

Chemistry 1B, General Chemistry

De Anza College Spring 2022 (4/4-6/24)

Chem 1B- Section 01
Lecture TTh 11:30AM-12:45, SC1102
Lab MW 7:30AM-10:20, SC2204

Chem 1B-Section 02
Lecture TTh 11:30-12:45, SC1102
Lab TTh 7:30AM-10:20, SC2204

Instructor: Dr. Margarete Leclerc, email: leclercmargarete@fhda.edu

Office Hours: Tuesday and Thursday 11:00-11:30 and 1:00- 2:00 pm

Course Description:

This class is a continuation of an introduction to the principles of chemistry. It covers principles and investigation of intermolecular forces and their effects on chemical and physical properties, reversible reactions from the standpoints of kinetics, thermodynamics, and equilibrium and application of gas laws and kinetic molecular theory. This course is divided into two separate instructional periods, the lecture and laboratory sections. The lecture portion is primarily devoted to the material discussion while the laboratory portion gives a chance for students to practice chemical experimentation. One registration code will enroll for the lecture and lab sections. Lecture and lab sections must be taken together to pass Chem 1B and will both go towards a single grade.

Prerequisites:

Prerequisite: CHEM 1A or CHEM 1AH with a grade of C or better.

Required Course Material:

1. **Lecture Text:** CHEMISTRY: The Molecular Nature of Matter and Change, Silberberg and Amateis, 9e. Other editions will be essentially the same and will work great to study. You can also get an ebook of this textbook. I will not use the Connect or ALEKS platform, so you can safely get a used book.
2. **Chem101 subscription for homework and quizzes.** We will use Chem101 as our online homework (12% of your final grade) and in-class practice problem platform this quarter. You must sign up for a Chem101 account before the end of the first week. You will have complimentary access to Chem101 for the first two weeks of the quarter. After this period, Chem101 costs \$22.95.
3. **Lab Manual:** <http://www.deanza.edu/chemistry/Chem 1 B.html>. Lab manuals must be read BEFORE performing each lab. Further instructions in lab section below.
4. **Lab Notebook:** Permanently bound, 8 ½ X 11 notebook. NO SPIRAL NOTEBOOK.
5. **Scientific Calculator.** Logarithm and exponential functions required, No graphing calculators. You are encouraged to bring your calculator each day to work through examples as they are presented. Phones will not be allowed for calculations during tests so be sure to bring a calculator those days.
6. **Canvas course shell:** Turn on Canvas notifications to receive class announcements.
7. **Optional course material:** Student Solutions Manual, Silberberg. Lab Coat for lab.

Registration details:

Class Registration. This class is a lecture and laboratory-based course, so the registration limit is strictly set at 30 students per section based on the number of people able to safely conduct experiments in the space provided.

Dropping the Course. Students that choose to drop this course are responsible for requesting a withdrawal through the admissions and records department **before** the deadline. Students who drop the class are to be also required to officially check-out of the lab locker. Failure to check out by the scheduled check-out date will result in fees and a block placed on future registrations.

Resources: Academic support can be found at the Learning Resources Division <https://www.deanza.edu/learningresources/>. Information about tutoring can be found at the Math Science and Technology Resource Center <https://www.deanza.edu/studentsuccess/mstrc/>. Additionally, you are encouraged to email me with class questions.

Academic Integrity: By enrolling in classes at De Anza College, you are agreeing to the academic integrity policy and are held to all standards. Specifics can be found at <https://www.deanza.edu/studenthandbook/academic-integrity.html>. Cheating will not be tolerated and will result in 0 for that quiz/exam. Working in groups for homework is encouraged but copying is not allowed. Original work must be turned in for homework credit. For laboratory work you will have to write your own lab report and show your own data analysis even when the data was collected together with a lab partner.

Disability Service Support: De Anza is committed to providing support for students with disabilities. Please contact me as soon as possible if you require special accommodations and I will be happy to do what I can to help. For more information, visit Disability Service Support at <https://www.deanza.edu/dss/>

Missing class: If you miss a lab or lecture on the first day of class, you will be dropped from the course unless previous arrangements have been made with the instructor. Lab class is in-person and mandatory for this course. More than one unexcused absence from lab may result in an automatic "F" for the course.

Grades/Evaluations: Approximate points and %

Item	Points	Overall%
Chem 101 Homework (10)	100	12
Lecture Exams, 3 total (100 points each)	300	35
Lecture Final	200	23
Lecture Total	600	70
Prelabs, 8 total (4 points each)	32	4
Lab Experiments 1-2 Day Labs, 6 total (14 points each)	84	10
Lab Experiments 3-4 Day Labs, 2 total (20 points each)	40	5
Postlab question 8 total (4 pts)	32	4
Lab cleanup	12	1
Lab quiz 3 total (20 each)	60	7
Lab Total	240	30
Course total	790	100

Grade Assignment. Grade cut offs are as follows:

A+ (97), A (93), A- (90), B+ (87), B (83), B- (80), C+ (76), C (72), C- (69), D+ (65), D (60), F (59-0)

Assignments fall into the following categories. **NOTE:** You must receive at least 55% on the lab assignments **and** homework **and** exams for a passing grade.

Homework through Chem 101. Weekly practice is essential to master chemistry concepts. Before attempting the Chem 101 homework you need to have practiced solving questions as assigned on canvas. The homework on the Chem 101 platform is graded homework and you should use the homework to assess your learning. You will have 2 attempts on the homework. However, make sure that you can solve a majority of homework problems (at least 70%!) without any assistance of notes, the internet, a friend, etc. in order to pass the Midterms and final. If you have difficulty completing the homework questions without assistance, you need to seek out support and/or practice more examples. Take advantage of all learning resources.

Lecture Exams. There will be three lecture exams to test comprehension throughout the quarter, the dates are indicated in the lecture schedule below. Exams will cover material from lectures, homework, and book chapters. Questions will range from easy to difficult and may require solving problems that have not been explicitly demonstrated before. Each midterm exam is worth **100 points** and the dates are given in the schedule section. There are no make-up exams. Missing a midterm will result in 0 credit without written proof for an excused absence such as a police report, an official doctors note, etc.

Lecture Final. A comprehensive final will be worth 200 pts and will cover all material from the course. The time is set by the final schedule. Please do not sign up for this class if you can't make the final time.

Lab assignments. They consist of prelabs (4%), Lab experimentation which included data acquisition and calculations, and written conclusions (15%), postlab questions (4%). More details are given below.

Lab quizzes. There are 3 lab quizzes that will cover lab specific concepts and skills. (7%). The dates will be announced on canvas. You will be allowed to use your lab notebook during this test. Make sure to efficiently organize your notebook and to pay attention to the topic introduction at the beginning of lab. No early or late exams will be allowed.

Class Lecture

This class (Chem 1B) will cover chapters 5, 12, 16, 17, 18, and 20 from the assigned textbook. The lecture will serve to cover the most important aspects of the chapter. However, students are still responsible **for all material** in the indicated book chapters. More details will be given in the respective Chapter modules on Canvas. Below are four helpful tips that make learning much easier this quarter.

1. Prepare for lecture by reading the textbook chapter before attending lecture. This will make the presented material much easier to understand and you will be able to engage in exercises and discussion about the material. Pre-reading the textbook before class will allow you to sort the presented information more effectively and therefore will help retain the concepts.

2. Attend lecture. Attending lecture will clarify material and will also include additional active learning activities that will help you make deep connections with the material. In lecture additional information may be presented that is not in your textbook. Also, Chemistry concepts are built on previous concepts and foundational knowledge. If you miss too many lecture classes, you will increase the likelihood that you may fail the class.

3. Review the lecture material and complete practice problems in each sub-chapter we covered as you review material. By engaging with the material through problem solving, you actively learn the material! There is not enough time to go over every concept in detail in lecture, so re-reading the textbook in connection with problem solving is essential to master the concepts. Don't wait until the midterm exam is approaching: Review the material promptly such as within 1 day of the lecture!

4. Each week work out the chapter problems. Plan on spending at least 2-3 hours studying outside of class for each lecture hour (including lab lectures). That's at least 7-10 hours weekly! Extensive practice is the best way to ensure mastering the chem 1B material. It is essential to practice the material promptly, so do the Chapter problems **in the same week as the material is covered**. Relevant Chapter problems are posted in the modules for the chapter. There are plenty of additional problems in the textbook throughout the chapters as well as at the end of each chapter, which will prepare you for midterms and final. I also post practice questions on Chem101.

5. Complete the HW as your self-assessment, treat it as a quiz/exam question. The homework should inform you if you have mastered the concepts of the chapter and uncover gaps you need to work on closing. Ultimately, you will need to be able to solve the questions without assistance of your notes, the textbooks, friends, the internet etc to score high on the exams.

6. Don't fall behind. Make sure to set aside time to complete your assignments weekly by the due date. Cramming before exams without studying the material during the weeks leading up to an exam does not usually work. Also, in chemistry, each new topic will build on the previous, so it is essential to understand the topics as they are presented (hence do the practice problems). Following a lecture when you do not understand the previous material is not an effective method for learning and will lead to further problems. To avoid falling behind...

7. Get help. If you are having a difficult time with a topic, it is your responsibility to get help. There are plenty of resources, including myself, for aiding in material comprehension, but it all starts with you making an effort to get this help. You are encouraged to find a study group, working with peers is extremely helpful for mastering material. Also come to office hours to get any follow up questions answered.

Laboratory

This course will require the completion of 8 different lab-based activities including preparation, experimentation, calculations, and analysis. The topic of the experiment will loosely mirror that of the lecture to give you an opportunity to prove to yourself what we are learning in class is valid. Towards the end of the syllabus are the guides for lab safety, notebook formatting and lab assignments.

Prelabs. To ensure each student has read the experiment and can perform the experiment safely, a prelab must be completed before every laboratory experiment in a specifically designated lab notebook. There will be a prelab quiz on Canvas that will prompt you to complete the prelab.

Before each experiment, I will check to see if you have completed the title/date, abstract, hazards, experimental procedure, and data tables. Each prelab is worth **4 points** and must be completed before the laboratory session. If not completed, the student will not be allowed to complete the experiment and will receive a 0 for that lab for that day. Instructions for keeping a proper lab notebook and completing a prelab are given towards the end of this syllabus.

Lab Lecture/Experiment. Students are required to attend all lab sessions. This includes the lecture at the beginning of the lab period and the entire experiment. Timely arrival and proper completion of a lab are worth **5 points** for 1-2 day labs and **6 points** for 3-4 day labs.

Arriving during the lab lecture will result in a loss of 1 point, while arriving after the lab lecture may prevent the student from participating in the lab that day. Labs are generally broken up into more than one section and all section must be attended for credit for that experiment. Students are required to record all laboratory data in a designated notebook.

There are no make-up labs. Missing lab will result in a 0 for that lab and more than one unexcused absence will result in an "F" for the class. It is also the student's responsibility to understand all theory and practice of lab experiments as they will be on the lab quizzes and are essential for safe lab experimentation. If there is a documented excusable absence, you must notify *before* the missed lab, or this will count as a missing lab. If there is an emergency and you cannot contact me before lab, please do so as soon as possible. The safe and effective completion of the lab work for the day will also be graded.

Lab Clean up: Students who do not clean up their work bench or assigned areas will lose points.

Data/Calculations. Students are required to record all laboratory data and perform all calculations in a designated notebook. After each lab session, I will check your lab book to make sure you have recorded the correct data and with the correct number of significant figures for each instrument.

Additionally, before of leave, you will need to demonstrate calculations for one trial's worth of data (you still need to do the calculations for the other trial, but do not need to show this). The data and calculations together are worth **4 points** for 1-2 day labs and **8 points** for 3- 4 day labs. I will generally let you know when you show me the data/calculations if you have something missing so you can complete what is missing and get all the points. Do not leave lab before you have shown me your lab notebook at least 20 min before end of lab time! Otherwise, you will lose out on some or all of these points!

Lab report. For each experiment, a report will be due that is worth **5-6 points depending on the length of the experiment.** You will answer the questions that are posed in the lab manual and fill out the data in the data sheets. You will summarize the experiment and describe the experimental data and discuss how your experimental data compare to expected values if applicable. You will include an error discussion and a conclusion. Is in a typed form and is uploaded to Canvas together with the data and data analysis table from the lab manual. Each lab report is due 1 week after the lab is completed. Late submissions will be penalized by 5% per day. I will wave one late subtraction per student. I will not accept lab reports that are more than 1.5 weeks late for credit.

Class Schedule

Tentative schedule subject to change which is announced on Canvas. All dates, including exams are subject to change throughout the quarter. The final exam date will not change.

Week Of	Week#	Tuesday	Thursday
4/3/22	1		Chapter 5 (Gases)
4/10/22	2	Chapter 5 (Gases)	Chapter 9/12 (IMFs)
4/17/22	3	Chapter 12 (IMFs)	Chapter 12 (IMFs)
4/24/22	4	EXAM 1	Chapter 16 (Kinetics)
5/1/22	5	Chapter 16 (Kinetics)	Chapter 16 (Kinetics)
5/8/22	6	Chapter 17 (Equilibrium)	Chapter 17 (Equilibrium)
5/15/22	7	NO CLASS. PRESIDENTS DAY	Chapter 17 (Equilibrium)
5/22/22	8	EXAM 2	Chapter 18 (Acids/Bases)
5/29/22	9	Chapter 18 (Acids/Bases)	Chapter 18 (Acids/Bases)
6/5/22	10	Chapter 20 (Thermodynamics)	Chapter 20 (Thermodynamics)
6/12/22	11	EXAM 3	Final Review
6/19/22	Finals Week 6/20 (section 1) 6/21 (section 2) from 7:00 am – 9:00 am		

LECTURE FINAL EXAM

Monday June 20, 7:00-9:00 AM section 01

Tuesday June 21, 7:00-9:00 AM section 02

WEEK OF	WEEK	MONDAY	TUESDAY	WEDNESDAY	THURSDAY
4/3/22	1			Syllabus, safety, Lab notebook	Syllabus, safety, Lab notebook
4/10/22	2	Lab check in, B1 molar volume 1	Lab check in, B1 molar volume 1	molar volume 2	molar volume 2
4/17/22	3	B2 vaporization 1	B2 vaporization 1	vaporization 2	vaporization 2
4/24/22	4	B7 green crystal 1	B7 green crystal 1	green crystal 2	green crystal 2
5/1/22	5	green crystal 3	green crystal 3	green crystal 4	green crystal 4
5/8/22	6	B3 iodine clock 1	B3 iodine clock 1	iodine clock 2	iodine clock 2
5/15/22	7	iodine clock 3	iodine clock 3	iodine clock 4	iodine clock 4
5/22/22	8	B4 Kc 1	B4 Kc 1	Kc 2	Kc 2
5/29/22	9	MEMORIAL DAY	Free Period/No Lab	B5 Ka/Kb 1	B5 Ka/Kb 2
6/5/22	10	B6 pKa 1	B6 pKa 1	pKa 2	pKa 2
6/12/22	11	B8 CaOH 1	B8 CaOH 1	CaOH 2 Checkout	CaOH2 Checkout
6/19/22	12	FINALS	FINALS		

Lab Safety/Preparedness

Maintaining safety in a laboratory is a primary concern. There are many hazards associated with chemistry labs and it is important to understand these hazards and that with proper techniques, the risk drops significantly. There are a few, very simple steps students should take to execute safe lab techniques and gain full points for this section.

First, always wear personal protective equipment (PPE) when performing lab experiments. Such items include, but are not limited to, safety goggles, long pants, sleeved shirt, and closed toe shoes. **All of this safety equipment must remain on until you leave the lab, or until everyone has completed the experiment for the day.** A detailed list containing safe lab procedures and general practices is given on the next page and must be reviewed and signed before starting experiments.

Second, read the lab procedure **BEFORE** coming to lab and write in your notebook the materials needed and step required so that all hazards are known ahead of time and may be properly addressed. Notes, facts, or some recognition of the hazards is required for the prelab to ensure the section on safety has been read. Reading the procedure ahead of time and knowing what tasks are at hand will also help the experiment go smoothly.

Finally, listen carefully to the directions provided at the beginning of the lab session. Many techniques can be performed safely and easily with the proper technique but become a safety hazard when performed improperly. If the lab lecture is missed, the student will not be allowed to perform that lab.

As a concern for the environment and to follow county, state and federal law, proper chemical disposal is essential. *Students who do not comply with directed procedures may be expelled from the lab or failed in the course for repeated offenses.* Check with the instructor if you have any questions.

The beginning of each laboratory session is designated as a laboratory lecture period for which you **must be on time** in order to perform the scheduled experiment. The instructor will use this lecture period to outline important details of the procedure, overview theory and calculations, and to emphasize safety hazards and proper chemical disposal. *If you are more than **10 minutes** late for lab lecture, you may not be allowed to do the experiment for that day.*

What follows is a list from the American Chemical Society Safety in Academic Laboratories Guidelines, 7th Ed., the following mandatory minimum safety requirements must be followed by all students and be rigorously enforced by all Chemistry faculty:

The following mandatory minimum safety requirements must be followed by all students and be rigorously enforced by all Chemistry faculty. Disregard may result in expulsion from lab.

- 1) Chemistry Department-approved safety goggles purchased from the De Anza College bookstore (NOT safety glasses) must be worn at all times once laboratory work begins, including when obtaining equipment from the stockroom or removing equipment from student drawers, and may not be removed until all laboratory work has ended and all glassware has been returned to student drawers.
- 2) Shoes that completely enclose the foot are to be worn at all times; NO sandals, open-toed, or open-topped shoes, or slippers, even with socks on, are to be worn in the lab
- 3) Shorts, cut-offs, skirts or pants exposing skin above the ankle, and sleeveless tops may not be worn in the lab: ankle-length clothing must be worn at all times. Basically, your body below your neck to the ankles and to the elbows must be covered so that potential exposure of skin to chemicals is minimized.
- 4) Hair reaching the top of the shoulders must be tied back securely
- 5) Loose clothing must be constrained
- 6) Wearing "...jewelry such as rings, bracelets, and wristwatches in the laboratory..." should be discouraged to prevent "...chemical seepage in between the jewelry and skin...".
- 7) Eating, drinking, or applying cosmetics in the laboratory is **forbidden at ALL times**, including during lab lecture
- 8) Use of electronic devices requiring headphones in the laboratory is **prohibited at ALL times**, including during lab lecture
- 9) Students are advised to inform their instructor about any pre-existing medical conditions, such as pregnancy, epilepsy, or diabetes, that they have that might affect their performance
- 10) Students are required to know the locations of the eyewash stations, emergency shower, and all exits
- 11) Students may not be in the lab without an instructor being present
- 12) Students not enrolled in the laboratory class may not be in the lab at any time after the first lab period of each quarter
- 13) Except for soapy or clear rinse water from washing glassware, **NO CHEMICALS MAY BE Poured INTO THE SINKS**; all remaining chemicals from an experiment must be poured into the waste bottle provided.
- 14) Students are required to follow the De Anza College Code of Conduct at all times while in lab: "horseplay", yelling, offensive language, or any behavior that could startle or frighten another student is not allowed during lab;
- 15) Strongly recommended: Wear Nitrile gloves while performing lab work; wear a chemically resistant lab coat or lab apron; wear shoes made of leather or polymeric leather substitute.

By signing below, I, _____,
First Name Family Name

acknowledge that I fully understand and agree to abide by the laboratory safety rules listed above. Further, I acknowledge that my failure to abide by these rules will result in my being dropped from this chemistry class immediately.

Signature

Date

Maintaining a Neat and Effective Lab Notebook

Laboratory notebooks are essential for any scientist. Our primary goal as chemists is to understand the complexities of the world around us by performing specifically designed controlled experimentation. An easily accessible and highly organized lab notebook to recording observations or data is necessary to obtain the most accurate and detailed account of the experiment.

Follow these guidelines to keep a professional notebook:

Write your name on the cover of your notebook, which must be a dedicated permanently bound, 8 ½ X 11 (8x10 will be accepted too) notebook. **NO SPIRAL NOTEBOOK.** In the case you misplace it, and it is turned in, we can know the owner of the notebook!

Table of Content. Keeping a detailed table of content is another easy and effective way to organize your observations and data entries. This table must include the title of the experiment, the date of the entry, and the page number. Update each lab session. Reserve the first 4 pages of your notebook.

Number the pages of your notebook. Write page numbers on each odd page of your notebook before you start using the notebook (before the second week of this course). Never remove the pages from your notebook, because the sequence of numbers on these pages may not be broken.

Keeping the notebook according to these guidelines will be graded. The data and calculations together are worth **4 points** for 1-2 day labs and **8 points** for 3-4 day labs and are checked during lab sessions, so make sure to bring your notebook to each lab session!.

1. Do not remove pages, ever!
2. Each experiment should begin on a new page.
3. Near the front of your lab notebook, print your identifying information: name, section #, email address and phone number (in case you misplace the notebook and want it returned to you).
4. All writing in your notebook **MUST** be done in ink, not pencil.
5. All laboratory measurements or other observations must be recorded **directly into your laboratory notebook.** Do not use scratch paper for the purpose of copying data into your lab notebook later! The notebook is the primary source of data and calculations. It is okay if your notebook feels a little sloppy! Science is rarely perfect the first time through.
6. Record data in a data table **you have drawn as part of your prelab.** Use the format of the data tables from the lab manual to record the data from an experiment. **First**, record the data in your notebook and only after all calculations are finished, transfer the information on the Report Sheet.
7. An incorrect entry in your notebook should be changed by drawing a single line through the error and writing the correct answer above it or any other place where it is easily seen by the reader. **No overwriting or total blackout is permitted.** You can void a whole page by drawing a line across it and writing “void” on it.
8. Do not include the results of a classmate (even if you think your results are inaccurate).

Each Experiment

The items I - V need to be completed before the experiment for the prelab. If not completed, the student will not be allowed to complete the experiment and will receive a 0 for that lab for that day. You will submit a picture of your prelab through canvas before the lab starts.

Items VI-and VII will be filled in during the lab experiment. At least 20 min before the end of each lab you will shown me the data entries and calculations. Do not leave lab before you have shown me your lab notebook! Otherwise, you will lose out on some or all of these points!

- I. **Title and Date.** Title of the experiment and date of lab session must be at the top of the page.
- II. **Abstract.** A *brief* summary of the experiment should follow the title. This should include the main purpose of the experiment, the laboratory procedures you will use, and the relevant mathematical relationships between measurable quantities and a chemical equation in case a chemical reaction is observed.
- III. **Hazards.** In addition to reading the experiment, you will also need to read the hazards for the chemicals required for each lab. Write the chemical, the associated hazards, and any special steps needed. Typically the "special steps" will be something like, "Gloves are recommended".
- IV. **Experimental Procedure.** The experimental procedure is a detailed description of the method utilized to obtain experimental data. The written procedure should be in your own words, not copied directly from the lab manual and should be detailed enough that you do not need to look at the laboratory manual. This must all be completed before the laboratory session or you will not be allowed to perform the experiment for safety reasons.
- V. **Data Tables.** **The data table will be drawn into your notebook**, but data will be filled in during the experiment). Recording data should be done in a well-organized table next to the corresponding experimental procedure or after the procedure. This will ensure you know exactly what measurements you record. Good examples of effective data table organization can be found in the laboratory manual for each experiment. Be sure to pay attention to units and significant figures for all data collection.
- VI. **Observations.** The phenomena you observe can yield as much information as the most detailed measurements. Observations like temperature change, bubbling, color change, or solid formation should be recorded next to the related experimental procedure. Additionally, record any instrument problems or issues with the experiment. If your data is extremely far from expected, your experimental observations may give insight as to the source of such discrepancies.
- VII. **Calculations.** Calculations should be written neatly and final answers should include units. For each type of calculation, you must demonstrate one example using your data. If graphing is required, both computer generated and hand-drawn representations are acceptable as long as axes are appropriately labeled and scaled. These must be completed before leaving lab that day to receive full credit.

Lab report. A lab report consists of the filled out data and analysis tables (including questions if applicable) from the lab manual and a conclusion of the experiment. The conclusion will be typed and submitted through canvas together with the data table that is included in the lab manual as one file. The Lab report will be due 1 week after the completion of the experiment.

The conclusion should contain at least these three sections.

The first is a brief summary of the experiment including the main goal and the methods used to collect/analyze data. This should not be more than two sentences and should be specific to each experiment.

For the next section, present the key values. Many of the experiments require numerous tables and measurements and including all of these values is not the point of this section. Only include the values that directly relate to the experimental goal. For example, in the lab titled "Molar Volume of a Gas", the conclusion should contain the calculated value for the molar volume of a gas but does not need all the pressure measurements. Additionally, compare one trial to the next and/or compare the average value to literature values if possible.

Finally, provide a source of error that may have resulted in discrepancies between trials or accepted values. This should go beyond simple factors like human error and should connect an experimental design or procedural step to an error in your value. That is, explain how such an error could have affected your result by following this error through the calculation process.

Student Learning Outcome(s):

*Evaluate the principles of molecular kinetics.

*Apply principles of chemical equilibrium to chemical reactions.

*Apply the second and third laws of thermodynamics to chemical reactions.