
Code: CHEM-101 **Title:** General Chemistry I

Institute: STEM **Department:** Chemistry

Course Description:The student will investigate the fundamental concepts of chemistry from a theoretical approach and participate in a laboratory program that demonstrates this theory. The subjects covered include atomic structure; chemical bonding, acids and bases, gases, solids and liquids and properties of solutions. The course content is designed for the science major who wishes to transfer to a four year institution.

Prerequisites:HS Chemistry or a grade of “C” or higher in CHEM 100 or equivalent, and a grade of “C” or higher in MATH 151.

Credits: 5 **Lecture Hours:**4 **Lab/Studio Hours:**3

REQUIRED TEXTBOOK/MATERIALS:

Textbook: See WebAdvisor and the College Bookstore for textbook information.

Laboratory Manual: See WebAdvisor and the Collee Bookstore for manual and required materials.

Safety Goggles: New Jersey state law requires that all students wear appropriate splash and impact proof safety goggles while performing laboratory experiments. They are available at the College Store

Laboratory Coat: available at the College Store

ADDITIONAL REQUIREMENTS:

Students must attend their regularly scheduled weekly laboratory class.

COURSE LEARNING OUTCOMES:

Upon completion of this course, students will be able to:

- Utilize critical thinking skills to learn fundamental chemical concepts from inorganic chemistry.
- Use the scientific method to perform chemistry-based problem-solving. Reinforcement of chemical concepts will be made as hands-on skills are developed in the laboratory program.
- Identify unknown compounds based on observed physical properties
- Describe how chemical reactions proceed
- Run successful titration experiments
- Analyze atomic spectra

GRADING STANDARD:

A	=	92 – 100%
A-	=	89 - 91%
B+	=	86 - 88%
B	=	82 - 85%
B-	=	79 - 81%
C+	=	76 - 78%
C	=	70 - 75%
D	=	65 - 69%
F	=	<65%

Unit examination results will be reported as the grade assigned by the faculty calculated to the first decimal place. These grades will be weighed according to course grading policy. In calculating the course grade, 0.5 will round up to the next numerical grade and 0.4 will round down to the next lower numerical grade.

COURSE CONTENT:

Unit 1: Introduction; Chemistry: The Study of Change; Atoms, Molecules, and Ions; Mass Relationships in Chemical reactions

Unit 2: Reactions in Aqueous Solutions; Quantum Theory and the Electronic Structure of Atoms; Periodic Relationships Among the Elements

Unit 3: Chemical Bonding I: Basic Concepts; Chemical Bonding II: Molecular Geometry and Hybridization of Atomic Orbitals

Unit 4: Gases; Intermolecular Forces and Liquids and Solids; Physical Properties of Solutions

DEPARTMENT POLICIES:

1. Students must attend their regularly scheduled weekly laboratory section. Students are not allowed to attend any other lab section for any reason.
2. Students must pass (65% or better) both the lecture and the laboratory portion of the course in the same semester or they will fail the course.

COLLEGE POLICIES:

For information regarding:

- ◆ Brookdale's Academic Integrity Code
- ◆ Student Conduct Code
- ◆ Student Grade Appeal Process

Please refer to the [BCC STUDENT HANDBOOK AND BCC CATALOG.](#)

NOTIFICATION FOR STUDENTS WITH DISABILITIES:

BrookdaleCommunity College offers reasonable accommodations and/or services to persons with disabilities. Students with disabilities who wish to self-identify must contact the Disabilities Services Office at 732-224-2730 (voice) or 732-842-4211 (TTY) to provide appropriate documentation of the disability, and request specific accommodations or services. If a student qualifies, reasonable accommodations and/or services, which are appropriate for the college level and are recommended in the documentation, can be approved.

ADDITIONAL SUPPORT/LABS:

Lab/instructional assistants are available for help both for lab and lecture. The times of availability are posted at the lab/instructional assistants' office.

WEBSITE: <https://www.brookdalecc.edu/stem-institute/chemistry/>

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GENERAL CHEMISTRY I
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#1 OF 4 UNITS

5.0
credits

CHAPTERS: 1, 2, 3

NAME OF UNIT: Introduction, Mathematical Operations, Elements and Compound Composition, and a Study of Aqueous Reactions

UNIT OBJECTIVE: To acquaint the student with the mathematics necessary to pursue the subject matter of chemistry. To review basic chemical concepts and calculations covered in the prerequisite introductory chemistry course.

Learning Objectives	Recommended Learning Experiences
1. Understand the science of chemistry and the scientific method.	READ: 1.1 DO: Questions and Problems: 1.3
2. Distinguish between elements, compounds, and mixtures. Identify the symbols for some elements.	READ: 1.2 DO: Questions and Problems: 1.9, 1.37, 1.39, 1.41, 2.3
3. Distinguish between the three states of matter.	READ: 1.2 DO: Questions and Problems: 1.95
4. Distinguish between physical and chemical properties/changes.	READ: 1.2 DO: Questions and Problems: 1.27, 1.29, 1.31, 1.33, 1.35
5. List the basic SI units and the common metric prefixes and their meanings.	READ: 1.4 DO: Questions and Problems: 1.21, 1.61
6. Perform calculations involving density.	READ: 1.4 DO: Questions and Problems: 1.87, 1.89, 1.91, 1.99, 1.105
7. Convert temperatures among Fahrenheit, Celsius, and Kelvin scales.	READ: 1.4 DO: Questions and Problems: 1.73d, 1.81, 1.83, 1.85, 1.103
8. Use scientific notation to express numbers.	READ: 1.3 (pg14). Appendix A.2

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Learning Objectives	Recommended Learning Experiences
9. Express the result of a calculation with the proper number of significant figures.	READ: 1.3 DO: Questions and Problems: 1.17, 1.19, 1.43, 1.45, 1.47, 1.49, 1.51, 1.53, 1.55, 1.57, 1.59, 1.105
10. Interconvert units using the factor-label method (dimensional analysis).	READ: 1.4 DO: Questions and Problems: 1.23, 1.63, 1.65, 1.69, 1.71, 1.73, 1.75, 1.77, 1.79, 1.93
11. Describe the contribution of each of the following to our understanding of the atom: Dalton, Thomson, Millikan, Rontgen, Becquerel, Curie, Rutherford, and Chadwick.	READ: 2.1, 2.2 DO: Questions and Problems: 2.1, 2.5
12. Give the approximate size, relative mass and charge of an atom, a proton, a neutron, and an electron	READ: 2.2
13. Describe the composition of the atom in terms of protons, neutrons, and electrons. Know their relationship to atomic number, mass number, and isotopes.	READ: 2.3 DO: Questions and Problems: 2.9, 2.29, 2.31, 2.33, 2.35, 2.37, 2.39, 2.41, 2.127, 2.131
14. Understand the arrangement of elements in the periodic table. Use the table to classify elements as metals, nonmetals or metalloids.	READ: 2.5 DO: Questions and Problems: 2.21, 2.27, 2.53, 2.55, 2.57, 2.59, 2.61, 2.63, 2.65, 2.67
15. Determine the charge a particular atom will have when it becomes an ion (an anion or cation). State the numbers of protons, neutrons, and electrons it will have.	READ: 2.3 DO: Questions and Problems: 2.77, 2.123, 2.131
16. Distinguish between empirical formulas and molecular formulas	READ: 2.6, 2.7 DO: Questions and Problems: 2.13, 2.69, 2.73, 2.75

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Learning Objectives

Recommended Learning Experiences

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| 17. Determine the formula of an ionic compound based on ion charges determined from the periodic table. | READ: 2.7
DO: Questions and Problems: 2.25, 2.79, 2.81, 2.113, 2.119 |
| 18. Write the name of an inorganic compound given its chemical formula and perform the reverse operation. Memorize the name, charge, and formula of each of the polyatomic ions in Table 2.2 | READ: 2.7, 2.8
MEMORIZE: Table 2.2
DO: Questions and Problems: 2.15, 2.17, 2.19, 2.83, 2.85, 2.87, 2.89 2.93, 2.95, 2.97, 2.99, 2.101, 2.103, 2.107, 2.115, 2.117, 2.121, 2.125, 2.129 |
| 19. Identify substances as acids and bases. Distinguish between them. | READ: 2.8, 3.1
DO: Questions and Problems: 2.99, 2.101, 2.121, 3.25a, 3.27a |
| 20. Relate atomic mass to the abundance and mass of the isotopes. | READ: 2.4
DO: Questions and Problems: 2.43, 2.45, 2.47, 2.49 |
| 21. Do conversions involving numbers of moles, mass in grams and numbers of atoms or molecules. | READ: 3.2
DO: Questions and Problems: 3.9, 3.51, 3.53, 3.55, 3.61, 3.63, 3.65, 3.67, 3.69, 3.71, 3.73, 3.153 |
| 22. Calculate the molar mass of a compound. | READ: 3.2
DO: Questions and Problems: 3.57, 3.59, 3.155 |
| 23. Describe the mass spectrometer. | READ: 2.4
DO: Questions and Problems: 2.49 |
| 24. Calculate the percent composition of compounds. | READ: 3.3
DO: Questions and Problems: 3.77, 3.79, 3.83, 3.85, 3.87, 3.89, 3.91, 3.93, 3.145, 3.149 |
| 25. Determine both the empirical formula and the molecular formula of compounds experimentally. | READ: 3.3
DO: Questions and Problems: 3.13, 3.95, 3.97, 3.99, 3.101, 3.103, 3.105, 3.107, 3.109, 3.111, 3.113, 3.115, 3.117, 3.161 |

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Learning Objectives

27. Use a balanced equation to calculate amounts of reactants and products with stoichiometry.
28. Solve problems involving limiting and excess reagents.
29. Calculate percent yield using a balanced chemical equation.

Recommended Learning Experiences

- READ:** 3.4
DO: Questions and Problems: 3.15, 3.119, 3.121, 3.123, 3.125, 3.143, 3.151, 3.159
- READ:** 3.5
DO: Questions and Problems: 3.17, 3.127, 3.129, 3.131, 3.157
- READ:** 3.5
DO: Questions and Problems: 3.133, 3.139, 3.141

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GENERAL CHEMISTRY I
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#2 OF 4 UNITS

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credits

CHAPTERS: 3, 4, 18, 7

NAME OF UNIT: Aqueous Solutions, Quantum Theory and the Electronic Structure of Atoms

UNIT OBJECTIVE: To study reactions in aqueous solution. To study the quantum theory and its relationship to the structure of atoms.

Learning Objectives

Recommended Learning Experiences

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| 1. Classify compounds as strong electrolytes, weak electrolytes and non-electrolytes, and distinguish between them. | READ: 4.1
DO: Questions and Problems 4.4, 4.5 |
| 2. Classify compounds as soluble or insoluble in water. | READ: 4.1
DO: Questions and Problems 4.3, 4.15, 4.17 |
| 3. Write balanced molecular equations, balanced ionic equations, and balanced net ionic equations. | READ: 4.1
DO: Questions and Problems 4.19, 4.20, 4.23 |
| 4. Classify compounds as strong or weak acids, strong or weak bases, or salts. Write balanced chemical equations for the neutralization of an acid and a base. | READ: 3.1 (pages 98-99), 4.1, 4.4
DO: Questions and Problems 3.29 |
| 5. Define and give examples of: oxidation, reduction, oxidizing agent, reducing agent, oxidation number and half reaction. | READ: 18.1, 3.1 (pages 100-102) |
| 6. Calculate the oxidation number of each element in a compound. | READ: 18.1, 3.1
DO: Questions and Problems 18.9, 18.11 |

Learning Objectives

Recommended Learning Experiences

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| 7. Complete and balance the following types of redox reactions: Combination; Decomposition; Displacement; Disproportionation. | READ: handout |
| 8. Calculate the molar concentration of compounds or ions. Solve dilution problems. Perform stoichiometry calculations for reactions in solution. Perform calculations involving standardization. | READ: 4.2, 4.3
DO: Questions and Problems 4.33, 4.35, 4.37, 4.43, 4.67, 4.73 |
| 9. Solve problems involving gravimetric analysis. | READ: 4.4
DO: Questions and Problems 4.99 |
| 10. Describe the analytical method of titration and solve titration problems. | READ: 4.4
DO: Questions and Problems 4.87, 4.91 |
| 11. Use the equations $c = \lambda$ and $E = hv$ to describe the wave properties of light. | READ: 7.1
DO: Questions and Problems: 7.19, 7.21, 7.23 |
| 12. Explain Planck's quantum theory and relate it to Einstein's explanation of the photoelectric effect. | READ: 7.1
DO: Questions and Problems: 7.35 |
| 13. Explain the origin of spectra and relate it to the quantum theory and the Bohr model of the atom | READ: 7.2
DO: Questions and Problems: 7.4 |
| 14. Calculate the energy differences between any two allowed energy states (transitions) of the electron in hydrogen. | READ: 7.2
DO: Questions and Problems 7.39, 7.91 |
| 15. Calculate the wavelength of a particle from its mass and velocity (De Broglie's equation). | READ: 7.3
DO: Questions and Problems 7.41, 7.45 |
| 16. Describe Heisenberg's uncertainty principle. | READ: 7.3 |

Learning Objectives

Recommended Learning Experiences

17. Explain the concepts of orbital, electron density, probability and Ψ^2 as used in the quantum theory.

READ: 7.3
DO: Questions and Problems: 7.6

18. Describe the quantum numbers n , l , m_l and m_s .

READ: 7.4
DO: Questions and Problems 7.7, 7.8, 7.49, 7.51, 7.53, 7.55

19. Describe the shapes of the s , p , and d orbitals.

READ: 7.4
DO: Questions and Problems 7.57 parts a-b, 7.59, 7.61, 7.65

20. Write the electron configuration (longhand and abbreviated) and orbital diagram of any atom (regular or anomalous). Predict if an atom is paramagnetic or diamagnetic

READ: 7.5, 7.6, and 7.7
DO: Questions and Problems 7.71, 7.73, 7.75, 7.79, 7.85

21. Apply the Pauli Exclusion Principle, Aufbau Principle, and Hund's Rule to electron configurations and orbital diagrams.

READ: 7.6
DO: Questions and Problems 7.16, 7.17, 7.97

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CHAPTERS: 8, 9, 10

NAME OF UNIT: Periodic Relationships Among Elements, Molecular Bonding, and Geometry

UNIT OBJECTIVE: To study the relationship of chemical properties based on elements' positions on the periodic table and on molecular bonding and shapes

Learning Objectives

Recommended Learning Experiences

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| 1. Explain the development of the Periodic Table and how electron configurations relate to the arrangement. | READ 8.1
DO: Example 8.1 (in chapter) |
| 2. Explain the periodic nature of and trends in atomic radius, ionic radius, and metallic and nonmetallic behaviors. | READ: 8.3
DO: Questions and Problems 8.4, 8.5 |
| 3. Describe the periodic trends in ionization energy and electron affinity. | READ: 8.4, 8.5
DO: Questions and Problems 8.6, 8.7, 8.9--8.12, 8.16—8.19 |
| 4. Describe the chemical behavior of Group 1A, 2A & 7A elements. | READ: 8.6
DO: Questions and Problems 8.77, 8.79, 8.102 |
| 5. From its location in the Period Chart and/or the electron configuration you draw predict charges of monoatomic ions. | READ: 8:2
DO: Examples 8.2—8.4 (in chapter) |
| 6. Determine the number of valence electrons for any atom and write its Lewis symbol. | READ: 9.1
DO: Examples 9.1 (in chapter) and Questions and Problems9.1-9.2, 9.24 |
| 7. Predict on the basis of the Periodic Table the probable formulas of ionic substances formed between common metals and nonmetals. | READ: 9.2
DO: Examples 9.2 (in chapter) Questions and Problems9.2-9.3, 9.27 |

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Learning Objective

Recommended Learning Experiences

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| 8. Use a Born-Haber cycle to calculate lattice energies and explain variations in Lattice Energy using Coulomb's Law. | READ: 9.2
DO: Examples 9.3 (in chapter) Questions and Problems 9.4-9.5, 9.7, 9.32 |
| 9. Describe a covalent bond in terms of Lewis structures and describe the trend in bond length and bond stability. | READ: 9.3, 9.8
DO: Questions and Problems 9.8—9.10 |
| 10. Define, give Periodic Chart trend for and use electronegativity values to predict relative bond polarities. | READ: 9.4
DO: Questions and Problems 9.11—9.14, 9.52, 9.56 |
| 11. Write Lewis structures for molecules and ions containing covalent bonds including molecules that do not obey the octet rule. | READ: 9.3, 9.7
DO: Questions and Problems 9.2-9.3, 9.18-9.20, 9.34-9.35, 9.37, 9.43, 9.76, 9.80 |
| 12. Calculate Formal Charges on atoms from Lewis structures and use Formal Charges to determine relative stability of isomeric Lewis Structures. | READ: 9.5
DO: Questions and Problems 9.15, 9.17, 9.57, 9.63 |
| 13. Write resonance forms for molecules and polyatomic ions | READ: 9.6
DO: Questions and Problems 9.16, 9.65, 9.68 |
| 14. Calculate enthalpy changes for reactions using bond disassociation energies. | READ: 9.8
DO: Questions and Problems 9.21-9.22, 9.83, 9.89 |

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Recommended Learning Experiences

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| 15. Relate the number of electron pairs in the valence shell of an atom in a molecule to their geometrical arrangement around the atom. | READ: 10.1
DO: Questions and Problems 10.1-10.5, 10.23-10.25 |
| 16. Use VSEPR Theory to predict shapes of molecules. | READ: 10.1
DO: Questions and Problems 10.1-10.5, 10.26-10.29, 10.34, 10.39, 10.43 |
| 17. Predict whether a molecule has a dipole moment from the molecular shape and electronegativities | READ: 10.2
DO: Questions and Problems 10.2, 10.45-10.47, 10.51 |
| 18. Explain the concept of hybridization and its relationship to geometrical structure using Valence Bond Theory. | READ: 10.3
DO: Questions and Problems 10.3, 10.9-10.13, 10.55-10.57, 10.63, 10.69 |
| 19. Assign hybrid orbitals to an atom knowing the number and geometrical arrangement of the atoms to which it is bonded. | READ: 10.3
DO: Questions and Problems 10.13-10.6, |
| 20. Formulate the bonding in a molecule in terms of bond overlap, sigma bonds and pi bonds. | READ: 10.3, 10.4
DO: Questions and Problems 10.17-10.18, 10.71, 10.73-10.76, 10.108 |
| 21. Describe how molecular orbitals are formed by overlap of atomic orbitals. | READ: 10.5
DO: Questions and Problems 10.17-10.22, 10.855-10.86, 10.88-10.89, 10.93, 10.97-10.98 |
| 22. Explain the relationship between bonding and antibonding molecular orbitals. | READ: 10.5
DO: Questions and Problems 10.17-10.22, |

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#4 OF 4 UNITS

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CHAPTERS: 6, 11, 12

NAME OF UNIT: Gases, Liquids, Solids and Solutions

UNIT OBJECTIVE: To study the three states of matter. To study the physical properties of solutions.

Learning Objectives

Recommended Learning Experiences

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| 1. Recognize substances that are gases. | READ: 6.1
DO: Questions and Problems 6.1,6.2 |
| 2. Define the units of pressure: atm, mm Hg, Torr, and Pa. Be able to interconvert them. Describe how a barometer works. | READ: 6.1
DO: Questions and Problems 6.3, 6.5 6.19 |
| 3. Describe how a gas responds to changes in pressure, volume, temperature, and quantity of gas. Be able to do calculations involving Boyle's Law, Charles's Law, and Avogadro's Law. | READ: 6.2
DO: Questions and Problems 6.6, 6.8, 6.23-6.27 |
| 4. Solve problems using the Ideal Gas Law. Use the Ideal Gas Law in problems involving molar mass, and density. | READ: 6.3
DO: Questions and Problems 6.9, 6.37-6.50, 6.53, 6.55 |
| 5. Use the Ideal Gas Law to do calculations from balanced chemical equations (using stoichiometry). | READ: 6.4
DO: Questions and Problems 6.59, 6.60, 6.63-6.67, 6.71, 6.123, 6.125, 6.127. 6.133 |
| 6. Calculate the partial pressure of any gas in a mixture. Calculate the mole fraction of the gas. | READ: 6.5
DO: Questions and Problems 6.75, 6.77, 6.79, 6.81, 6.89 |
| 7. Explain the assumptions on which the Kinetic Molecular Theory is based. | READ: 6.6
DO: Questions and Problems 6.13, 6.14 |

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Learning Objectives

Recommended Learning Experiences

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| 8. Describe how the distribution of speeds and the average speed of gas molecules changes with temperature. | READ: 6.6
DO: Questions and Problems 6.15, 6.16
6.95, 6.97, 6.99, 6.101, 6.103.
6.105 |
| 9. Describe the deviation of real gases from ideal behavior and give reasons for it. Make corrections using the van der Waals equation. | READ: 6.8
DO: Questions and Problems 6.10, 6.11,
6.17, 6.111-6.117. |
| 10. Relate the Kinetic Molecular Theory to Intermolecular forces and states of matter | READ: 11.1
DO: Questions and Problems 11.1, 11.2, |
| 11. Explain the way in which the vapor pressure of a substance changes with intermolecular forces and temperature. | READ: 11.2
DO: Questions and Problems 11.4, 11.27,
11.29, 11.31a, 11.33a |
| 12. Describe the relationship between the pressure on the surface of a liquid and the boiling point of that liquid. | READ: 11.2
DO: Questions and Problems 11.5 |
| 13. Calculate the energy change when a compound is heated, cooled or undergoes a change in phase. Know the terms associated with each kind of phase change. | READ: 11.2
DO: Questions and Problems 11.6-11.7,
11.35, 11.10, 11.1, 11.37, 11.85, 11.95 |
| 14. Draw and explain Heating/Cooling Curves | READ: 11.2
DO: Questions and Problems 11.45, 11.46 |
| 15. Define critical temperature and pressure. Draw a phase diagram of a substance given appropriate data, and use a phase diagram to predict what phases are present at any given temperature and pressures. | READ: 11.3
DO: Questions and Problems 11.41-11.44 |
| 16 Identify and explain the types of intermolecular forces present in a molecule. | READ: 11.4
DO: Questions and Problems 11.49-11.54,
11.59-11.62, 11.9, 11.100 |

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Learning Objectives

Recommended Learning Experiences

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| 17. Explain the meaning of the terms viscosity and surface tension, and account for the variations of these properties in terms of intermolecular forces and temperature. | READ: 11.5
DO: Questions and Problems 11.18 |
| 18. Classify substances as to type of solid and predict the general properties of each. | READ: 11.6
DO: Questions and Problems 11.22, 11.23, 11.63-11.64 |
| 19. Determine the net contents of a cubic unit cell. Relate this information to density. | READ: 11.7
DO: Questions and Problems 11.73, 11.75, 11.79, 11.81 |
| 20. Describe packing patterns of equal size spheres. | READ: 11.7
DO: Questions and Problems 11.65, 11.67, 11.89 |
| 21. Describe how X-ray Diffraction studies provide crystal structures. | READ: 11.7 |
| 22. Define various concentration units: percent by mass, mole fraction, molarity, and molality. | READ: 12.1
DO: Questions and Problems 12.1-12.3, 12.15, 12.17, 12.19, 12.21, 12.25, 12.33 |
| 23. Rationalize the solubilities of substances in various solvents in terms of their molecular structures and intermolecular forces. | READ: 12.2
DO: Questions and Problems 12.41, 12.43, 12.45, 12.47, 12.91 |
| 24. Describe the effects of temperature and pressure on solubility of solids and gases. | READ: 12.2, 12.3
DO: Questions and Problems 12.5-12.10, 12.49 |
| 25. Describe the effect of solute concentration on the vapor pressure, boiling point, freezing point, and osmotic pressure of a solution. Calculate any of these properties given appropriate concentration data. | READ: 12.4
DO: Questions and Problems 12.63 |

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Recommended Learning Experiences

26. Determine the concentration and molar mass of a nonvolatile nonelectrolyte from its effect on the colligative properties of a solution.

READ: 12.4
DO: Questions and Problems 12.69

27. Explain the difference in the change in colligative properties caused by electrolytes compared to nonelectrolytes.

READ: 12.5
DO: Questions and Problems 12.15, 12.77

28. Compare colloids with solutions showing their similarities and differences.

READ: 12.6
DO: Questions and Problems 12.85