Introductory Organic Chemistry Lecture – CHM 124
Course Information & Syllabus – Spring Semester, 2022

Instructor

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Course Description and Goals

CHM 124 is a second-semester freshman organic chemistry course, taken after successful completion (C- or higher) of an introductory or general chemistry course (at URI: CHM103, CHM 101, or CHM 112).

The course is designed to not only advance students' scientific knowledge, but also increase their competency in the critical thinking skills identified as essential to success in their programs of study.

Topics include the elementary principles of organic chemistry, and physical and chemical properties of the primary organic functional groups. The emphasis is primarily on aliphatic compounds, particularly those with physiological significance, including simple and complex carbohydrates, amino acids and proteins, and dietary and membrane lipids.

Specific learning outcomes for each topic are provided in both the Brightspace Content lesson modules and CHM 124 Skills Practice Book.

Required Learning Materials

- *CHM 124 site within the Brightspace platform:* Content Lessons, Skill Checks, Assignments, Discussions
- *Digital Platform:* "OWLv2 with eBook for Chemistry for Today: General, Organic, and Biochemistry, Seager/Hansen, 9th Edition;" purchase from Cengage.com or Bookstore. *Course Key Code* = E-YQD928SYXMRQ6

Students from recent CHM 103 sections will still have access to OWLv2 and the Seager eReader textbook. Students from CHM 101/112 will need to purchase access to the OWLV2 digital platform w/eBook from Cengage.com or URI Bookstore.

- *CHM 124 Skills Practice Book:* Dr. Graham's Skills Summaries, One Page Lessons, and Practice Exam Questions; all pdf files available within Brightspace; printed and bound hardcopies available at URI Bookstore ($25)
- *Scientific calculator*: Logarithm and exponent functions may be needed for pH calculations

Students must take responsibility for working each Brightspace Content lesson module and completing the embedded Skill Checks and linked OWL assignments. Students should also give careful attention to all Brightspace Announcements and the Discussion posts

Grading and Testing Policies

Each student's course grade will be determined from their strategic use of the Brightspace LMS (Learning Management System) and OWLv2 online skill practice systems, and performance on the four Exams and a comprehensive Final Exam:

Brightspace Content Lessons with Skill Checks, Assignments, Discussions	14%
OWLv2 (Online Web Learning) Homework	14%
Four Exams, administered in class and via Brightspace LMS (14% each)	56%
Comprehensive Final Exam	16%
	100%

The score on the comprehensive Final Exam may be used to replace the grade of one of the four Exams which was missed or was lower than the Final Exam score. The Final will then count as 30% of a student's overall grade.

This policy is designed to assist students who miss the in-class portion of an exam due to injury, illness, or family need. It allows these students to focus on their rest and recovery, or the needs of their loved ones, without the additional stress of arranging to make up of a proctored written exam.

The missed-test policy applies to all students who are absent *for any reason* on the day of an in-class exam. Thus students should plan to adhere to the exam schedule specified in the syllabus. No make-ups will be given for missed in-class exams, and students who are absent on the day of an in-class exam should not request a make-up.

Students who miss the in-class portion of an exam may still complete the online portion of that exam in Brightspace during the 48+ hour exam window.

Alternate testing will be available for students with a documented disability. These students should contact the course instructor as early as possible in the semester regarding the arrangements for reasonable accommodations, as indicated by URI's Office of Disability, Access and Inclusion (DAI).

The alternate testing arrangements for DAI students – and for students serving in the military, participating in University-sanctioned events, or observing religious holidays – require written notification to the instructor, and should be made at least one full week prior to the scheduled exam.

No extra credit assignments will be given (other than those designated for all students in OWLv2 and Brightspace), and students should expect that the standard grading scale will be applied:

90%+ = A- / A; 80-89% = B- / B / B+; 70-79% = C- / C / C+; 60-69% = D / D+; < 60% = F.

Grades in CHM 124 are earned by demonstrating proficiency in the required skills. These skills include critical thinking and problem solving: the ability to apply organic chemistry concepts to relevant scenarios and predict physical and chemical properties from a study of a compound's molecular structure (i.e., explain how *structure determines function*).

Each student's grade will be determined by the quality of the student's performance on the course work items. The grade is not open to negotiation, and it is not dictated by what's needed to progress in the student's chosen program of study. Each student's grade must be earned by achieving proficiency in (and ideally, mastery of) the skills identified as essential to ongoing success in the student's degree program.

Students can anticipate that graded papers from in-class exams will be returned in class approximately one week after the exam date. In the interim, students should not inquire as to the status of their test papers. Exam scores will be communicated to students at the earliest opportunity through the Brightspace Gradebook.

If the Kingston campus is closed due to weather (or other unexpected event) on a scheduled in-class exam day, students should anticipate that the exam will be given at the next class meeting. Details will be communicated via Brightspace.

CHM 124 Class Meetings

Section 001:	M W	3:00 – 4:15 PM	Beaupre Center 100

The most successful students in CHM 124 are those who consistently prepare to come to class, participate fully in each meeting, and diligently practice the required skills – thus becoming efficient, competent, and confident analyzing and solving organic chemistry problems.

Students should strive to adhere to the Community Standards of Behavior: University Policies and Regulations in the University Student Handbook. These standards include arriving at class on time and remaining engaged and attentive until the session has concluded. Computers, tablets, and cell phones should be turned off and put away during class.

The Brightspace Learning Management System (LMS) serves as a virtual extension of the Beaupre classroom. Within this online classroom, attendance is measured by each student's active presence in both Brightspace and OWL, and the submission of assignments to these sites. The importance of regular logins, active participation, and active utilization of the Content lessons cannot be overstated; these contribute to both students' learning quality and overall course grade.

Students should make a habit of checking their Class Progress in Brightspace, particularly their Content progress: the Topics (Content Lessons) visited, the number of visits to each page, and the total time invested in working that page.

The CHM 124 Study Cycle: Prepare – Participate – Practice

You'll need to plan for significant skills practice outside of class – both before and after you attend class. The rule of thumb for most college courses: two to three hours of study time outside of class for every one hour spent in class.

Since CHM 124 meets a total of 2½ hours each week, this means you should plan to spend approximately 5 to 7½ hours every week practicing your chemistry skills outside of class.

To be successful in CHM 124, you'll need to be not just actively engaged, but pro-actively engaged in building your skills in organic chemistry. You'll need to prepare for each class meeting, participate actively while you're in class, and then practice the skills outside of class, until you've achieved skill mastery.

Study Cycle: Prepare

You should invest time getting acquainted with the concepts we'll discuss in each class before you come to class. We can use our limited class time more strategically – to help students understand new concepts and practice new skills.

You can begin your Study Cycle by pre-viewing the Content lesson modules in Brightspace, studying any posted video lessons, looking over the relevant pages in the CHM 124 Skills Book, and making your initial attempts at the Brightspace Skill Checks.

Study Cycle: Participate

Then come to class, with your CHM 124 Skills Practice Book in hand, ready to take notes (as we review new concepts), ask and/or answer questions (as we discuss applications of concepts), and practice new skills (as we work selected Skills Book problems).

Study Cycle: Practice

Because skills mastery requires extensive skills practice outside of class, you'll follow up your lecture participation by completing homework assignments. You should *start* with the OWLv2 homework system, since the OWL online assignments are designed to help you first learn and then practice new skills.

OWL will provide hints/feedback and allow you to skill-drill on a particular problem set as many as ten times before you submit the completed assignment. *More skills practice = greater brain growth.*

After you finish up the OWL assignments, you can continue your skills practice with additional learning resources: the practice exam problems in the Skills Book, and within-chapter Learning Checks in your textbook. The e-Reader textbook makes it convenient to work within-chapter and end-of-chapter problems, since solutions to Learning Checks and even-numbered End-of-Chapter Exercises are available as pull-down menu items directly beneath the problem statement.

You should continue your skills practice – getting help as needed from Dr. Graham, CHM 124 TA Quentin Mylie, members of your Weekly Tutoring Group, a Chemistry Teaching Assistant (TA), or an Academic Enhancement Center (AEC) tutor – right up until each one of the in-class exams.

You'll want to identify several study partners within the class. Thus in the event of an absence, you'll have arrangements to get copies of lecture notes from one (or more) of your study partners. After you've worked the corresponding Brightspace Content lessons and relevant portions of the Skills Book, then reviewed your study partner's class notes, make plans to bring your written list of questions to Dr. Graham's Beaupre 117A office to discuss the concepts and practice the skills that were demonstrated in class.

You cannot afford to fall behind in this course. Every new concept will build on concepts that you should have previously mastered in this course or in the pre-requisite course (at URI: CHM 101/112 or CHM 103). You must take responsibility for reviewing those concepts as needed.

Course Work Items

1. Brightspace LMS Skill Checks, Assignments, Discussion

The Brightspace Skill Checks will probe at your understanding of key skills and push you to think more deeply and critically about fundamental concepts. Each consists of a pooled set of questions, meaning a fixed number of questions will be selected at random from a larger pool each time you open the Skill Check.

Each Skill Check can be taken up to five times. Correct answers and limited feedback will be provided for any answered questions. After reviewing the feedback, you can re-take the Skills Check two more times, to answer a different set of questions, and to maximize your learning.

Occasionally, Written Reflection assignments will be posted in Brightspace. Each completed and submitted assignment will also contribute to your LMS % score.

The Brightspace Discussions provide a way for you to share and talk over your work with your classmates, with Dr. Graham, and with TA Quentin Mylie. Discussion posts that share worked solutions and/or discuss problem-solving strategies will also contribute to your LMS % score.

$$LMS\ \%\ Score = \frac{total\ points\ earned\ (Skills\ Checks + Assignment + Discussion)}{required\ points\ possible\ (Skills\ Checks + Assignments)}\ x\ 100$$

2. OWLv2 (Online Web Learning) System

The OWLv2 (Online Web Learning) System was designed to help students both learn and practice the skills needed for success in their chemistry course.

Three types of assignments contribute to the OWL portion of each student's grade: 1) mastery assignments (with pooled, algorithmic questions), 2) non-mastery multimedia activities (with tutorials and/or videos), and 3) end-of-chapter (EOC) problems. The mastery assignments require that you answer a certain number of questions correctly out of a Group (usually two out of three). The questions are pulled at random from a larger pool of questions each time you Retry the Group.

You'll have one submission for each OWL assignment, but up to ten attempts to complete each question within the assignment before you submit the completed assignment for credit. This means you can cycle through a Group of questions – or choose to Save and Exit the assignment (and return to it later) – as many as ten times.

Your objective should *not* be to click through assignments until each question shows the green check of a correct response. It should be to carefully work your way through each assignment – trying to learn as much as you can. This means working the more challenging Mastery questions several times, to draw new questions from the pool and get additional skills practice. Please plan to take full advantage of OWL's ability to provide both skills practice opportunity and instant feedback on how you're progressing in building the needed skills.

So that you'll stay on track and on time with your skills practice, each OWL homework assignment will have a *due date* (corresponding to the timing of that topic in the course), and an *unavailable date* (corresponding with an exam or other course milestone). If you've started an assignment prior to its due date, you can continue working on the assignment until the unavailable date, with a 10% late penalty. Due dates of missed OWL assignments will not be extended.

Mastery and end-of-chapter OWL assignments are required; non-mastery activities are extra credit.

$$OWL\ \%\ Score = \frac{total\ points\ earned\ (required + extra\ credit)}{required\ points\ possible}\ x\ 100$$

Be aware that there's a learning curve to using OWL's ChemDoodle structure-drawing software. A tutorial is provided, but you should start working the assignments immediately, so you'll have time to build proficiency, and to get help if needed. And realize you should always make a practice of drawing molecular structures on paper first, and then attempting to draw the structures in OWL.

3. Exams and Comprehensive Final Exam

The first four exams will be given in two parts:

- The in-class portion will include questions that require drawing structures and/or intermolecular interactions and writing IUPAC names. The in-class portion of each exam is to be taken timed, proctored, and closed-book/closed notes.
- The online LMS portion will consist of large pools of conceptual multiple-choice questions programmed in the Brightspace Quizzes tool. This portion of the exam is also timed, but students can refer to the Skills Book and other study materials as needed.

The comprehensive Final Exam will consist of 100 multiple-choice questions selected from pools on functional group structure, nomenclature, physical and chemical properties, as well as the three major types of biological molecules: carbohydrates, proteins, and lipids.

Exam questions will come directly from the content presented in the Skills Book and Brightspace Content lesson modules, and the skills demonstrated and practiced in class meetings. Thus the exam questions are likely to be similar to the problems in the OWL online study system and the practice questions in the Skills Book.

You must commit to working as many of these problems as possible as practice for the exams. Your goal is to become confident, competent, and efficient at interpreting and solving organic chemistry problems. It's the students who get the *MOST* practice solving problems that tend to have the greatest success in science and math courses.

Additional Study Help Resources

Nearly all students recognize that regardless of how well or how poorly they're doing in a given class, there are ways to improve their learning and studying. The Chemistry Department (Beaupre) and the Academic Enhancement Center (AEC) and Writing Center (Roosevelt Hall) offer several kinds of support that help students improve their learning and academic performance in this class as well as other classes.

- ***Weekly Tutoring Groups, provided by the Academic Enhancement Center (AEC)***

The AEC Weekly Tutoring Groups are for students looking for continuous, structured tutoring throughout an academic term. Participants will meet in small groups once a week and work with the help of a trained peer tutor – to better understand what's being taught in class, practice and strengthen problem-solving skills, and learn more effective ways to engage with the material.

Weekly Tutoring Groups will be available on multiple days and times throughout the week, so as to accommodate all students who are interested in joining. Students can join by submitting an online request form; they'll then be notified of their Weekly Tutoring Group appointment by an AEC staffer.

As the available time slots will be scheduled on a first-come, first-served basis, students should plan to join a Weekly Tutoring Group early on in the semester. Students who don't join a group right away, but would like to join later on in the term, will be placed into groups where space is available.

A commitment to regular ongoing attendance is key characteristic of this tutoring program, and participants *must* comply with this attendance policy. However, students may choose to leave a tutoring group for any reason at any time during the term, and be replaced by a classmate who wishes to join the group.

- ***Chemistry Walk-In Tutoring at the Academic Enhancement Center (AEC)***

The chemistry walk-in center is staffed with trained tutors prepared to guide you through difficult course content. CHM 124 students should come to tutoring with their *Skills Practice Book* and written list of specific questions. Some students work online homework in the walk-in centers, knowing there are tutors nearby to whom they can ask questions as needed. This is also a great opportunity to meet other students in the course. Check the AEC website (uri.edu/aec) for the most up-to-date schedules of when the walk-in center is open, and feel free to stop by during any of those hours – no appointment needed!

- ***Chemistry Graduate Student Teaching Assistants in the Beaupre 115 Learning Center***

The Chemistry Help Office is a place where students can gather to study and work problems, either alone or in small groups, and get help on an as-needed basis – from Dr. Graham, another Chemistry Lecturer, or one of the Chemistry Graduate Student Teaching Assistants who staff the office during the week.

Some of the most successful students in chemistry courses are those who become "regulars" in the Help Office, preferring to study there, rather than in their dorm room, the AEC, or the Library. They set up camp, bring their breakfasts and/or lunches, and work practice problems – on paper or online, using their own laptop or one of the two desktop computers available in the Help Office – and get help as needed.

A complete schedule of TA office hours is available via a link within Brightspace. The TAs listed as teaching the CHM 126, 226, or 292 Organic Chemistry labs will be *most* familiar with the content of the CHM 124 lecture course.

- ***Assistance from Dr. Graham, during office hours or via Brightspace and/or email.***

My class/meeting and office hour schedule is available to you through URI's Starfish Success Net. You're welcome to schedule an appointment via Starfish, or simply walk in at a day/time you can see I'll be available.

Please understand that because I have responsibility for several courses – all with high enrollments – I receive a substantial number of email messages each day.

To ensure that your email will be answered, it's recommended that you:

- Use a concise, yet descriptive subject line.
- Include your full name, chemistry course and section number in the message.
- Make sure the question asked or information conveyed in your message is both clear and complete.

Unless you have a confidential question regarding your graded work in the course, please considering posting your inquiry to the Brightspace Discussions, so your classmates can also benefit from the answer(s) to your question.

- ***Academic Coaching at the Academic Enhancement Center (AEC)***

The AEC's academic skills and strategies programs help students identify their individual planning and studying needs in this or any other course, and can teach you to implement new, more effective ways of studying, planning, managing time and work, and dealing with challenges like procrastination and motivation.

Academic skills sessions are 30-minute, one-to-one appointments that students can schedule online by visiting the AEC on Starfish and making an appointment with Dr. David Hayes, the AEC's academic skills development specialist.

UCS 160: Success in Higher Education is a one credit course, offered each semester to all undergraduates on learning how to learn and excel in college academics. For more information on these programs or assistance with setting an appointment, visit https://web.uri.edu/aec/academic-skills/, or contact Dr. Hayes directly at davidhayes@uri.edu.

Study Help Advice

Whether you're seeking help from Dr. Graham, CHM 124 TA Quentin Mylie, another CHM TA, or an AEC Tutor, you'll want to arrive at your help session on time and fully prepared, to make the discussion as productive and efficient as possible. This means that you should bring all relevant study/reference materials with you to the session.

These include:

- Your CHM 124 Skills Practice Book
- Your notebook of worked homework problems and lecture notes
- For help with the OWLv2 online homework – send an email message from within that Assignment, then bring your laptop (or hand-written notes and/or a screen print that clearly indicate that assignment and question).
- And the most important item – your written list of specific questions and/or your goals for the help session.

COVID-19 Statement

The University is committed to delivering its educational mission while protecting the health and safety of our community. While the university has worked to create a healthy learning environment for all, it is up to all of us to ensure our campus stays that way.

As members of the URI community, students are required to comply with standards of conduct and take precautions to keep themselves and others safe. Visit web.uri.edu/coronavirus/ for the latest information about the URI COVID-19 response.

- Universal indoor masking is required by all community members, on all campuses, regardless of vaccination status. If the universal mask mandate is discontinued during the semester, students who have an approved exemption and are not fully vaccinated will need to continue to wear a mask indoors and maintain physical distance.
- Students who are experiencing symptoms of illness should not come to class. Please stay in your home/room and notify URI Health Services via phone at 401-874-2246.

- If you are already on campus and start to feel ill, go home/back to your room and self-isolate. Notify URI Health Services via phone immediately at 401-874-2246.

If you are unable to attend class, please notify Dr. Graham at cbrittain@uri.edu, and make plans to stay current with your learning and skills practice via strategic use of the online resources (i.e., Brightspace Content lessons, OWL Assignments).

Anti-Bias Statement

As members of the URI Community, we respect the rights and dignity of each individual and group. We reject prejudice and intolerance, and we work to understand differences. We believe that equity and inclusion are critical components for campus community members to thrive.

If you are a target or a witness of a bias incident, you are encouraged to submit a report to the URI Bias Response Team at www.uri.edu/brt. There you will also find people and resources to help.

Basic Needs Resources

Any students who face challenges securing their food, housing, or learning resources and believe this may affect their course performance are urged to contact Jacqui Springer (jacqui_springer@uri.edu) in the Student Support and Advocacy Services Office.

If you're comfortable doing so, please also notify Dr. Graham, so she can assist in providing resources and support.

Important Spring Semester Deadlines

- *Last day of e-Campus open add period:* Sunday, January 30
- *Last day of e-Campus add with permission number:* Sunday, February 6
- *Last day for students to drop courses via e-Campus with no transcript designation:* Sunday, February 14
- *Last day for students to drop courses via e-Campus (with drop designated on transcript):* Monday, March 7
- *Mid-term progress reports posted in e-Campus:* Tuesday, March 22

Academic Honesty

Academic dishonesty in any form is considered a serious offense, and disciplinary action will be taken immediately. The URI policy on academic honesty is detailed in the student handbook (available online), and it is summarized here:

Students are expected to be honest in all academic work. A student's name on ANY written work shall be regarded as assurance that the work is the result of the student's own thought and study. Work should be stated in the student's own words, and produced without assistance.

The following are examples of academic dishonesty:

- *Unauthorized possession or access to exams.*
- *Unauthorized communication during exams.*
- *Unauthorized use of another's work or preparing work for another student.*
- *Taking an exam for another student.*
- *Altering or attempting to alter grades.*
- *The use of notes or electronic devices (e.g. cell phones, calculators) to gain an unauthorized advantage during exams.*
- *Facilitating or aiding another's academic dishonesty.*

When there is an allegation of academic dishonesty, the instructor may:

- ***Fail the student for the assignment, or recommend that the student fail the course.***

CHM 124-001 Class and Exam Schedule – Spring 2022

Timing	*Monday*	*Wednesday*	*Work Items*
Week 1 1/24– 1/28	Organic Compounds: Alkanes Unsaturated Hydrocarbons	Organic Compounds: Alkanes Unsaturated Hydrocarbons	Mondays: OWL due dates Fridays: Brightspace due dates
Week 2 1/31 – 2/4	Organic Compounds: Alkanes Unsaturated Hydrocarbons	Organic Compounds: Alkanes Unsaturated Hydrocarbons	Mondays: OWL due dates Fridays: Brightspace due dates
Week 3 2/7 – 2/11	Unsaturated Hydrocarbons	**EXAM 1** **(In-class 2/9; online 2/9-11)**	Mondays: OWL due dates Fridays: Brightspace due dates
Week 4 2/14 – 2/18	Unsaturated Hydrocarbons	Alcohols, Phenols, and Ethers	Mondays: OWL due dates Fridays: Brightspace due dates
Week 5 2/21 – 2/25	***President's Day Holiday***	Alcohols, Phenols, and Ethers	Mondays: OWL due dates Fridays: Brightspace due dates
Week 6 2/28 – 3/4	Alcohols, Phenols, and Ethers Aldehydes and Ketones	Aldehydes and Ketones	Mondays: OWL due dates Fridays: Brightspace due dates
Week 7 3/7 – 3/11	Aldehydes and Ketones	**EXAM 2** **(In-class 3/9; online 3/9-11)**	Mondays: OWL due dates Fridays: Brightspace due dates
Week 8 3/14– 3/18	***Spring Break***	***Spring Break***	***UNAVAILABLE date for first half of OWL/Brightspace work***
Week 9 3/21– 3/25	Carboxylic Acids and their Derivatives	Carboxylic Acids and their Derivatives	Mondays: OWL due dates Fridays: Brightspace due dates
Week 10 3/28– 4/1	Carboxylic Acids and their Derivatives	Amines and Amides	Mondays: OWL due dates Fridays: Brightspace due dates
Week 11 4/4 – 4/8	Amines and Amides	**EXAM 3** **(In-class 4/6; online 4/6-8)**	Mondays: OWL due dates Fridays: Brightspace due dates
Week 12 4/11– 4/15	Carbohydrates	Carbohydrates	Mondays: OWL due dates Fridays: Brightspace due dates
Week 13 4/18– 4/22	Carbohydrates	Proteins	Mondays: OWL due dates Fridays: Brightspace due dates
Week 14 4/25– 4/29	Proteins	Lipids	Mondays: OWL due dates Fridays: Brightspace due dates
Week 15 5/2 – 5/6	**EXAM 4** **(In-class 5/2; online 4/28-30)**	***Reading Day***	Mondays: OWL due dates Fridays: Brightspace due dates
Week 16 5/9 – 5/13	**FINAL EXAM** **(online 5/5-11)**	**FINAL EXAM** **(online 5/5-11)**	***UNAVAILABLE date for second half of OWL/Brightspace work***

Skills you should be bringing with you from your CHM 103 or CHM 101 pre-req course:

- Describe the *two* ways atoms can achieve the stability of a noble gas electron configuration: gaining / losing electrons to become ions; sharing electrons / forming covalent bonds within molecules.
- Predict the charges on metal and nonmetal ions (for the Representative elements). Explain the concept of being atoms/ions being *isoelectronic,* and the relative sizes of isoelectronic atoms/ions. Given the name of an ionic compound, provide the chemical formula. Given the chemical formula of an ionic compound, provide the name.
- Given the chemical formula of a compound, identify it as *ionic* or *molecular (covalent).*
- Predict the covalent bonding patterns (# bonds, # lone pairs) of the nonmetal atoms. Given the chemical formula of a molecular (covalent) compound, draw the Lewis structure. Determine the *electron group* and *molecular geometries* of the central atoms in Lewis structures. Use electronegativity values to determine the *polarities* of covalent bonds in Lewis structures.
- Explain the concept of *isomers* – *different* molecules that have the *same* chemical formula (for structural / constitutional isomers, the atoms are *connected* in a different order).
- Identify the inter-*particle* attractive forces that elements and/or compounds can use to interact with others of their own kind. Explain the relative strengths of these various inter-*particle* attractive forces (covalent bonds, metallic bonds, ionic bonds, hydrogen bonds, dipolar forces, IDDI/dispersion forces). Draw sketches to illustrate the "particles" interacting with one another (e.g., hydrogen bonding between molecules).
- Consider *ALL* of the factors that affect the physical state of a compound (mass, surface area, strength of inter-*particle* attractions), and then predict the states of matter and melting/boiling point behavior from chemical formulas and/or molecular structures.
- Identify the inter-*particle* attractive forces that elements and/or compounds can use to interact with *SOLVENT* molecules. Explain the *"like dissolves like"* rule for solubility, and predict the solubility of given solutes in specified solvents, based on an assessment of their chemical structure. Draw sketches to show solute "particles" and solvent molecules interacting with one another (e.g., hydrogen bonding, hydration of dissociated ions).
- Determine the oxidation *number* (oxidation *state*) of an atom in an element or compound. Identify the atoms that are being *oxidized and reduced* in a reaction (and the oxidizing and reducing *agents*). Recognize when an ion or an atom in a molecule is *"highly oxidized"* or *"highly reduced."*
- Write equilibrium constant expressions for reversible reactions: K = [products]/[reactants]. Interpret equilibrium constant values (K), in terms of the relative quantities of reactants and products at equilibrium. Use Le Chatelier's Principle to predict the effect of a change made to a system at equilibrium.
- Explain the Bronsted-Lowry and Arrhenius definitions of an acid and base. Write chemical reactions that illustrate an acid donating a proton to produce its conjugate base, and a base accepting the proton to produce its conjugate acid.
    - Specifically, write chemical reactions that illustrate an acid dissociating (ionizing) in water by donating a proton to a water molecule. And write chemical equations that illustrate a base ionizing in water by accepting a proton from a water molecule.
- Explain the terms *"strong"* and *"weak"* mean when applied to acids and bases.
    - Use equilibrium constants to compare the strength (proton-donating ability) of *weak* acids. These would be acid dissociation constants, K_a.
    - Use equilibrium constants to compare the strength (proton-accepting ability) of *weak* bases. These would be base ionization constants, K_b.
- Show/describe the self-ionization of water that occurs in every aqueous solution. Use the *Ion Product of Water* (K_w) to convert between hydroxide and hydronium ion concentrations in any aqueous solution.
- Explain the pH and pOH methods of expressing the hydronium and hydroxide ion concentrations. Use the expression derived from the *Ion Product of Water* (pH + pOH = 14) to convert between pH and pOH for any aqueous solution.
- Explain the composition and function of a *buffer*, a solution that changes pH only slightly when a small amount of strong acid or strong base is added. Use the K_a expression and value to predict the pH of a buffer made from a particular weak acid/conjugate base combination. *Most important:* $pH = pK_a$ when $[HA] = [A^-]$.

Check of Introductory/General Chemistry Pre-Requisite Skills from CHM 103/CHM 101

Consider the compounds *ethanol* and *sodium hydroxide*.

ethanol: $CH_3–CH_2–OH$ *sodium hydroxide:* NaOH

Ethanol is the alcohol in alcoholic beverages, and is produced by the fermentation of sugars by yeasts. It's also used as a solvent, an antiseptic, a fuel, and as the active fluid in modern thermometers. It is a volatile, flammable, colorless liquid, with a boiling point of 78.4 ^oC.

Sodium hydroxide, also known as lye, is a highly caustic metallic base and an alkali salt. Available in pellets, flakes, and granules, NaOH is a white solid with a melting point of 318 ^oC. You should recall that in water, NaOH is a *strong base.*

a) What type of "particles" (atoms, ions, or molecules) is each compound made of?

ethanol: _____ *sodium hydroxide:* _____

b) How are the particles in each compound interacting with one another? That is – what is the attractive force between the "particles" of ethanol? And what is attractive force between the "particles" of sodium hydroxide?

ethanol: _____ *sodium hydroxide:* _____

c) Which of these interactions is *stronger*, the attractive force between the ethanol "particles," or the attractive force between the sodium hydroxide "particles?"

_____

d) For your answer above, *explain WHY* this is the stronger attractive force. Is your answer *consistent* with the physical states of these two compounds?

e) *Illustrate your explanation* – draw a sketch that shows ethanol "particles" interacting with one another, and a sketch that shows the sodium hydroxide "particles" interacting with one another.

f) As noted above, ethanol is *volatile* (relatively low boiling point of 78.4 ^oC), and it is also *flammable*. Explain the difference between the *boiling* (volatility) and *burning* (flammability) of ethanol.

g) Write a balanced chemical equation for the combustion of ethanol. Draw Lewis structures of all reactant and products. What *type* of reaction is this, and how can you tell?

h) Ethanol is *miscible* with water, and sodium hydroxide can form a 50% w/w *saturated* solution with water. What does *miscible* mean? What does *saturated* mean?

i) Draw sketches of the ethanol and sodium hydroxide "particles" *interacting* with water molecules. Then state briefly (on the basis of their chemical structures) *WHY* you would expect both compounds to be water-soluble.

j) An aqueous solution of sodium hydroxide will conduct electricity, but an aqueous solution of ethanol cannot. Explain how your sketches above of ethanol and sodium hydroxide particles in water illustrate why aqueous sodium hydroxide is conductive, but aqueous ethanol is not.

k) As noted above, sodium hydroxide is a "*strong" base*. Explain what this means. Determine the pH of a 0.010 M solution of sodium hydroxide.