

SYLLABUS
10623

CHE*K122 General Chemistry II
Three Rivers Community College
Norwich, Connecticut 06360

Instructor: Michael P. Carta

Office: C168

Office Phone: 860-215-9413

E-mail: mcarta@threeivers.edu

Office Hours:

M	9:00-10:00 a.m.
T	1:00-2:00 p.m./4:30 – 5:30 p.m.
W	9:00-10:00 a.m.
R	5:00 – 5:30 p.m.

Disabilities Notice:

If you have a disability that may affect your progress in this course, please meet with a Disability Service Provider (DSP) as soon as possible. Please note that accommodations cannot be provided until you provide written authorization from a DSP.

TRCC Disabilities Service Provider: Matt Liscum (860) 215-9265
Counseling & Advising Office
Room A-119

- Physical Disabilities
- Sensory Disabilities
- Medical Disabilities
- Mental Health Disabilities
- Learning Disabilities
- ADD/ADHD
- Autism Spectrum

Course: General Chemistry II/CHE*K122

Credits: 4 credit hours (3hr lecture/3hr lab each week)

Course Description: Further study of the principles, theories and laws of chemistry. Topics include kinetics, equilibrium, thermodynamics, oxidation-reduction, electrochemistry, organic chemistry, nuclear chemistry and the chemistry of the elements and their compounds.

Prerequisites: CHE*K121 with a “C” grade or better, MAT* K186 with a “C” grade or better.

Text: *Chemistry The Central Science*, 13th ed., Brown, LeMay, Bursten, Murphy, Woodward, Stoltzfus; Pearson Publishing.

Lab Manual: *CHE 122 General Chemistry II Laboratory Exercises*, second edition, M. Carta, Academx.

Other Required Materials: Chemical safety goggles, scientific calculator.

General Course Objectives:

1. To provide students with a solid understanding of the fundamental concepts of chemistry.
2. To encourage students to apply problem-solving skills toward chemical calculations.
3. To educate students in the language and nomenclature of chemistry.
4. To help students relate chemical concepts to practical applications.

Class Attendance Policy:

Attendance of all class activities in lecture and laboratory is required. Absences are counted from the first meeting of class. More than four consecutive or more than six accumulative absences could result in a student receiving an “F” grade in this course. An explanation of the cause of all absences should be given to your instructor either by phone or email. Any missed handouts or other supplemental material may be obtained from BlackBoard.

Learning Portfolio: All students are required to maintain an online learning portfolio in Digication that uses the college template.

Academic and Classroom Misconduct:

The instructor has primary responsibility for control over classroom and/or laboratory behavior and maintenance of academic integrity, and can request the temporary removal or exclusion from the classroom or laboratory of any student engaged in conduct that violates the general rules and regulations of the institution. This includes any student engaged in conduct deemed hazardous in the laboratory. Extended or permanent exclusion from lecture or laboratory activities or further disciplinary action can only be effected through appropriate procedures of the institution. Plagiarism, cheating on quizzes or tests, or any form of academic dishonesty is strictly prohibited. Students guilty of academic dishonesty directly or indirectly will receive a zero for the exercise or quiz or test and may receive an “F” grade for the course in addition to other possible disciplinary sanctions which may be imposed through the regular institutional procedures. Any

mitigating circumstances beyond the control of the student such as illness, death in the family, or change in condition of employment. Make-up tests must be scheduled within a week of the missed test and arranged with the Testing Center by calling 860-215-9061 or stopping by the Welcome Center- A105.

Cell Phones and/or beepers: Cellular phones and beepers are only allowed in class or lab if they are turned off or in silent mode. Under no circumstances are phones to be answered in class. When there are extenuating circumstances that require that a student be available by phone or beeper, that student must speak to the instructor prior to class, so that together they can arrive at an agreement. **A cell phone is not permitted as a substitute for a calculator.**

Course Objectives: CHE*K122- General Chemistry II

1. The student will learn about the factors which affect the rate of chemical reaction.
2. The student will be able to write a rate law.
3. The student will understand the meaning of reaction order.
4. The student will learn how to calculate the half-life for a reactant.
5. The student will be able to understand the meaning of activation energy.
6. The student will learn about different types of catalysts and how they function.
7. The student will be able to calculate the instantaneous and the average reaction rate.
8. The student will be able to understand the concept of reaction mechanism.
9. The student will be able to define enzymes and understand basic enzyme catalysis.
10. The student will be able to define chemical equilibrium.
11. The student will learn how to write an equilibrium expression.
12. The student will learn how to interpret the equilibrium constant.
13. The student will be able to understand the relationship between kinetics and equilibrium.
14. The student will learn how to calculate equilibrium concentrations of reactants and products.
15. The student will understand LeChatelier's principle and factors which affect equilibrium.
16. The student will learn the definitions of acids and bases.
17. The student will learn how to determine the strength of acids and bases.
18. The student will be able to define pH and calculate the pH of acid or base solutions.
19. The student will be able to understand weak acids and the acid ionization constant.
20. The student will learn how to calculate the pH of a weak acid or base solution.
21. The student will be able to understand the concept of Lewis acids and bases.
22. The student will learn how to determine the acid-base properties of salts.
23. The student will be able to understand how titrations are used to quantitate acids and bases.
24. The student will learn how acid-base indicators are used.
25. The student will be able to define a buffer and learn how buffers work.
26. The student will learn how to use the Henderson-Hasselbalch equation.
27. The student will be able to understand the concept of solubility equilibria.
28. The student will learn the definition of the solubility product, K_{sp} .
29. The student will be able to understand the common ion effect.
30. The student will be able to understand the laws of thermodynamics.
31. The student will be able to differentiate spontaneous from nonspontaneous processes.

32. The student will be able to define entropy.
33. The student will be able to understand the concept of free energy.
34. The student will learn how to predict spontaneity based on the free energy change, ΔG .
35. The student will learn about the relationship between the equilibrium constant and free energy.
36. The student will be able to understand the relationship between enthalpy, entropy and free energy.
37. The student will be able to understand how equilibrium and free energy are central to living systems.
38. The student will learn how to balance redox equations.
39. The student will be able to understand the basics of galvanic cells.
40. The student will learn the significance of standard reduction potentials.
41. The student will be able to write half-cell reactions.
42. The student will be able to understand the thermodynamics of redox reactions.
43. The student will be able to define the Faraday constant.
44. The student will learn how to use the Nernst equation.
45. The student will be able to understand how batteries work.
46. The student will learn how an electrolytic cell works.
47. The student will be able to understand corrosion of metals.
48. The student will learn the basics of atmospheric chemistry.
49. The student will be able to understand the phenomenon of acid rain.
50. The student will be able to understand the greenhouse effect.
51. The student will be able to understand various aspects of environmental chemistry including smog.
52. The student will learn the definition of a coordination compound.
53. The student will be able to define coordination number, ligand, and chelating agent.
54. The student will learn the basic nomenclature of coordination compounds.
55. The student will be able to understand the bonding in coordination complexes.
56. The student will learn how coordination chemistry applies to biological systems.
57. The student will learn the basic nomenclature of organic compounds.
58. The student will be able to distinguish between types of organic compounds.
59. The student will be able to define and differentiate between geometric, optical and constitutional isomers.
60. The student will be able to predict the physical and chemical properties of various organic compounds.
61. The student will be able to differentiate between the different types of nuclear particles.
62. The student will be able to understand the fundamentals of nuclear reactions.
63. The student will be able to understand the basis of nuclear stability.
64. The student will be able to write and balance nuclear equations.
65. The student will learn the definition of nuclear binding energy.
66. The student will be able to understand natural radioactivity and half-life of radioactive decay.
67. The student will be able to understand the concept of nuclear transmutation.
68. The student will be able to understand the concept of nuclear fission.
69. The student will learn how radioactive isotopes are used in biology and medicine.
70. The student will learn about the chemistry of metals and nonmetals in greater detail.

Course Outline: CHE*K122- General Chemistry II

UNIT 1

I. Chemical Kinetics

A. Reaction Rate

1. factors affecting reaction rate
2. measuring reaction rates
 - a. instantaneous rate
 - b. average rate
 - c. rate constants
3. rate law
4. reaction order
5. half-life

B. Activation Energy and Collision Theory

1. transition state
2. Arrhenius equation for determining E_{act}

C. Reaction Mechanism

1. elementary steps
2. rate-determining step
3. reaction intermediates
4. molecularity
 - a. unimolecular, bimolecular and termolecular reactions

D. Catalysts

1. homogeneous catalysts
 - a. enzymes
2. heterogeneous catalysts
 - a. Haber process
 - b. catalytic converters
 - c. catalytic hydrogenation

II. Chemical Equilibrium

A. Law of Mass Action

1. Equilibrium Constant

C. Equilibrium Expressions

1. homogeneous equilibria
2. heterogeneous equilibria
3. K_c vs. K_p
4. multiple equilibria

D. Relationship between Kinetics and Equilibrium

E. Reaction Quotient, Q_c

F. LeChatelier's Principle

1. factors affecting equilibrium

UNIT 2

- I. Acids and Bases
 - A. Definitions/Theories
 - 1. Arrhenius
 - a. hydronium ion
 - 2. Bronsted-Lowry
 - a. conjugate acid-base pairs
 - 3. Lewis
 - B. Properties of Acids and Bases
 - C. Ion Product of Water
 - 1. K_w
 - 2. pH, pOH
 - D. Strengths of Acids and Bases
 - 1. acid ionization constant K_a ; percent ionization
 - 2. monoprotic, diprotic, polyprotic acids
 - 3. molecular structure and acid strength
 - E. Acid-Base Properties of Salts
 - F. Acid-Base Properties of Oxides and Hydroxides
 - 1. acidic and basic oxides
 - 2. basic and amphoteric hydroxides
 - G. Organic Acids and Bases
 - 1. carboxylic acids
 - 2. amines
- II. Acid-Base Equilibria
 - A. Common Ion Effect
 - 1. Henderson-Hasselbalch equation
 - 2. pKa
 - B. Buffers
 - 1. importance in biological systems
 - C. Acid-Base Titrations
 - 1. strong acid-strong base
 - 2. strong acid-weak base
 - 3. weak acid-strong base
 - 4. indicators
- III. Solubility Equilibria
 - A. Solubility Product
 - 1. K_{sp}
 - 2. ion product, Q
 - 3. solubility
 - 4. molar solubility
 - B. Precipitation Reactions
 - 1. fractional precipitation
 - 2. qualitative analysis
 - C. Factors Affecting Solubility
 - 1. common ion effect

- 2. pH effect
- D. Complex Ions

UNIT 3

- I. Second Law of Thermodynamics
 - A. Entropy
 - 1. spontaneous processes
 - 2. microstates
 - 3. standard entropy
 - 4. relationship between ΔS and ΔH
- II. Third Law of Thermodynamics
 - A. Absolute Entropy
 - B. Gibbs Free Energy (G)
 - 1. standard free energy change, ΔG°
 - 2. relationship between ΔG , ΔS and ΔH
 - a. predicting the sign of ΔG
- III. Free Energy and Equilibrium
 - A. $\Delta G = -RT \ln K$
 - B. Application of Thermodynamics in Biological Systems
 - 1. glycolysis
 - 2. biosynthesis
- IV. Electrochemistry
 - A. Oxidation-Reduction Reactions
 - 1. balancing redox equations
 - B. Galvanic Cells
 - 1. anode, cathode
 - 2. half-cell reactions
 - 3. cell potential or emf
 - 4. Daniel cell
 - 5. standard reduction potentials
 - C. Thermodynamics of Redox Reactions
 - 1. relationship between E_{cell} , ΔG and K
 - D. Effect of Concentration on E_{cell}
 - 1. Nernst equation
 - E. Batteries
 - 1. dry cell battery
 - 2. mercury battery
 - 3. lithium ion battery
 - 4. lead storage battery
 - F. Fuel Cells
 - G. Corrosion
 - H. Electrolytic Cells and Electrolysis
- V. Environmental Chemistry
 - A. Chemistry of the Atmosphere
 - 1. troposphere, stratosphere, mesosphere, ionosphere (thermosphere)

- 2. nitrogen cycle
- 3. oxygen cycle
- 4. ozone
- 5. CFC's
- B. Volcanoes
- C. Greenhouse Effect
 - 1. greenhouse gases
- D. Acid Rain
- E. Smog and Emissions
- F. Water
- G. Alternative Fuels
- VI. Chemistry of Nonmetals
 - A. Carbon, Nitrogen, Oxygen, Sulfur, Phosphorus and the Halides

UNIT 4

- I. Chemistry of Metals
 - A. Sources/Production
 - 1. minerals
 - 2. ores
 - 3. alloys
 - B. Band Theory
 - 1. conductors and semiconductors
- II. Transition Metal Chemistry
 - B. Electron Configurations
 - C. Coordination Chemistry
 - 1. coordination number
 - 2. donor atom
 - 3. ligand
 - 4. chelating agent
 - 2. nomenclature
 - 3. structure
 - 4. isomerism
 - a. geometric isomers, optical isomers, chirality
 - 5. bonding
 - a. crystal field theory
 - 6. reactivity
 - 7. applications of coordination chemistry
 - a. industrial
 - b. biological
- III. Organic Chemistry
 - A. Classes of Compounds/Nomenclature
 - 1. aliphatic hydrocarbons
 - a. alkanes, alkenes, alkynes, alicyclic hydrocarbons

- 2. aromatic hydrocarbons
 - a. benzene and related compounds
- B. Functional Groups
 - 1. alcohols
 - 2. carboxylic acids
 - 3. amines
 - 4. amides
 - 5. aldehydes
 - 6. ketones
 - 7. esters
 - 8. ethers
- C. Physical and Chemical Properties
 - 1. mp, bp, solubility
 - 2. reactivity
- D. Isomers
 - 1. cis/trans isomers
 - 2. constitutional isomers
 - 3. optical isomers and chirality
- IV. Nuclear Chemistry
 - A. Subatomic Particles
 - 1. protons, neutrons, electrons
 - 2. beta particles, alpha particles, positrons
 - B. Fundamentals of Nuclear Reactions
 - 1. radioactive decay
 - 2. nuclear transmutation
 - 3. conservation of atomic number
 - 4. conservation of mass number
 - C. Nuclear Stability
 - 1. belt of stability
 - 2. nuclear binding energy
 - D. Kinetics of Radioactive Decay
 - 1. half-life
 - 2. radiocarbon dating
 - E. Nuclear Fission
 - 1. critical mass
 - 2. nuclear chain reaction
 - 3. nuclear reactors
 - F. Uses of Radioisotopes
 - 1. mechanistic studies
 - 2. biology and medicine

CHE*K122 General Chemistry II Tentative Academic Schedule Spring 2016

10623 Lecture: MW 11:00 a.m.-12:25 p.m. D126

10624 Lab: F 9:00 a.m.-12:00 p.m. B222

week 1

F-Jan 22 Syllabus, lab protocol, review exercise.

week 2

M-Jan 25 Chemical Kinetics Ch 14

W-Jan 27 Chemical Kinetics Ch 14

F-Jan 29 Lab: The Iodine Clock Reaction (#1)week 3

M-Feb 01 Chemical Kinetics Ch 14

W-Feb 03 Chemical Kinetics Ch 14

F-Feb 05 Lab: Kinetics of Sucrose Hydrolysis (#2)week 4

M-Feb 08 Chemical Equilibrium Ch 15

W-Feb 10 Chemical Equilibrium Ch 15

F-Feb 12 **Presidents Day- COLLEGE CLOSED**week 5M-Feb 15 **Presidents Day- COLLEGE CLOSED**

W-Feb 17 Chemical Equilibrium Ch 15

F-Feb 19 Lab: Chemical Equilibrium (#3)week 6M-Feb 22 **UNIT TEST 1** (Ch 14-15)

W-Feb 24 Acid-Base Equilibria/Solubility Equilibria Ch 16-17

F-Feb 26 Lab: Aspirin: Synthesis and Melting Point (#5)week 7

M-Feb 29 Acid-Base Equilibria/Solubility Equilibria Ch 16-17

W-Mar 02 Acid-Base Equilibria/Solubility Equilibria Ch 16-17

F-Mar 04 Lab: Thin-Layer Chromatography (#7)week 8

M-Mar 07 Acid-Base Equilibria/Solubility Equilibria Ch 16-17

W-Mar 09 Acid-Base Equilibria/Solubility Equilibria Ch 16-17

F-Mar 11 Lab: pH and Buffers (#6)

week 9

M-Mar 14 Chemical Thermodynamics Ch 19

W-Mar 16 Chemical Thermodynamics Ch 19

F-Mar 18 **LAB MIDTERM**week 10Mar 21-25 **SPRING BREAK**week 11M-Mar 28 **Unit Test 2** (Ch 16-17)

W-Mar 30 Chemical Thermodynamics Ch 19

F-Apr 01 Lab: Determination of Vitamin C in Fruit Juice (#4)week 12

M-Apr 04 Electrochemistry Ch 20

W-Apr 06 Electrochemistry Ch 20

F-Apr 08 Lab: Determination of Iron by Redox Titration (#9)week 13

M-Apr 11 Chemistry of the Nonmetals Ch 22/Chemistry of the Environment Ch 18

W-Apr 13 Chemistry of the Nonmetals Ch 22/Chemistry of the Environment Ch 18

F-Apr 15 Lab: K_{sp} of Calcium Hydroxide (#8)week 14

M-Apr 18 Chemistry of the Nonmetals Ch 22/Chemistry of the Environment Ch 18

W-Apr 20 Transition Metals and Coordination Chemistry Ch 23

F-Apr 22 Lab: Spectroscopy and Structure (handout)week 15M-Apr 25 **Unit Test 3** (Ch 18, 19, 20, 22)

W-Apr 27 Transition Metals and Coordination Chemistry Ch 23

F-Apr 29 Lab: Molecular Models II: Stereochemistry (#10)week 16

M-May 02 Organic Chemistry Ch 24

W-May 04 Organic Chemistry Ch 24

F-May 06 Lab: Analysis of Sugars by Optical Rotation (#11)week 17

M-May 09 Nuclear Chemistry Ch 21

W-May 11 Nuclear Chemistry Ch 21

F-May 13 **Lab Final**week 18M-May 16 **Unit Test 4** (Ch 21, 23, 24)