Diablo Valley College Course Outline for CHEM-120

CHEM-120: General College Chemistry I

Description

An introduction to the fundamentals of chemistry including the topics: atomic theory, chemical reactions, bonding, structure, stoichiometry, gases, solutions, redox, thermochemistry, equilibrium, and acid-base chemistry.

Prerequisite

CHEM - 108 or score of 3,4 or 5 on AP Chemistry Test or appropriate chemistry skill level demonstrated through Chemistry Diagnostic Test or equivalent
MATH 120 or equivalent
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Recommended

Eligibility for ENGL 122 or equivalent

General Information

Department: Chemistry, Physical Science and Engineering Division
Units: 5.00
Grade Code: Letter grade
Repeatability: none
Max class size: 28

Number of Hours

Per Semester
Lecture: 90.00
Laboratory: 72.00

Objectives

Students will be able to:

A. Apply the basic concepts of chemistry, both as ends in themselves and as bases for further study in chemistry and other disciplines.
B. Solve complex quantitative problems and express non-quantitative relationships.
C. Apply the inductive-deductive process by which science evolves, and the use of theoretical models.
D. Perform basic laboratory techniques and apply statistical analysis to quantitative measurements.

Content

A. INTRODUCTION
1. Basic definitions
2. Systems of measurement-metric system
3. Significant figures, experimental error

B. SUBSTANCES AND MIXTURES
1. Atoms, molecules, and ions
2. Classification of matter
3. Balancing chemical equations

C. STOICHIOMETRY
1. Atomic and molecular weights
2. The mole concept
3. Empirical formula
4. Weight relationships
5. Molarity

D. CHEMICAL NOMENCLATURE
2. Naming ionic compounds, acids, and binary covalent compounds

E. REACTIONS OF AQUEOUS SOLUTIONS
1. Electrolytes and ionic equations
2. Oxidation-reduction reactions and balancing redox equations.

F. THERMOCHEMISTRY
1. Heat of reaction
2. Hess' Law
3. Enthalpies of formation
4. Bond energy

G. GASES
1. Gas laws
2. Kinetic molecular theory
3. Diffusion and effusion
5. Nonideal gases

H. LIQUIDS, SOLIDS, AND CHANGES OF STATE
1. Intermolecular forces
2. Properties of liquids
3. Phase changes

I. SOLUTIONS
1. The solution process
2. Concentration units
3. Colligative properties

J. CHEMICAL EQUILIBRIUM
1. The equilibrium constant
2. Equilibrium calculations
3. LeChatlier's principle

K. ACID-BASE THEORY
1. Arrhenius theory
2. Autoionization of water
3. pH
4. Bronsted-Lowry theory
5. Strong acids and bases
6. Weak acids and bases
7. Lewis theory

L. ACID-BASE EQUILIBRIUM
1. Equilibrium constants for weak acids, Ka, and weak bases, Kb
2. Salts and their corresponding Ka and Kbs
3. Equilibrium constants for polyprotic acids and their conjugate bases
3. Polyprotic acids

M. ATOMIC THEORY
1. Historical development
2. Quantum mechanical model
3. Electron configuration and chemical periodicity

N. CHEMICAL BONDING
1. Ionic and covalent bonding
2. Drawing Lewis structures
3. Electronegativity and polarity
4. Exceptions to the octet rule
5. VSEPR theory and molecular geometry
6. Valence bond model and hybridization

O. LABORATORY TECHNIQUES

1. Use of analytical balance
2. Use of volumetric glassware
3. Measurement of pH of aqueous solutions
4. Colorimetric analysis
5. Titration
6. Laboratory Notebook
7. Statistical analysis of data
8. Use of spreadsheets for processing data and generating graphs
9. Use of computers for data acquisition

Methods

Lecture, Laboratory, Demonstration, Discussion, (1) Lecture, three hours per week. Presentation of new material, discussions of assignments. (2) Laboratory lecture and discussion, two hours per week; (3) Laboratory, 4 hours per week. Experiments may illustrate lecture principles or new concepts. Most of the experiments are of a quantitative nature.

Assignments

Reading 1: After reading the chapter on gases, the student should be able to:

a. Define gases and pressure.

b. Explain the relationship of pressure, volume, moles and temperature for ideal gases.

c. Analyze quantitative and qualitative gas problems.

d. Use the kinetic molecular theory of gases to explain the pressure, volume, moles, and temperature relationship of ideal gases.

e. Analyze problems involving mixtures of gases.

f. Explain the differences between real and ideal gases.

g. Analyze the effect of molecular weight on rates of effusion and diffusion.

Reading 2: After reading the chapter on equilibrium, the student should be able to:

a. Explain the terms "equilibrium constant", and "equilibrium expression".

b. Use equilibrium constants and expressions to solve simple and complex word problems involving chemical reactions at equilibrium.

c. Define "le Chatlier's Principle" and use it to solve qualitative problems involving chemical reactions at equilibrium.

Writing, problem solving, performance 1: A 20.0 L nickel container was charged with 0.500 atm of xenon gas and 1.50 atm of fluorine gas at 400. degrees Celsius. The xenon and fluorine react to form xenon tetrafluoride. What mass of xenon tetrafluoride can be produced assuming 100% yield?

Writing, problem solving, performance 2: A handbook states that the solubility of methylamine in water at 1 atm pressure and 25 degrees C is 959 volumes of the methylamine gas per volume of water. a) Estimate the maximum pH that can be attained by dissolving methylamine in water. b) What molarity of NaOH(aq) would be required to yield the same pH?

Lab, field activity, product or report: Laboratory - a) Prepare and standardize a 0.1 M NaOH solution. b) Using class data determine the average molarity of the unknown NaOH solution. c) Detemine the standard deviation in the average molarity. d) Determine the percent potassium hydrogen phthalate (KHP) in an unknown sample by titration with the standard base to within 0.5% precision.

Evaluation

Sample One: Calculate the percent ionization of a 0.10 M weak acid, having a Ka of 0.00020. Compare its pH to the pH of a strong acid of the same molarity.

Sample Two: Balance the following oxidation/reduction reaction which occurs under basic conditions.

Al(s) + MnO4- --> MnO2 + Al(OH)4-

Frequency of Evaluation: Evaluations will adhere to the DVC "Fairness in Grading" guidelines and will include as a minimum: (1) Evaluation of students within the first quarter of the course and notifying student of the results (2) Counting a final examination for no more than one-half the course grade (3) Basing final grades on at least three students' tests and/or reports

Additional: 1. A minimum of three closed book, one hour in-class exams and a final exam
2. Homework problems assigned and evaluated or short quizzes given
3. Laboratory evaluation will represent approximately 25% of grade.
4. Formal lab write-ups including laboratory reports and pages from the student lab notebook.
5. Web-based problems may be assigned.

Sample Textbook

See the current course syllabus or bookcenter.dvc.edu for the actual course textbook.

Book One

Author: Diablo Valley Chemistry Department
Title: Chemistry 120 Experiments and Exercises
Publisher: DVC Book Center
City: Pleasant Hill, CA
Year: 2010

Book Two

Author: Zumdahl, Steven and Susan Zumdahl
Title: Chemistry, 8th edition
Publisher: Houghton Mifflin
City: Boston, MA
Year: 2008

Other

(1) Safety eye protection; (2) Bound laboratory notebook; (3) Scientific calculator; (4) Portable memory device

Approval Date

Oct 12 2010