

SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY
SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title: CHEMISTRY

Code No.: CHM 300-3

Program: FISH & WILDLIFE TECHNOLOGY / GEOLOGY TECHNICIAN

Semester: FIVE / TWO

Date: AUGUST 1987

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New: _____ Revision: X

APPROVED:  Chairperson  Date

CHEMISTRY

CHM 300-3

Course Name

Course Number

PHILOSOPHY/GOALS:

CHM 300-3 is a one-semester course designed to provide a basic understanding of chemistry with emphasis on its application in other sciences. Topics discussed include: the structure of matter, physical and chemical change, density and specific gravity, the mole concept, percent composition, nomenclature, chemical formulas, equations, solubility, concentration, and acid-base theory. The related lab work will include basic procedures as well as a component relating directly to the associated program, eg. separation of mixtures for Geology students, serial dilution for Fish and Wildlife students.

METHOD OF ASSESSMENT:

A+ = 90%+	Theory = 65% based on class tests
A = 80 - 89%	
B = 70 - 79%	Lab = 35% based on lab reports
C = 60 - 69%	
R = 59% or less	

At the discretion of the instructor, students having over 50% but less than 60% will be given the opportunity to obtain a passing grade ("C") by writing a make-up test on the whole semester's work. Eighty-five (85%) per cent attendance is mandatory for labs.

STUDY TEXTBOOK:

MacQuarrie and Rock, General Chemistry, W.H. Freeman & Co., 1984

REFERENCES:

Malone, Leo J., Basic Concepts of Chemistry, John Wiley and Sons, N.Y.

TOPIC NO.	PERIODS	TOPIC DESCRIPTION
1	5	ATOMS AND MOLECULES 1-2,3 Elements - The Simplest Substances 1-4 Density of Metals 1-5 Relative Amounts of Each Element in a Compound is Constant 1-7 Molecules - groups of elements joined together 1-8 Chemical Nomenclature 1-9 Atomic and Molecular Mass 1-11,13 The Structure of the Atom - Sub Atomic Particles 1-12 The Nucleus 1-13 Isotopes, Atomic No., Mass No. 1-16,17 Significant Figures 1-18 Metric Units in Chemistry Summary Problems on Unit 1
2	4	CHEMICAL ELEMENTS AND THE PERIODIC TABLE 2-1 Chemical Reactions 2-2,3 Chemical Equations 2-4 Properties of Elements 2-5,10 Periodic Table - Periods - Groups - Metals, Non-metals - Trends 2-11,13 Use of Table Summary Problems on Unit 2
3	3	CHEMICAL CALCULATIONS 3-1,2 The Mole, Arogadro's No. 3-3 Simplest or Empir 3-5 Molecular Formula 3-6,7,8 Chemical Equations 3-10 Molarity Summary Problems on Unit 3

TOPIC NO.	PERIODS	TOPIC DESCRIPTION
4	1	INTERCHAPTER B - SEPARATION OF MIXTURES (N.B. Some of the topics are related to Lab #3) Heterogeneous vs. Homogeneous Extraction with Solvents, Sublimation Filtration Distillation Chromatography
5	4	CHEMICAL REACTIONS 4-1 Combination Reactions 4-2 Stable Polyatomic Ions 4-3 Ions with More than One Possible Charge (Oxidation State) 4-4 Reactions of Oxides with Water 4-5 Decomposition Reactions 4-6 Single Replacement 4-7 Reactivity of Metals 4-8 Single Replacement Reactions with Solids (Metals) 4-9 Reactivity of the Halogens 4-10 Double Replacement Reactions 4-11 Neutralization 4-12 Titrations Summary Problems
6	4	QUANTUM THEORY Ionization Energy - Trends Wave Nature of EMR Energy Levels Quantum Numbers
6	5	ELECTRON STRUCTURE & PERIODIC PROPERTIES OF ATOMS Memory Aid for Ordinary Orbital Energies of Atoms Pauli Exclusion Principle Hund's Rule to Predict Ground State Electronic Configurations Electron Configurations & The Periodic Table Atomic Radius - Trend Summary Problems
7	4	CHEMICAL BONDING 9-1,2,3 Ionic Bonds 9-4 Ionic Radii 9-5,6 Ions & Conductivity 9-7 Electron Affinity Summary Problems

TOPIC NO.	PERIODS	TOPIC DESCRIPTION
7	8	COVALENT BONDING 10-1 Definition - Sharing 10-2 Lewis Formulas & Octet Rule 10-3,4,9,10 Exceptions, H ₂ , etc. 10-5,6 Polyatomic Ions 10-7 Resonance 10-8 Use of Charges to Choose a Preferred Lewis Formula 10-11 Electronegativities 10-12 Polarity Summary Problems

LABORATORY EXPERIMENTS

A two-hour lab session will be run every other week. The labs are designed to give the student practice in basic lab techniques. Experiments to be conducted are:

(6 weeks x 2 hours) = 12 hours

1. Physical Properties - densities of liquids & solids 2 hours
2. Serial Dilution 2 hours
3. pH Measurements using papers, indicators & meters 2 hours
4. Titration for Total Inflection Point Alkalinity 2 hours
5. Energy Determinations Using Bomb Calorimeter 4 hours

LAB ASSIGNMENTS ARE DUE ONE WEEK AFTER COMPLETION OF LAB WORK. LATE ASSIGNMENTS WILL NOT BE ACCEPTED.

**OBJECTIVES FOR CHM 300 - CHEMISTRY FOR FORESTRY TECHNOLOGY
FISH AND WILDLIFE TECHNOLOGY PROGRAM**

AUGUST, 1985

UNIT 1: CHEMISTRY, MATTER, CHANGES AND ENERGY

Ref: Chapters 1, 2 and 3. Malone, Leo J. Basic Concepts in Chemistry.

AFTER COMPLETION OF THESE CHAPTERS, THE STUDENT SHOULD BE ABLE TO:

1. Give the definitions of chemistry and matter.
2. Describe the three states of matter and give examples of each.
3. Classify a sample of matter as either heterogeneous or homogeneous.
4. Distinguish between a mixture, a solution and a pure substance.
5. Classify a list of pure substances as either elements or compounds.
6. State the names and symbols of the first 20 common elements.
7. Give examples of physical and chemical properties and physical and chemical changes.
8. Apply the law of conservation of mass to explain observed chemical changes.
9. Classify a physical or chemical change as either endothermic or exothermic.
10. Name and describe the various forms of energy.
11. Distinguish between potential and kinetic energy.
12. Distinguish between density, buoyancy and specific gravity.
13. Calculate density given appropriate experimental data and use it as a conversion factor between mass and volume.
14. Convert temperatures in degrees Celsius to Fahrenheit and Kelvin and vice versa.
15. Describe the nuclear atom, including the name, location, mass (in amu) and electrical charge of the three particles in the atom.

CHM 300 OBJECTIVES...2

UNIT 1: CHEMISTRY: MATTER, CHANGES AND ENERGY...CONTINUED

16. Give the atomic number and mass number of a specified isotope.
17. Write the number of protons, neutrons and electrons from the representation of a specified isotope.
18. Define atomic weight and describe how it differs from mass number.
19. Distinguish between atoms and molecules.
20. Describe the function of a covalent bond in a molecule.
21. List the elements and the number of atoms of that element in a compound from the formula.
22. Write definitions for the terms ion, cation, anion and electrostatic force.
23. Distinguish between molecular and ionic compounds.
24. List the number of protons, neutrons and electrons present in a specified atom or ion.

UNIT II:

Reference: Chapters 4 & 5 - Malone.

AFTER COMPLETION OF THESE CHAPTERS, THE STUDENT SHOULD BE ABLE TO:

1. Describe how to locate elements with similar chemical properties in the periodic table.
2. Give brief discussion of the origin of the periodic table and describe how it was first constructed.
3. Locate on the periodic table those elements existing as gases, liquids and solids.
4. Locate on the periodic table those elements that are metals, nonmetals and metalloids.
5. Explain what is meant by a period and a group.
6. Locate on the periodic table the elements in the first seven periods.

CHM 300 OBJECTIVES...3

UNIT II: CONTINUED..

7. Give the characteristics of the electron configuration of the four general categories of elements.
8. Predict the general trend of the atomic radii of the representative elements.

UNIT III: CHEMICAL FORMULAS AND NOMENCLATURE OF INORGANIC COMPOUNDS

Ref: Chapters 7 & 8 - Malone.

AFTER COMPLETION OF THESE CHAPTERS, THE STUDENT SHOULD BE ABLE TO:

1. Determine the oxidation state of an element in a compound.
2. List the metals which have only one oxidation state.
3. Name metal-nonmetal binary compounds and write formulas given a name.
4. Apply the Stock method for naming compounds with metals that have variable oxidation states.
5. Write the names and formulas for the polyatomic ions listed in Table 7-3 (the charge must be correct).
6. Name metal-nonmetal binary compounds by use of Greek prefixes listed in Table 7-4.
7. Name binary oxyacids and write formulas given a name.
8. Describe the information represented by a balanced equation.
9. Write and balance simple equations.
10. Classify chemical reactions among the five types listed in the text.

UNIT IV: THE MOLE CONCEPT

Ref: Chapters 8 & 9 - Malone.

1. Describe the unit known as the mole and tell why it is needed in chemistry.

UNIT IV: THE MOLE CONCEPT...CONTINUED

2. Write the molar mass of any element from the periodic table.
3. Calculate the mass of the same number of atoms of one element given the mass of a different element.
4. Convert between moles, mass, and number of atoms of any element.
5. Calculate the formula mass of a specified compound.
6. Convert between moles, mass and number of molecules of formula units of a compound.
7. Calculate the percent composition of the elements in a compound.
8. Distinguish between an empirical and a molecular formula.
9. Calculate the empirical formula of a compound from its present composition or weight composition.
10. Use the data from chemical analysis to establish the molecular formula of a compound.
11. Use the balanced equation to obtain mole relationships among reactants and products.
12. Make the following stoichiometric conversions:
 - a) Mole to mole
 - b) Mole to weight (mass)
 - c) Mass to mass
13. Calculate the percent yield from the actual yield and the theoretical yield.
14. Calculate the percent purity of a sample from the yield of a product.

UNIT IV: AQUEOUS SOLUTIONS

Ref: Chapter 12 - Malone.

15. Describe the conductivity properties and compositions of nonelectrolytes, strong electrolytes and weak electrolytes in water solution.
16. Write equations illustrating the solution of various ionic compounds in water.

CHM 300 OBJECTIVES...5

UNIT IV: AQUEOUS SOLUTIONS...CONTINUED

17. Determine whether a specific ionic compound is soluble in water given a table of solubilities.
18. Solve problems involving percent composition of a solute.
19. Apply the definition of Molarity to solve the following types of problems:
 - a) Preparation of a specified quantity and concentration of a solution.
 - b) Calculation of the quantity of solute in a given quantity of solution.
 - c) Dilution of a concentrated solution to make a specified dilute solution. Serial dilution using the formula

$$C_1V_1 = C_2V_2$$

20. Determine the Equivalent Weight of acids, bases, salts, and elements.
21. Calculate the amount of solute required to prepare solutions of varying normalities.
22. Convert normalities to molarities and vice versa.
23. Mix solutions of different concentrations and calculate the resulting concentrations.

UNIT V: ACID-BASE EQUILIBRIA

Ref: Chapter 13 - Malone.

1. Apply the Arrhenius definition to identify compounds as acids or bases and to write equations illustrating this behaviour.
2. Give the names and formulas of some common acids and bases derived from specified anions or cations.
3. Distinguish between behaviour of a strong and a weak acid in water.
4. Describe the dynamic equilibrium involved in the partial ionization of a weak acid or base in water.
5. Calculate $[\text{OH}^-]$ from a specified $[\text{H}_3\text{O}^+]$ and vice versa by use of K_w .

CHM 300 OBJECTIVES...6

UNIT V: ACID-BASE EQUILIBRIA...CONTINUED

6. Distinguish between acidic, basic, or neutral solutions in terms of $[H_3O^+]$ and $[OH^-]$.
7. Convert $[H_3O^+]$ to pH and vice versa.
8. Distinguish between acidic, basic or neutral solutions in terms of pH.
9. Determine whether a specified solution acts as a buffer.

UNIT VI: ORGANIC AND BIOLOGICAL COMPOUNDS

Ref: Chapter 16, Malone and notes.

1. Define and give examples of the term Isomers.
2. Distinguish between the three homologous series, alkanes, alkenes, and alkynes.
3. Identify Aromatic Compounds.
4. Identify the functional group in the eight classes of compounds listed below:

Alcohols, ethers, acids, esters, amines, amides, aldehydes and ketones.
5. Define nutrient and essential nutrient.
6. Describe the general characteristics of carbohydrates, lipids and proteins.
7. Distinguish between simple and complex carbohydrates.
8. Distinguish between saturated and unsaturated fats.
9. Define "enzyme".
10. Explain how protein molecules become denatured.
11. List some common sources of carbohydrates, lipids and proteins.
12. Explain the role of the liver in fat metabolism.
13. Distinguish between essential and non-essential amino acids.
14. Distinguish between complete and incomplete proteins.

CHM 300 OBJECTIVES...7

15. Describe the major functions of amino acids.
16. Define "calorie".
17. Define "energy balance".
18. Define "Basal Metabolic Rate".
19. List some of the factors that affect BMR.
20. Distinguish between a vitamin and a mineral.
21. Explain what is meant by Vitamin B complex.
22. Discuss the general characteristics of fat-soluble vitamins.
23. Discuss the general characteristics of the mineral nutrients.
24. Define "enzyme".
25. Describe how an enzyme is thought to interact with its substrate.
26. Explain how an enzyme can be denatured.