to indicate equilibrium
- not appreciating that the exceptions to the octet rule are almost as common as the examples of substances that obey it
- confusing the octet rule with having any 8 valence electrons (e.g., $4s^2$ $3d^6$ for iron)
- thinking that all polar substances conduct electricity

CHAPTER 10 Learning Outcomes: Students will be able to:

10.1 Artificial Sweeteners: Fooled by Molecular Shape

- Know and understand that energy content and taste are due to microscopic properties related to structure but are independent of each other.
- Know that taste depends a great deal on the three-dimensional structures of food molecules.
- Know that a simple model to determine and predict molecular shapes is VSEPR theory, valence shell electron pair repulsion theory.

10.2 VSEPR Theory: The Five Basic Shapes

- Know and understand that VSEPR theory is based on electron groups that repel each other.
- Know that VSEPR predicts five basic shapes according to the number of electron groups surrounding a central atom: linear (2), trigonal planar (3), tetrahedral(4), trigonal bipyramidal (5), and octahedral (6).
- Know the bond angles for each basic shape.
- Recognize molecules in their correct shapes based on their number of electron groups.

10.3 VSEPR Theory: The Effect of Lone Pairs

- Understand the difference between electron geometry and molecular geometry.
- Know and understand the effect of lone pair electrons on molecular geometry with respect to shape and bond angle.
- Know the different molecular geometries that arise from tetrahedral, trigonal bipyramidal, and octahedral electron geometries.

10.4 VSEPR Theory: Predicting Molecular Geometries

- Know the procedures for predicting and drawing molecular geometries.
- Predict and draw the electron and molecular geometries for molecules, including molecules with more than one central atom.

10.5 Molecular Shape and Polarity

- Identify polar bonds in molecules based on ΔEN.
- Understand how polar bonds translate into net dipole moments for molecules.
- Know and understand how vector addition is used to predict net dipole moments.
- Understand how microscopic polarity results in macroscopic properties of molecules, e.g. the immiscibility of water and oil.

10.6 Valence Bond Theory: Orbital Overlap as a Covalent Bond

- Understand an interaction energy diagram for the formation of bonds with respect to internuclear distance.
- Know and understand how the overlap of atomic orbitals leads to bonds and how this is explained by valence bond theory.

10.7 Valence Bond Theory: Hybridization of Atomic Orbitals

- Define and understand hybridization and the role of atomic orbitals.
- Know and understand the common types of hybridization: sp^3, sp^2, and *sp*.
- Know the hybridizations for expanded octets: sp^3d and sp^3d^2.
- Know how to predict hybridization and draw valence bond models of molecules.

10.8 Molecular Orbital Theory: Electron Delocalization

- Know the basis for molecular orbital theory.
- Know and understand how linear combinations of atomic orbitals (LCAO) form molecular orbitals.
- Define bonding orbital and antibonding orbital and understand the differences between the two.
- Predict and draw molecular orbital diagrams.
- Understand that molecular orbital theory provides the best explanation of the paramagnetism of O_2 and provides the best model for electron delocalization in molecules.

<u>Impediments to avoid to achieve CHAPTER 10 Learning Outcomes:</u>

- finding it difficult to think in three dimensions or believing that a square planar arrangement is the best arrangement for the least repulsion of four electron domains
- confusing the electron domain geometry and the molecular geometry (shape)
- not realizing that in order to determine whether a molecule is polar, the correct molecular geometry needs to be established
- not realizing that large molecules with several central atoms do not have easily describable molecular shapes and not realizing the geometry about each central atom has to be determined individually
- finding it difficult to understand how a molecule with polar bonds can be nonpolar; possibly needing a review of basic vector algebra to illustrate how the net dipole is derived
- attempting to determine polarity of ions
- not realizing that hybridization is related to the electron-domain geometry, not the molecular geometry
- not realizing that in wave mechanics bonding orbitals result from constructive interference and antibonding orbitals form destructive interference

<u>CHAPTER 11 Learning Outcomes</u>: Students will be able to:

11.1 Climbing Geckos and Intermolecular Forces

- Know that intermolecular forces are attractive forces between individual molecules.
- Know that the gecko's ability to climb smooth surfaces is due to intermolecular forces.

11.2 Solids, Liquids, and Gases: A Molecular Comparison

- Know the properties that differentiate the phases of matter: density, molar volume, molecular shape, and strength of intermolecular forces.
- Define crystalline and amorphous and recognize the difference in solids.
- Know that both temperature and pressure can affect phase changes.

11.3 Intermolecular Forces: The Forces That Hold Condensed States Together

- Know and understand that intermolecular forces originate from the interactions between charges, partial charges, and temporary charges on molecules, atoms, and ions.

- Know how Coulomb's law describes the mathematical relationship between energy of attraction, magnitude of charge, and distance.
- Know and understand that dispersion (London) forces result from fluctuations of electron distribution within molecules and atoms.
- Identify and predict how the shape and sizes of molecules or atoms affects the magnitude of dispersion forces the particles exhibit as well as macroscopic physical properties like boiling point.
- Know and understand that polar molecules have permanent dipoles that attract each other through dipole-dipole interactions.
- Know and understand the phenomenon of hydrogen bonding.
- Predict the ability of molecules to exhibit hydrogen bonding.
- Recognize hydrogen bonding as the force that holds double-stranded DNA together.
- Rank a series of molecular compounds with respect to boiling point.
- Know and understand that the interaction of ions and dipoles leads to the dissolution and solvation of ions by water and other polar liquids.

11.4 Intermolecular Forces in Action: Surface Tension, Viscosity, and Capillary Action
- Know and understand that surface tension is due to intermolecular forces.
- Describe examples of surface tension.
- Know and understand that viscosity is due to intermolecular forces, mass, shape, and length.
- Know and understand that capillary action is the result of both cohesive and adhesive forces.

11.5 Vaporization and Vapor Pressure
- Understand the process of vaporization and how it changes with temperature, surface area, and the degree of intermolecular forces.
- Understand that molecules or atoms have a distribution of thermal energies that changes as a function of temperature.
- Know that the heat of vaporization, ΔH_{vap}, is a quantitative measure for the process of vaporization.
- Calculate and interconvert mass, moles, and energy using the heat of vaporization.
- Know and understand how vapor pressure and dynamic equilibrium dictate vaporization and condensation.
- Know that the vapor pressure of a liquid depends on temperature and that the boiling point of a liquid depends on the external pressure.
- Use the Clausius-Clapeyron equation to relate temperature and vapor pressure.
- Define critical temperature and critical pressure.

11.6 Sublimation and Fusion
- Define and understand sublimation and deposition.
- Define and understand fusion in the context of phase changes.
- Use the heat of fusion, ΔH_{fus} in calculations involving energy, masses, and moles.

11.7 Heating Curve for Water
- Understand the different segments in the heating curve for H_2O that ranges from below the melting point to above the boiling point.
- Calculate the energy changes associated with heating a substance (like H_2O) through a series of temperature changes and phase changes.

11.8 Phase Diagrams
- Know that a phase diagram relates the states of matter for a substance to temperature and pressure.
- Identify the main regions and significant points in a phase diagram.
- Understand the effect of changes in temperature and changes in pressure on the phase of a substance as shown by its phase diagram.

11.9 Water: An Extraordinary Substance
- Know that water has unique properties compared with similar molecules based on size, constituent atoms, and molar mass.
- Know that the unique properties of water are attributable to hydrogen bonding.

11.10 Crystalline Solids: Determining Their Structure by X-Ray Crystallography
- Recall that waves can interfere constructively and destructively.
- Know that X-rays diffract when interacting with the atoms in crystalline solids, forming diffraction patterns.
- Know that diffraction patterns can be analyzed and used to identify the three-dimensional structure of the atoms or molecules in a crystalline solid.
- Use Bragg's law to calculate the relationship between the distance between crystalline layers, the wavelength of electromagnetic radiation, and the angle of reflection.

11.11 Crystalline Solids: Unit Cells and Basic Structures
- Define and identify unit cells.
- Know and identify the cubic crystalline lattice types: simple, body-centered, and face-centered.
- Identify the kind of unit cell, the coordination number, and the edge length for the three cubic crystalline lattice types.
- Use the kind of unit cell and the radius of an atom to calculate the density of a metal.
- Identify the hexagonal and cubic closest-packing structures, and know their unit cells and component layers.

11.12 Crystalline Solids: The Fundamental Types

- Know the organization of crystalline solids—molecular, ionic, and atomic—including basic properties and examples.
- Know and identify constituent atoms, lattice types, and unit cells for some common ionic solids: CsCl, NaCl, ZnS, and CaF_2.
- Know and identify atomic solid types—nonbonding, metallic, and network covalent—and some of their properties and examples.

11.13 Crystalline Solids: Band Theory

- Know that the organization of conduction and valence bands of molecular orbitals forms the basis for conductors, semiconductors, and insulators.

Impediments to avoid to achieve CHAPTER 11 Learning Outcomes:

- confusing intermolecular and intramolecular forces
- not appreciating how important information from earlier chapters is for the understanding of concepts in this chapter
- having difficulty predicting the relative strength of intermolecular forces involved in different materials
- being unaware that there can be intramolecular hydrogen bonding
- confusing cohesion and adhesion
- not realizing that, under the right set of conditions, water also sublimes
- thinking that more viscous necessarily means more dense
- thinking that the "liquid" in liquid crystals refers to these materials being pliable rather than actually being liquid

WORTH MENTIONING AGAIN!

Make sure you have a valid JJ email address listed on Blackboard. Otherwise you will not receive email announcements from your professors. Even if the email address listed for you on Blackboard is not correct you are responsible for all emails sent to the class via Blackboard. Check and, if necessary, update your profile on Blackboard today.

When emailing your professor,

- **use a meaningful subject line starting with the course and section, such as "Che 103-04 Question about MasteringChemistry password."**
- **include your full name in the body of EVERY email you write related to this course.**

Attendance and punctuality counts.

Keep up with the MasteringChemistry homework.

Yes, the homework is graded and can make a significant difference in your course grade.

Bring the chapter under discussion and your approved calculator with you to class every day.

Take care of the clicker assigned you. You will have to replace it if it is damaged, lost or stolen.

The provisions of this syllabus will be strictly enforced. Keep a copy of this syllabus with you when at the college and refer to it often.

If you don't have safety glasses for labwork or arrive after safety instructions have been discussed, you will be marked absent for the lab.

Help us help you succeed. Study each chapter by reading it at least twice before class, do as much online homework as you can, show up on time prepared, participate in class, ask questions as needed, and then re-read each chapter at least two more times after the lecture and finish the homework.

Study, study and then study some more. The more you study the "luckier" you will be on the next exam.

Prerequisites
Open to students who have received a grade higher than C in high school chemistry or who received a grade of at least 80% on the Chemistry Regents. Co-requisite: MAT 141 or MAT 105 . Not open to students who completed CHE 102 or CHE 192.

GRADING POLICY: This five credit course has three components-- lecture, recitation, and laboratory. Each component has a separate grading policy which contributes a percentage to the overall course grade. In general, the course grade is the sum of the grades earned in the lecture (70%), recitation (5%) and lab (25%) sessions, plus, if applicable, 10% of an American Chemical Society (ACS) exam grade. However, since the lab sessions are an integrated component of the course, where lab safety skills and dexterity are taught for use in subsequent science courses, for safety reasons, a minimum lab grade of 60.00% is required to pass the course. Unethical/unprofessional conduct will result in a failing course grade and referral for additional action. Deviation from this syllabus, which represents a contract, are not permitted except in extraordinary circumstances applicable to all sections. A TI-30 model calculator is required for this course. See calculator details in this syllabus. Students not seated along a wall may use a tablet or laptop in the classroom but only to view their e-book, class PowerPoints, or take notes. Students using a computer along a wall or viewing social media or non-chemistry related data during class time even for a short period of time will be marked absent and may be subject to other sanctions.

Lecture: Four lecture exams will be given. The lowest grade on the first three exams is dropped and each of the grades on the remaining two exams constitute 20% of the course grade (40% for both). There are no make-up exams. The policy of dropping one exam was instituted to accommodate absence and extraneous circumstances resulting in an uncharacteristically poor performance. During final exam week a fourth lecture exam is given that counts as 30% percent of the course grade. The grade on the fourth exam cannot be "dropped." Students may earn 5% of their Exam 4 grade added to their Exam 4 grade by achieving an in lecture correct clicker response grade of at least 75% for the semester. After week one, students who do not bring the required clicker to a class and use it when requested will be marked absent.

Recitation: Recitation constitutes 5% of the course grade, based on successfully completing twelve of fourteen online homework assignments by their due dates, as well as attendance and meaningful participation in the recitation sessions. Active participation during the recitation sessions by all students benefits all students, providing varying approaches to mastering the subject material, incentive for success, and progress evaluation. Consequently, attendance and participation are NOT optional. Each excessive absence (more than two) or failure to meaningfully participate in recitation sessions will result in a 10% reduction per occurrence of the grade total earned on the assigned online homeworks. After week one, students who do not bring the required clicker to a class and use it when requested will be marked absent.

Laboratory: The final laboratory grade is based on two factors: (1) the comprehensive lab final (which tests mastery of the theoretical and practical aspects of the assigned laboratory exercises) and (2) a "performance" factor (0.00 - 1.00). The lab grade is calculated by multiplying the lab exam score (0-25.0 pts) by the performance factor. To be objective, the performance factor will be 1.00 unless a safety rule is violated, instructions are not followed, there are excessive absences (more than two), lab equipment is lost or broken, an approved calculator is not used, participation is not meaningful or a completed ASA is not submitted when requested. There is a severe (5%) performance factor penalty for each violation. The clarity of any written explanations needed to answer questions on the ASA or handouts will be graded. Any lab keys or equipment issued must be personally returned to the Lab Technician by the last day of classes to avoid a significant performance factor penalty, an SC registration stop being imposed, and "IN" grade. Before a letter grade is issued, missing, lost or stolen lab keys must be replaced. "IN" grades automatically convert permanently to "F" if not timely resolved.

Overall Grade: The lab grade (25.00 pts max) is added to the lecture (70.00 pts max) and recitation (5.00 pts max) grades. If the total is a passing grade, 10% of the ACS grade is added, producing the final course grade.

American Chemical Society (ACS) Exam: A national ACS exam will be administered on Department Exam Day only. There are no make-ups. 10% of the grade earned on the exam will be added to the course grade if it is a passing course grade. The ACS exam grade cannot be used to raise a failing course grade to a passing course grade, but it can be used to increase a passing grade to a higher passing grade. Letter grades for the course will then be assigned based on the letter grade criteria in the 2005-2007 Undergraduate Bulletin. The letter grade criteria is also posted on the course's Blackboard Web site.

ATTENDANCE POLICY: Students enrolled in this course are *required* to attend all lecture, recitation and laboratory sessions of the section for which they registered. In general, there are two one period lecture sessions, a one period recitation session and a two period laboratory session each week. (During summer session, two weeks of classes are covered each calendar week.) Excessive absences (defined above) will result in a reduction in the grade. Attendance is taken solely from roll sheets circulated at the beginning and/or end of each session. Lateness or early departure (resulting in missing no more than 15 minutes of a session) counts as ½ absence. Students missing more than 15 minutes of a session will be counted as absent. If the college is officially closed, thereby canceling all classes, an announcement will be found on 237-8000, and broadcast on AM stations WINS (1010), WOR (710), WCBS (880), WADD (1280), WMCA (570), WLIB (1190), and WFAS (1230), as well as FM stations WCBS (101.1) and WBLS (107.5). If a class will be cancelled for extraordinary circumstances, the instructor will email an announcement using Blackboard to enrolled students as soon as practicable. This has not happened in recent memory.

ACTIVE COLLEGE E-MAIL/BLACKBOARD ACCOUNT REQUIRED: Students are expected to maintain active and accessible college email and Blackboard accounts. Blackboard will be used to send emails and may be used to post announcements, handouts, additional study materials, text supplements, grades, etc. Use the CUNY Portal Login page help features for a forgotten username or password, or contact DoIT, 212-237-8200 for other help. Verify your CUNY email address is correctly listed on Blackboard and keep the mailbox from filling up and refusing delivery, because you will be responsible for the contents of any email sent to that account. When emailing instructors for this course, start the email's subject line with the course and section number (e.g., Che 103-01) followed by a brief description. Include your full name in the body of every email. Emails that do not contain these descriptive details may be considered spam, and remain unopened and unanswered. Students are expected to check email regularly.

TUTORING: Although a considerable amount of remediation is done during the course, when necessary students are encouraged to attend-- on a first come, first served basis—free tutoring offered to students requesting such help. Scheduled weekly or biweekly appointments are encouraged. "Crash" sessions immediately before an exam are discouraged. A student who fails an exam (less than 60.00%) is required to sign into and attend at least one hour of tutoring weekly until the next exam. An additional hour of tutoring is required for every seven days, or part thereof, homework is past due. (The homework must still be completed.) Failure to sign in and attend required tutoring and provide attendance documentation counts as a recitation absence per occurrence. Attendance at tutoring is automatically forwarded to the instructor by the Math and Science Resource Center.

HOMEWORK: Graded online MasteringChemistry® (**MC**) assignments must be successfully completed by their due dates to receive full credit. Some credit will be awarded for late assignments. Frankly, the knowledge you gain by doing the assignments, even if late, justifies the effort even if no credit were awarded. You will be emailed (using Blackboard) your MasteringChemistry course code which you will use to register for your specific course and section on MasteringChemistry. You may switch sections on MasteringChemistry later but all your homework data and grades up to that point will be lost, so register correctly the first time. Use your JJ email address as your Login ID. Although more information will be sent to you in an email, for now please do not use your SSN anywhere on the site. Homework is also shown on this syllabus. The exercises at the back of each chapter in the text are grouped by topic. Do as many red numbered textbook problems in each group as possible. The answers at the back of the book should only be used after a thorough attempt at answering each problem has been made. Much is learned from the struggle to derive the correct answer. Much is lost by simply seeing "how the book does it." You may do the MasteringChemistry problems before or after the textbook problems. Be prepared to provide answers in recitation to exercises similar to those listed as homework in this syllabus. We have made great effort to ensure that ample tools are available to help students succeed in this course, if the tools are used diligently.

WRITING ACROSS THE CURRICULUM (WATC): Reports written by Forensic Scientists must be clear, concise, and unambiguous. Consequently, where a homework assignment requires a written explanation, spelling, grammar, and clarity of expression will be considered in determining the "correctness" of the answer proffered. It is important that careful attention is directed to writing what you mean and meaning what you write.

STUDENTS WITH DISABILITIES: Qualified students with disabilities will be provided reasonable academic accommodations if determined appropriate by the Office of Accessibility Services (OAS), 212-237-8031, located in room L.66.00. Prior to granting disability accommodations, verification of a student's eligibility must be timely received from OAS by the chemistry course coordinator, Professor Francis Sheehan (FSheehan@jjay.cuny.edu), and the instructor, from the OAS. It is the student's responsibility to initiate contact with the OAS and to follow the established procedures for having the accommodation notice sent to both the course coordinator and the instructor.

ACADEMIC INTEGRITY: Students who succeed in this course and graduate with a degree in Forensic Science may be hired by government or private agencies to analyze evidence and testify in a court of law, placing in jeopardy another person's reputation and/or liberty. Dishonesty of any kind cannot and will not be tolerated. Students are expected to become thoroughly aware of the "John Jay College Policy on Academic Integrity" (and other college policies), available on the college's Web site. Sanctions to the extent permitted by the policy will be imposed and any written material submitted may be transmitted by the instructor to Turnitin.com (or equivalent service) to help analyze its originality. See the Undergraduate Bulletin for the College's Policy on Plagiarism and Cheating, which will be strictly enforced. Plagiarism includes copying ASA or homework answers from others. A handout will be provided you so that there will be no misunderstanding of what constitutes plagiarism. You are required to do your own work to avoid severe grade and disciplinary penalties. Use of a headset at any time is prohibited. The College subscribes to Turnitin.com and Blackboard has a similar module called SafeAssign. Any written assignments submitted may be subject to evaluation by these or similar programs.

Statement of the College Policy on Plagiarism

Plagiarism is the presentation of someone else's ideas, words, or artistic, scientific, or technical work as one's own creation. Using the ideas or work of another is permissible only when the original author is identified. Paraphrasing and summarizing, as well as direct quotations require citations to the original source. Plagiarism may be intentional or unintentional. Lack of dishonest intent does not necessarily absolve a student of responsibility for plagiarism. It is the student's responsibility to recognize the difference between statements that are common knowledge (which do not require documentation) and restatements of the ideas of others. Paraphrase, summary, and direct quotation are acceptable forms of restatement, as long as the source is cited. Students who are unsure how and when to provide documentation are advised to consult with their instructors. The Library has free guides designed to help students with problems of documentation. (John Jay College of Criminal Justice Undergraduate Bulletin, http://www.jjay.cuny.edu/academics/654.php, see Chapter IV Academic Standards.)

Note: You will be presented with a handout called "The Perils of Plagiarism" that you will be required to read and return signed to your professor on the next meeting date.

Extra Work:

Extra work (more studying, more practice exercises) is encouraged to help you improve your performance on an *upcoming* exam or lab. The grade for the course is strictly computed as defined on the previous page. Students must focus on doing well on the standardized assessments (exams, online homework, lab work, class participation, attendance, etc.) on the assessment date stated on this syllabus. The time to do the extra work is before the exam is given and/or the lab is performed, as extra work after-the-fact is not provided. The grading policy stated herein sufficiently accommodates an unexpected absence and uncharacteristic poor performance during the semester.

Grade of Incomplete:

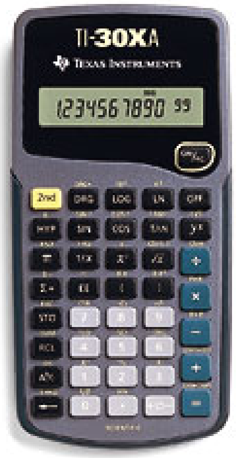
A grade of incomplete will only be issued if the student is absent from Exam 4 and/or the Lab Exam and the average of the best two of the first three exam grades applied to the missed Exam 4 and/or Lab Exam results in a passing grade. If a grade of Incomplete is assigned, it is the student's responsibility to resolve it during the following semester on the specific date published on the Undergraduate Academic Calendar on www.jjay.cuny.edu. The exam(s) must be scheduled at least two weeks in advance via email with the Chemistry Courses Coordinator (FSheehan@jjay.cuny.edu), who will administer the exam(s). The exam(s) will only be administered on the published date, except in extraordinary documented circumstances . Incompletes must be avoided because they will prevent advancement to more advanced chemistry courses the following semester since successful completion of this course is a pre-requistite for more advanced chemistry courses. Incompletes that remain unresolved after the published make-up date are automatically changed to FIN.

"SC" Science Equipment/Key Registration Stop:

If equipment is issued to you, timely return it. Did you know that an "SC" Science Equipment/Key Stop (also known as Hold) restricts students from registrating, receiving financial aid, requesting transcripts, receiving certification letter of attendance, receiving the diploma, etc.? JJC Policy Reg.017 12/15/12

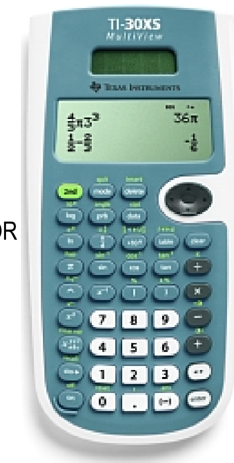
COME TO LECTURE/RECITATION PREPARED:

Do your homework. Stay up with the course material. Stay slightly ahead of the professor with your studying. You will need a blue or black ink pen to sign the attendance sheet, a TI-30 calculator, safety glasses on lab days, your notebook and any book/manual required. Although a TI-30XA is the preferred calculator for the course, any TI-30 calculator is acceptable (e.g., TI-30XA, TI-30XS, TI-30XIIS, etc.).



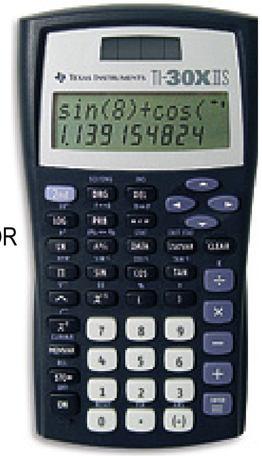
TI-30XA

OR



TI-30XS

OR

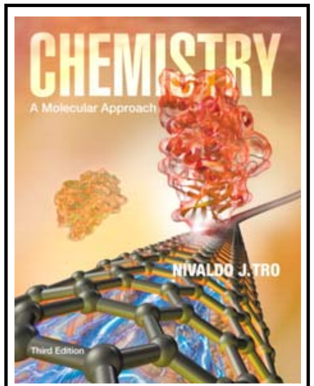


TI-30X IIS

AND

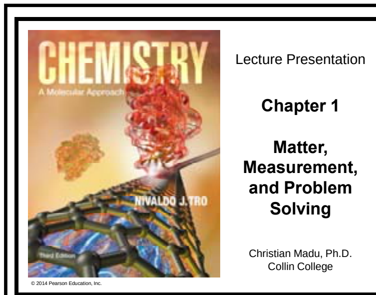
Turning Technologies NXT (RCXR-03)

AND



The chapter under discussion must be brought to class.

AND



If PowerPoint slides are used in class and posted in advance for you to download, print them and bring them to class so you may take notes on them.

COME TO LAB PREPARED:

Do the assigned Advance Study Assignment (ASA) before coming to class. Thoughly read the lab exercise to be conducted and prepare questions to ask regarding anything you don't understand about the procedure. You will need a blue or black ink pen to sign the attendance sheet, a TI-30 calculator, safety glasses on lab days, your notebook and the lab manual. Dress appropriately for lab work, as described on the safety rules. Bring your Z87.1 approved splash resistant safety glasses or goggles. You will not be allowed to be in the lab (and will be marked absent) if you are not dressed appropriately for lab (as described on the safety rules) or if you do not have and wear Z87.1 splash approved safety glasses or goggles while in the lab.

PREPARE FOR EXAMS AND THEN COME TO EXAMS PREPARED:

Study, study and then study some more. The more you study the "luckier" you will be in earning a high grade. If you are ever unsure of what to do on an exam day, check the lab door, 3.66NB, for instructions.

Arrive early:

If you don't have a class immediately prior to the exam, please arrive approximately 15 minutes before your scheduled exam. The attendance sheet will be circulated in the hallway outside the classroom. Note your seat number as you sign the attendance sheet. The seat number will be the four digit number in the middle column, immediately to the left of your signature. It will likely not be your usual seat number. Remember or write down that number, as you will need to know it when you enter the classroom.

Sit in assigned seat:

When instructed to enter the classroom, enter and sit in the seat labeled with your exam seat number.

Follow the instructions of the proctors and hallway monitors:

The proctors assigned to your classroom will walk you through these instructions. It is important that you not try to anticipate what to do next and get ahead of the proctor. Doing so will not result in more exam time. Listen carefully to what they say and follow their instructions so the exam can be promptly started.

Put all materials, including electronic devices, under your seat:

Put all materials other than a pen, pencil and your TI-30 calculator (with its case removed) under your seat. Make sure all chemistry related books, manuals, and notes, as well as rubber bands, PDAs and cell phones,[1] are placed in a closed bag or other opaque covering under your seat and not visible to you or anyone else in the room. It is your responsibility to make sure no one can gain an unfair advantage from material(s) brought with you to the college on exam day. Please note: You are not permitted to have any non-medical electronic devices, notes or other chemistry-related material on your person at any time during exams. If you do not bring a bag or other opaque covering with you on exam day to store your materials under your seat, leave the material(s) at home.

Relax:

The exam will fairly assess the chapters/topics you were told would be on the exam.

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[1] Cell phones, PDAs, and similar devices, and their accessories, may not be accessible, accessed or used during the exam for any purpose. (If truly extraordinary circumstances, such as a seriously ill family member, requires the cell phone to be on vibrate, write your name and seat# on the envelope provided by the proctor, who will store the phone on the front desk and provide it to you should it vibrate.)

Che 103 Lecture Schedule

LEC	DATE*	TOPICS / Readings	TEXTBOOK EXERCISES (Also see MC homework note on right)
1	(08/28)	Course Intro; Ethics, Science and the Scientific Method; MC	
		1.1 Atoms and Molecules	
		1.2 The Scientific Approach to Knowledge	33, 35
		1.3 The Classification of Matter	37, 39, 41
		1.4 Physical and Chemical Changes and Physical and Chemical Properties	43, 45, 47, 49
2	09/09	1.5 Energy: A Fundamental Part of Physical and Chemical Change	
		1.6 The Units of Measurement	51, 59, 67, 71
		1.7 The Reliability of a Measurement	77, 79, 83, 85, 87
		1.8 Solving Chemical Problems	89, 93, 95, 98
3	(09/11)	2.1 Imaging and Moving Individual Atoms	
		2.2 Early Ideas about the Building Blocks of Matter	
		2.3 Modern Atomic Theory and the Laws That Led to It	31, 33, 35, 39
		2.4 The Discovery of the Electron	43, 47
4	09/16	2.5 The Structure of the Atom	41
		2.6 Subatomic Particles: Protons, Neutrons, and Electrons in Atoms	53, 57, 59, 61
		2.7 Finding Patterns: The Periodic Law and the Periodic Table	63, 67, 69
		2.8 Atomic Mass: The Average Mass of an Element's Atoms	71, 75, 77
		2.9 Molar Mass: Counting Atoms by Weighing Them	83, 87, 89
5	(09/18)	3.1 Hydrogen, Oxygen, and Water	
		3.2 Chemical Bonds	2
		3.3 Representing Compounds: Chemical Formulas and Molecular Models	17, 23, 25
		3.4 An Atomic-Level View of Elements and Compounds	27, 29, 31
6	09/23	3.5 Ionic Compounds: Formulas and Names	33, 35, 37, 41, 43
		3.6 Molecular Compounds: Formulas and Names	47, 49, 51, 53
		3.7 Summary of Inorganic Nomenclature	55, 57
		3.8 Formula Mass and the Mole Concept for Compounds	59, 61, 65, 67
7	(09/25)	3.9 Composition of Compounds	71, 75, 81, 83
		3.10 Determining a Chemical Formula from Experimental Data	85, 87, 93, 95
		3.11 Writing and Balancing Chemical Equations	105, 107, 109
		3.12 Organic Compounds	111, 113, 115
8	09/30	4.1 Climate Change and the Combustion of Fossil Fuels	
		4.2 Reaction Stoichiometry: How Much Carbon Dioxide?	25, 29, 33
		4.3 Limiting Reactant, Theoretical Yield, and Percent Yield	37, 41, 45
9	(10/02)	4.4 Solution Concentration and Solution Stoichiometry	53, 55, 57, 59, 63
		4.5 Types of Aqueous Solutions and Solubility	71, 73
		4.6 Precipitation Reactions	75, 77
	10/07	**LECTURE EXAM 1**	**Chapters 1, 2 and 3**
10	(10/09)	4.7 Representing Aqueous Reactions: Molecular, Ionic & Complete Ionic Equations	79, 80, 81
		4.8 Acid-Base and Gas-Evolution Reactions	85, 87, 89
		4.9 Oxidation-Reduction Reactions	91, 93, 95, 97

Fall 2013 Semester Details

First day of clases: 8/28
No classes: 9/2, 9/4-6, 9/13-14, 10/13-14, 11/28-12/1
Last day of classes: 12/15
Reading Day: NONE
Department Exam Day: 12/16
Finals Week: 12/16 – 12/23

Occasionally due to classroom space limitations on Dept. Exam Day, another day, 12/17–12/23, is used to give General Chemistry Departmental Exams.

Do not make vacation or other plans for any part of 12/16-12/23 because exam dates are subject to change.

SYMBOLS USED IN THIS SYLLABUS
S or s = Study. Each time you see the letter it should be a reminder to study. The more you study, the "luckier" you will be come exam time.

◊ Tuesday 10/15 is a JJ Monday. Monday classes meet. Tuesday classes do not meet.

† Last day to withdraw without academic penalty is Friday, 11/08

‡ Last Day of Classes, 12/15

MC = MasteringChemistry®
= required and graded online homework.
Go to http://MasteringChemistry.com

LOANED CLICKERS – AVOIDING THE STOP

Students who drop or withdraw have 10 days from the drop or withdrawal date to return the Loaned Clicker to avoid the "SC" Science Department stop. For all others, Clickers must be returned and Loan Agreement cancelled by 12/16 at 5pm to avoid an "SC" Science Dept. equipment registration stop being imposed.

Timely Return or Replace the Clicker

LECTURE	DATE*	TOPICS / Readings	TEXTBOOK EXERCISES (Also see MChomework note on right)
11	10/15	5.1 Breathing: Putting Pressure to Work 5.2 Pressure: The Result of Molecular Collisions 5.3 The Simple Gas Laws: Boyle's Law, Charles's Law, Avogadro's Law 5.4 The Ideal Gas Law 5.5 Applications, Ideal Gas Law: Molar Volume, Density, and Molar Mass	 25, 27, 29 31, 33, 35 37, 39, 41, 45 53, 55, 57, 59
12	(10/16)	5.6 Mixtures of Gases and Partial Pressures 5.7 Gases in Chemical Reactions: Stoichiometry Revisited 5.8 Kinetic Molecular Theory: A Model for Gases 5.9 Mean Free Path, Diffusion, and Effusion of Gases 5.10 Real Gases: The Effects of Size and Intermolecular Forces	61, 63, 65, 67 71, 73, 75 81, 83 85, 87, 89 91, 92, 93
13	10/21	6.1 Chemical Hand Warmers 6.2 The Nature of Energy: Key Definitions 6.3 The First Law of Thermodynamics: There Is No Free Lunch 6.4 Quantifying Heat and Work 6.5 Measuring ΔE for Chemical Reactions: Constant-Volume Calorimetry	 33, 35 37, 39, 41, 43 47, 49, 51 73
14	(10/23)	6.6 Enthalpy: The Heat Evolved in a Chemical Rxn at Constant Pressure 6.7 Constant-Pressure Calorimetry: Measuring ΔH_{rxn} 6.8 Relationships Involving ΔH_{rxn} 6.9 Determining Enthalpies of Rxn from Standard Enthalpies of Formation 6.10 Energy Use and the Environment	55, 57, 59 65, 67, 69 77, 79, 81 83, 85, 87 93, 95
15	10/28	7.1 Schrödinger's Cat 7.2 The Nature of Light 7.3 Atomic Spectroscopy and the Bohr Model	 36, 37, 39, 41, 43, 45
16	(10/30)	7.4 The Wave Nature of Matter: The de Broglie Wavelength, the Uncertainty Principle, and Indeterminacy 7.5 Quantum Mechanics and the Atom 7.6 The Shapes of Atomic Orbitals	51, 53, 55 57, 59, 61, 65, 67, 69 63, 64
	11/04	**LECTURE EXAM 2**	**Chapters 4, 5 and 6**
17	(11/06) †	8.1 Nerve Signal Transmission 8.2 The Development of the Periodic Table 8.3 Electron Configurations: How Electrons Occupy Orbitals 8.4 Electron Configurations, Valence Electrons, and the Periodic Table	 41, 43, 45, 47, 49 51, 53
18	11/11	8.5 The Explanatory Power of the Quantum-Mechanical Model 8.6 Periodic Trends in the Size of Atoms and Effective Nuclear Charge 8.7 Ions: Electron Configurations, Magnetic Properties, Ionic Radii, and Ionization Energy 8.8 Electron Affinities and Metallic Character 8.9 Some Examples of Periodic Chemical Behavior: The Alkali Metals, the Halogens, and the Noble Gases	 55, 57, 61, 63 65, 67, 69, 71, 75 79, 81, 83 85, 87, 89
19	(11/13)	9.1 Bonding Models and AIDS Drugs 9.2 Types of Chemical Bonds 9.3 Representing Valence Electrons with Dots 9.4 Ionic Bonding: Lewis Structures and Lattice Energies 9.5 Covalent Bonding: Lewis Structures	 2, 3 35, 36 37, 39, 41, 47 51, 53

THE MATHEMATICS & SCIENCE RESOURCE CENTER (MSRC) IS AVAILABLE TO HELP

Tutoring is available free of charge for this course in the Mathematics & Science Resource Center (MSRC). The center also has a computer lab with internet access and a room for quiet study.

How do you get the most out of a tutoring session?

i. *Start right away*. Students who begin tutoring from the beginning of the semester typically do better than those who wait.

ii. *Book your appointments early*. During peak times, you may need to book at least a week in advance to get the times you want. To book your own appointments over the web, first read the instructions on the MSRC web site, then log on to TutorTrac at the URL below.

iii. *Come prepared*. Please bring your class notes and textbook. Look over the reading and try the problems. If you can, bring a list of specific questions. The more you prepare, the more you will get out of the session.

iv. If you miss a class, please get notes from a classmate *before* your session. Tutoring is not a substitute for attending class.

v. If you are repeating the course (previous grade of "F" or "W"), you are eligible to participate in the Math Advancement Program (MAP) which provides weekly one-on-one tutoring with an experienced tutor. The deadline to sign up for the MAP program is Monday, September 9, 2013. Please see Ms. Michele Doney in room 01.94 NB by *5:00 PM* on September 9 for details.

Contact Information for the MSRC:
Room: 01.94 NB:
Phone: (646) 557-4635
Email: msrc@jjay.cuny.edu

MSRC Website:
http://www.jjay.cuny.edu/academics/592.php

TutorTrac (for scheduling appointments):
https://jjctutortrac.jjay.cuny.edu

20	11/18	9.6 Electronegativity and Bond Polarity 9.7 Lewis Structures of Molecular Compounds and Polyatomic Ions 9.8 Resonance and Formal Charge 9.9 Exceptions to the Octet Rule: Odd-Electron Species, Incomplete Octets, and Expanded Octets 9.10 Bond Energies and Bond Lengths 9.11 Bonding in Metals: The Electron Sea Model	55, 57 59, 60, 61 63, 65, 69 73, 75, 77 79, 80, 81
21	(11/20)	10.1 Artificial Sweeteners: Fooled by Molecular Shape 10.2 VSEPR Theory: The Five Basic Shapes 10.3 VSEPR Theory: The Effect of Lone Pairs 10.4 VSEPR Theory: Predicting Molecular Geometries	 33, 35, 39, 41, 45
	11/25	**LECTURE EXAM 3**	**Chapters 7, 8 and 9**
22	12/02	10.5 Molecular Shape and Polarity 10.6 Valence Bond Theory: Orbital Overlap as a Covalent Bond 10.7 Valence Bond Theory: Hybridization of Atomic Orbitals 10.8 Molecular Orbital Theory: Electron Delocalization	47, 49, 51 53, 57, 61, 67 71, 73, 75, 79
23	(12/04)	11.1 Climbing Geckos and Intermolecular Forces 11.2 Solids, Liquids, and Gases: A Molecular Comparison 11.3 Intermolecular Forces: The Forces That Hold Condensed States Together 11.4 Intermolecular Forces in Action: Surface Tension, Viscosity, and Capillary Action	 49, 51, 55, 57, 59 61, 63, 65
24	12/09	11.5 Vaporization and Vapor Pressure 11.6 Sublimation and Fusion 11.7 Heating Curve for Water 11.8 Phase Diagrams 11.9 Water: An Extraordinary Substance	71, 73, 77 79, 81, 83 85, 86, 87 91, 93
25	(12/11)‡	11.10 Crystalline Solids: Determining Their Structure by X-Ray Crystallography 11.11 Crystalline Solids: Unit Cells and Basic Structures 11.12 Crystalline Solids: The Fundamental Types 11.13 Crystalline Solids: Band Theory	95, 96 97, 99, 101 105, 107, 109, 111 115, 117
	12/23	**LECTURE EXAM 4**	**Chapters 10 and 11**

STOP THE STOP

RETURN THE LOANED CLICKER WITHIN TEN DAYS OF WITHDRAWING/ DROPPING THE COURSE OR BY DEPARTMENT EXAM DAY, 07/22/13, WHICHEVER OCCURS FIRST

Did you know that an "SC" Science Equipment/Key Stop (also known as Hold) restricts students from registering, receiving financial aid, requesting transcripts, receiving certification letter of attendance, receiving the diploma, etc. JJC Policy Reg.017 12/15/12

Email FSheehan@jjay.cuny.edu in advance of the deadline to make arrangements to return the Clicker or submit an identical replacement by the deadline, to cancel your Clicker Loan Agreement.

GOT THE MESSAGE?

We want the clickers back so other students may benefit from their use.

Che 103 Laboratory / Recitation* Schedule

SESSION	-05,06	-03,04,07,08	-01,02,09	LABORATORY SESSION	LAB MANUAL PGS****
1	9/09	8/28	8/30	Introduction, Syllabus, Safety Rules, Emergency Notification Data, Grading, Math Intro, Significant Figures & Scientific Notation Accuracy of Common Measuring Devices** Lab Drawer Check-In and Equipment** Introduction to Advance Study Assignments: Density ASA Work Session, p. 41	Handouts & Appendices IV, V
2	9/16	9/11	9/20	Apparatus Setup and Use (students will individually practice the following techniques)** A. Handling Chemicals, pp 3-4 ; B. Weighing Techniques, pp. 5-7; C. Volumetric Techniques, pp. 7-12; D-E. Bunsen Burners, pp. 12-13; F. Separation Techniques, pp. 13-16; H. Working with Glass, pp. 17-20; I1. Testing for Odor, p. 20; J. Spectrophotometry, pp. 22-23; K. Treatment of Experimental Data, pp. 23-24	3 – 36, Appendices IV, V
3	**11/25**Δ	9/18	11/27Wed	The Densities of Liquids and Solids**	37 (41)
4	9/23	09/25	09/27	Resolution of Matter into Pure Substances, I. Paper Chromatography**	43 (49)
5	09/30	10/02	10/04	*Review of Chapters for Monday, October 07, Lecture Exam I (two periods)******	
6	**10/07Δ**	10/09	10/11	Resolution of Matter into Pure Substances, II. Fractional Crystallization**	51 (57)
7	10/15	10/16	10/18	Analysis of Al-Zn Alloy**	59 (65)
8	10/21	10/23	10/25	Heats Effects and Calorimetry**	67 (73)
9	10/28	10/30	11/01	*Review of Chapters for Monday, November 04, Lecture Exam II (two periods)* *****	
10	**11/04**Δ	11/06	11/08	The Geometrical Structure of Molecules—An Experiment Using Molecular Models	75 (83)
11	11/11	11/13	11/15	Determination of a Chemical Formula**	85 (89)
12	11/18	11/20	11/22	*Review of Chapters for Monday, November 25, Lecture Exam III (two periods)* *****	
13	12/02	12/04	12/06	Identification of a Compound Using Mass Relationships**	91 (95)
14	12/09	12/11	12/13	Determination of the Hardness of Water	97 (101)
	12/16	**12/16**	**12/16**	DEPARTMENTAL COMPREHENSIVE LAB EXAMINATION***	

* There is generally one recitation session per week in accordance with the boxed schedule on page one. ****Must have/wear safety glasses** Δ= lab is held after lecture exam

*** The Comprehensive Lab Examination will be held on Departmental Exam Day. The date, 12/16, is determined by the Registrar's Office and is subject to change, so plan to be present 12/16 – 12/23.
The Advance Study Assignment (ASA) for each exercise may be found on the page indicated in ( ) and must be completed prior to the scheduled lab.

**** You must be prepared to hand in Advanced Study Assignments (ASA's) at the beginning of the laboratory session. Located at the end of each laboratory exercise in your lab manual, they are designed to assist you in understanding the theoretical principles and mathematical calculations required before you come to the laboratory so that you can work efficiently and-- more importantly-- safely. Failure to submit a completed ASA when requested will result in a severe performance factor penalty. In order to receive full credit on an ASA, you must show all work, including, when applicable, formulas, unit conversions required to use the formulas, significant digits, etc. Do not omit documenting any steps. Note: On Exam Day, scheduled labs will meet but Recitation Sessions will not since classrooms will be used for exams.

*****The instructors will review the chapters which will be the subject of the next exam. It is not a review of the upcoming exam and they will not "teach to the test." Students prepare by learning the chapters' contents.

General Chemistry lab technicians (responsible for all lab preparations, supplies and equipment):
Angela Vuong (Supervising CLT, 03.82.04NB, M/W/F). Joshua Angeles (3.82.02NB, Fri: 7:30am-2:00pm). Olivia Coym (3.82.02NB, Mon: 10-2pm, Wed:7:30am-2:00pm)

Lab Manual: (The lab manual must be brought to each lab session. Any recent JJC General Chemstry custom 103/104 lab manual not written in is fine.)
JJC Science Dept. General Chemisty Che 103-104 Customized Laboratory Manual. Cengage Learning Inc. 2013. (ISBN-13: 978-1-285-90999-8)

Other required material (must be brought to each laboratory session):
--- Splash-resistant safety goggles or safety glasses meeting the ANSI Z87.1 standard. All students must wear safety glasses or goggles in lab. Students requiring corrective lenses must wear safety glasses or goggles over the lenses. (Two sizes of safety glasses and large goggles are available at the book store. Ask specifically for Che 103/104 safety glasses at the help desk.)
--- Chemical-resistant gloves.
--- An approved calculators specified in this syllabus. Course professors will use Texas Instruments TI-30XA.

A SIGNED COPY OF THE SAFETY RULES MUST BE TAPED TO THE INSIDE COVER OF YOUR LAB MANUAL