

Professor: Dr. Linda Wilkes
 Office: Chem 212
 Office phone: 549-2560 Department phone: 549-2574
 Office Hours: M 4 - 6 pm; T 4 - 6 pm in C114
 Th 10:30 - 11:30 am; F 10 - 11 am in C212
 and by appointment

Corequisite: Chem 122 Lecture

Required:

- *General Chemistry: Lab Text for Chemistry 121/122*, Linda M. Wilkes, Fountainhead Press
- Approved safety goggles (available at CSU-Pueblo bookstore)

Tentative Course Schedule

Day	Activity/Lab Experiment	Report Due Date
Jan 15	No Lab	
Jan 22	Check-in, Course Intro, and Safety	
Jan 29	Kinetic Molecular Theory	Feb 5
Feb 5	Freezing Point Depression	Feb 12
Feb 12	Reaction of Crystal Violet	Feb 19
Feb 19	Determination of Activation Energy, E_a	Feb 22
Feb 26	Midterm Exam	
Mar 4	Determination of K of a Complex Ion	Mar 11
Mar 11	Standardization of NaOH	
Mar 18	Determination of K_a for Acetic Acid	Apr 1
Mar 25	Spring Break – no lab	
Apr 1	Cu in Effluent (Handout)	Apr 8
Apr 8	Analysis of Soda Ash	Apr 15
Apr 15	Final Exam, Check-out	Dec 6

Grading Policy:

Lab reports	70%
Prelab Questions	15%
Exams	15%

NOTE: YOU WILL NOT PASS THE COURSE BY SIMPLY ATTENDING THE LAB – YOU MUST SUBMIT REASONABLY PREPARED LAB REPORTS AND QUESTIONS AND PERFORM AT A PASSING LEVEL ON EXAMS.

Grading Scale:

90 - 100%	A
80 - 89	B
65 - 79	C
56 - 64	D
< 56%	F

Policies:

1. Lab reports are due one week following completion of the lab (SEE ATTACHED DOCUMENTATION ON THE REQUIRED FORMAT OF LAB REPORTS).
2. Prelab questions for each lab experiment are **due the day** the lab experiment is to be performed **at the beginning** of the lab period.
3. Late labs will be deducted 25% off *per day late* for one day **only** (**no** reports will be accepted later than Wednesday, 2 pm of the week the lab report is due).
4. **No** makeup labs are allowed, the one, lowest lab report score is dropped and a missed lab experiment counts as a zero for that lab report.
5. The Colorado State University-Pueblo Catalog has a section on Academic Dishonesty on page 38. You should review the official university position on issues of conduct in the Student Code of Conduct Policies and Procedures Manual. Scientific honesty is particularly important in experimental work, i.e., in a field such as chemistry. The scientific body of knowledge on which the advancement of our civilization is based would not have been possible without the rigid integrity of the scientific observations that are its foundation. Your personal integrity is worth more than a few points on an exam. Cheating will be grounds for failure of the course.
6. This University abides by the Americans with Disabilities Act and Section 504 of the Rehabilitation Act of 1973, which stipulates that no student shall be denied the benefits of an education "solely by reason of a handicap." If you have a documented disability that may impact your work in this class and for which you may require accommodations, please see the Disability Resource Coordinator as soon as possible to arrange accommodations. In order to receive accommodations, you must be registered with and provide documentation of your disability to: the Disability Resource Office, which is located in the Psychology Building, Suite 232.

**CHEMISTRY 121/122
Requirements for Lab Reports**

The main reason for the **Lab Report** is to show your instructor that you understand the experiment and can report on and make sense of your data. To that end, a **Lab Report** should include:

- I. A paragraph summarizing the objectives and concepts of the experiment—pretend that you are explaining the experiment to your roommate who has **not** taken any chemistry!
 - This is **NOT COPIED DIRECTLY FROM THE LABORATORY EXPERIMENT TEXT!** It is a compilation of information written in your own words (grammatically correct!) and it should have multiple sources: (1) your instructor's lecture; (2) your chemistry text; (3) your laboratory experiment text.
- II. All data collected—**make sure all data is labeled**—if it is not labeled, it is not submitted. Your data may be submitted directly by using the tear-out data sheets from your lab text (make sure they are neat and readable!).
- III. All calculations, shown clearly! The calculations can generally be on the data sheets with your data, however, if there is not enough room, you may need to submit an extra sheet of calculations.
 - The calculations should be organized such that they are easy to follow, show all steps of the calculations.
- IV. A paragraph summarizing your results must be included; both qualitative results (observations) as well as quantitative results (numerical).
 - In addition, you should *analyze* your results in this paragraph. For example, in one experiment you produced several different graphs by plotting some data in different forms. Some graphs were linear, some were non-linear. In your results you state which graphs were linear and which were non-linear. In your analysis or discussion of your results, you discuss **why** a linear relationship in the data is important and what it tells you about your data if the graph is linear and if the graph is non-linear.
- V. All calculations/answers to any post-lab questions, these may be submitted by using the tear-out post-lab questions in the lab text.

Sample Lab Report**Part I.****Vapor Pressure of Water****Introduction:**

The purpose of this experiment is to determine the molar heat of vaporization of water (ΔH_{vap}) using the Clausius-Clapeyron equation:

$$\ln P = -\frac{\Delta H_{\text{vap}}}{RT} + A$$

where P is the vapor pressure of water and T is the temperature of the water in Kelvin, R is the gas constant (8.314 J/mol K) and A is a constant. The Clausius-Clapeyron equation exhibits a relationship between the natural log of the vapor pressure ($\ln P$) and the reciprocal of the temperature ($1/T$), such that by plotting $\ln P$ (y axis) vs $1/T$ (x axis) a straight line occurs with a slope = $-\frac{\Delta H_{\text{vap}}}{R}$. In other words, the Clausius-Clapeyron equation is in the form of a straight line ($y = mx + b$).

A liquid boils when its vapor pressure matches the prevailing atmospheric pressure so as atmospheric pressure decreases so does the temperature at which the liquid boils. This experiment will reduce the apparent atmospheric pressure in a closed flask of water and measure the boiling temperatures of the water under these different conditions of apparent atmospheric pressure. A set of corresponding vapor pressure and temperature values will be collected for the water under these conditions. The collected set of vapor pressure/temperature data are then plotted in order to find the slope of the straight line so that the ΔH_{vap} can be calculated:

$$\Delta H_{\text{vap}} = -(slope)(R)$$

The literature value listed for the molar heat of vaporization of water is $\Delta H_{\text{vap}} = 40.67$ kJ/mol.

Part II. This section should contain the tear-out data sheets from the lab text and any Excel graphs produced.

Part III. This section should contain all calculations necessary to obtain the experimental results from the experimental data.

Part IV.**Results and Discussion:**

The Clausius-Clapeyron equation gives the relationship between the vapor pressure and temperature of a liquid:

$$\ln P = -\frac{\Delta H_{\text{vap}}}{RT} + A$$

Given that a liquid boils when its vapor pressure is equal to the atmospheric pressure, we were able to acquire vapor pressure data at different temperatures by reducing the pressure inside a flask of water and gradually heating the water to determine its vapor pressure and respective boiling temperature under conditions of lower apparent atmospheric pressure. The plot of $\ln P$ vs $1/T$ produced a nearly straight line with a linear regression fit shown by the equation $y = -4635.1x + 18.985$ and a correlation coefficient of $R^2 = 0.9989$. The correlation coefficient indicates that the data points fit the straight line quite well. The slope of the line is related to the molar heat of vaporization of water:

$$\Delta H_{\text{vap}} = -(slope)(R)$$

The calculated value of $\Delta H_{\text{vap}} = 38.5$ kJ/mol from the experimental data. The literature value of $\Delta H_{\text{vap}} = 40.67$ kJ/mol. The error, then, is 5.24%. It should be noted that data for the calculated molar heat of vaporization is only as good as the slope of the best straight-line fit of the data. In addition, the calibration of the thermister and the pressure sensors is extremely important in the collection of accurate data. If the calibration of either (or both) of the units is incorrect, a small variation in slope can greatly affect the calculated value (a slope of -3635 instead of -4635 would produce a $\Delta H = 30.2$ kJ/mol, over 10 kJ/mol lower than the literature value!).