UNIVERSITY of GUELPH

Department of Chemistry

College of Engineering and Physical Sciences

CHEM*1040 General Chemistry I

Winter 2020 Student Course Information

Course Description: CHEM*1040 General Chemistry I F,W (3-3) [Credit Weight: 0.50]

This course introduces concepts of chemistry, the central link between the physical and biological sciences. Principles discussed include chemical bonding, simple reactions and stoichiometry, chemical equilibria and solution equilibria (acids, bases, and buffers), and introductory organic chemistry.

Prerequisite(s): 4U Chemistry, (or equivalent grade 12 chemistry) or CHEM*1060

Instructor: R. de Laat (SSC 2506; rdelaat@uoguelph.ca)

Please do not email chemistry questions – use email for course administration only – if you have a chemistry question please come and see me – I find it much easier to help with chemistry questions in person.

Lecture: WMEM, Room 103 Tues, Thurs 10:00 – 11:20 AM

Laboratory: Times and locations are listed on WebAdvisor (http://webadvisor.uoguelph.ca/).

The Teaching Assistant (TA) list is posted on CourseLink, under Content >> Web Lab Resources

1. COURSE MATERIALS

(a) **Textbook:** D. Ebbing & S. Gammon, General Chemistry. Students can use the 10th, 9th or 8th ed. (and for CHEM*1050 next semester). The publisher provides 10th ed. textbook options (text and/or e-book plus OWL resources). A package can be purchased from one of the campus bookstores. **Note:** 10th edition copies of the text and solutions manual are found on Library Course Reserve.

(b) **CHEM*1040 Laboratory Manual and Organic Chemistry Notes** are only purchased from the Chemistry Department. Sales run Jan. 6 - 10, 9:30 AM – 3:30 PM in SSC 2106.

(c) **Safety Goggles** (not safety glasses) and a **Lab coat** are **both mandatory**. Goggles can be purchased from either the Chemistry Department or University Bookstore.

(d) **Scientific calculator** with ln, e^x, $\log_{10}$ and 10^x functions is required. Calculators or notebook computers capable of storing information are **NOT** allowed in exams, *e.g.*, graphing calculators. It is your responsibility to bring a properly working calculator to exams and know how to use it.

(e) **Organic/Inorganic Molecular Model Kit** (optional) will assist in visualising molecular shapes, organic chemistry structures and Dry Lab D exercises and can be purchased from one of the bookstores.

2. WET LABORATORIES – Begins Monday, Jan. 13!

Labs are a required component of this course. A schedule is provided on the next page. Students attend their labs according to their lab section. For example, CHEM*1040*0234 has the section number 0234, where the last two numbers represent the lab section. If your lab section ends with an **odd** number (*i.e.*, 1, 3, 5, 7 or 9), you follow the "**Week Acid Schedule**". If it ends in an even number (*i.e.*, 2, 4, 6, 8 or 0), as is the case for lab section 34, you follow the "Week Base Schedule".

(a) **Mandatory Online Lab Safety Course**: You must complete the CourseLink course entitled "*Student Science Safety I (W20)*" with a grade of 90% or better, before undertaking "wet" experiments. It takes 2-3 hours to complete. You have unlimited attempts to pass the quiz. Upon successful completion, you receive an electronic badge that you must show your TA (print or electronic form), as proof of completion, prior to being allowed to participate in Experiment #1. You may show your TA a badge from F19. Badges earlier than F19 will not be accepted.

WINTER 2020 CHEM*1040 LABORATORY SCHEDULE

DATE	"WEEK ACID" Schedule (Sections ending with **ODD** number)	Activity	"WEEK BASE" Schedule (Sections ending with **EVEN** number)	Activity
Week 1 Jan. 6 – 10	No CHEM*1040 Labs this Week	Independent Study	No CHEM*1040 Labs this Week	Independent Study
Week 2 Jan. 13 – 17	**Arrive for regular starting time.** Sign-in & safety training. Safety training is mandatory and a legal requirement.	Bring Class Schedule & Lab Manual (no lab coat & goggles)	**Arrive 90 min after regular starting time** (*i.e.*, for 10 AM, 4 PM or 8:30 PM)**.** Sign-in & safety training. Safety training is mandatory and a legal requirement.	Bring Class Schedule & Lab Manual (no lab coat & goggles)
Week 3 Jan. 20 – 24	**Arrive for regular starting time.** Experiment 1: Introduction to Laboratory Equipment	**Report due in 1 week by 11:55 PM**	**Arrive 90 min after regular starting time.** Experiment 1: Introduction to Laboratory Equipment	**Report due in 1 week by 11:55 PM**
Week 4 Jan. 27 – 31	**Arrive for regular starting time.** Experiment 2: Chemical Reactions in Aqueous Solution	**Report due in 1 week by 11:55 PM**	**Do not go to lab room this week.** *Online Computer Lab: Dry Lab A: Atomic Spectroscopy*	*Dry Lab A Marking Module*
Week 5 Feb. 3 – 7	**Do not go to lab room this week.** *Online Computer Lab: Dry Lab A: Atomic Spectroscopy*	*Dry Lab A Marking Module*	**Arrive at regular starting time.** Experiment 2: Chemical Reactions in Aqueous Solution	**Report due in 1 week by 11:55 PM**
Atomic Spectroscopy Marking Module DEADLINE: Sunday, Feb. 9, 11:55 PM				
Week 6 Feb. 10 – 14	**Arrive for regular starting time.** Experiment 3: Standardization of Sodium Hydroxide	**Report due in 1 week by 11:55 PM**	**Do not go to lab room this week.** *Online Computer Lab: Dry Lab B: Volumetric Analysis*	*Dry Lab B Marking Module*
Winter Break Feb. 17 – 21 – No Classes – No Labs				
Week 7 Feb. 24 – 28	**Do not go to lab room this week.** *Online Computer Lab: Dry Lab B: Volumetric Analysis*	*Dry Lab B Marking Module*	**Arrive at regular starting time.** Experiment 3: Standardization of Sodium Hydroxide	**Report due in 1 week by 11:55 PM**
Volumetric Analysis Marking Module DEADLINE: Sunday, Mar. 1, 11:55 PM				
Week 8 Mar. 2 – 6	**Arrive at regular starting time.** Experiment 4: Synthesis of Aspirin	**Report due the next day by 11:55 PM**	**Do not go to lab room this week.** *Online Dry Lab C: Gaseous Equilibria*	*Dry Lab C Marking Module*
Week 9 Mar. 9 – 13	**Do not go to lab room this week.** *Online Dry Lab C: Gaseous Equilibria*	*Dry Lab C Marking Module*	**Arrive at regular starting time. Experiment 5:** Buffers, Titration Curves and Indicators	**Report due in 1 week by 11:55 PM**
Gaseous Equilibria Marking Module DEADLINE: Sunday, Mar. 15, 11:55 PM				
Week 10 16 – 20	**Arrive at regular starting time.** Experiment 5: Buffers, Titration Curves and Indicators	**Report due in 1 week by 11:55 PM**	**Do not go to lab room this week.** *Online Dry Lab D: Aspects of Organic Chemistry*	*Dry Lab D Marking Module*
Week 11 Mar. 23 – 27	**Do not go to lab room this week.** *Online Dry Lab D: Aspects of Organic Chemistry*	*Dry Lab D Marking Module*	**Arrive at regular starting time.** Experiment 4: Synthesis of Aspirin	**Report due the next day by 11:55 PM**
Organic Chemistry Marking Module DEADLINE: Sunday, Mar. 29, 11:55 PM				
Week 12 Mar. 30 – Apr. 3	**Arrive at regular starting time.** Clean-up & Check-out	**Attendance will be taken.**	**Arrive 90 min after regular starting time.** Clean-up & Check-out	**Attendance will be taken.**

Friday, April 3rd is absolutely the last day to resolve any lab grade questions (first with your T.A.) and submit an application for lab regrade. Any remaining lab excuses must be submitted online by **Friday, April 3rd at 5 PM**, or else a grade of zero is assigned.

(b) Mandatory 1st Lab Meetings – Jan. 13 to 17 – Bring your lab manual.

You must attend your first lab to receive mandatory safety training, required by law. This safety meeting is a pre-requisite for all subsequent scheduled labs. As proof of your registration, you must either bring a printed copy of WebAdvisor's "*My Class Schedule*", dated **Jan. 01, 2020 or later**, or a device that can display your schedule electronically. You do not need a lab coat or googles for this first lab meeting, but you do need your CHEM*1040 lab manual.

(c) Lab Flowcharts:

Prior to each "wet" lab, you must prepare a procedural flowchart to show the main tasks/procedural steps of the experiment, and the order in which they will be carried out. Your flowchart is presented to your TA prior to starting your scheduled lab. You will not be allowed to proceed with the experiment without it. Further info can be found in your lab manual.

(d) Online "Wet" Pre-lab Quizzes – CHEM*1040 CourseLink

Pre-lab quizzes are worth 3% of your final grade and are based on the "wet" lab activities that you are about to perform **– refer to the Lab Schedule**. To prepare for these quizzes, review the material in your lab manual. You have two attempts at each quiz. If a quiz is not attempted, a grade of zero is assigned. To access, go to *Quizzes* on the Main CourseLink page. NOTE: Each quiz is available for review after the deadline for a two week period.

Everyone has the same due date for the Pre-Lab Quizzes. The experiments will be discussed in class after the pre-lab quiz is due:

Pre-lab Quiz#1 (Safety & Expt#1)	due	Jan 16, 2020	9:00 AM
Pre-lab Quiz#2 (Expt#2)	due	Jan 23, 2020	9:00 AM
Pre-lab Quiz#3 (Expt#3)	due	Feb 6, 2020	9:00 AM
Pre-lab Quiz#4 (Expt#4)	due	Feb 27, 2020	9:00 AM
Pre-lab Quiz#5 (Expt#5)	due	Mar 5, 2020	9:00 AM

(e) Laboratory Reports – submitted electronically online

Lab reports are submitted through Chemistry's online General Lab Marker System (ULab). During your lab period, you collect data and submit a copy to your TA before leaving the lab. You then complete your online lab report on your own and submit it for grading. Lab reports are normally due one week after your lab and by 11:55 PM. (If your lab was Monday your report is due the next Monday by 11:55 PM **unless indicated otherwise on the lab schedule**). Marks are deducted for lateness. Further info and the link to the site are provided on CourseLink, under *Content >> "Wet" Lab Resources*. Additional info can be found in the Introduction section of your lab manual.

(f) "Wet" Lab Exemptions for students repeating CHEM*1040

DEADLINE: WEDNESDAY, January 8 → *www.chemistry.uoguelph.ca/labexemption*

Students who previously attempted the course in full (*i.e.*, did not drop the course), obtained a wet lab grade of **at least 60%,** but who failed the course, may apply for a lab exemption. The "wet" lab must have been completed in F'19, W'19 or F'18, with a maximum of one excused absence. One must successfully apply online by the deadline to be granted a "wet" lab exemption. If exempted from the "wet" lab (reports and quizzes), students **must** still complete all online "dry" labs.

3. EVALUATION

(a) Your final course grade will be based on the scheme below:

Course Components	*Scheme*
Online "Wet" Pre-lab Quizzes (CourseLink)	3%
Online "Dry" Lab Work (CourseLink)	10%
"Wet" Lab Reports (General Lab Marker System)	12%
Test 1 (In Class Tues., Feb., 4th)	16%
Test 2 (In Class Tues., March., 17th)	21%
Final Examination (Mon., April 6, 2:30 - 4:30PM)	38%

Note: To obtain credit, a minimum of 50% in the overall course **AND** at least five out of the nine lab activities must have been **completed**, else a maximum final grade of 49% is assigned.

(b) **Practice Online Quizzes** – not for credit (see *CourseLink >> Content*)
A *Self-Assessment Quiz* is available until Jan. 10, 11:55 PM and can be accessed twice. Find out what you know! There are also topic specific practice quizzes, and a Midterm Prep Quiz, posted under the Quizzes. These quizzes can be attempted multiple times to help you test your knowledge.

(c) **Online "Dry" Labs** (see *CourseLink >> Content >> Online "Dry" Labs*)
Each online lab consists of 2 parts: the experiment and its marking module. Both are delivered through CourseLink. Background info and worksheets are provided in your lab manual. Experiments can be done as many times as you wish, however, some labs assign a new "unknown" number with each attempt. Make sure to record this number for grading purposes. Once you have completed all calculations, **only then** open the marking module to evaluate your work. You have one attempt and 60 minutes to enter your answers. If a marking module is not attempted, a grade of zero is assigned.

1. *Dry Lab A: Atomic Spectroscopy* – explore energy levels in atoms & "fireworks" colours. Results are submitted through Marking Module by **Sunday, Feb. 9, 11:55 PM**, else a zero grade is assigned.
2. *Dry Lab B: Volumetric Analysis* – test your understanding of stoichiometric concepts and analysis skills. Marking Module due before **Sun., Mar. 1, 11:55 PM**, else a zero is assigned.
3. *Dry Lab C: Gaseous Equilibria* – study factors that influence chemical equilibria. Marking Module due before **Sun., Mar. 15, 11:55 PM**, else a grade of zero is assigned.
4. *Dry Lab D: Aspects of Organic Chemistry* – investigate the structure of organic molecules. Marking Module due before **Sun., Mar. 29, 11:55 PM**, else a grade of zero is assigned.

NOTE: Results can only be reviewed during the two week period that follows the final class deadline.

(d) **Test 1 - In Class Tues., Feb., 4th** - covering material up to and including class Thurs., Jan., 30 and all labs up to that point.

Test 2 - In Class Tues., March., 17th – covering material up to and including class Thurs., March 12 and all labs up to that point with a focus on material covered since Test 1.

Each test will consist of multiple choice questions and be completed during regular scheduled class time in the regularly scheduled room. Past midterms, which were designed to be completed in 90 minutes, can be found under Content >> Course Resources.

(e) **Final Examination: Mon., April 6, 2:30 - 4:30PM,** locations TBA
For room assignments, refer to *www.uoguelph.ca/registrar/scheduling/index.cfm?exam_fall* prior to the final exam period. This regular 2 hour exam evaluates the entire course through multiple choice questions.

(f) Exams / Tests are closed book. Notes, printed material of any kind, any communication with other students or any other aids are not permitted. Computers or calculators capable of storing text information or formulas are **not permitted**.

4. POLICY ON MISSED WORK

(a) **Missed Laboratory:** Applications to be excused from a missed lab are submitted through ULab and are due one week after the missed lab. Refer to "*Purple Page for Lab Absences in First-Year Chemistry*" posted on CourseLink, under *Content >> "Wet" Lab Resources* for details on how to apply.

(b) **Missed Tests:** If you do not write one of the Tests, documentation must be e-mailed or given to R. de Laat. Doctor's notes are acceptable, but not required. If a valid excuse is received, the percentage value of the midterm is added to the percentage value of the final exam. Otherwise, a grade of zero will be assigned. **No make-up Tests will be given.**

(c) **Missed Final Examination:** If you miss a final exam, contact your Program Counsellor as soon as possible (refer to *www.uoguelph.ca/uaic/programcounsellors* for contact info). Official documentation is required within **five working days** of the missed examination. Consult the Undergraduate Calendar: *https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml*

(d) **Other Work:** When you find yourself unable to meet an in-course requirement, due to illness or compassionate reasons, e-mail R. de Laat via your U of G account. Include your full name and student ID number. If a valid excuse is received, your work will be re-evaluated; otherwise, a grade of zero is assigned. Regulations and procedures for Academic Consideration are found in the Undergraduate Calendar (*https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml*)

5. EQUAL OPPORTUNITY AND EVALUATION POLICY

The University is committed to academic integrity and has high ethical and moral standards. All students will be treated equally and evaluated using the criteria presented in this outline. Evaluation criteria are based strictly on achievement and not effort. There is no extra work for extra credit or to "make up" a grade. The need to obtain a higher grade for various reasons is not grounds for increasing your grade. If your grade were "bumped" (*i.e.* you received a grade you did not legitimately earn), it would be unfair to all the other students in the course.

6. COURSE RESOURCES

(a) **CHEM*1040 Website –** access through portal *http://www.uoguelph.ca/courselink/*
Your **Username** is the part of your University of Guelph e-mail address before the "@" sign. Your **password** is the same as your University e-mail. The course website provides a wealth of resources *(i.e.*, video lessons, animations, questions of the week, and sample midterms, *etc*.), practice quizzes and a discussion board to post your course questions. Weekly announcements are posted on the course homepage to help you stay up-to-date. It is your responsibility to check this site on a regular basis.

(b) **Your Instructor –** will be available at certain times for consultation and assistance. These office hours are arranged at the 1st class meeting and are posted on CourseLink, along with their lecture materials.

(c) **Chemistry Learning Centre** (3rd Floor Library – Science Commons – LIB 360)
Teaching Assistants (TAs) are available to answer questions and assist you with both the lecture and laboratory material. Hours are posted on CourseLink under "Announcements".

(d) **Supported Learning Groups** (SLGs) – *www.lib.uoguelph.ca/get-assistance/studying/slgs*
SLGs are regularly scheduled small group study sessions. Attendance is voluntary and open to all students in the course. SLGs are facilitated by students who have successfully completed the course. SLG leaders attend all lectures and work with faculty/staff to create study activities that integrate course content with effective approaches to learning. They are not tutors. The peer-supported group study format exposes students to various approaches to learning, problem solving, and exam prep. Session time(s) and location(s) are available on the SLG website.

7. LECTURE SCHEDULE

You are responsible for all course material, whether or not it is explicitly covered in class. Topics marked with an asterisk (*) on the next page are not covered in class but will be examined. To best prepare for class, review the appropriate sections in the text **before** your lecture.

Week	Dates	Topics	CourseLink Resources (see Content tab)	Text Reference
Week 0		Measurement Significant figures Atoms, molecules & ions	Review Video Lessons Self-Assessment Quiz	*Review: Ch. 1, 1.4 – 1.8 Ch. 2, 2.3 – 2.10
Week 1–2	Jan. 6 to Jan. 17	Atomic structure Periodic trends Lewis structures VSEPR & bonding	Periodic Tables Bonding & Molecular Structure Activity VSEPR Interactive Tutorial Questions of the Week Atomic & Molecular Structure Practice Quiz	*Review: 7.1 – 7.4 Ch. 7, 7.5 Ch. 8, 8.1 – 8.7 Ch. 9, 9.2 – 9.9 Ch. 10, 10.1 – 10.4
Week 3–4	Jan. 20 to Jan. 31	The Mole Stoichiometry & Chemical Rxns	Stoichiometry Video Lessons Nomenclature Practice Titration and Analysis Problem Questions of the Week Stoichiometry & Rxns Practice Quiz A & B	*Review 3.1 – 3.5 Ch. 3, 3.6 – 3.8 Ch. 4, 4.1 – 4.4, 4.7 – 4.10 *Review 5.1 – 5.4
Test 1 - In Class Tues., Feb., 4th				
Week 5-6	Feb. 6 to Feb. 14	Equilibrium	Equilibrium Practice Quiz	Ch. 14, 14.1 – 14.8
Week 7–9	Feb. 24 to Mar. 13	Acids and bases Salts and buffers Titration curves	Acids and Bases Video Lessons Acids and Bases Practice Quiz Salts and Buffers Video Lessons Salts and Buffers Practice Quiz Titration Curve Animation Titration Curves Practice Quiz Questions of the Week	Ch. 15, 15.1 – 15.8 Ch. 16, 16.1 Ch. 16, 16.3 – 16.7
Test 2 - In Class Tues., March., 17th				
Week 10–12	Mar. 19 to Apr. 3	Organic chemistry Intermolecular forces	Organic nomenclature quizzes Structural isomer tutorial Stereoisomers Organic Chemistry Practice Quizzes The Macrogalleria Questions of the Week	Ch. 11, 11.5 Ch. 23, 23.1 – 23.7 Ch. 24, 24.1 Organic Chemistry Notes – all questions

FINAL EXAMINATION: Mon., April 6th, 2:30 - 4:30PM

Note: You are expected to be respectful of your fellow classmates and your lecturer during class. Please refrain from making noise during lectures that distracts others and make sure your cell phone is turned off prior to class.

8. END OF CHAPTER PROBLEMS

There is a good correlation between mastering the concepts within the course on a week-by-week basis and performance in the course as a whole. Problems are assigned to provide reinforcement of the principles covered in lectures, to allow you to practice problem-solving techniques and to check your own knowledge before the midterm and final exam. For the end of chapter problems, answers are provided at the back of your textbook. For full solutions, consult the textbook's Student Solutions Manual. Copies are available in the Chemistry Learning Centre and on Course Reserve at the library.

Work the problems in the week the material is covered in lectures. A common reason why students are unsuccessful in CHEM*1040 is that they fall so far behind with the material that they never catch up. Lectures become harder to comprehend without the reinforcement effect of constant practice. If you have difficulties, **seek help early**!

The questions within the text are organised according to categories (*e.g.*, Review, Concept and Cumulative-Skills Problems). If you find the early review questions unchallenging, move on to the other sections. Additional questions are provided under "*Resources*" on the course website as "*Questions of the Week*", which represent the types of questions that may appear on examinations.

Review:

Chapter 1: 1.35, 1.41, 1.81, 1.83, 1.127.

Chapter 2: 2.43, 2.51, 2.65, 2.67, 2.75, 2.77, 2.79, 2.83, 2.85, 2.87, 2.91, 2.93, 2.99, 2.101, 2.109, 2.111, 2.119, 2.123, 2.127.

Chapter 3: 3.37, 3.39, 3.45, 3.61, 3.65, 3.67, 3.73.

Atomic structure, periodic trends, molecular structure and bonding (Weeks 1 – 2):

Chapter 7: 7.25, 7.33, 7.37, 7.45, 7.69, 7.87, 7.97, 7.114, 7.117.

Chapter 8: 8.16, 8.21, 8.24, 8.39, 8.43, 8.49, 8.61, 8.63, 8.65, 8.81.

Chapter 9: 9.43, 9.45, 9.49, 9.57, 9.59, 9.63, 9.65, 9.69, 9.71, 9.77, 9.93, 9.97, 9.99, 9.128, 9.139.

Chapter 10: 10.27, 10.31, 10.33, 10.35, 10.39, 10.41, 10.45, 10.49, 10.53, 10.65, 10.69, 10.73, 10.100.

Stoichiometry, Reactions and Chemical Equilibrium (Weeks 3 – 5)

Chapter 3: 3.24, 3.81, 3.83, 3.89, 3.91, 3.93, 3.97, 3.103, 3.105, 3.117, 3.119, 3.135, 3.137.

Chapter 4: 4.31, 4.35, 4.37, 4.39, 4.41, 4.43, 4.51, 4.69, 4.71, 4.77, 4.81, 4.85, 4.87, 4.89, 4.93, 4.105, 4.107, 4.109, 4.111, 4.115, 4.119, 4.123, 4.127, 4.141, 4.143, 4.151.

Chapter 5: 5.75, 5.77, 5.87, 5.119, 5.137, 5.143.

Chapter 14: 14.23, 14.25, 14.35, 14.37, 14.39, 14.41, 14.43, 14.55, 14.57, 14.59, 14.61, 14.63, 14.73, 14.75, 14.83, 14.87, 14.121, 14.123.

Equilibria and Acid-Base (Weeks 6 – 9)

Chapter 15: 15.27, 15.28, 15.29, 15.31, 15.33, 15.35, 15.41, 15.53, 15.57, 15.59, 15.61, 15.67, 15.71, 15.85, 15.99, 15.127.

Chapter 16:

Weak Acids/Bases: 16.1, 16.9, 16.23, 16.25, 16.35, 16.39, 16.41, 16.45, 16.51, 16.53, 16.55, 16.57, 16.59, 16.63, 16.65, 16.101, 16.111, 16.115.

Salts & Buffers: 16.27, 16.29, 16.71, 16.73, 16.75, 16.77, 16.81, 16.83, 16.113, 16.141.

Titration Curves: 16.15, 16.31, 16.85, 16.87, 16.89, 16.93, 16.107, 16.109, 16.119, 16.121, 16.135, 16.143.

Organic Chemistry & Intermolecular Forces: (Weeks 10 – 12)

Chapter 11: 11.63, 11.69, 11.71, 11.105, 11.109 b & d.

Organic Chemistry Notes for CHEM*1040: All study questions from each section.

Chapter 23: 23.14, 23.25, 23.29, 23.35, 23.39, 23.41, 23.53, 23.55, 23.65.

Chapter 24: 24.29, 24.53, 24.55.

9. CHEM*1040 EXPECTATIONS AND LEARNING OBJECTIVES

The pre-requisite for CHEM*1040 is two full high school chemistry courses (*e.g.*, 3U and 4U or grade 11 and 12 chemistry). In reviewing the course content of CHEM*1040 you may feel you know most of the material already. **Don't be misled!** The topics may be familiar, but we will be providing a deeper understanding of the fundamental concepts within chemistry. The purpose of CHEM*1040 (and CHEM*1050) is to build upon your previous exposure to the subject. You will need to move away from just memorization terms and definitions and spend more time thinking about the processes and concepts within chemistry. This will lay the foundation

for more advanced courses such as analytical chemistry (*i.e.*, CHEM*2400 or CHEM*2480), biochemistry (*i.e.*, BIOC*2580), organic chemistry (*i.e.*, CHEM*2700), inorganic chemistry and physical chemistry (*i.e.*, CHEM*2060, CHEM*2880 and CHEM*2820). **Note that the course is not designed to "teach" you chemistry. It is, however, constructed to help you learn chemistry.**

For some of you, it may have been more than a year since you last took a chemistry course and it is not unrealistic to assume that you have forgotten some of what you have already learned. We will review some basic concepts but this will not be a comprehensive review. **You must review carefully the sections of the textbook that have been assigned as review on your own.**

a) What We Expect You Already Know/Understand:

- classifications of matter and terms associated with its physical properties (e.g., temperature; density, homogeneous vs. heterogeneous mixtures). (Refer to Sections 1.4 and 1.7)
- how to report the number of significant figures in a given quantity and **how to round off the result of a calculation to the correct number of significant figures**. (Refer to section 1.5 in text as well as the introductory notes within your laboratory manual.)
- SI base units and SI prefixes (from *tera* through to *femto*) and are able to convert between units. (Section 1.6 & 1.8)
- basic concepts and terminology associated with atoms and atomic structure (*e.g.*, electron, proton, neutron, atomic number, mass number, atomic mass unit, isotope, natural abundance, mole, molar mass) (Section 2.3–2.4)
- information provided by any periodic table (e.g., atomic symbols and names, period versus group), and be familiar with the overall structure and organization of the modern periodic table. (Section 2.5)
- names of groups 1, 2, 17 and 18; how to classify an element as a metal, non-metal or metalloid based on its position in the periodic table; the common forms of the most common non-metals: H_2, F_2, Cl_2, Br_2, I_2, N_2, O_2, P_4, S_8. (Section 2.5)
- names and formulas of simple inorganic and organic compounds. Familiarise yourself with Tables 2.4 to 2.6. Sections 2.6–2.8 and pages 1–26 in the Organic Notes.
- how to write and balance simple chemical equations by inspection. (Sections 2.9–2.10)
- concepts and calculations that involve quantities of atoms, ions or molecules, Avogadro's number, molar mass and molecular formula. (Sections 3.1–3 .2)
- to use % composition & molar mass to determine empirical and molecular weights. (Sect's 3.3–3.5)
- how to use a balanced chemical equation to relate masses and moles of reactants and products. (Sections 3.6–3.7)
- meaning of terms such as empirical formula, molecular formula; structural formula; anion; cation; oxidation state; limiting reagent; excess reagent; actual, theoretical and percent yields; molarity (Sections 3.8, 4.7)
- units of pressure used for gas law problems and be able to convert between them. (Section 5.1)
- concepts and terminology associated with the ideal gas law (PV=nRT) (Sections 5.3–5.4)
- difference between wavelength and frequency and are familiar with the electromagnetic spectra and the different regions of the spectra (X-ray, UV, visible, IR, Microwave, radio). (Section 7.1)
- concept of a photon and how the energy of a photon is directly proportional to the frequency and inversely related to wavelength. (Section 7.2)
- when and why the Bohr Theory of the atom is useful, and as well as its limitations, and why it is not really correct. (Section 7.3)
- how to work with exponential (i.e., scientific) notation, logarithms (*e.g.,* log & ln), exponentials (i.e., 10^x and e^x) and the quadratic formula. Practice: *https://atrium.lib.uoguelph.ca/xmlui/handle/10214/1755*

- how to solve for an unknown within a linear equation. In some instances, it may be helpful if you can solve for two unknowns using two linear equations.
- how to use a table of (x,y)-data pairs to construct a plot. For straight line plots, you will be expected to calculate slope.

b) **CHEM*1040 Learning Objectives** – the course can be subdivided into six sub-sections and the learning objectives for each are as follows:

Atomic structure and Periodic Table (Sections 7.4 – 8.7 & 9.2-9.3)

1. Understand the significance of the quantum numbers, understand how they can be used to code for the electron energy levels within atoms and know the shapes of the boundary surfaces of *s*, *p* and *d* orbitals. (Sections 7.4–7.5)
2. Understand the organization of the periodic table in terms of the types of orbitals being filled; be able to apply the Pauli Exclusion Principle and Hund's Rule. (Sections 8.1–8.2 & 8.4)
3. Predict the magnetic behaviour of an atom or ion. (Section 8.4)
4. Write ground-state electron configurations for any atom or ion using only the Periodic Table. (Sections 8.3 & 9.2)
5. Know periodic trends such as atomic dimensions and how atomic dimensions change as a function of position in the Periodic Table; compare the sizes of two atoms, two ions, or an atom and ion. (Sections 8.6 and 9.3)
6. Define ionization energy, electron affinity and electronegativity. Know how these parameters change as a function of position in the Periodic Table. (Section 8.6)

Lewis structures, VSEPR & bonding (Sections 9.4 –9. 9 & 10.1 – 4)

1. Apply the Octet Rule to the construction of Lewis structures for multi-atom, multi-element molecules. Be able to recognize violations of the rule. (Sections 9.4–9.6 and 9.8)
2. Know what resonance is and be able to draw resonance structures. (Section 9.7)
3. Show how formal charges can facilitate the generation of "better" Lewis structures. (Section 9.9)
4. Apply VSEPR Theory to Lewis structures to determine approximate molecular geometries. (Section 10.1)
5. Understand the significance of electronegativity and use it to identify polar bonds; use geometry to identify polar molecules. (Sections 9.5 & 10.2)
6. Understand the logic behind the need to invoke hybridization of atomic orbitals; use number of electron pair locations to determine hybridization used by the central atom. (Section 10.3)
7. Describe single, double or triple bonds in terms of the overlap of hybrid or pure atomic orbitals. (Section 10.4)

Stoichiometry (Sections 3.6 – 3.8, 4.1 – 4.4, 4.7 – 4.10)

1. Relate quantities in chemical equations (*e.g.*, single & multi-stepped reactions) (Sect's 3.6–3.7)
2. Connect the concepts of limiting reagent (or reactant), theoretical yield, actual yield and percentage yield. Be able to work problems related to these concepts. (Section 3.8)
3. Perform calculations involving molarity. Be able to determine solution concentration, prepare a solution or interconvert units. (Sections 1.8 & 4.7 – 4.8, 4.10)
4. Apply the solubility rules in Table 4.1 to either compounds or reactions. (Sections 4.2–4.3)
5. Differentiate between molecular and net ionic equations. Be able to write either. (Section 4.2)
6. Write precipitation and neutralization reactions. (Section 4.3 – 4.4)

7. Understand the logic behind both gravimetric and volumetric analyses, and be able to perform stoichiometric calculations involving solids, solutions or gases. (Sections 4.9–4.10 and 5.3–5.5)

Chemical Equilibrium (Chapter 14)

1. Describe the characteristics of dynamic equilibrium. (Section 14.1)
2. Connect the dependence of K on the way the balanced equation is written. What happens to K if the reaction is reversed? (Sect. 14.2)
3. Write a K expression for homogenous or heterogeneous equilibrium. (Sect's 14.2–14.3)
4. Relate K to ***extent of reaction***, relative amount of reactant/product at equilibrium. (Sect. 14.4)
5. Relate Q value to ***direction of reaction***, forward or reverse, to reach equilibrium. (Sect. 14.5)
6. Be able to solve an equilibrium problem. (Sect. 14.6)
7. Use Le Chatelier's principle to describe the effect of a stress on equilibrium position, equilibrium constant K and equilibrium concentrations or pressures. Stresses include adding or removing a reagent, a temperature change, or a change in overall volume or pressure. (Sect. 14.7)

Acids, bases, salts, buffers and titration curves (Chapters 15 & 16):

1. Differentiate between the three definitions of acids and bases (*i.e.,* Arrhenius, Brønsted-Lowry and Lewis). Identify examples of each. (Sections 15.1–15.3)
2. Identify the six common strong acids (see Table 15.1).
3. Identify strong bases (group I and II hydroxides and oxides) (see Table 15.1)
4. Identify conjugate acid/base pairs in an acid/base reaction. (Section 15.2)
5. Write an equation for the auto-ionization of water and its K expression. (Section 15.6)
6. Recognize strong acid and base aqueous solutions, and determine the pH and equilibrium concentrations. (Sections 15.7–15.8)
7. Calculate pH from $[H^+]$ or $[H^+]$ from pH; relate $[OH^-]$ and $[H^+]$ using K_w. (Section 15.8)
8. Recognize weak acids and weak bases, write an equation for the dissociation of an acid or base in water, identify the substances acting as the acid and base on either side. (Sections 16.1 & 16.3)
9. Write the equilibrium constant expression for a weak acid or weak base dissociation, determine pH and equilibrium concentrations. (Sections 16.1 & 16.3)
10. Relate K_a and K_b using K_w. (Section 16.4)
11. Classify salts as producing neutral, acidic or basic solutions in water; determine the pH of a salt solution (Sections 16.4–16.5).
12. Recognize and determine the pH of buffer solutions; suggest a reasonable buffer solution to maintain a certain pH. (Section 16.6)
13. Understand how and why an indicator changes color (Section 15.8 & 16.7).
14. Know the difference between equivalence point (or stoichiometric point), endpoint, and midpoint (or half equivalence/half stoichiometric point).
15. Evaluate the reaction between a strong acid and strong base, a weak acid and strong base or a strong acid and weak base to determine the pH at various points including: (1) before titration, (2) before equivalence point, (3) at equivalence point & (4) after equivalence point. (Section 16.7)
16. Write an equation for an acid/base reaction and determine the direction from acid/base strengths.

Organic chemistry (Organic Notes; Sections 11.5, 23.1 – 23.7 & 24.1 – 2)

1. Identify and name the various functional groups. (Organic Notes (ON) pp. 1–22)
2. Identify and relate the different types of isomers. (ON pp. 23–30)
3. Identify types of intermolecular forces present between molecule (Section 11.5, ON pp. 31-32)
4. Compare and contrast boiling points, melting points and water solubility based on intermolecular forces. (ON pp. 32–34)
5. Identify chemically reactive centres (electrophiles, nucleophiles and free radicals), reaction intermediates and intermediates stability. (ON pages 35–36)
6. Know the following representative organic reactions:
   (a) *Alkanes* – substitution reaction through halogenation (ON pp. 36–38)
   (b) *Alkenes* – addition of acid or hydrogen & polymerisation (ON pp. 39–42)
   (c) *Alkyl Halides* – nucleophilic substitution reactions (ON pp. 42–43)
   (d) *Alcohols* – oxidation with dichromate and acid (ON pp. 44–45)
   (e) *Aldehydes/Ketone*s – addition of H_2 & nucleophilic attack of H_2O & alcohol (ON pp. 45–47)
   (f) *Carboxylic Acids* – formation of esters and polyesters (ON pp. 47; 49–50)
   (g) *Esters* – formation of amides and polyamides(ON pp. 48, 50–52)
7. Differentiate between addition and condensation polymers (ON pp. 40–42; 49–52).
8. Recognise the acid & base properties of organic compounds and their salts. (ON pp. 52–53)

c) CHEM*1040 Learning Outcomes

On successful completion of this course, students should be able to:

1. Demonstrate knowledge and understanding of atomic structure, periodic trends, Lewis structures, VSEPR and bonding.
2. Understand and apply the concepts of chemical equilibrium, especially in associating with acids, bases, salts, buffers and titration curves.
3. Solve quantitative problems (stoichiometric) involving chemical formulas and equations which include solids, liquids, solutions or gases.
4. Demonstrate knowledge and understanding of physical and chemical aspects of organic molecules and their reactions.
5. Perform laboratory experiments demonstrating safe and proper use of standard chemical glassware and equipment.
6. Record, graph, chart and interpret data obtained from experiments through working co-operatively with others or independently.

10. ADVICE FROM STUDENTS ON HOW TO DO WELL IN CHEM*1040

- "Be sure to mark down all your deadlines."
- "Read a bit ahead in the text. The lectures make much more sense..."
- "Keep on top of the lecture material and textbook reading/question assignments... the midterm and final will not seem half as difficult!"
- "Try to understand what you are doing, not just know how to do it."
- "KNOW your material, and be able to explain it well to someone else with little difficulty."
- "Ask questions if you don't understand … it will not get better with time."
- "… read textbook, pay attention in lecture, ask questions, visit your Prof., go to SLG's, go to the Chem Learning Centre, whatever you need to do, do it. Resources are there, you just need to go get them."

11. UNIVERSITY POLICIES & INFORMATION

a) **Academic Advisors –** If you are concerned about any aspect of your academic program, make an appointment with a Program Counsellor within your degree program. For contact info, please refer to: *https://www.uoguelph.ca/uaic/programcounsellors*

b) **Academic Assistance –** If you are struggling to succeed academically, the Learning Commons (*https://www.lib.uoguelph.ca/*) offers numerous academic resources, including workshops related to time management, taking multiple choice exams and general study skills. You can also set up individualized appointments with a learning specialist.

c) **Academic Integrity** – The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. Note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from the responsibility of verifying the academic integrity of their work before submission. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult their Instructor. Refer to the Academic Misconduct Policy in the Undergraduate Calendar:
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

d) **Accessibility** – The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student. When accommodations are needed, students are required to register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway. Accommodations are available for both permanent and temporary disabilities. Note that common illnesses, such as a cold or the flu, do not constitute a disability. Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance, and no later than the 40th Class Day. For more information, go to the SAS website: *www.uoguelph.ca/sas*

e) **Copies of out-of-class assignments –** Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

f) **Copyright of Course Materials –** All course materials are copyrighted by the Department of Chemistry, the instructor who prepared the materials or the publisher who provided the materials. These materials can only be reproduced with permission and in conjunction with associated copyright rules. **Note**: Lectures and laboratories **cannot** be recorded without the permission of the presenter. Material recorded with permission is restricted to personal use for that course, unless further permission is granted.

g) **Course Evaluation** (CEVAL) – Students will be invited to complete a short online evaluation of their TA**,** as well as their Instructor and the course, near the end of the semester. The department regards this information as important in evaluating the course, as well as your TA and Instructor's performances. All comments are reviewed and your suggestions are followed whenever possible. To access the online evaluation, go to *https://courseeval.uoguelph.ca/*.

h) **E-mail Communication** – As per university regulations, all students are required to check their <uoguelph.ca> e-mail account **regularly**: e-mail is the official route of communication between the University and its students.

i) **Use of Personal Information** – Personal information is used by University officials to carry out their authorized academic and administrative responsibilities and also to establish a relationship for alumni and development purposes. The University of Guelph's policy on the Collection, Use and Disclosure of Personal Information can be found in the Undergraduate Calendar: *https://www.uoguelph.ca/registrar/calendars/undergraduate/current/intro/index.shtml*

j) **Resources** – Academic Calendars provide information about the University of Guelph's procedures, policies and regulations: *www.uoguelph.ca/registrar/calendars/index.cfm?index*

i. **Drop Date**: Students have until the last day of classes (Fri., Apr., 3rd), to drop courses without academic penalty. Evaluate your performance regularly and if you are not doing well, seek advice from your Instructor prior to this date. Students who drop the course will not be eligible for a wet lab exemption if they repeat CHEM*1040 in a subsequent academic semester. Regulations and procedures for course registration are listed in the Undergraduate Calendar: *https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml*

ii. **Schedule of Dates**:
www.uoguelph.ca/registrar/calendars/undergraduate/current/c03/index.shtml

k) **Wellness –** If you are struggling with personal or health issues:

- **Counselling Services** (*https://wellness.uoguelph.ca/counselling/*) offers individualized appointments to help students work through personal struggles that may be impacting their academic performance.
- **Student Health Services** (*https://wellness.uoguelph.ca/health/*) provides medical attention.
- For support related to stress and anxiety, besides Health Services and Counselling Services, Kathy Somers runs training workshops and one-on-one sessions related to stress management and high performance situations (*http://www.selfregulationskills.ca/*)