CH 111 – Introduction to Chemical Principles 4 credits
MW 12:00-13:20, F 12:00-12:50 CRN:12139

1 Vital Info

Instructor – Mark Lonergan (Professor)

Assistant – Ethan Walker (graduate teaching fellow)

Description (from catalog) – Chemical concepts for students in health care, biological applications, and environmental studies. Topics include atomic structure, solutions, acids, bases, stoichiometry, equilibrium, biomolecules, and organic functional groups. Lecture, demonstration.

Flipped Fridays – The first seven Friday classes of the term will be flipped. You will watch an online presentation and answer questions on blackboard BEFORE coming to class. In class, you will work in groups to solve problems based on the online material.

Assessment Wednesdays – Every Wednesday except for the first and the day before Thanksgiving, there will be an in-class quiz or exam. There will also be an exam on the Monday before Thanksgiving (see schedule).

Office Hours – Room 107 Klamath Hall. Mark: M 4pm, W 8am, and F 1pm. Ethan: Tu noon and 4 pm.

Prerequisite – MATH 95. I will expect that you are proficient with logarithms, exponents, scientific notation, fractions and solving simple algebraic equations.

Textbook – The course will use a *subset* of the chapters from the 6th edition of McMurry, Castellion, Balantine, Hoeger, and Peterson, Fundamentals of General, Organic, and Biological Chemistry. There are at least two options by which you can acquire this material:

1. Purchase the chapters as a customized text (ISBN: 1256338869) available both new and used only at the University bookstore. I will use this customized text in the future so you should be able to sell it back to the bookstore at the end of the term. Note that new texts come with Mastering Chemistry an online tutorial and homework system, but this is NOT required for the course.
2. Purchase the entire book (**6th edition**, ISBN: 0136054501), new or used, from a book seller.

Additional Required Materials – i>clicker**2** and a basic scientific calculator. See below for more detail.

2 Communication and Blackboard

This course will use the blackboard course management system (blackboard.uoregon.edu). If you need to communicate with Mark or Ethan, use the appropriate email link on the blackboard site (these links helps us sort emails so that we can be more responsive). Lecture notes, exam results, and other course materials will be posted to the blackboard site. **All email communication regarding the course will go to your uoregon account. Please check this regularly.**

3 Student expectations

I expect that students in this class will treat others with respect, and be engaged in (see study guide) and take responsibility for their own education. I also expect that students will abide by the Student Conduct Code.

4 Assessment

Grading Scale – Grades will be assigned on the following scale (pluses and minuses will be assigned within these ranges based primarily on examination, not quiz or extra credit, scores).

$\geq 90\%$	A	80%-89%	B	67%-79%	C	55%-66%	D	$\leq 54\%$	F

Graded elements and weighting:

Item	
Unit 1/2 Exam	20%
Unit 3/4 Exam	20%
Comprehensive Final	40%
Quizzes (Highest 5 scores)	20%

In Class Exams and Quizzes (see schedule) – Every Wednesday except for the first and the Wednesday before Thanksgiving, there will be a quiz or exam. In addition, there will be a comprehensive final at the end of the term. Your quiz score will be based on the highest five scores out of seven quizzes. Make-up or early exams/quizzes will not be given. Notify Professor Lonergan as soon as possible if you will miss an exam or quiz due to an authorized and unavoidable University event.

Homework – Not directly graded, but many exam and quiz questions will follow closely from the homework.

Extra Credit – *Non-flipped classes* – You can earn up to 1.5 percentage points of extra credit toward your final grade through i>clicker2 participation. Participation will be graded on the fraction of clicker questions you respond to beginning the second week of the class. Your lowest two days of clicker scores will be dropped. *Friday flipped classes* – You can earn up to 1.5 percentage points of extra credit toward your final grade based on activities related to flipped Friday classes. Extra credit will be based on the number of correct responses to blackboard homework questions and in-class clicker questions. Your lowest week score will be dropped.

Core Concepts: Alternate Grading for C-/P – Certain questions on assessments will cover a *single* core concept aligned to a learning objective (see Study Guide). These questions will follow closely from homework problems or questions you have seen before in other quizzes, exams, or in-class clicker questions. If you score 67% or greater on these question, you will be guaranteed a passing grade of C- or P.

5 Course policies and procedures

Academic Honesty – Academic dishonesty in any form will not be tolerated. All work submitted in this course must be your own and produced exclusively for this course. Any incident of academic dishonesty will result in an automatic failure (grade of F) for the course and be noted in student disciplinary records. Additional sanctions may be imposed as described in the Student Conduct Code.

Accessible Education – Any student with a documented disability, who may anticipate needing accommodations in this course, should arrange to meet with Mark during the first week of class. Please request that a counselor at the Office of Accessible Education send a letter verifying the disability. The testing center fills up quickly so requests need to be submitted early in the term.

Calculator policy – An *simple*, *inexpensive* scientific calculator is required for use during exams/quizzes. The calculator should be capable of square roots, logarithms, scientific notation operations, and have a y^x key. You may **NOT** use calculators that can be programmed, communicate with other devices, store text, produce graphs, or that make noise. Examples of acceptable calculators are the Texas Instruments TI-30Xa, Casio FX-260, Sharp EL-501WBBK (all are under $15). Violation of the calculator policy will result in academic sanctions.

Computers In Class – Students wishing to use a computer during class are asked to sit in the upper section above the railing to minimize distraction to other students.

Tutoring – The Department of Chemistry provides contact information for private tutors. For more information, visit the Chemistry office in room 91 Klamath Hall.

Exam/quiz policies and procedures Scratch paper and exam/quiz sheets will be provided. You are required to bring the following to each exam/quiz: No. 2 pencils with eraser, approved calculator (see section above), i>clicker2 and student identification card. These cards may be checked at anytime during the exam/quiz or when you turn in your exam/quiz. Note the following policies regarding exams and quizzes.

1. YOU WILL BE PENALIZED 10% IF YOU DO NOT HAVE A **BLACKBOARD REGISTERED** i>clicker2 TO RECORD YOUR ANSWERS
2. All exams/quizzes are closed book/closed note.
3. You may not receive assistance from others during the examination.
4. Once an exam begins, you will not be allowed to leave until you have submitted your exam for grading (if this presents a problem please notify the instructor in advance).
5. Seats will be assigned. You are required to sit in the seat matching the number on your exam/quiz. Please ask when receiving your exam if you need a left-handed seat.
6. Baseball caps or brimmed hats must be removed or turned backwards.
7. Wireless communication devices, including cellphones, must be turned off.
8. Headphones and unauthorized earpieces must be removed.
9. All personal materials must be put away under your seat.

Classroom response system: i>clicker2 and BLACKBOARD registration – The course will use i>clicker2s, which are available at the UO bookstore. To register your i>clicker2, follow the link titles "Register your i>clicker2" on the sidebar of the blackboard site. **IMPORTANT:**

- your i>clicker2 is registered using your Duck ID, NOT your student ID number. The Duck ID should autofill in the blackboard registration form. Registering connects your i>clicker2 ID to your Duck ID. As this connection is available to all courses using blackboard registration, you only need to register your i> clicker2 once during a term.
- REGISTERING ON THE i>clicker2 WEBSITE (www.iclicker.com) IS NOT BLACKBOARD REGISTRATION AND IS THE WRONG PLACE TO REGISTER YOUR i>clicker2.

6 Homework and Vocabulary – How to succeed in this course!

Homework – Working problems is the best way to learn chemistry. It is essential that you diligently complete the assigned problems and *critically* evaluate your own performance using the answer keys that will be provided. Use office hours to get help!

If you have trouble with a particular problem, work similar problems. The problems in the book are well organized so that closely related problems can generally be found. *Students that do well on tests are generally able to solve the homework problems in random order (so there is not context to guide problem solving) and without referring to the text, notes, or asking for assistance in any way (mimicking the test environment).*

Vocabulary – Chemistry can be like learning a new language and so vocabulary is important. At the end of each chapter in a sidebar next to the summary, there are lists of key words that you should be able to define.

Chemistry is a cumulative topic. Start studying now. DO NOT FALL BEHIND!

Approximate Course Schedule (Exam and quiz dates are firm)

Note special review dates before exams.

week	date	topic
Week 1		*Unit 1: Chemistry's Building Blocks.*
	9/29	1. What is chemistry? The atom and the elements.
	10/01	2. Physical quantities and Significant Figures
	10/03	3. Calculation and conversions (flipped).
Week 2	10/6	4. Matter and Chemical Compounds
	10/8	5. Periodic Table. **Quiz 1**
	10/10	6. Electronic structure of the Atom (flipped).
Week 3	10/13	7. Electron configuration and the Periodic Table.
		Unit 2: Holding it together. Chemical compounds
	10/15	8. Ion formation and Ionic bonds. **Quiz 2**
	10/17	9. Ionic charges and compounds (flipped).
Week 4	10/20	10. Molecules and Covalent Compounds
	10/22	11. Drawing Lewis structures. **Quiz 3**
	10/24	12. Shapes of Molecules (VSEPR) and Naming (flipped)
Week 5	10/27	TBA
	10/29	**Unit 1/2 Exam (Review: Tu 10/28, 7pm, 123 Pac)**
		Unit 3: Transformations. Chemical Reactions
	11/31	13. Chemical Equations (flipped)
Week 6	11/3	14. The Mole & Mass/number Relationships.
	11/5	15. Mass/Number Relations and Chemical Reactions (Stoichiometry)**Quiz 4**
	11/7	16. Spontaneity and Reactions (flipped).
Week 7	11/10	17. Rates of Chemical Reactions.
	11/12	18. Chemical Equilibrium. **Quiz 5**
		Unit 4: Chemistry in Water. Solutions.
	11/14	19. Intermolecular Forces and Solutions (flipped).
Week 8	11/17	20. Concentration and Dilution of Solutions
	11/19	21. Acids and Bases **Quiz 6**
	11/21	22. Acid Strength
Week 9	11/24	**Unit 3/4 Exam (Review: Su 11/23, 7pm, 123 Pac.)**
	11/26	23. pH
	11/28	Thanksgiving Holiday - No Class
Week 10		*Unit 5: Molecules of Life. Organic Compounds.*
	12/1	24. Organic Compounds and Functional Groups.
	12/3	25. Drawing and Naming Organic Compounds **Quiz 7**
	12/5	26. TBA
	12/10	**Compreshensive Final, Wednesday @ 10:15a**

See study guide for homework and reading assignments.

CH111: Study Guide Including Assigned Homework and Reading – 2014

1 How to succeed in this course

Come to class. Be engaged. The UO recommends students engage in 120 hrs of activities (10-11 hrs/wk) for this 4 credit course. Table 1 shows a recommended student engagement inventory.

Do not fall behind on the assigned reading and homework problems. The assigned reading and homework for a given topic (see below) should ideally be completed before we move to the next topic in lecture. Sometimes scheduling will prohibit this, but it is a good goal to strive for. The material in this class is cumulative, and if you fall behind, it is difficult to catch up.

Working problems is the best way to learn chemistry. Since many quiz and exam problems will follow from the homework, it is also an excellent way to assure success on these assessments. You must *critically* evaluate your performance using the answer keys provided. If you have trouble with a problem, work similar ones. The problems in the book are well organized so that closely related problems can generally be found. *Students that do well on tests are generally able to solve the homework problems in random order (so there is not context to guide problem solving) and without referring to the text, notes, or asking for assistance in any way (mimicking the test environment).*

Come to office hours. Office hours provide a great venue for working problems in smaller groups or to get help on specific topics. You can also schedule an individual appointment.

Learn the language of chemistry In the sidebar next to the summary at the end of each chapter, there is a list of key words that you should be able to define.

Table 1: Weekly student engagement inventory

Activity	Hours	Comments
On-line lectures	0.5	Part of Flipped Fridays
Course attendance	4	Including assessment (quizzes and exams)
Assigned reading	2	Every sentence of a science textbook must be carefully considered for full comprehension (don't forget the examples)
Working problems	4	Key to success!

2 Assigned Reading, Homework and Learning Objectives

The overall objectives of this course are for students to be able to: (1) describe matter and transformations of matter at an atomic level, (2) use representations and models to describe, understand and predict chemical phenomena, and (3) solve quantitative problems. Specific learning objectives for the course are listed on the following pages along with the assigned reading and homework. It is essential that you keep up with reading and assigned homework. Chemistry is a cumulative subject. It is very hard to catch up if you fall too far behind. A couple of notes on the list:

- Problems marked with a * have a related companion problem (also with answer in the back of the book). Depending on chapter, these companion problems are either immediately before or after the assigned problem.
- Each learning objective lists problems associated with it and some appear more than once.

Unit: I. Chemistry's Building Blocks

1. The Atom and the Elements

Reading: Sections 3.1-3.3 (7 pages)

Homework: 3.36, 3.37, 3.44, 3.45, 3.47*, 3.49*, 3.50, 3.55*

Objectives: 1.1. State modern atomic theory (3.36).

1.2. Describe the composition of an atom in terms of subatomic particles (3.44, 3.45).

1.3. Describe how atoms of one element are different or the same as atoms of another element (3.37, 3.47*).

1.4. Describe how atoms of isotopes of a given element differ (3.50).

1.5. Create and use element symbols ${}^{A}_{Z}\mathrm{X}$ to determine/represent the number of electrons, protons, and neutrons in an atom (3.49*, 3.55*).

---

2. Physical Quantities and Significant Figures

Reading: Sections 2.1-2.6 and 2.9-2.12 (18 pages)

Homework: 2.3, 2.34, 2.43*, 2.44, 2.45, 2.47*, 2.49*, 2.50, 2.51, 2.54, 2.65*, 2.73*, 2.75*

Objectives: 2.1. Use scientific notation (2.44, 2.45).

2.2. Explain the difference between a physical quantity and a number (2.34).

2.3. Be able to convert between the Farenheit (°F), Celcius (°C) and Kelvin (K) temperature scales if given the formula relating Celcius and Farenheit (2.65*).

2.4. Calculate density and use it to interrelate mass and volume (2.73*, 2.75*).

2.5. Know select SI system prefixes, use them in representing very large or small physical quantities, and interconvert between them (2.3, 2.43*, 2.54).

2.6. Express the precision of a measurement using significant figures and determine which figures in a physical quantity are significant (2.47*, 2.49*).

2.7. Determine significant figures in adding, subtracting, multiplying or dividing physical quantities (2.50, 2.51).

---

3. Calculations and Conversions

Reading: Sections 2.7-2.8 (5 pages)

Homework: 2.12, 2.13, 2.52, 2.53, 2.57*, 2.59, 3.41*

Objectives: 3.1. Write conversion factors from equivalences (2.12).

3.2. Use conversion factors to convert a physical quantity from unit to another including multistep conversions and units raised to powers (2.13, 2.52, 2.53, 2.57*, 2.59, 3.41*).

3.3. Cancel units like factors (same as last item).

---

4. Matter and Chemical Compounds

Reading: Sections 1.2-1.6 (9 pages)

Homework: 1.6,1.9, 1.19*, 1.20, 1.23*, 1.25*, 1.27*, 1.29*, 1.41*, 1.45, 1.55

Objectives: 4.1. Define matter and explain its composition in terms of atoms.

4.2. Define a bond.

4.3. Define a chemical compound.

4.4. Explain the difference between the way atoms are connected in a molecule versus an extended solid.

4.5. Define solid, liquid, and gas, including the arrangement and movement of atoms or molecules in each, and the terms melting and boiling points (1.20, 1.23*).

4.6. Use chemical formulas to express the atomic composition of chemical compounds (1.9, 1.41, 1.45).

4.7. Understand how chemical equations represent chemical reactions including identifying reactants and products (1.29*).

4.8. Classify changes or properties as physical or chemical (1.6, 1.19*, 1.55).

4.9. Classify matter as mixtures, pure substances, compounds, or elements and describe how the atoms and/or molecules are arranged or bonded in each (1.25*, 1.27*).

---

5. Periodic Table

Reading: Sections 3.3-3.5 (6 pages)

Homework: 3.32, 3.59*, 3.63*, 3.67*, 3.69*, 3.70, 3.71, 3.96, 3.103

Objectives: 5.1. Define a group or period of the periodic table.

5.2. Describe how the properties of the elements are reflected in the organization of the periodic table (3.32, 3.69*).

5.3. Identify on the periodic table main group elements, transition metals, metals, nonmetals, metalloids, alkali metals, halogens, and noble gases (3.63*, 3.67*, 3.70, 3.71, 3.96).

5.4. Differentiate a metal from a nonmetal based on its properties (3.32).

5.5. Describe the difference between atomic mass and atomic weight.

5.6. Calculate the atomic weight of an element from its isotope distribution (3.59*, 3.103).

---

6. Electronic Structure of the Atom.

Reading: Sections 3.6-3.7 (7 pages)

Homework: 3.20, 3.22, 3.30, 3.72, 3.73, 3.74, 3.75, 3.76, 3.77, 3.79*, 3.83

Objectives: 6.1. Define an orbital and how many electrons it holds (3.72).

6.2. Describe the organization of orbitals into shells and subshells including the numbers and types of orbitals in each (3.75, 3.76, 3.77).

6.3. Describe the shapes of the s-, p- and d-orbitals and how their size changes with shell number (3.30) .

6.4. Determine the number of electrons each shell and subshell can hold (3.74, 3.77, 3.79*).

6.5. Write orbital filling diagrams and the electron configuration of an atoms (3.20, 3.22, 3.83).

---

7. Electron Configuration and The Periodic Table

Reading: Sections 3.8-3.9 (5 pages)

Homework: 3.33, 3.80, 3.85*, 3.87, 3.88, 3.89, 3.108,

Objectives: 7.1. Explain how the electronic structure of the atom determines the shape of the periodic table (i.e. use your knowledge of electron configuration to draw the organization of "boxes" in the periodic table) (3.33).

7.2. Use knowledge of atomic structure to explain periodic trends in atomic radii.

7.3. Identify s-block, p-block, and d-block element and explain what about their electron configuration leads to this assignment.

7.4. Determine the valence electron configuration of an element (3.80, 3.85*, 3.87, 3.89).

7.5. Draw dot structures of the main group elements (3.85, 3.88).

Unit: II. Holding it Together: Chemical Compounds

8. Ion Formation and Ionic Bonds

Reading: Sections 4.1-4.6 (10 pages)

Homework: 4.8, 4.31, 4.32, 4.40, 4.42, 4.44, 4.45, 4.47*, 4.48, 4.50, 4.64, 4.78

Objectives: 8.1. Describe the difference between an ionic and covalent bond.

8.2. Define ion, cation, and anion.

8.3. Write chemical equations for the formation of ions from neutral atoms and determine the ions charge from the number of electrons added or removed (4.40, 4.42, 4.47*).

8.4. Explain why combining a metal with a nonmetal forms an ionic compound.

8.5. Identify groups of the periodic table that form anions or cations and elements that form more than one type of cation (4.31).

8.6. Write the electron configuration of an ion (4.50).

8.7. Explain the octet rule (4.44, 4.45).

8.8. For main group elements that form ions, predict their charge using the octet rule (4.8, 4.32, 4.42, 4.48).

8.9. Recognize polyatomic ions (you will be given Table 4.3 on assessments) (4.64).

8.10. Name and write the chemical formula of the ions that acids and bases form in water (4.78).

---

9. Ionic Compounds

Reading: Sections 4.7-4.11 (10 pages)

Homework: 4.36, 4.43, 4.60, 4.64, 4.71*, 4.73*, 4.77, 4.96, 4.98, 5.38

Objectives: 9.1. List some distinguishing properties of ionic compounds (4.43, 5.49 on later assignment).

9.2. Explain why the combination of a metal with a nonmetal forms an ionic compound.

9.3. Recognize an ionic compound from its chemical formula (5.38).

9.4. For main group elements that form ions, predict the chemical formula for ionic compounds formed from the reaction of a metal with a nonmetal (4.36, 4.98).

9.5. Write the chemical formula for ionic compounds formed from a particular cation and anion, including polyatomic ions (4.71*, 4.77, 4.96).

9.6. Name ions and ionic compounds (4.60, 4.73*).

---

10. Molecules and Covalent Compounds

Reading: Sections 5.1-5.5 (10 pages)

Homework: 5.1, 5.2, 5.4, 5.27, 5.37, 5.40,5.41, 5.49, 5.50, 5.51

Objectives:

10.1. Describe a covalent compound including the types of elements that form them (5.37).

10.2. Describe the difference between covalent and ionic compounds and the difference between a molecule and an extended solid (5.27, 5.49).

10.3. Describe and predict covalent bond formation in molecules using the octet rule and electron dot structures (5.2, 5.4, 5.40, 5.41).

10.4. Explain why certain elements exist as diatomics and use the octet rule to predict whether they have a single, double or triple bond (5.1).

10.5. Define a lone pair.

10.6. Determine the number of valence electrons in molecules and polyatomic ions (5.50).

10.7. Identify correct Lewis structures (5.51).

---

11. Drawing Lewis Structures

Reading: 5.5-5.6 (5 pages)

Problems: 5.48, 5.54, 5.59*, 5.61*, 5.65*, 5.67*

Objectives:

11.1. Use dot structures to predict the number of bonds nonmetal elements from the first and second row and the halogens will form (common bonding rules), and use this in drawing structural formula and Lewis structures (5.61).

11.2. Draw Lewis structures of molecules (5.59*, 5.65*).

11.3. Draw Lewis structures of polyatomic ions (5.67*).

11.4. Given one of chemical formula, structural formula, condensed structure, or Lewis structure, write the others (5.48, 5.54)

---

12. Shapes of Molecules (VSEPR) and Naming

Reading: 5.7 and 5.9 (6 pages)

Problems: 5.69, 5.70, 5.71, 5.72, 5.73, 5.87*, 5.89*

Objectives:

12.1. Use VSEPR to predict the molecular geometry about a central atom (5.69, 5.70, 5.72, 5.73*).

12.2. Draw common molecular geometries (5.71).

12.3. Name binary molecular compounds (5.87*, 5.89*).

Unit: III. Transformations: Chemical Reactions

13. Chemical Equations

Reading: 6.1-6.3 (9 pages)

Problems: 6.2, 6.28, 6.29, 6.37, 6.38, 6.42

Objectives:

13.1. Use the principle of conservation of mass to explain why chemical equations must be balanced (6.28)

13.2. Explain the difference between the coefficients of chemical equations and the subscripts in chemical formulae (6.29, 6.37)

13.3. Write balanced chemical equations that show chemical transformations and include phase labels (6.2, 6.38, 6.42)

13.4. Use the coefficients of chemical equations to determine the ratios in which chemical compounds or elements combine.

---

14. The Mole and Mass/Number Relationships

Reading: 6.4-6.5 (4 pages)

Problems: 6.12, 6.45, 6.47*, 6.49, 6.50, 6.54, 6.55, 6.57, 6.58, 6.60, 6.63, 6.100

Objectives:

14.1. Define a mole (6.45, 6.47*).

14.2. Know why Avogadro's number is 6.022×10^{23} (3.41* (from earlier assignment)).

14.3. Calculate the molar mass of elements or compounds and interconvert between moles, mass and the number of molecules, atoms, or formula units (6.49, 6.50, 6.54, 6.55, 6.57, 6.58, 6.60, 6.100)

14.4. Use the coefficients of a chemical equation to calculate the moles of a reactant or product needed to produce or consume a certain number of moles of a different reactant or product (6.12, 6.63)

---

15. Mass Number Relations and Chemical Reactions (Stoichiometry)

Reading: 6.6-6.7 (5 pages)

Problems: 6.14, 6.15, 6.64, 6.66, 6.67, 6.68, 6.69

Objectives:

15.1. Calculate the the amount (in moles, numbers, or mass) of a reactant or product needed to produce or consume a certain amount (in moles, numbers or mass) of a different reactant or product (6.14, 6.15, 6.64, 6.66, 6.67, 6.68, 6.69)

---

16. Spontaneity and Reactions

Reading: 7.1-7.4 (10 pages)

Problems: 7.1, 7.6, 7.18, 7.19, 7.26, 7.29*, 7.31*, 7.33, 7.34, 7.37, 7.38, 7.40

Objectives:

16.1. Define a spontaneous process.

16.2. Define entropy and predict whether a chemical reaction proceeds with an increase or decrease in entropy or equivalently a positive or negative ΔS (7.18, 7.19, 7.31*, 7.38).

16.3. Define enthalpy change ΔH and identify a reaction as exothermic or endothermic, or equivalently with $\Delta H < 0$ or $\Delta H > 0$, based on whether heat is released or absorbed (7.1, 7.26, 7.29*, 7.38).

16.4. Use the ΔH of a chemical reaction to calculate the amount of heat released or absorbed in reacting a given amount (mass or moles) of a chemical compound (7.26, 7.29*).

16.5. Describe how ΔH and ΔS contribute to the spontaneity of a chemical reaction (7.18, 7.19, 7.34, 7.37, 7.38).

16.6. Calculate and use the free energy change ΔG to predict whether a reaction will be spontaneous or not, including as a function of temperature (7.6, 7.33, 7.40).

---

17. Rates of Chemical Reactions

Reading: 7.5-7.6 (4 pages)

Problems: 7.8, 7.9, 7.10, 7.44, 7.46, 7.47, 7.48, 7.50, 7.51

Objectives:

17.1. Define activation energy E_{act}.

17.2. Describe the difference between spontaneity and the rate of a chemical reaction (7.50, 7.51).

17.3. Sketch and interpret reaction energy diagrams including how they are affected by ΔG and E_{act} (7.8, 7.9, 7.44)

17.4. Describe how temperature, activation energy, and contact between reactants (e.g. concentration) affect the rate of a chemical reaction and explain in terms of an atomic-level picture of a chemical reaction (7.10, 7.46, 7.47).

17.5. Describe how a catalyst affects the rate of a chemical reaction and explain in terms of reaction energy diagrams and an atomic-level picture of a chemical reaction (7.10, 7.48)

---

18. Chemical Equilibrium

Reading: 7.7-7.9 (10 pages)

Problems: 7.11, 7.12, 7.13, 7.52, 7.55*, 7.57*,

Objectives:

18.1. Explain the concept of equilibrium for a reversible chemical reaction including its dynamic nature (7.52).

18.2. Write the equilibrium constant expression for a chemical equilibrium and calculate it based on equilibrium concentrations (7.11, 7.13, 7.55*, 7.57*).

18.3. Use the equilibrium constant to predict whether the reactants or products are favored in a chemical equilibrium (7.12, 7.55).

Unit: IV. Chemistry in Water. Solutions

19. Intermolecular Forces and Solutions

Reading: 5.8-5.9, 8.11, 9.1-9.2 (16 pages)

Problems: 5.77*, 5.79*, 5.85*, 8.18, 8.20, 8.90, 8.116, 9.40, 9.42, 9.43

Objectives:

19.1. Describe the forces that hold molecules together, their relative strength, and their relation to molecular structure (8.18, 8.20, 8.90, 8.116).

19.2. Relate the strength of intermolecular forces to boiling point (8.18, 8.116).

19.3. Describe a polar covalent bond.

19.4. Define electronegativity and how it changes across the periodic table (5.77*).

19.5. Use electronegativity difference to predict whether a bond is covalent, polar covalent, or ionic (5.79*).

19.6. Based on electronegativity and molecular structure, predict whether or not a molecule is polar (5.85*).

19.7. Identify solutions (9.42).

19.8. Use knowledge of intermolecular forces to predict or rationalize solution formation (9.40, 9.43).

---

20. Concentration and Dilution of Solutions

Reading: 9.7-9.9 (12 pages)

Problems: 9.8, 9.9, 9.11, 9.36, 9.52, 9.66, 9.72, 9.73, 9.80

Objectives:

20.1. Define solute, solvent, and solution

20.2. Define and calculate molarity (9.8, 9.52).

20.3. Use molarity to interconvert amount (moles or grams) of solute and liters of solution (9.9, 9.11, 9.66, 9.80).

20.4. Relate the molarity of solutions resulting from dilution (9.36, 9.72, 9.73).

---

21. Acids and Bases

Reading: 10.1-10.4 (8 pages)

Problems: 10.32, 10.38, 10.40, 10.47, 10.48, 10.49, 10.53

Objectives:

21.1. Define Arrhenius acids and bases and write the chemical equation for an Arrhenius acid or base reacting with water (10.38, 10.40).

21.2. Define Brønsted-Lowry acids and bases and use this definition to identify the acids and bases in an acid base reaction (10.32, 10.47, 10.53).

21.3. Identify conjugate acid/base pairs in an acid/base reaction (10.47, 10.48, 10.49, 10.53,).

21.4. Identify common acids or bases based on their chemical equation.

---

22. Acid Strength

Reading: 10.5-10.7 (5 pages)

Problems: 10.5, 10.35, 10.44, 10.50, 10.51, 10.54, 10.56, 10.61, 10.62

Objectives:

22.1. Write the acid dissociation reaction for the reaction of water with an acid.

22.2. Explain the difference between a strong and weak acid (10.35).

22.3. Use Table 10.1 to classify the relative strength of acids or bases (10.44, 10.62)

22.4. Write the expression for the acid dissociation constant K_a for an acid (10.54).

22.5. Use K_a to classify the strength of acids (10.61).

22.6. Use values of K_a to predict which side of an acid/base equilibrium is favored (10.51).

22.7. Define amphoteric and recognize water acting as an acid or a base in chemical reactions (10.5, 10.50).

22.8. Write the expression for the ion-product constant K_w of water and use it to explain how concentration of H_3O^+ ($[H_3O^+]$) and concentration of OH^- ($[OH^-]$)in water are related (10.56).

---

23. pH

Reading: 10.8-10.10 (6 pages)

Problems: 10.11, 10.12, 10.16, 10.63, 10.70, 10.71, 10.72, 10.110

Objectives:

23.1. Classify solutions as acidic, basic or neutral based on $[H_3O^+]$, $[OH^-]$, pH or pOH (10.11, 10.16, 10.63).

23.2. Use the ion-product constant of water and the definition of the p-function to interrelate $[H_3O^+]$, $[OH^-]$, pH and pOH in water (10.12, 10.70, 10.71, 10.72, 10.110).

Unit: V. Molecules of Life: Organic Compounds

24. Organic Compounds and Functional Groups

Reading: 12.1-12.3 (10 pages)

Problems: 12.4, 12.22, 12.26, 12.33*, 12.35*, 12.37, 12.45*, 12.47*

Objectives:

24.1. Define organic compound (12.26).

24.2. Define hydrocarbon.

24.3. Define isomer (12.37).

24.4. Identify and draw structural formula that correspond to the same compound, different compounds, or constitutional isomers (12.4, 12.45*, 12.47*)

24.5. Recognize the functional groups characteristic of alkanes, alkenes, aromatics, alcohols, amines, and carboxylic acids. Others if provided Table 12.1 (12.22, 12.33*, 12.35*).

---

25. Drawing and Naming Organic Compounds

Reading: 12.4-12.5 (15 pages)

Problems: 12.6, 12.20, 12.21, 12.43, 12.50, 12.53, 12.56

Objectives:

25.1. Use common bonding rules and octet rule to add hydrogens to the carbons of an organic structure that omits them (12.19).

25.2. Structural formula, condensed structure, line structure: given one, draw the others (12.6, 12.20, 12.21,12.43).

25.3. Name an alkane based on its structure and vice versa (12.50, 12.53*, 12.56)
