Fall 2018 **Chemistry 1A**

Instructor: **Dr. Kirk Kawagoe** (dr.k)
Office: **Soc 38**
Email: **via Canvas**

Class schedule

§55194 Lecture M/W 1:00–2:15 PM Room 82
Lab M/W 2:30–5:20 PM Room 77
Office Hours W/Th 10-11:00 AM, F 12-2:00 PM

Required Materials

- Chemistry: A Molecular Approach, Nivaldo J. Tro
  - *Any version*, **but** you must buy the online homework

On-line Homework (bundled with book)

- www.masteringchemistry.com
  Course ID: MCKAWAGOE75665
- Scantron form 882E (letter answers)
- Lab Notebook: Provided
- Calculator: TI-36X Pro (non-graphing)
- Approved Safety Goggles and Lab Coat
- Lecture notes and experiments are found on the course **Canvas** page.

Attendance Policies

If you are absent four (4) times in the first 9 weeks you will be dropped from the course. In order to be counted as present you must arrive on time, participate in the experiment or activity, and, unless otherwise instructed, stay the entire lab period. In other words, if you arrive late, leave early, or do not participate in lab activities, you may be counted absent and given a zero on your lab exercise. Note: Showing up late for lab is a safety risk for you and others, as specific safety concerns are generally addressed at the beginning of lab. Contact me if you miss class. If you are absent, you must still meet the assignment due dates. You may also be counted absent if you leave class early. I will accept most reasonable excuses for being absent (circumstances beyond your control).

Disabled Students Programs Services

if you have a verified need for an academic accommodation or materials in alternate media (i.e., Braille, large print, electronic text, etc.) per the Americans with Disabilities Act (ADA) or Section 504 of the Rehabilitation Act, please contact me as soon as possible.

Homework

Homework grade policies and due dates are found on MasteringChemistry.com.

Do your work in a notebook and show me during lab to receive credit. See the prerequisite math note for what to include for calculation problems.

Final Exams

Your Final Exam is the American Chemical Society (ACS) First Term Exam. A mid-C grade is the 50th percentile on the exam. The exam is timed (approximately 2 hours, 70 questions) and **the ACS does not allow students to use graphing calculators during the exam.**
The final exam 12/12/18 (Wednesday) 1:00 – 2:50 PM

Grading and Exams

- The **grading scale** *starts* as:
  A = 100% - 90%; B = 89% - 80%; C = 79% - 70%; D = 69% - 60%; F = 59% - 0%
  Exams, labs, and homework are not curved, but the overall grades in the class may be curved at the end of the semester.
- Exam dates are found in the accompanying schedule, I will try and stick with this exam schedule, but may alter the material covered or dates if necessary. There are no makeup exams. If you miss an exam, you will receive a zero. At the end of the semester, I will replace your lowest exam score with your final exam score.
- No one who fails the lab portion of this course (a letter grade of D or lower) will receive a grade higher than a D.

Class Tests	45 %
Homework (online)	10 %
Final exam	20 %
Laboratory & Worksheets	25 %
Total	100 %

Academic Dishonesty

Cheating is the act or attempted act of taking an examination or performing an assigned, evaluated task in a fraudulent or deceptive manner. Cheating may include, but is not limited to, copying from another's work, supplying one's work to another, giving or receiving copies of examinations without an instructor's permission, using or displaying notes or devices inappropriate to the conditions of an examination, allowing someone other than the officially enrolled student to represent the student, or failing to disclose research results completely.

You are encouraged to work together on labs. However, ***your individual work must be evident***. **Do not copy work or allow others to copy from your work**. Instances of confirmed cheating will generally result in failure and be referred to the Dean for further action.

Electronic devices such as cell phones, tablets, etc. are not allowed during exams and must be put away in a backpack or purse; confirmed use of these devices constitutes cheating.

In general, students will get either an F for the course or minus the number of points on the assignment for cheating or plagiarism. The colleges academic dishonesty policy is found in your College Catalog (Pages 49-50, RC 2017-18 Catalog).

COURSE DESCRIPTION

***5 units**. 3 lecture hours, 6 lab hours. (A, CSU-GE, UC, I)*

Course Description: This is the first course in a two-course sequence in general chemistry and is intended for students majoring in science or satisfying prerequisites for professional schools. This course covers the principles and laws of inorganic chemistry with an emphasis on quantitative, mathematical problem-solving. Topics included in the course are atoms, molecules and ions; formulas and equations; stoichiometry; gas laws; electronic structure of atoms; bonding; atomic orbital and molecular orbital theories; solutions; precipitation reactions; oxidation reduction reactions; introduction to acids and bases; thermochemistry; properties of liquids; solids and crystal structures; solution behavior; colligative properties; associated laboratory experiments; and volumetric and gravimetric analysis methods. (A, CSU-GE, UC, I) (C-ID CHEM 110) (C-ID CHEM 120S: CHEM 1A & CHEM 1B)

Prerequisite: High school chemistry with laboratory component or Chemistry 3A or 10 or equivalent, and **Mathematics 103 or equivalent*.**

Advisories: English 1A.

A. Matter and energy
   1. The laws of conservation of mass and energy
   2. States and classifications of matter, including elements, ionic compounds, molecules, homogeneous mixtures and heterogeneous mixtures
   3. Chemical and physical properties of matter
   4. Chemical and physical changes of matter
   5. Scientific method

B. Measurements in chemistry
   1. SI units and derived units of measurement: length, mass, volume, density, pressure
   2. Temperature scales
   3. Dimensional analysis and problem solving
   4. Precision and accuracy in making measurements
   5. Significant figures
   6. Standard deviation

C. Atoms and elements
   1. Laws of conservation of mass, of constant composition, and of multiple proportions
   2. Modern atomic theory
   3. Protons, electrons, and neutrons
   4. Atomic number, atomic mass and atomic mass unit
   5. Isotopes including isotopic abundance and determining atomic mass
   6. Classification of elements, including metals, metalloids, non-metals and groups
   7. Conversions between mass, moles and atoms using Avogadro's number and molar masses

D. Molecules, ions, ionic compounds and organic molecules
   1. Chemical bonds: ionic and covalent bonds
   2. Ionic compounds, including formulas, nomenclature and properties
   3. Molecules, including formulas, nomenclature and properties
   4. Acids, including formulas, nomenclature and properties
   5. Organic Molecules
      - Recognizing alkane, alkene, alkyne, alcohol, aldehyde, ketone, carboxylic acid, amine and aromatic functional groups.
      - Nomenclature of alkanes
   6. Formula mass and molar mass, including conversions between grams to molecules to atoms
   7. Percent composition, empirical formulas, molecular formulas and combustion analysis

E. Chemical equations and stoichiometry
   1. Writing and balancing chemical equations
   2. Reaction classifications, including synthesis, decomposition, single displacement, double displacement, combustion, acid base neutralization and redox reactions.
   3. Stoichiometry calculations including limiting reactant, theoretical yield, and percent yield.

F. Solutions
   1. Concentration including percent by mass, percent by volume and molarity
   2. Dilution of solutions
   3. Solution stoichiometry

G. Aqueous Reactions
   1. Strong, weak and non-electrolytes
   2. Precipitation reactions, including prediction of products and solubility rules
   3. Molecular, complete and net ionic equations
   4. Acid-base reactions
   5. Arrhenius acids, bases and salts
   6. Bronsted-Lowry acids and bases
   7. Properties of acids and bases
   8. Acidity scale and pH
   9. Gas-forming reactions
   10. Redox reactions
   11. Assigning oxidation numbers
   12. Recognizing redox reactions by the change in oxidation state
   13. Identifying oxidant and reductant
   14. Balance redox reactions by the half-reaction method in acidic and basic conditions
   15. Acid-base and redox titrations

H. Gases
   1. Gas pressure
   2. The relationship of pressure and volume; Boyle's Law
   3. The relationship of volume and temperature. Charles' Law
   4. Kelvin absolute temperature scale
   5. Standard temperature and pressure (STP)
   6. Combined gas law
   7. Ideal gas law, including molar volume, determining the density and molar mass of a gas and stoichiometry calculations
   8. Gas mixtures and partial pressure, including Dalton's law of partial pressures
   9. Kinetic molecular theory
   10. Diffusion and effusion, including Graham's law

I. Thermochemistry
   1. Kinetic, potential, thermal and chemical energy
   2. Exothermic and endothermic reactions
   3. First Law of thermodynamics
   4. Pressure-volume work
   5. Enthalpy
   6. Calorimetry, specific heat, and related calculations
   7. State functions and Hess' law
   8. Standard enthalpies of formation
   9. Heat of reactions and stoichiometry

J. Atomic Structure
   1. Nature of light, including electromagnetic radiation, wave properties, electromagnetic spectrum, interference, diffraction, Planck's equation, quanta and the photoelectric effect
   2. Bohr's model of the atom
   3. Atomic spectra and calculations of transition energies
   4. Quantum numbers, orbitals, main shells, subshells, electron spin

K. Periodic properties and the relationship to atomic structure
   1. The periodic arrangement of atoms
   2. Electron configuration, Pauli's exclusion principle, Hund's rule
   3. Orbital diagrams of atoms and ions
   4. Valence electrons
   5. The periodic table
   6. Periodic properties and trends, including ionization energy, electron affinity, electronegativity, atomic and ionic size, metallic character

L. Chemical Bonding
   1. Covalent, ionic and metallic bonds
   2. Lewis structures
   3. Octet rule
   4. Incomplete octets, expanded octets and odd-electron structures
   5. Organic molecules including degrees of unsaturation, constitutional isomers, cis and trans stereoisomers, chiral carbons and stereoisomers.
   6. Line-bond structures of organic molecules
   7. Formal charges
   8. Bond length and bond energies
   9. Resonance structures
   10. VSEPR Theory and molecular geometry of molecules and polyatomic ions
   11. Electronegativity and bond polarity
   12. Molecular shape and polarity
   13. Hybridization and molecular geometry, including organic molecules
   14. Sigma and pi orbital overlap and bond rotation
   15. Energy level diagram of orbitals
   16. Homonuclear diatomic molecules
   17. Heteronuclear diatomic molecules

M. Intermolecular forces, liquids and solids
   1. Intermolecular forces
   2. Hydrogen bonding, including organic molecule examples
   3. Phase changes and phase diagrams, including boiling points, freezing points, vapor pressure, vaporization, condensation, sublimation, deposition, critical point, and heating curves.
   4. Liquid state, including adhesion, cohesion, vapor pressure, viscosity and surface tension.
   5. Solid state, including cubic crystal structures, molecular, ionic, metallic and covalent network solids.

N. Solutions
   1. Solutions terminology
   2. Solution concentration units, including molarity, molality, mole fraction, percent mass/volume, percent volume/volume, ppm, ppb and ppt.
   3. Colligative properties, including freezing point depression, molecular mass determination, boiling point elevation, van't Hoff factor, osmosis

STUDENT LEARNING OUTCOMES:

Upon completion of this course, students will be able to:

A. Collect and analyze data and have reasonable conclusions. Assessed by the lab practical.
B. Competent knowledge of the periodic table, molecules, and compounds. Assessed from a pre-test administered at the beginning of the semester and the final exam administered at the end of the semester.
C. Ability to apply skills to solve chemical problems especially math skills. Assessed from a pre-test administered at the beginning of the semester and the final exam administered at the end of the semester.

COURSE OBJECTIVES:

In the process of completing this course, students will:

A. Use systematic nomenclature to name and classify chemical species.
B. Predict ionic and covalent bonding between species.
C. Convert from the English to the metric system in weights, volume, and linear measurements.
D. Calculate molecular weights, formula weights, gas volumes, temperature, pressure concentration of solutions, molarity, empirical and molecular formulas, and percentage composition.
E. Define the structural periodicity of the elements and discuss the trends in all directions on the periodic chart and the terms for grouping elements, i.e., metalloids, transition elements, inner transition, etc..
F. Use stoichiometric relationships to calculate quantities of reactants, products, limiting reactants, theoretical yields, percent yields, and chemical formulas.
G. Describe covalently bonded structures using Lewis theory, valence bond theory (including hybrid orbitals), and molecular orbital theory of diatomic molecules.

H. Define the theoretical and mathematical description of ideal gases, including the concepts of temperature and kinetic energy distribution.
I. Identify types of reactions, predict the outcomes of chemical reactions, and write and balance chemical reactions.
J. Apply the first law of thermodynamics, contrast internal energy and enthalpy, describe how energy changes are related to temperature, atomic motions, and change in chemical bonding and perform thermochemical calculations.
K. Describe colligative properties of solutions of ionic and non-ionic substances and solve their numerical problems.
L. Effectively collect, record, and analyze experimental data, recognize the limitations of measurements and identify sources or error, and interpret experimental results and correlate experimental results with the appropriate theory

*** Prerequisite math note**: My experience is that students who have completed more math will do better in the course. This is not because the course requires more math, but the problems in chemistry require the ability to read and apply math to word problems. Make sure you work on your problem-solving skills throughout the semester. Follow the textbook method given in the solutions to the calculation examples throughout the text. In brief:

1. Sort the information
   a. Given
   b. Find
2. Strategize
   a. Conceptual Plan – how are the given and "find" related
   b. Relationships – What relationships do you need?
      i. Equations
      ii. Conversion factors
3. Solve
   a. Set up a solution based on the plan
   b. Check your units
   c. Calculate the answer
   d. Check your significant figures and round
4. Check
   a. Does the answer make sense?

Advice on Reading

1) Read the **summary** of the chapter first.
   a) You may not know what you are reading, but this will give you a framework to remember things.
2) **Do all the examples** before reading each section. Read the answers given in the text. They help explain how each problem is done.
   a) If it's not perfectly clear, read the section carefully.
   b) If it is clear, then move to the next section (we assume you learned enough from lecture or previous classes)
3) Take notes in the margins as you read. Write short summary statements or questions to ask in class.
4) Take the end of chapter "Self-Assessment Quiz". These will also be posted on-line.

LAB

- **You are responsible for knowing the lab safety rules**, therefore carefully read the lab safety contract. <u>You will need to **sign** the lab safety contract before being allowed to perform any experiments.</u>
- **Experiments: Experiments are downloaded from Canvas.** You are required to **complete prelab assignments before starting any experiment.** If you do not have the prelab work completed, you forfeit the points for that assignment. (see prelab instructions on below).
- **Worksheets: You must bring your own copies of worksheets and study guides.**

Prelab Assignments

There are **two different prelab assignments**. Both need to be completed **before coming to *class*** to do an experiment.

- **Prelab Worksheets** – These are found ***in*** the lab instructions you download from Canvas. Most of the questions can be answered by reading the experiment or the introduction to the experiment.
- **Notebook** – You need to write out the following in your notebook ***before you come to class. Use a pen!***
  - Purpose
  - Materials
  - Hazards

- Procedure (For Chem 1A, you are allowed to bring a copy of the procedure at the beginning of the semester, but you must work from the procedure in your notebook. If important information is missing, you can refer to and supplement your prelab notes).
- You should also leave space in your notebook for recording data. We will discuss this more in class.

If the notebook work is not done before class, you will not be allowed to do your experiment for the day. You will receive a zero for that day.

- If we are doing a worksheet in class, **you will have to bring a copy of the worksheet**. I will allow you to do your work on separate paper, but you'll have to copy it to a worksheet before turning it in (i.e. you get to do it twice).

Some of the Syllabus quiz questions and answers.
Note the quiz will be multiple choice. (End of first week). 5 pts.

1) Which of the following are required course materials?
   a) Text book, lab notebook, non-graphing calculator, goggles and a lab coat.
2) Which of the following statements are true?
   a) You have to pass lab to pass the class.
   b) You need a score of 70% or greater pass the class.
   c) Total lab points are worth about 2 exams.
   d) Total homework points are worth about the same amount as an exam.
3) If I am caught cheating, I should expect:
   a) to receive minus the possible score of the assignment or a failing grade for the course.
4) Which are you required to tell me contact me about?
   a) ADA accommodations and absences
5) For this course, how many absences are considered excessive by the school?
   a) Four
6) In order to receive points for homework I have to:
   a) Complete them before the due date and show your work (notebook is acceptable)
7) If I miss an exam:
   a) I get a zero, but my lowest score will be replaced by the next lowest exam score at the end of term.
8) Which of the following are part of the "prelab"?
   a) Prelab worksheet and lab notebook work.
9) What is done in the notebook before class starts?
   a) Purpose, Materials, Hazards, Procedure, and a space to record data.
10) If I don't finish the prelab assignments on time:
    a) I will get a zero
11) What kind of writing tool can I use in my lab notebook?
    a) A non-erasing pen.

Memorization Quiz
What you need to know for the **memorization quiz** (end of second week). 20 questions, 8 minutes. 10 pts.

1) Names and symbols for the first 36 elements and silver, cadmium, tin, tellurium, iodine, xenon, barium, iridium, platinum, gold mercury, lead, bismuth, radon, and uranium.
2) Names, formulas, and charges of the common polyatomic ions. Look these up in the book or online.
   - Carbonate, nitrate, phosphate, sulfate, chlorate, arsenate, selenate, bromate, oxalate, hydroxide, acetate (CH_3COO^- or $C_2H_3O_2^-$), permanganate, and ammonium ions.

Here are some equations that are used to analyze data. Not all apply to every report.

Average value: $average, \bar{x} = \frac{\sum x}{n}$	Slope, intercept, correlation coefficient: y = mx + b, r (correlation) are calculated using a spreadsheet or calculator
Comparison to known values: $\% = \frac{your\ value - theoretical\ value}{theoretical\ value} \times 100\%$	Rejection of outliers: $Q_{exp} = \frac{Gap}{Range}$; $Q_{exp} < Q_{crit}$, the data point is kept
Precision of results, standard deviation: $s_x = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}}$	Rejection of outliers: $G_{sus} = \frac{\lvert x_{suspect} - \bar{x} \rvert}{s}$, $G_{sus} > G_{crit}$, the data point is rejected
Percent relative standard deviation (RSD): $\%RSD = \frac{s_x}{\bar{x}} \times 100\%$	

Critical Values for G at 95% confidence

# of values	4	5	6	7	8	9	10
Critical Values	1.463	1.672	1.822	1.938	2.032	2.110	2.176

* These are the "one-sided" critical values, as recommended in ASTM method E178-02.

G-test example

Data

You carry out the same experiment four times. For each experiment, you obtain a final mass of sample. These are the masses recorded.

1.675 g, 1.633 g, 1.669 g, 1.683 g, 1.672 g

Here's the question. The value 1.633 g seems like it might be a little low, but how do you know if it can be statistically removed?

Calculations

Here are the steps involved in answering the question:

1. Calculate the average and standard deviation.
2. Identify the potential outlier
3. Calculate the value G_{sus}
4. Compare G_{sus} to G_{crit}
5. If $G_{sus} > G_{crit}$ it means that the suspected value can be eliminated based on statistical grounds. Recalculate the average and standard deviation without the suspect data. Otherwise, you keep all the data.

1. Calculate the average and standard deviation.

   There are 5 data points (N = 5)
   Average = 1.6664 g
   Standard Deviation = 0.0193856 g (if you need help calculating this, let me know)

2. Identify the potential outlier
   There are many ways to calculate the potential outlier, but it is always either the highest or lowest value. In this case the value 1.633 g is furthest from the average.

3. Calculate the value G_{sus}

$$G_{sus} = \frac{\left| x_{suspect} - \overline{x} \right|}{s} = \frac{\left| 1.633 - 1.6664 \right|}{0.0193856} = 1.723$$

4. Find G_{crit}
   Since N = 5, G_{crit} = 1.672.

5. Compare G_{sus} to G_{crit}. If $G_{sus} > G_{crit}$ it means that the suspected value can be eliminated based on statistical grounds. Otherwise, you keep all the data.
   Because 1.723 > 1.672, we "reject" the value 1.633 g and recalculate the average and standard deviation without the suspect value.

   The new average is 1.675 g, s = 0.0060 g.