Syllabus
Chem 102

Introduction to General, Organic, and Biological Chemistry

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Lectures: Tue, Thu, and Fri 2:00-3:15 PM
PS 130

All lecture slides will be posted on Blackboard

Text: Chemistry, An introduction to General, Organic, and Biological Chemistry, 12th edition (Pearson)
Timberlake

Office hours at CSL 322: Monday 8:30-10:00
Tuesday 8:30-10:00
Alternative times may be arranged by appointment.

Prerequisites: High School Chemistry

Course description.

This course gives an overview of the concepts in general, organic, and biological chemistry that are necessary to understand human biochemistry and pharmacology. These include measurements, use and conversion of units, significant figures, chemical bonding, stereochemistry, acidity, functional groups, thermodynamics, carbohydrates, lipids, nucleotides, nucleic acids, amino acids, proteins, enzymes, and metabolic pathways.

Learning Objectives:

Define the term chemistry and identify substances as chemicals. Describe the activities that are part of the scientific method. Use place values, positive and negative numbers, percentages, solve equations, interprete graphs, and write numbers in scientific notation.

Use metric or SI units in measurement, including length, volume, mass, temperature, and time. Distinguish measured and exact numbers and determine the number of significant figures in a measured number. Adjust calculated answers to give the correct number of significant figures. Use the numerical values of metric prefixes. Write and use conversion factors. Calculate the density, the mass, or volume of a substance.

Distinguish pure substances and mixtures. Identify the states, the physical properties, and chemical properties of matter. Interconvert temperatures of different scales. Distinguish potential and kinetic energy and convert between units of energy (calculate the kilocalories (kcal) or kilojoules (kJ) for a food). Use specific heat to calculate heat loss or gain. Describe the changes of state between solids, liquids, and gases; calculate the energy involved.

Focusing on elements relevant to biology, write the correct symbol for a given element; write the correct name for a symbol. Use the periodic table to identify the group and the period of an element; identify the element as a metal, a nonmetal, or a metalloid. Describe the electrical charge and location in an atom for a proton, a neutron, and an electron. Given the atomic number and the mass number of an atom, state the number of protons, neutrons, and electrons. Determine the number of protons, electrons, and neutrons in one or more of the isotopes of an element; calculate the atomic mass of an element using the percent abundance and mass of its naturally occurring isotopes. Given the name or symbol of one of the first 20 elements in the periodic table, write the electron arrangement. Use the electron arrangement of elements to explain the trends in periodic properties.

Describe the nature of alpha, beta, positron, and gamma radiation. Write balanced nuclear equations for radioactive decay. Describe the detection and measurement of radiation. Calculate the amount of radioisotope remaining after one or more half-lives. Describe the use of radioisotopes in medicine. Describe the processes of nuclear fission and fusion.

Write the symbols for the simple ions of the representative elements. Using charge balance, write the correct formulas for ionic compounds. Given formulas and correct names for ionic compounds. Given the formulas and names of molecular compounds. Use electronegativity to determine the polarity of a bond. Predict the three-dimensional structure of a molecule, and classify it as polar or nonpolar. Describe the attractive forces between ions, polar covalent molecules, and nonpolar covalent molecules.

Use Avogadro's number to determine the number of particles in a given number of moles. Calculate the molar mass for a given substance; use molar mass to convert between grams and moles. Write a balanced chemical equation from the formulas of the reactants and products for a reaction; determine the number of atoms in the reactants and products. Classify reactions as combination, decomposition, single replacement, double replacement, or combustion. Define the terms oxidation and reduction; identify the reactants that are oxidized and that are reduced. Use mole-mole factors from balanced chemical equations to calculate the number of moles of reactants or products in the reaction. Use mole-mole and molar mass factors to carry out mass calculations for reactions. Describe exothermic and endothermic reactions and factors that affect the rate of a reaction.

Describe the kinetic molecular theory of gases and the units of measurement used for gases. Use the pressure-volume relationship (Boyle's law), the temperature-volume relationship (Charles's law), the temperature-pressure relationship (Gay-Lussac's law), the combined gas law, Avogadro's law, and Dalton's law of partial pressures in calculations regarding gasses.

Describe the formation of a solution and identify the solute and solvent in a solution. Identify solutes as electrolytes or nonelectrolytes. Define solubility and distinguish unsaturated and saturated solutions. Identify a salt as soluble or insoluble. Calculate the concentration and the amount of a solute in a solution. Describe the dilution of a solution and calculate the final concentration or volume of a diluted solution. Identify a mixture as a solution, a colloid, or a suspension. Describe how the number of particles in a solution affects the osmotic pressure of a solution.

Name and identify Bronsted-Lowry acids and bases. Write equations for the ionization of acids and bases. Use the concept of reversible reactions to explain acid-base equilibrium. Use Le Chatelier's principle to determine the effect on equilibrium concentrations when reaction conditions change. Use the ion product

for water to calculate the [H_3O^+] and [OH^-] in an aqueous solution. Calculate the pH or the H_3O^+ concentration of a solution. Write balanced equations for reactions of acids and bases. Calculate the molarity or volume of an acid from titration information. Describe the role of buffers in maintaining the pH of a solution.

Identify properties characteristic of organic or inorganic compounds. Write the IUPAC names and draw the condensed structural and skeletal formulas for alkanes and cycloalkanes. Write the IUPAC names for alkanes with substituents and draw their condensed structural and skeletal formulas. Identify the properties of alkanes and write a balanced chemical equation for combustion. Identify structural formulas as alkenes, cycloalkenes, and alkynes, and write their IUPAC names. Draw the condensed structural formulas and give the names for the cis-trans isomers of alkenes. Draw the condensed structural formulas and give the names for the organic products of addition reactions of hydrogenation and hydration of alkenes. Describe the bonding in benzene; name aromatic compounds and draw their skeletal formulas.

Give the IUPAC and common names for alcohols and phenols; give the common names for thiols and ethers. Draw their condensed structural or skeletal formulas. Describe the classification of alcohols; describe the solubility of alcohols in water. Write the IUPAC and common names for aldehydes and ketones; draw the condensed structural formulas. Describe the solubility of aldehydes and ketones in water. Write balanced chemical equations for the combustion, dehydration, and oxidation of alcohols. Write balanced chemical equations for the oxidation and reduction of thiols, aldehydes, and ketones.

Classify a monosaccharides based on the number of carbons and the presence of a carbonyl as an aldehyde or a ketone. Identify chiral and achiral carbon atoms in organic molecules. Use Fischer projections to draw the D or L stereoisomers for glucose, galactose, and fructose. Draw and identify the Haworth structures for monosaccharides. Identify the products of oxidation or reduction of monosaccharides; determine whether a carbohydrate is a reducing sugar. Describe the monosaccharide units and linkages in disaccharides. Describe the structural features of amylose, amylopectin, glycogen, and cellulose.

Give the IUPAC and common names for carboxylic acids; draw their condensed structural formulas or skeletal formulas. Describe the solubility, ionization, and neutralization of carboxylic acids. Give the IUPAC and common names for esters; write balanced chemical equations for ester formation. Draw the condensed structural formulas for the products of acid and base hydrolysis of esters. Give the common names for amines; draw the condensed structural formulas when given their names. Classify amines as primary, secondary, or tertiary. Describe the solubility, ionization, and neutralization of amines. Give

the IUPAC and common names for amides and draw the condensed structural formulas for the products of their formation and hydrolysis.

Describe the classes of lipids. Draw the condensed structural formulas of saturated ad unsaturated fatty acids. Draw the condensed structural formula for a wax or triacylglycerol produced by the reaction of a fatty acid and an alcohol or glycerol. Draw the condensed structural formula of the compounds produced during hydrogenation, hydrolysis, or saponification of triglycerides. Describe the structure of phospholipids containing glycerol or sphingosine. Describe the structures of steroids. Describe the composition and function of the lipid bilayer in cell membranes.

Classify proteins by their functions. Give the names and abbreviations of amino acids and draw their structures. Draw the condensed structural formulas for amino acids at pH values above or below its isoelectric point. Draw the condensed structural formula for a peptide and give its name. Describe the primary structure for a protein. Describe the secondary, tertiary, and quaternary structures for a protein; describe the denaturation of a protein. Describe enzymes and their role in enzyme-catalyzed reactions. Describe the effect of temperature, pH, and inhibitors on enzyme activity.

Describe the bases and ribose sugars that make up the nucleic acids DNA and RNA. Describe the primary structures of RNA and DNA. Describe the double helix of DNA and the process of DNA replication. Identify the different types of RNA; describe the synthesis of mRNA. Describe the process of protein synthesis from mRNA. Describe some ways in which DNA is altered to cause mutations. Describe the methods by which a virus infects a cell.

Describe three stages of catabolism and the role of ATP in metabolism. Give the sites and products of digestion for carbohydrates, triacylglycerols, and proteins. Describe the components and functions of the coenzymes NAD^+, FAD, and coenzyme A. Describe the conversion of glucose to pyruvate in glycolysis and the subsequent conversion of pyruvate to acetyl-CoA or lactate. Describe the oxidation of acetyl-CoA in the citric acid cycle. Describe electron transport and the process of oxidative phosphorylation; calculate the ATP from the complete oxidation of glucose. Describe the metabolic pathway of B oxidation; calculate the ATP from the complete oxidation of a fatty acid. Describe the reactions of transamination, oxidative deamination, and the entry of amino acid carbons into the citric acid cycle.

Lecture schedule		
Date	**Topic**	**Reading**
Tu Aug 30	Introduction; Chemicals; Scientific method	Ch. 1 pp. 1-6
Th Sept 1	Math skills; Units	Ch. 1/2 pp. 7-25
Fr Sept 2	Measured and Significant Numbers; Significant Numbers and Calculations; Prefixes and equalities; conversion factors; Problem solving with unit conversions; Density	Ch. 2 pp. 26-56
Tu Sept 6	Classification of matter; States and properties of matter; Temperature; Energy	Ch. 3 pp. 57-73 Ch. 3/4 pp. 73-100
Th Sept 8	Specific heat; Changes of state; Elements and symbols; Periodic table	Ch. 4 pp. 101-111 Ch. 4/5 pp. 119-138
Fr Sep 9	The atom; Atomic and mass numbers	Ch. 5 pp. 138-164
Tu Sept 13	Isotopes; Electron energy levels	Ch. 4 pp. 111-118
Th Sept 15	Periodic trends; Natural radioactivity	Ch. 4 pp. 119-133
Fr Sept 16	Nuclear reactions; Measuring radiation; Half life; Medical applications	Ch. 5 pp. 134-164
Tu Sept 20	Ions; Formulas; Naming ionic compounds	Ch. 6 pp. 165-177
Th Sept 22	Polyatomic ions; Molecular compounds	Ch. 6 pp. 177-188
Fr Sept 23	Electronegativity; Shapes and polarity; Attractive forces	Ch. 6 pp. 189-210
Tu Sept 27	Mole; Molecular mass calculations; Equations for chemical reactions	Ch. 7 pp. 211-222
Th Sept 29	Types of reactions	Ch. 7 pp. 222-234
Fr Sept 30	Oxidation-reductions reactions; Mole relationships; Mass calculations; Properties of gasses	Ch. 7/8 pp. 235-258
Tu Oct 4	Midterm 1: Chapters 1-6	
Th Oct 6	Pressure and volume; Temperature and volume; Temperature and pressure; Combined gas law; Volume and moles; Partial pressure	Ch. 8/9 pp. 258-283
Fr Oct 7	Solutions; Electrolytes	Ch. 9 pp. 283-290
Tu Oct 11	Solubility; Concentration; Dilution	Ch. 9 pp. 290-304
Th Oct 13	Properties of solutions; Acids and bases	Ch. 9/10 pp. 305-325
Fr Oct 14	Strengths of acids and bases; Acid-base equilibrium	Ch. 10 pp. 326-335
Tu Oct 18	Ionization of water; pH scale; Reactions of acids and bases	Ch. 10 pp. 336-349
Th Oct 20	Buffers; Organic compounds; Alkanes	Ch. 10/11 pp. 349-365
Fr Oct 21	Alkanes with substituents; Properties of alkanes	Ch. 11 pp. 365-374

Tu Oct 25	Alkenes and alkynes; Cis-trans isomers; Addition reactions	Ch. 11 pp. 375-385
Th Oct 27	Aromatic compounds; Alcohols; Phenols	Ch. 11/12 pp. 386-403
Fr Oct 28	Thiols; Ethers; Properties of alcohols; Aldehydes	Ch. 12 pp. 404-410
Tu Nov 1	Ketones; Reactions of Alcohols and Thiols	Ch. 12 pp. 410-418
Th Nov 3	Reactions of Aldehydes and Ketones; Carbohydrates; Chiral molecules	Ch. 12/13 pp. 419-438
Fr Nov 4	Fisher projections; Haworth structures; Chemical properties of Monosaccharides	Ch. 13 pp. 439-452
Tu Nov 8	Midterm 2: Chapters 7-12	
Th Nov 10	Disaccharides; Polysaccharides	Ch. 13 pp. 452-471
Fr Nov 11	Veteran's Day	
Tu Nov 15	Carboxylic acids; Properties of Carboxylic acids	Ch. 14 pp. 472-480
Th Nov 17	Esters; Hydrolysis of esters; Amines	Ch. 14 pp. 481-493
Fr Nov 18	Amides; Lipids; Fatty acids	Ch. 14/15 pp. 494-514
Tu Nov 22	Waxes and Triglycerols; Chemical properties of Triglycerols	Ch. 15 pp. 515-527
Th Nov 24	Thanksgiving break	
Fr Nov 25	Thanksgiving break	
Tu Nov 29	Phospholipids; Sterols; Cell membranes	Ch. 15 pp. 528-550
Th Dec 1	Proteins and Amino acids; Amino acids as acids and bases; Protein structure.	Ch. 16 pp. 551-574
Fri Dec 2	Factors affecting enzyme activity; Bases and Nucleotides; Primary structure of Nucleic acids	Ch. 16/17 pp. 575-596
Tu Dec 6	The Double helix; RNA; Genetic code; Protein synthesis; Mutations; Viruses	Ch. 17 pp. 597-621
Th Dec 8	Metabolism and ATP; Digestion; Coenzymes; Glycolysis	Ch. 18 pp. 622-640
Fr Dec 9	Citric acid Cycle; Electron transport chain; Oxidation of Fatty acids; Degradation of Amino acids	Ch. 18 pp. 640-672
Tu Dec 13	Midterm 3: Chapters 13-18	

Lab schedule	
Week of Aug 29	Significant figures, scientific notation worksheet
Week of Sept 5	Solubility (Tuesday, Wednesday, Thursday sections)
Week of Sept 12	Specific heat
Week of Sept 19	Flame test, spectra, absorbance of light
Week of Sept 26	Magnesium oxide
Week of Oct 3	Introduction to acids and bases
Week of Oct 10	Titration part A
Week of Oct 17	Titration part B
Week of Oct 24	Synthesis of aspirin
Week of Oct 31	Molecular structure worksheet
Week of Nov 7	Properties and preparation of esters and soap
Week of Nov 14	Determination of protein concentration
Week of Nov 21	Thanksgiving Monday labs do solubility expt
Week of Nov 28	Enzyme catalysis
Week of Dec 5	Check out
Week of Dec 12	

For some of the laboratory exercises you will need a non-programmable calculator (e.g., TI-30Xa or Casio fx-300ms plus), Matches or butane lighter, safety glasses and an apron (available at the Bookstore).

Homework: Mastering chemistry

Go to http://www.pearsonmylabandmastering.com sign up for the course

To sign up you will need:

- An email address
- The course ID: SDSUCHEM102F2016
- An access code or credit card

Homework will be assigned weekly.

Homework will count for 120 out of the possible 1000 points in this course

Exams

Midterms: Tuesday, October 4: (Chapters 1-6)
Tuesday, November 8: (Chapters 7-12)
Tuesday December 13: (Chapters 13-18)

Final: Tuesday, December 20, 1:00-3:00 pm: (Chapters 1-18)

Bring a blue scantron (20788 or SC882-E) with you to each of the exams.

Grading

Homework	120 points
Labs 12 labs, 1 worksheet (15 points each) drop lowest grade	180
Midterm 1	150
Midterm 2	150
Midterm 3	150
Final	250
Total	1000 points

Letter grades	
90 % and above	A
80-89.9 %	B
70-79.9 %	C
60-69.9 %	D
below 60%	F

Slides will be posted on blackboard. However, remember that the slides do not contain a comprehensive overview of the material.

You will need a non-programmable calculator during the exams and some of the laboratories (e.g., TI-30Xa or Casio fx-300ms).

No cell phone use will be permitted during exams.

The final exam will be comprehensive.

Students with disabilities: If you are a student with a disability and believe you will need accommodations for this class, it is your responsibility to contact Student Disability Services at (619) 594-6473. To avoid any delay in the receipt of your accommodations, you should contact Student Disability Services as soon as possible. Please note that accommodations are not retroactive, and that accommodations based upon disability cannot be provided until you have presented your instructor with an accommodation letter from Student Disability Services.