Introductory Organic Chemistry Lecture ~ CHM 124
Course Information & Syllabus ~ Spring Semester, 2019

Instructor

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Course Description

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).

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

Course Materials

- *Digital Platform:* "OWLv2: Chemistry for Today: General, Organic, and Biochemistry, Seager/Hansen, 9th Edition;" Cengage.com or URI Bookstore (6-month = $105, 24-month = $120). *Course Key:* E-FHXL6ZZ2BDNQH

Students from recent CHM 103 sections should still have access to OWLv2 and the eReader textbook. Students from CHM 101/112 should purchase 6-month access to OWLV2 and the eReader from either Cengage.com or the URI Bookstore.

For students who prefer a hardcopy textbook to an online eReader – any recent edition of the Seager general / organic / biochemistry hardcopy textbook (published within the last decade) can be used.

Another option for students taking two or more URI courses that use Cengage learning materials: *Cengage Unlimited* provides access to *all* Cengage learning materials in every subject (one term = $119.99; one year = $179.99).

- *CHM 124 Skills Practice Book:* Skills Summaries, One Page Lessons, and Practice Exam Questions; printed and bound by URI Bookstore ($20)
- *CHM 124 Sakai site:* Lecture Prep Lessons, Pre-Req Skill Checks, Announcements, Community Forum

Students are responsible for completing *all* posted Sakai Lecture Prep Lessons and Pre-Req Skill Checks, as well as carefully reading *all* Sakai Announcements and Community Forum posts.

Class Meetings

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

The most successful students in this course are those who consistently and diligently *prepare* for class, *participate* fully in each class meeting, and make a strong effort to *practice* the required skills – and thus become confident, competent and efficient at analyzing and solving organic chemistry problems.

Students should be familiar with and adhere to the *Community Standards of Behavior: University Policies and Regulations* in the *University Student Handbook.* Thus students should arrive on time to each class meeting, and remain engaged and attentive until class has concluded. Computers, tablets, and cell phones should be turned off and put away during class.

Grading and Testing Policies

Grades in CHM 124 are *earned* by achieving proficiency in (and ideally, mastery of) the skills identified as essential to ongoing success in the student's degree program. 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 is determined by the quality of the student's performance on the lecture course work items. The grade is *not* dictated by what's needed to progress in the student's chosen program of study, and it is *not* open to negotiation.

No extra credit assignments will be given (other than those available to all students in OWLv2 and/or Sakai), and students should anticipate the standard grading scale will be in effect:

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

Each student's course grade will be determined from the results of Sakai and OWLv2 online skill practice systems, four in-class exams, and the comprehensive final exam:

Sakai Pre-Req Skill Checks	5%
OWLv2 (Online Web Learning) Homework	15%
Four In-Class Exams (16% each)	64%
Comprehensive Final Exam	16%
	100%

The Final Exam score will replace the grade of any *one* of the four in-class exams that is *missed OR lower than* the final exam score; thus the final may count as much as 32% of a student's overall grade.

This grading policy is designed to assist those students who miss an exam due to injury, illness, or family need. These students are able to focus on rest and recovery, or on meeting family needs, without the additional stress of arranging for a make-up exam. It also eliminates the need for make-up tests for *any* student who is absent for *any* reason on the day of an in-class exam. There will be no make-up tests, and students who miss an exam should *not* inquire as to whether they may be given a make-up test. Students should plan to adhere to the exam schedule specified in the syllabus and course Sakai site.

Alternate testing is available for students with a documented disability. These students should contact the course instructor as early as possible in the semester to make arrangements for reasonable accommodations, as indicated by the Disability Services for Students Office (DSS).

Any alternate test arrangements – for DSS students, for students with military obligations, for those participating in university-sanctioned events or observing religious holidays – require written notification to the instructor. This should be submitted at least one full week prior to a scheduled exam.

Students can anticipate that their graded exam papers will be returned in class at least one full week after the exam date. In the interim, students should not inquire as to the status of their test papers. Exam scores will also be communicated to students at the earliest opportunity through the Sakai 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 Sakai.

CHM 124 Learning Process: 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 of in-class time.

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.

Prepare:

Invest some time getting acquainted with the concepts we'll discuss in each class *before* you come to class. That way, we can use our class time more strategically – to help you understand the new concepts and *practice* the new skills. Your preparation activities should include:

- Reviewing skills from previous classes (or previous courses) that are essential to *new* skill building – by working through the relevant pages in the *CHM 124 Skills Book*, carefully studying any posted video lessons, and completing all available *Skill Checks.*
- Staying current in practicing problems relevant to each organic functional group – by completing the OWLv2 homework assignments, and by working recommended textbook problems and questions in the *CHM 124 Skills Book*.

Participate:

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

Practice:

Since skill mastery requires extensive problem-solving practice outside of class, follow up your lecture participation by completing homework assignments.

Start with the OWLv2 homework system, as the OWL online assignments are designed to help you both *learn* and *practice* the new skills. OWL provides hints and feedback, and lets you skill-drill on a particular problem set as many as ten times before you submit the completed assignment. *Remember: more skills practice = deeper learning.*

After you finish the OWL assignments, continue your skills practice with the exam problems in the *Skills Book,* the within-chapter *Learning Checks*, and the *End-of-Chapter Exercises* in your textbook.

Your *eReader* textbook makes it convenient to work the within-chapter and end-of-chapter problems, since the solutions to the *Learning Checks* and even-numbered *End-of-Chapter Exercises* are available as pull-down menu items directly beneath the problem statement.

Continue your skills practice – and get help as needed from Dr. Graham, your Weekly Tutoring Group, a Chemistry Teaching Assistant (TA), or an Academic Enhancement Center (AEC) tutor – *right up until each of the in-class exams*.

Identify several study partners in your lecture section. In the event of an absence, make plans to immediately get copies of class notes from one (or more) of your study partners.

After you've worked the pre-lecture activities and reviewed your study partner's class notes (and the relevant portions of the *Skills Book* and textbook), bring your written list of questions to Dr. Graham's Beaupre 325D office to discuss the concepts and skills demonstrated in the missed 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: CHM 101/112 or CHM 103. You must take responsibility for reviewing those concepts as needed.

Lecture Work Items:

1. Sakai Lecture Prep Lessons with Pre-Req Skill Checks

The Sakai *Pre-Req Skill Checks* will probe your understanding of key pre-requisite skills, and push you to think more deeply about these fundamental concepts.

- Each *Skill Check* consists of a pooled set of questions – this means that a fixed number of questions will be selected at random from a larger pool each time you open the *Skill Check.* After you've completed (and received credit for) a *Skill Check,* you can re-open it nine more times, to answer a different set of questions, until you're confident you've maximized your learning, and can answer each question correctly.
- You must stay on time and on track in completing the *Skill Checks,* as each will have a *due date* corresponding to the timing of that topic in the course, and a *retract date* corresponding with an exam or other course milestone. The due dates of missed *Skill Checks* will not be extended.
- Prior to the due date, you'll have up to *ten* attempts to take and submit a *Skill Check*. Your highest score will be recorded in the Sakai Gradebook.
- After each submission, you should go to the *Skill Checks* area of Sakai to study the feedback provided: the questions, the answers you submitted, the correct answers, and an explanation of each answer. As many of the *Skill Check* questions are included in the Multiple Choice Practice Exams in the *Skills Book*, many students chose to record notes on the feedback in their *Skills Book.*
- After the due date, but before the retract date, students who have not previously attempted a missed *Skill Check* will have only *one* opportunity to take it, and that score will be recorded in the Sakai Gradebook.

Occasional Sakai *Written Reflections* provide an opportunity for you to inform Dr. Graham of the particular concepts/skills you find challenging, as well as your learning strategies or plans for skills practice, so you can meet the challenge and master each skill. Each carefully written and submitted *Assignment* will add to your Sakai % score.

The Sakai *Community Forum* provides a way for you to post and discuss your work on organic chemistry concepts/skills with your CHM 124 classmates and with Dr. Graham. *Community Forum* posts that share worked solutions and/or discuss problem-solving strategies will also add to your Sakai % score.

Each student's Sakai % score is then the ratio: total points the student has earned in Sakai *(Skills Check + Written Reflection + Forum Contributions)* / the number of *Skills Check* points it's possible to earn.

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 your 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 may mean working some of the more challenging Mastery questions several times, to draw new questions from the pool and get additional skills practice. You'll want 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.

Since this homework is intended as a key part of your learning and skills practice, the assignments can be worked in student study groups and/or with help from a tutor.

You must stay on track and on time with your OWL homework, as each 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).

As long as you've started an assignment prior to the its date, you can continue working on that assignment until the unavailable date; however a 10% late penalty will apply. 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.

Each student's OWL% score is then the ratio: total points earned *(required + extra credit)* / the number of *required* points it's possible to earn.

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 assignments immediately, so you'll have time to build proficiency and get help if needed.

Finally – you should always make a practice of drawing the molecular structures on paper first, and then attempting to draw the structures in OWL.

3. Lecture Exams and Comprehensive Final Exam

Lecture exams are likely to have a variety of question types, including multiple-choice, short-answer, structure drawing, problem solving, and essay.

Exam questions will come directly from the content presented and discussed in both class and the course Sakai site. Exam questions likely to be similar to the Skill Check questions in Sakai, the problems in the OWL online study system, the recommended problems in the Seager textbook, and the practice exam questions in your *Skills Book.*

Students should commit to working as many of these problems as possible as practice for the exams. The goal is to become confident, competent and efficient at analyzing and solving problems. The students who get the *most* practice solving problems tend to have the greatest success in science and math courses.

The Final Exam will consist of 100 multiple-choice questions, and will be scantron-graded.

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 always additional 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 provide 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 new 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 in your CHM 124 Sakai site. 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 Sakai and/or email.***

My class/meeting and office hours 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 Sakai *Community Forum,* 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, a Teaching Assistant, or 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 particular 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.

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 Tisdale (jtisdale@uri.edu) in the Dean of Students Office for support. If you're comfortable doing so, please also notify Dr. Graham, as this will enable her to provide any resources that she may possess.

Illness Due to Flu

URI advises any student who develops flu-like symptoms to stay home until fever has subsided for 24 hours. If you exhibit such symptoms, please do *NOT* come to class, but please work to stay current in your studies – via the Sakai Lessons, the *Skills Practice Book,* and the OWLv2 online homework system.

The Centers for Disease Control and Prevention have recommended simple methods to avoid transmission of illness. *These include:* covering your mouth and nose with tissue when coughing or sneezing; frequently washing/sanitizing your hands; avoiding touching your eyes, nose, and mouth; and staying home when you are sick.

For more information, please view the CDC Flu website: http://www.cdc.gov/flu/.

Important Spring Semester Deadlines

- *Last day of e-Campus open add period:* Tuesday, January 29th
- *Last day of e-Campus add with permission number:* Tuesday, February 5th
- *Last day for students to drop courses via e-Campus with no transcript designation:* Wednesday, February 13th
- *Last day for students to drop courses via e-Campus (with W designated on transcript):* Wednesday, March 6th
- *Mid-term progress reports posted in e-Campus:* Monday, March 18th

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 Exam and Class Schedule ~ Spring 2019

Week #	***MONDAY***	***WEDNESDAY***
1	**1/21:** *Martin Luther King, Jr. Day*	**1/23:** *Course Information* *Ch 11:* Organic Compounds: Alkanes
2	**1/28:** *Ch 11:* Organic Compounds: Alkanes *Ch 12:* Unsaturated Hydrocarbons	**1/30:** *Ch 11:* Organic Compounds: Alkanes *Ch 12:* Unsaturated Hydrocarbons
3	**2/4:** *Ch 12:* Unsaturated Hydrocarbons	**2/6:** ***EXAM 1***
4	**2/11:** *Ch 12:* Unsaturated Hydrocarbons	**2/13:** *Ch 13:* Alcohols, Phenols, Ethers, Thiols
5	**2/18:** *Ch 13:* Alcohols, Phenols, Ethers, Thiols	**2/20:** *Ch 13:* Alcohols, Phenols, Ethers, Thiols *Ch 14:* Aldehydes and Ketones
6	**2/25:** *Ch 14:* Aldehydes and Ketones	**2/27:** ***EXAM 2***
7	**3/4:** *Ch 14:* Aldehydes and Ketones	**3/6:** *Ch 15:* Carboxylic Acids and their Derivatives
9	**3/11:** ***Spring Break***	**3/13:** ***Spring Break***
8	**3/18:** *Ch 15:* Carboxylic Acids and their Derivatives *Midterm Progress Reports*	**3/20:** *Ch 15:* Carboxylic Acids and their Derivatives
10	**3/25:** *Ch 15:* Carboxylic Acids and their Derivatives *Ch 16:* Amines and Amides	**3/27:** *Ch 16:* Amines and Amides
11	**4/1:** *Ch 16:* Amines and Amides	**4/3:** ***EXAM 3***
12	**4/8:** *Ch 17:* Carbohydrates	**4/10:** *Ch 17:* Carbohydrates
13	**4/15:** *Ch 17:* Carbohydrates	**4/17:** *Ch 19:* Proteins
14	**4/22:** *Ch 19:* Proteins	**4/24:** *Ch 18:* Lipids
15	**4/29:** ***EXAM 4*** *Last Day of Class*	**5/1:** ***Reading Day***
16	**5/6:**	**5/8:** ***FINAL EXAM*** **3:00 – 6:00 PM in Beaupre Center 100**

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. 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).
- 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.
- 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 ^{o}C.

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 ^{o}C. 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 ^{o}C), 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.