

# **General Chemistry 2 - CHEM 1002 A**

## **Winter 2024**

### **Department of Chemistry**

**Instructors:**  
**Dave Brock**  
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All dates and times referenced in this course pertain to local time at Carleton University. This corresponds to Eastern Standard Time (EST) with Daylight Savings Time applied on the appropriate dates.

#### **Lectures**

Lectures are pre-recorded and can be played back at any time.  
You must keep up to date in your lecture watching!

#### **“Classes”**

“Classes” are in-person on Tuesdays and Thursdays from 11:35am-12:55pm (according to your Timetable). You are encouraged to participate – These “classes” times will be used to work on problem solving skills, answer concept polls, show connections and applications of the content to the real world, perform chemical demonstrations as well as carrying out topic discussions. Barring any technical issues, the classes are also recorded and can be played back at any time.

#### **“Tutorials”**

“Tutorials” are drop-in in-person help center hours that take place during most laboratory time slots (according to your Timetable). You are encouraged to attend to ask questions about course content or any chemistry related questions you might have.

#### **Textbook**

The text for the course is "Chemistry" 4<sup>th</sup> Canadian Edition by Olmsted, Williams and Burk published by Wiley. The book is available from Carleton's bookstore, however, permanent electronic access is also available through the instructions listed on the course Brightspace page at a discounted price.

**The latter is the recommended package to buy.**

## Grading

Component	Notes	#1	#2	#3	#4	#5	#6	#7	#8
Mastering	6 Online Homework Assignments	5	--	5	--	5	--	5	--
Reef Polling	Tutorial concept polls	5	5	--	--	5	5	--	--
Quizzes	Weekly Online Quizzes	10	10	10	10	10	10	10	10
Laboratory	Four experiments	30	30	30	30	30	30	30	30
Test 1	2 h	10	10	10	10	5	5	5	5
Test 2	2 h	10	10	10	10	15	15	15	15
Final Exam	3 hours	30	35	35	40	30	35	35	40

Component	Notes	#9	#10	#11	#12	#13	#14	#15	#16
Mastering	6 Online Homework Assignments	5	--	5	--	5	--	5	--
Reef Polling	Tutorial concept polls	5	5	--	--	5	5	--	--
Quizzes	Weekly Online Quizzes	10	10	10	10	10	10	10	10
Laboratory	Four experiments	30	30	30	30	30	30	30	30
Test 1	2 h	10	10	10	10	5	5	5	5
Test 2	2 h	5	5	5	5	5	5	5	5
Final Exam	3 hours	35	40	40	45	40	45	45	50

**Grades for each component of the course will be released only via Brightspace.**

**To obtain credit for the course, all three requirements below must be met:**

1. Obtain a minimum of 50% on the overall course grade, as calculated above using the method that gives the highest grade.
2. All laboratory experiments **MUST** be completed and all lab reports **MUST** be submitted by the last day of classes (Apr 10, 2024).

Students who fail to meet the above requirements will receive a course grade of F and will not receive credit for the course.

## Mastering Chemistry Online Homework Assignments

Problem assignments will be given regularly via Mastering Chemistry (approximately one assignment every two weeks). It is your responsibility to check the answers and to take action if you have not understood the latest material. **Those who neglect these assignments do not typically do well on tests and exams, where the stakes are much higher. Evidence from previous years shows that those who scored well on their homework assignments typically also scored well in the course.**

### iClicker/Reef Polling

Your mark on the tutorial concept polls for the course will be determined as follows:

Points for responding to a concept poll in class:	2 points
<u>Points for the correct response:</u>	<u>1 point</u>
Total points per question asked	3 points

Percent of total points earned:	80 or over	75-79	70-74	60-69	50-59	40-49	30-39	20-29	Under 20
Mark out of 5.0:	5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.5	0

Please note that the threshold was set low to account for occasional absences or technical difficulties. As a result, adjustment to data will only take place if an absence *exceeds* one week of class and is accompanied by official accommodation.

### Quizzes

There will be 12 timed quizzes (60 minutes per quiz), but only the best 10 will be used to calculate your mark on the Brightspace Quiz component of the course. If you receive academic accommodations for a missed quiz, the remaining 10 quizzes will be counted.

Access to these timed quizzes starts on Sunday at 12:01 am and closes on Monday at 11:55 pm. Quizzes are 1 hour in length and therefore must be started by the Monday at 10:55pm at the latest. Quizzes will begin on Jan 8<sup>th</sup> and continue weekly for the rest of the term, with the exception of Fall Break (week of Feb 22<sup>nd</sup>). Please see the course calendar for more details.

### Laboratory

Details of the laboratory portions of this course can be found on the Brightspace site.

**An important detail is that you must complete all activities of the laboratory portion before the last day of classes (Apr 10, 2024) to receive a passing grade in this course.**

**Please note:** Students have *one to two weeks* (see the lab schedule for due dates) to complete and submit their lab reports for each lab, and multiple submissions are permitted up until the due date. As a result, lab reports that are submitted late for any reason will be subject to the late penalty of 10% per day, with a mark of 0 assigned if an assignment is submitted more than 4 days late. Therefore, you are encouraged to submit your lab report a day or two early, and update it if necessary, to ensure that you have no issues with your lab submission.

### **Term Tests**

The term tests will be scheduled by the Registrar's office and will take place on campus, outside of class time the weeks of Feb. 5 and Mar. 18 (which can include Friday evening, Saturday or Sunday).

### **The P.A.S.S. Program**

This course is associated with the Peer Assisted Study Sessions (PASS) program. In this program, weekly workshops are delivered by a facilitator. The facilitator is a student who recently took CHEM 1002 (and did very well). PASS is not a remedial program - it is intended for ALL students in the course. More details will be given in the first lecture or two.

### **Communicating With You**

This is a big class, but you will find that you can get any help you need easily by one of the following methods:

1. If it is a course content related question, please post it to the Brightspace forum. Chances are if you have the question, your colleagues do as well and could benefit from the answer.
2. Visit an instructor in their office hour. Both instructors' office hours will vary week to week and will be posted in Brightspace.
3. Attend the drop-in Help Center. Hours will be posted on Brightspace at the beginning of term and additional hours may be posted as well.
4. If it is an administration/accommodation related issue, email me directly (david.brock3@carleton.ca). Please note, if it is a course content related question, it will be redirected to the Brightspace forum, office hours or Brightspace.
5. Your TAs, fellow students and other people on campus are also great resources and form a great study tool.

### **Special Arrangements**

You may need special arrangements to meet your academic obligations during the term. A link to the university's Academic Accommodations can be found here:

[/students.carleton.ca/course-outline/](https://students.carleton.ca/course-outline/)

For an accommodation request the processes are as follows:

**Deferred term work:** For short term (a week or less) incapacitation, students must complete and submit a self-declaration form (<https://carleton.ca/registrar/wp-content/uploads/self-declaration.pdf>) to Dr. Brock ([david.brock3@carleton.ca](mailto:david.brock3@carleton.ca)) within 48 hours of the missed work.

For approved missed tests, the weight will be transferred to the final exam. For missed quizzes, the top 10 of 12 quizzes are used to calculate the final mark and the missed quiz would be 1 of the 2 quizzes not counted. In-class iClicker questions have been set for a threshold of 80% of the total marks to receive full marks and therefore include any accommodations for missed classes. No further accommodations will be provided for iClicker marks. Assignments are open for two week periods whereupon the answers are released. In the event that a due date is missed, the work on the assignment up to that point is used for that assignment grade and extensions are not provided. Students are encouraged to start the assignments early. There is a single makeup lab opportunity available to students in the event that they have received a lab deferral. Therefore,

missing more than one lab, deferred or not, will result in an F in the course as the course/department requirement that “All laboratory experiments MUST be completed and all lab reports MUST be submitted by the last day of classes (Apr 10, 2024)” would not be fulfilled.

Long term (longer than 1 week) incapacitation, will be evaluated on a case-by-case basis and discussions of accommodations may involve the Chair of the Department of Chemistry and/or the Office of the Dean of Science.

### **Academic Integrity**

The University Senate defines plagiarism as “presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one’s own.” This can include:

- reproducing or paraphrasing portions of someone else’s published or unpublished material, regardless of the source, and presenting these as one’s own without proper citation or reference to the original source;
- submitting a take-home examination, essay, laboratory report or other assignment written, in whole or in part, by someone else or by generative AI tools;
- using ideas or direct, verbatim quotations, or paraphrased material, concepts, or ideas without appropriate acknowledgment in any academic assignment;
- using another’s data or research findings;
- failing to acknowledge sources through the use of proper citations when using another’s works and/or failing to use quotation marks;
- handing in "substantially the same piece of work for academic credit more than once without prior written permission of the course instructor in which the submission occurs.

Plagiarism is a serious offence that cannot be resolved directly by the course’s instructor. The Associate Dean of the Faculty conducts a rigorous investigation, including an interview with the student, when an instructor suspects a piece of work has been plagiarized. Penalties are not trivial. They can include a final grade of "F" for the course.

## Syllabus

### 3. Energy and Its Conversion

Types of Energy  
Kinetic and Potential Energies  
Electrical Energy  
Chemical Energy  
Mass  
Thermal Energy  
Radiant Energy  
Energy Transfers and Transformations  
Thermodynamics  
Terms of Thermodynamics  
Conservation of Energy  
Heat  
Work  
First Law of Thermodynamics  
State and Path Functions  
Thermodynamic Path Functions  
Energy Changes in Chemical Reactions  
Features of Reaction Energies  
Path Independence  
Bond Energies  
Reaction Energies  
Measuring Energy Changes: Calorimetry  
Calorimeters  
Types of Calorimeters  
Calculating Energy Changes  
Molar Energy Change  
Enthalpy  
Expansion Work  
Definition of Enthalpy  
Energy and Enthalpy  
Energy and Enthalpy of Vapourization  
Enthalpies of Formation  
Enthalpy Changes for Chemical Reactions  
Enthalpy Changes Under Non-Standard Conditions  
Bond Energies and Enthalpies of Formation  
Born-Fajans-Haber Cycles  
Relationship Between Enthalpy and the Equilibrium Constant

### 12. Spontaneity of Chemical Processes

Spontaneity  
Dispersal of Matter  
Energy Dispersal

Energy and Spontaneity  
Opposing Dispersal Trends  
Entropy: The Measure of Dispersal  
Entropy and Dispersal of Matter  
Entropy and Dispersal of Energy  
Direction of Heat Flow  
Entropies of Pure Substances  
Minimization of Entropy  
Absolute Entropies  
Entropy and Concentration  
Standard Reaction Entropies  
Spontaneity and Free Energy  
Free Energy and Temperature  
Free Energy and Concentration  
Influencing Spontaneity  
Bioenergetics  
Biochemical Energy Production  
Coupled Reactions  
Energy Efficiency

### 13. Kinetics: Mechanisms and Rates of Reactions

What is a Reaction Mechanism?  
Example of a Mechanism: Formation of  $\text{N}_2\text{O}_4$   
Elementary Reactions  
Alternative Mechanisms  
Intermediates  
Rate-Determining Step  
Rates of Chemical Reactions  
A Molecular View  
A Macroscopic View: Concentration Changes  
Concentration and Reaction Rates  
Concentration Effects  
Rate Laws  
Mechanisms and Rate Laws  
Rate Constants  
Experimental Kinetics  
First-Order Reactions  
Second-Order Reactions  
Zeroth-Order Reactions  
Isolated Experiments  
Initial Rates  
Linking Mechanisms and Rate Laws

Rate-Determining Later Step  
Equality of Rates  
Rate of Reaction and the Equilibrium Constant  
Reaction Rates and Temperature  
Energy Changes in Unimolecular Reaction  
Energy Changes in Bimolecular Reactions  
Activation Energy  
Activation Energy and Rate Constant  
The Arrhenius Equation  
Values of Activation Energy  
Kinetics of  $S_N1$  and  $S_N2$  Reactions  
Catalysis  
Homogeneous and Heterogeneous Catalysts  
Biocatalysis: Enzymes

### 17. Electron Transfer Reactions

Recognizing Redox Reactions  
Oxidation Numbers  
Balancing Redox Reactions  
Half-Reactions  
Galvanic Cells  
Direct and Indirect Electron Transfers  
Ion Transport  
Electrodes  
Shorthand Cell Notations  
Cell Potentials  
Standard Electrical Potential  
Standard Cell Voltages  
Conventions for Standard Reduction Potentials  
Free Energy and Electrochemistry  
Cell Potential and Free Energy  
Cell Potentials and Chemical Equilibrium  
Nernst Equation  
The pH Meter  
Electrochemical Stoichiometry  
Redox in Action  
Batteries  
Corrosion  
Electrolysis  
Electrolysis of Water  
Competitive Electrolysis  
Electroplating

### 10. Organic Chemistry – Structure

Nomenclature  
Hydrocarbons  
Naming Benzene Compounds  
Kekulé Structures  
Functional Groups  
Stereochemistry  
*E/Z; cis/trans*  
Conformers  
Newman Projections  
Simple Potential Energy Diagrams  
Boat and Chair Conformations  
Enantiomers and Diastereomers  
Chirality  
*R* and *S*

### 11. Organic Chemistry – Reactions

Nucleophiles and Electrophiles  
 $S_N1$  and  $S_N2$  Mechanisms and Products  
 $E1$  and  $E2$  Mechanisms and Products  
Addition Reactions and Mechanisms  
Hydrogenation of Alkenes  
Markovnikov's Rule  
Acid-Catalyzed Hydration  
Electrophilic Addition of  $Br_2$  and  $Cl_2$  to Alkenes

### 19. The Transition Metals

Overview of the Transition Metals  
Coordination Complexes  
Ligands  
Isomers  
Nomenclature  
Bonding in Coordination Complexes  
Orbital Stability in Octahedral Complexes  
Magnetic Properties  
Crystal Field Splitting  
Colour in Coordination Complexes  
Square Planar and Tetrahedral Complexes

	Monday	Tuesday	Wednesday	Thursday	Friday
<b>January</b>					
<b>Intro Ch 3</b>	<b>8</b> Classes Begin	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>
<b>Ch 3</b>	<b>15</b> Quiz 1 Due 11:55 pm	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b> Last day for add/swap
<b>Ch 12</b>	<b>22</b> Quiz 2 Due 11:55 pm	<b>23</b>	<b>24</b>	<b>25</b> Mastering Chem. Assignment #1 Due 11:55 pm	<b>26</b>
<b>February</b>					
<b>Ch 13</b>	<b>29</b> Quiz 3 Due 11:55 pm	<b>30</b>	<b>31</b> Last day for withdrawal	<b>1</b>	<b>2</b>
<b>Ch 13 and Review</b>	<b>5</b> Quiz 4 Due 11:55 pm	<b>6</b>	<b>7</b>	<b>8</b> Mastering Chem. Assignment #2 due 11:55 pm	<b>9</b> Test this week (date/time TBA)
<b>Ch 17</b>	<b>12</b> Quiz 5 Due 11:55 pm	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>
No Labs or Classes	<b>19</b> Spring Break Holiday (University Closed)	<b>20</b> Spring Break	<b>21</b> Spring Break	<b>22</b> Spring Break	<b>23</b> Spring Break
<b>Ch 10</b>	<b>26</b> Quiz 6 Due 11:55 pm	<b>27</b>	<b>28</b>	<b>29</b> Mastering Chem. Assignment #3 due 11:55 pm	<b>1</b>
<b>March</b>					
<b>Ch 10</b>	<b>4</b> Quiz 7 Due 11:55 pm	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
<b>Ch 11</b>	<b>11</b> Quiz 8 Due 11:55 pm	<b>12</b>	<b>13</b>	<b>14</b> Mastering Chem. Assignment #4 due 11:55 pm	<b>15</b>
<b>Review</b>	<b>18</b> Quiz 9 Due 11:55 pm	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b> Test this week (date/time TBA)
<b>Ch 11</b>	<b>25</b> Quiz 10 Due 11:55 pm	<b>26</b>	<b>27</b>	<b>28</b> Mastering Chem. Assignment #5 due 11:55 pm	<b>29</b> Holiday (University Closed)
<b>April</b>					
<b>Ch 19</b>	<b>1</b> Quiz 11 Due 11:55 pm	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Review</b>	<b>8</b> Quiz 12 Due 11:55 pm	<b>9</b>	<b>10</b> Mastering Chem. Assignment #6 due 11:55 pm Classes End	<b>11</b>	<b>12</b>