SPRINGFIELD TECHNICAL COMMUNITY COLLEGE

ACADEMIC AFFAIRS

Course Number: CHEM 103 Department: Chemistry

Course Title: General Chemistry 1 Semester: Spring Year: 1997

Objectives/Competencies

Course Objective	Competencies
1. Know common units of measurement. 2. Develop a method of problem solving using dimensional analysis. 3. Understand basic atomic theory. 4. Understand and apply the mole concept to problem solving. 5. Understand and apply concepts of chemical reactivity. 6. Understand and apply concepts of solutions. 7. Understand and apply concepts of oxidation reduction. 8. Understand the concepts of thermochemistry. 9. Understand and apply modern atomic theory. 10. Understand and apply concepts of chemical periodicity. 11. Understand and apply modern concepts of bonding and molecular structure including hybridization, molecular orbitals, and metallic bonding.	1. Know common units in the English system, and the relationships between them. 2. For the metric system, state the basic units of mass, length, and volume, and the common prefixes. 3. State the relationships between English and metric units. 4. Determine the number of significant figures in a numerical calculation. 5. Express the result of a calculation with the appropriate number of significant figures. 6. Express numbers in scientific notation. 7. Write a conversion factor from a relationship between two quantities, and use conversion factors to solve problems. 8. Be able to convert between Fahrenheit and Celsius temperatures. 9. Convert between F, C, and K. 10. Solve algebraic equations that arise in the course of working chemistry problems. 11. State and apply the laws of conservation of mass, definite

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	composition, and multiple proportions. 12. State the basic assumptions of Dalton’s atomic theory. 13. List some of the characteristic properties of cathode rays and of canal (anode) rays 14. Describe the production of x rays, the phenomenon of radioactivity, and the characteristics of a, B, and Y radiation. 15. Describe Thompson’s elm experiment, Millikan’s oil drop experiment (to measure the change on the electron), and Rutherford’s gold-foil experiment (to establish the existence of the atomic nucleus). 16. State the features of Rutherford’s nuclear atom and how it differs from Thompson’s model of the atom. 17. Perform simple calculations involving the masses and charges of the proton, neutron and electron. 18. List the numbers of protons, neutrons, and electrons present in atoms and ions, using the symbolism A/Z x X. 19. Describe how atomic mass ratios are determined by mass spectrometry and use these rations to determine relative atomic masses. 20. Calculate the atomic weight of an element from the known masses and relative abundance of its naturally occurring isotopes. 21. Obtain and use relationships between the mole, the Avogaro constant (Avogadro’s number) and the molar mass of an element. 22. Distinguish between a mole of atoms and a mole of

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	molecules. 23. Distinguish between formula unit and molecule, empirical formula and molecular formula, and formula weight and molecular weight. 24. Calculate the number of atoms, ions, formula units or molecules in a substance from a given mass or vice versa. 25. Use chemical formulas as a source of conversion factors for stoichiometric calculations. 26. Use a compound's formula to determine its percent composition. 27. Use the percent composition of a compound to determine its empirical formula. 28. Use the masses of CO2 and H2O produced from the complete combustion of a compound containing only C, H, and O to determine the percent composition of the compound. 29. Know and apply the conventions used in determining oxidation states. 30. Know the names, formulas, and charges of the ions in Tables and be able to write formulas and names of the compounds formed from these ions. 31. Balance chemical equations by inspection. 32. Balance ionic equations by inspection. 33. Derive from balanced chemical equations conversion factors for use in stoichiometric calculations. 34. Solve problems based on balanced chemical equations with quantities given or sought in a variety of units.

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	35. Define the terms associated with solutions including molar concentration units, computer concentrations and solution volumes. 36. Apply the solubility rules to predict precipitation reactions and write net ionic equations for them. 37. Write net ionic equations for acid-base reactions. 38. Determine oxidation numbers of elements in compounds. 39. Balance redox equations by the half-equation method. 40. Relate molarity of a solute to number of moles and volume and molarities of ions. 41. Use balanced net ionic equations to determine the amount of product formed in a solution reaction and the volume of solution required for reaction and the concentration of a reactant. 42. Solve dilution problems and those involving the mixing of two solutions. 43. Solve stoichiometry problems when either the reactants of the products are species in solution and concentration and volume data are given. 44. Determine the reactant(s) in excess, the limiting reagent, and the amounts of products obtained in a chemical reaction. 45. Define the terms actual yield, theoretical yield, and percent yield and compute these quantities for a given reaction. 46. Identify compounds according to whether they are non-, weak, or strong electrolytes; strong or weak acids or

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	bases; or salts. 47. Be able to write the names and formulas of acids. 48. State general rules that apply to the aqueous solubilities of ionic compounds, and write net ionic equations based on these solubility rules. 49. Write net ionic equations for neutralization reactions and form reactions that result in the dissolving (dissolution) of a water-soluble substance or the evolution of a gas. 50. State and apply the conditions under which reactions between ions in aqueous solution may go to completion. 51. Recognize an oxidation-reduction reaction by changes in oxidation state and identify the oxidizing and reducing agents in an oxidation-reduction reaction. 52. Balance oxidation-reduction reactions by the oxidation-state change method. 53. Separate an oxidation-reduction equation into half equations; complete and balance the half equations; and recombine them into a balanced net oxidation-reduction equation. 54. Be familiar with the technique of titration – how the experiment is performed, what data are collected, whey an indicator is used, and how to use the data. 55. Distinguish between heat and work. 56. Use specific heat to determine temperature changes and quantities of heat. 57. Interconvert joules and calories. Apply the first law of thermodynamics.

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	58. State the meaning of the concept “state function,” especially as demonstrated by enthalpy. 59. Calculate the heat of a reaction at constant volume qv, using bomb calorimetry data. 60. Explain the purpose of enthalpy change. 61. Explain how to use a Styrofoam coffee cup calorimeter and interpret the data obtained. 62. Apply Hell’s law of constant heat summation. 63. State the definitions of “standard state” and “standard formation reaction” and write the standard formation reaction for any substance. 64. Apply Hess’s law in the special case of standard formation reactions. 65. Apply the fundamental expression relating the frequency, wavelength, and velocity of electromagnetic radiation, with appropriate regard for units. 66. List the various types of radiation and their approximate wavelengths. 67. Know how light is dispersed into a spectrum and the difference between continuous and line spectra. 68. Use the Balmer equation to determine the wavelengths of lines in the spectrum of hydrogen. 69. Know and be able to use Planck’s equation. 70. Know and be able to apply Bohr’s model of the hydrogen atom: the assumptions, the picture of the atom, the energy expression, and the energy-level diagram. 71. Summarize de Broglie’s and Heisenberg’s ideas.

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	72. Explain the differences between Bohr's and Schroedinger's models of the atom. 73. Know and be able to apply the quantum number relationships of wave mechanics. 74. Know what an orbital is and sketch the appearance of s, p, and d orbitals. 75. Know how orbital energies are modified when more than one electron is present in an atom. 76. Learn the three basic principles governing electron configuration. 77. Apply the Aufbau principle and write electron configurations with many different methods. 78. Illustrate the periodic law with graphs of selected properties of the elements as a function of atomic number. 79. Use the terms periods, groups, families, representative elements, and transition elements to describe individual elements and groupings of elements in the periodic table. 80. Use the periodic table to describe the Aufbau process; and explain the basic features of the electron configurations of the representative and transition elements, especially the number of valence electrons in each representative group. 81. Describe metals, non metals, metalloids, and noble gases in several ways and locate them in the periodic table. 82. State the factors that influence atomic size; distinguish among covalent, ionic, metallic, and van der Waals radius; and describe the general trends in atomic size that occur

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	within families and groups. 83. Define first, second, ... ionization energies; describe the factors that affect the magnitude of these ionization energies; and relate ionization energies to the location of elements in the periodic table. 84. Define electron affinity; cite the factors influencing its magnitude; and describe the variation of electron affinity within periods and groups of the periodic table. 85. Define electronegativity, and use its value to assess the relative metallic/non metallic character of an element. 86. Relate the magnetic properties of an atom or ion to its electron configuration. 87. Use the periodic law, the periodic table, and trends in atomic properties to make predictions about the physical and chemical behavior of various elements. 88. State the basic assumptions of the Lewis theory. 89. Relate the Lewis symbol for an element to its position in the periodic table. 90. Write Lewis structures for simple ionic compounds. 91. Use the Born-Fajans-Haber cycle to calculate lattice energies of ionic compounds from thermochemical, atomic, and molecular data. 92. Describe the relationship between electronegativity difference and the percent ionic character of a bond. 93. Use the basic rules of Lewis theory to propose a plausible skeleton structure for a molecule and assign valence electrons to this structure.

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	94. Compute the formal charge on each atom in a Lewis structure; and use formal charges to determine which of several Lewis structures is the most plausible. 95. Recognize situations when resonance occurs and draw plausible resonance structures. 96. Draw Lewis structures for odd-electron and electron-deficient structures. State which elements can have expanded octets and be able to draw Lewis structures with expanded octets. 97. Predict the electron-pair geometry and the molecular shape of a molecule or ion with VSEPR theory. Know that single bonds act similarly to multiple bonds in determining molecular shape. 98. Use electronegativities to determine if a bond is polar and use bond polarities and molecular shape to predict whether a molecule has a dipole moment.