**CHEM 1312 - Lower Division AGCM Spring 2012 Course Description**

Chemical equilibrium; phase diagrams and spectrometry; acid-base concepts; thermodynamics; kinetics; electrochemistry; nuclear chemistry; an introduction to organic chemistry and descriptive inorganic chemistry.

*(http://www.thecb.state.tx.us/aar/undergraduateed/workforceed/acgm.htm)*

**University of North Texas Course Description**

This is the second of two-course sequence in General Chemistry.

Thermodynamics, reaction rates, equilibrium, electrochemistry, organic chemistry, polymers, radioactivity and nuclear reactions.

*(CHEM 1420: General Chemistry II course description from the 2011-12 University of North Texas Course Catalog)*

**Hours of Credit**: Three (3)

**Required Co-requisite**

* CHEM 1112: General Chemistry II for Science Majors Laboratory must be taken concurrently.

**Prior Knowledge and Prerequisites**

* CHEM 1311 and CHEM 1111: General Chemistry I for Science Majors course and laboratory is required.

Students who expect to be successful in CHEM 1312 should exhibit the following Texas College and Career Readiness Standards skills. Only the specific standards and performance expectations pertinent to the course are listed.

**Science College and Career Readiness Standards**

1. **Nature of Science: Scientific Ways of Learning and Thinking**
2. Cognitive skills in science
3. Scientific inquiry
4. Collaborative and safe working practices
5. Current scientific technology
6. Effective communication of scientific information
7. **Foundation Skills: Scientific Applications of Mathematics**
   1. Basic mathematic conventions
   2. Mathematics as a symbolic language
   3. Understand relationships among geometry, algebra, and trigonometry
   4. Scientific problem solving
   5. Scientific application of probability and statistics
   6. Scientific measurement
8. **Foundation Skills: Scientific Applications of Communication**
   1. Scientific writing
   2. Scientific reading
   3. Research skills/information literacy
9. **Science, Technology, and Society**
   1. Interactions between innovations and science
   2. Social ethics
   3. History of science
10. **Cross-Disciplinary Themes**
    1. Matter/States of matter
    2. Energy (thermodynamics, kinetic, potential, energy transfers)
    3. Change over time/equilibrium
    4. Classification
    5. Measurements and models
11. **Chemistry**
    1. Matter and its properties
    2. Atomic structure
    3. Periodic table
    4. Chemical bonding
    5. Chemical reactions
    6. Chemical nomenclature
    7. The mole and stoichiometry
    8. Thermochemistry
    9. Properties and behavior of gases, liquids, and solids
12. Nuclear Chemistry

**Mathematics College and Career Readiness Standards**

1. **Numeric Reasoning**
2. **Algebraic Reasoning**
3. **Measurement Reasoning**
4. **Probabilistic Reasoning**
5. **Statistical Reasoning**
6. **Functions**
7. **Problem Solving and Reasoning**

**Cross-Disciplinary Standards**

1. **Key Cognitive Skills**
   1. Intellectual curiosity
   2. Reasoning
   3. Problem solving
   4. Academic behaviors
   5. Work habits
   6. Academic integrity
2. **Foundational Skills**
   1. Reading across the curriculum
   2. Writing across the curriculum
   3. Research across the curriculum
   4. Use of data
   5. Technology

**Course Objectives**

Upon successful completion of CHEM 1312, students should be able to:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Week** | |  | | --- | | **Topic** | | **Objective(s)** | **Chemistry CCRS** | **Cross-Disciplinary Science CCRS** |
| **1** | **Chapter 12: Chemical Kinetics: Rates of Reaction** | * **Determine the order of a chemical reaction and calculate the rate constant from initial rate data** * **Write reaction mechanisms consistent with the rate law expression for a reaction.** | **E. Chemical Reactions**  **6. Understand chemical kinetics** | **C. Change over time/Equilibrium**  **1. Recognize patterns of change.**  **E. Measurements and Models**  **1. Use models to make predictions.** |
| **2** | **Chapter 12: Chemical Kinetics: Rates of Reaction**  **Chapter 13: Chemical Equilibria** | **Kinetics:**   * **Write reaction mechanisms consistent with the rate law expression for a reaction.**   **Equilibrium**   * **Apply Le Chatelier’s Principle to chemical systems at equilibrium.** | **E. Chemical Reactions**  **4. Understand chemical equilibrium**  **6. Understand chemical kinetics** | **C. Change over time/Equilibrium**  **1. Recognize patterns of change.**  **E. Measurements and Models**  **1. Use models to make predictions.** |
|  | |  | | --- | | **Weekly Topic** | | **Objective(s)** | **Chemistry CCRS** | **Cross-Disciplinary Science CCRS** |
| **3** | **Chapter 13: Chemical Equilibria** | * **Perform equilibrium constant calculations for chemical reactions involving gases.** * **Apply Le Chatelier’s Principle to chemical systems at equilibrium.** | **E. Chemical Reactions**  **4. Understand chemical equilibrium** | **C. Change over time/Equilibrium**  **1. Recognize patterns of change.** |
| **4** | **Chapter 14: The Chemistry of Solutes and Solutions** | * **Calculate molar and molal concentrations of chemicals in various solutions and mixtures.** * **Work stoichiometric problems using aforementioned concentrations.** | **G. The Mole and Stoichiometry**  **2. Understand molar relationships in reactions, stoichiometric calculations, and percent yield.**  **I. Properties and Behaviors of Gases, Liquids, and Solids**  **2. Understand properties of solutions.** | **C. Change over time/Equilibrium**  **1. Recognize patterns of change.** |
| **5** | **Begin Chapter 15: Acids & Bases (up to 15.4)** | * **Solve basic stoichiometry problems involving acid-base chemical reactions.** * **Construct pH titration curves for the titration of both monoprotic and polyprotic weak acids** | **E. Chemical Reactions**  **2. Describe the properties of acids and bases and identify the products of a neutralization reaction.**  **4. Understand chemical equilibrium** | **C. Change over time/equilibrium**  **1. Recognize patterns of change.** |
| **Week** | |  | | --- | | **Weekly Topic** | | **Objective(s)** | **Chemistry CCRS** | **Cross-Disciplinary Science CCRS** |
| **6** | **Chapter 15: Acids & Bases (finish chapter)** | * **Construct pH titration curves for the titration of both monoprotic and polyprotic weak acids.** * **Calculate the pH of solutions containing weak acids, weak bases, and salts of weak acids or bases.** | **E. Chemical Reactions**  **2. Describe the properties of acids and bases and identify the products of a neutralization reaction.**  **4. Understand chemical equilibrium** | **C. Change over time/equilibrium**  **1. Recognize patterns of change.** |
| **7** | **Chapter 16: Additional Aqueous Equilibria** | * **Determine changes in buffer equilibria when acid or base is added.** * **Interpret acid-base titration curves.** | **E. Chemical Reactions**  **2. Describe the properties of acids and bases and identify the products of a neutralization reaction.**  **4. Understand chemical equilibrium** | **C. Change over time/equilibrium**  **1. Recognize patterns of change.** |
| **8** | **Chapter 16: Additional Aqueous Equilibria** | **Solve numerical problems pertaining to the solubility of ionic salts in water.** | **E. Chemical Reactions**  **4. Understand chemical equilibrium**  **I. Properties and behavior of gases, liquids, and solids**  **2. Understand properties of solutions.** | **C. Change over time/equilibrium**  **1. Recognize patterns of change.** |
| **Week** | |  | | --- | | **Weekly Topic** | | **Objective(s)** | **Chemistry CCRS** | **Cross-Disciplinary Science CCRS** |
| **9** | **Chapter 17: Chemical Thermo-dynamics** | **Solve thermochemical problems.** | **E. Chemical Reactions**  **5. Understand energy changes in chemical reactions.**  **H. Thermo-chemistry**  **2. Understand energy changes and chemical reactions.** | **B. Energy (thermodynamics, kinetic, potential, energy transfers)**  **1. Understand the Laws of Thermodynamics**  **2. Know the processes of energy transfer.** |
| **10** | **Chapter 17: Chemical Thermo-dynamics** | * **Calculate the equilibrium constant based on thermodynamic data.** * **Apply the laws of thermo-dynamics to determine whether or not a chemical reaction is spontaneous under a given set of experimental conditions.** | **E. Chemical Reactions**  **5. Understand energy changes in chemical reactions.**  **H. Thermo-chemistry**  **2. Understand energy changes and chemical reactions.** | **B. Energy (thermodynamics, kinetic, potential, energy transfers)**  **1. Understand the Laws of Thermodynamics**  **2. Know the processes of energy**  **transfer.** |
| **11** | **Chapter 18:**  **Electrochemistry and its Applications** | * **Determine oxidation numbers of atoms in common compounds.** * **Balance oxidation-reduction equations using both the method of half-reactions and method of oxidation numbers.** | **E. Chemical Reactions**  **3. Understand oxidation-reduction reactions**  **5. Understand energy changes in chemical reactions.** |  |
| **Week** | |  | | --- | | **Weekly Topic** | | **Objective(s)** | **Chemistry CCRS** | **Cross-Disciplinary Science CCRS** |
| **12** | **Chapter 18: Electrochemistry and its Applications (through 18.2)** | * **Balance oxidation-reduction equations using both the method of half-reactions and method of oxidation numbers.** * **Compute the potential of an electrochemical cell using standard reduction potentials.** | **E. Chemical Reactions**  **3. Understand oxidation-reduction reactions** |  |
| **13** | **Chapter 18: Electrochemistry – finish chapter** | * **Calculate useful work energy for an electro-chemical cell.** * **Describe applications of electro-chemistry including batteries, electroplating, and corrosion.** | **E. Chemical Reactions**  **3. Understand oxidation-reduction reactions** | **B. Energy (thermodynamics, kinetic, potential, energy transfers)**  **2. Know the processes of energy transfer.** |
| **14** | **Chapter 19: Nuclear Chemistry** | * **Identify types of radioactive decay, compare their properties, and write equations representing the decay process.** * **Describe** * **transmutation reactions.** * **Explain the concept of half-life for a radioisotope.** * **Using the rate law for radioactive decay, determine either the amount of radioisotope left, the half-life, or the original amount of radioisotope.** * **Compare/ contrast nuclear fusion and fission.** | **K. Nuclear chemistry**  **1. Understand radioactive decay** | **B. Energy (thermo-dynamics, kinetic, potential energy transfers)**  **2. Know the**  **processes of energy transfer.**  **C. Change Over Time/ Equilibrium**  **1. Recognize patterns of change.** |

**Student Learning Outcomes**

*(According to the spring 2012 ACGM)*

1. State the characteristics of liquids and solids, including phase diagrams and spectrometry.
2. Articulate the importance of intermolecular interactions and predict trends in physical properties.
3. Identify the characteristics of acids, bases, and salts, and solve problems based on their quantitative relationships.
4. Identify and balance oxidation-reduction equations, and solve redox titration problems.
5. Determine the rate of a reaction and its dependence on concentration, time, and temperature.
6. Apply the principles of equilibrium to aqueous systems using LeChatelier’s Principle to predict the effects of concentration, pressure, and temperature changes on equilibrium mixtures.
7. Analyze and perform calculations with the thermodynamic functions, enthalpy, entropy, and free energy.
8. Discuss the construction and operation of galvanic and electrolytic electrochemical cells, and determine standard and non‐standard cell potentials.
9. Define nuclear decay processes.
10. Describe basic principles of organic chemistry and descriptive inorganic chemistry.

**Class Policies and Practices**

**Attendance**

All students are expected to attend every class and every recitation. If you have to miss class, you do not need to notify the instructor of the absence, but you are responsible for the material that is covered in the class lecture and during the recitation. Should a student miss a lecture or recitation class, it is the student's responsibility to get the lecture notes from other students.

**Test Policy**

It is important to show up on time for the examination. The only time that one has to work the examination is the allotted class time. No examinations will be passed out once the first student has completed the examination and left the classroom. Cell phones and cell phone calculators are not to be used during the examination.

**Accommodation for Disability (Section 504)**

The Chemistry Department believes in reasonably accommodating individuals with disabilities and complies with university policy established under Section 504 of the *Rehabilitation Act of 1973* and the *Americans with Disabilities Act (1990)* to provide for equal access and opportunity. Please communicate with your professor at the beginning of the semester as to your specific needs so that the appropriate arrangements/accommodations can be made.

**Academic Integrity**

In accordance with University policy, academic dishonesty and cheating will not be tolerated. The term "cheating" includes, but is not limited to:

(a) Use of any unauthorized assistance taking quizzes, tests or examinations.

(b) Acquisition, without permission, of tests, notes or other academic belonging to a faculty member or staff member of the University.

(c) Any other act designed to give a student an unfair advantage.

Academic dishonesty and cheating is not appropriate and are grounds for dismissal from the course with an "F" and the students will be referred to the appropriate University official.

**Disruption of Class**

Disruption of classes is forbidden by the Student Code of Conduct and will result in dismissal of the student from the classroom. Disruption of classes includes, but is not limited to: horseplay, chatting socially, noisy or other offensive behavior that is disturbing to fellow classmates, and operation of cell phones.

**Course Texts and Materials**

Moore, Staniski, Jurs. (2008) *Principles of Chemistry*. New York: Thomson Brooks/Cole.

**Grade Practices: Assessments and Assignments**

Your grade is determined entirely by your performance on the regular 100-point

examinations and a 200-point comprehensive final exam. There will be no extra credit assignments, reports, papers, etc.

THERE ARE NO MAKEUP EXAMINATIONS SO IT IS IMPORTANT THAT ONE SHOW UP ON TIME FOR EVERY ONE OF THE REGULAR EXAMINATIONS.

You will be allowed to drop the lowest of the five 100-point examinations.

Should you miss one of the 100-point examinations, for whatever reason, you will receive a grade of zero for the missed examination. Remember that you are allowed to drop the lowest examination score and the missed examination can then serve as your one dropped examination. **The 200-point comprehensive final exam grade will not be dropped.**

What happens if you miss a second examination? Then your score on the final examination (pro- rated to a 100-point scale) will then be used as the score for the second missed examination. **There are no makeup examinations.**

Should you have a question concerning the way that your examination was graded, or if you think that there was an error in calculating the exam score, then it is your responsibility to bring the matter to the attention of the Instructor in timely fashion. Except for the last 100 point exam, students have two weeks from when the examination was passed back to the class to bring up grading errors or other such concerns. On the last 100 point examination students have until the day of their Final Examination to bring up grading concerns. It is your responsibility to check your examination for grading errors, and to make sure that the score was correctly calculated.

Grades will be based upon the best four of five 100-point regular examinations and 200-point comprehensive final examination.

Points will be assigned as follows:

Best four 100-point regular examinations 400 Points

200-Point Comprehensive Final Examination 200 Points

1. Exams - 67%

a. There will be five (5) exams that consist of multiple choice questions, short answer questions, and problems.

2. Final Exam - 33%

a. There will be a comprehensive final exam.

3. Homework

a. Homework is suggested and does not count toward your grade

Letter grades will be based upon the following grading scale:

90 - 100 % of the total points 540 - 600 Points Grade = A

80 - 89 % of the total points 480 - 539 Points Grade = B

70 - 79 % of the total points 420 - 479 Points Grade = C

60 - 69 % of the total points 360 - 419 Points Grade = D

Below 60 % 0 - 360 Points Grade = F

The University does have very strict rules concerning "Incomplete" grade.

The incomplete grade is given only during the last one-fourth of a term/semester, and only if a student: (1) gives notice to the instructor of being required to participate in active military service: or (2) is passing the course and has justifiable reason why the work cannot be completed on schedule.

Grades of incomplete are not to be used as a substitute for "F". The rules governing "Incomplete" are explained in greater detail in the UNT Undergraduate Catalog

**Method of Instruction**

1. Lecture - 75%

a. Lecture is defined as a method of instruction in which the instructor has full responsibility for presenting material orally and visually.

b. Lectures will take place in the form of formal lectures.

c. Students will be expected to come to class ready to contribute to the class discussion.

d. Students will be expected to listen and respond appropriately to each other's comments.

2. Recitation - 25%

a. Recitation is defined as a method of instruction in which students work in groups to discuss pertinent issues in chemistry and solve problems related to the current lectures for the week.

b. Students take turns facilitating small group discussions during recitation time.

c. Students are expected to attend recitation and are expected to be prepared with appropriate problem solving tools on hand.

d. Students are expected to work together as a team to answer questions or solve problems posed by the instructor.

**Class Schedule**

|  |  |  |
| --- | --- | --- |
| Week | Topics | Assignments and Assessments |
| 1 | Chapter 12: Chemical Kinetics: Rates of Reaction | HW:  Chapter 12 #9-11, 17-24, 34-38, 49, 52, 53, 63-66, 73, 74 |
| 2 | Chapter 12: Chemical Kinetics: Rates of Reaction  Chapter 13: Chemical Equilibria | HW:  Chapter 13 #11-17, 20-23, 26-34, 35-37, 42-44, 48-53, 65-67 |
| 3 | Chapter 13: Chemical Equilibria | Exam over Chapters 12 & 13 |
| 4 | Chapter 14: The Chemistry of Solutes and Solutions | HW:  Chapter 14 #5-14, 38-44, 53-62 |
| 5 | Chapter 14: The Chemistry of Solutes and Solutions |  |
| 6 | Begin Chapter 15: Acids & Bases (up to 15.4) | Exam over Chapters 14 and 15 (through 15.4) |
| 7 | Chapter 15: Acids & Bases (finish chapter) | HW:  Chapter 15 #1-7, 14-23, 31-35, 41, 42, 47-50, 53-58, 67-69 |
| 8 | Chapter 16: Additional Aqueous Equilibria | HW:  Chapter 16 #2, 3, 5-7, 22-24, 28, 31, 32, 36, 44-46, 47, 51-56, 60, 61 |
| 9 | Chapter 16: Additional Aqueous Equilbria | Exam over Chapter 15 and 16 |
| 10 | Chapter 17: Chemical Thermodynamics | HW:  Chapter 17 #6-14, 18, 22, 23, 27-31, 35, 37, 40, 49-52, 64, 65, 68, 78-80, 93 |
| 11 | Chapter 17: Chemical Thermodynamics |  |
| 12 | Chapter 18: Electrochemistry and its Applications (through 18.2) | Exam over Chapter 17 and 18 (through 18.2) |
| 13 | Chapter 18: Electrochemistry – finish chapter | HW:  Chapter 18 #6, 7, 10, 11, 14-17, 24, 28-30, 36-38, 43-46, 49, 52-58 |
| 14 | Chapter 19: Nuclear Chemistry | |  | | --- | | HW:  Chapter 19 #11-14, 18-21, 25-31, 43, 55, 56, 61  Exam over Chapters 18 & 19 | |
| 15 | Pre-Finals Week: Review for Final Exam |  |
| 16 | Final Exam | Final comprehensive exam |

**Supplementary Resources**

* The textbook's web page is an excellent resource *(http://www.wadsworth.com/cgi-wadsworth/course\_products\_wp.pl?fid=M20b&product\_isbn\_issn=9780495390794&token=)*
* Tutoring is available every day from 8:00 a.m. to 5:00 p.m. at the Chemistry Resource Center (CRC) in room 232. Chemistry graduate students provide both individual and small group help with various topics in chemistry.
* Office hours are a valuable resource to get one-on-one help with your instructor.
  + The instructor holds office hours in Chemistry\_\_\_\_ at X time on Y day.
* Students who qualify for specific accommodations under the Americans with Disabilities Act (ADA) should notify the instructor the first week of class. It is the student's responsibility to provide the necessary documentation to the Special Populations Coordinator in Student Services.

**Supplementary Materials**

* CHEM 1312 Sample Exam: Electrochemistry and Nuclear Chemistry
* CHEM 1312 Sample Exam: Equilibrium
* CHEM 1312 Sample Exam: Thermochemistry

**CHEM 1312 Sample Exam: Electrochemistry and Nuclear Chemistry**

***I. Multiple Choice***

1. 2 H2O + 4 MnO4– + 3 ClO2– 🡪 4 MnO2 + 3 ClO4– + 4 OH–

Which species acts as an oxidizing agent in the reaction represented above?

(A)H2O (B) ClO4– (C) ClO2– (D) MnO2 (E) MnO4–

2. … Ag+ + … AsH3*(g)* + … OH– 🡪 … Ag*(s)* + … H3AsO3*(aq)* + … H2O

When the equation above is balanced with lowest whole–number coefficients, the coefficient for OH– is

(A) 2 (B) 4 (C) 5 (D) 6 (E) 7

3. Zn*(s)* + Cu2+ 🡪 Zn2+ + Cu*(s)*

An electrolytic cell based on the reaction represented above was constructed from zinc and copper half–cells. The observed voltage was found to be 1.00 volt instead of the standard cell potential, *E*, of 1.10 volts. Which of the following could correctly account for this observation?

(A) The copper electrode was larger than the zinc electrode.

(B) The Zn2+ electrolyte was Zn(NO3)2, while the Cu2+ electrolyte was CuSO4.

(C) The Zn2+ solution was more concentrated than the Cu2+ solution.

(D) The solutions in the half–cells had different volumes.

(E) The salt bridge contained KCl as the electrolyte.

4. Which of the following acids can be oxidized to form a stronger acid?

(A) H3PO4 (B) HNO3 (C) H2CO3 (D) H3BO3 (E) H2SO3

5. Which of the following expressions is correct for the maximum mass of copper, in grams, that could be plated out by electrolyzing aqueous CuCl2 for 16.0 hours at a constant current of 3.0 amperes?

(A)

(B)

(C)

(D)

(E)

6. A direct–current power supply of low voltage (less than 10 volts) has lost the markings that indicate which output terminal is positive and which is negative. A chemist suggests that the power supply terminals be connected to a pair of platinum electrodes that dip into 0.1–molar KI solution. Which of the following correctly identifies the polarities of the power supply terminals?

(A) A gas will be evolved only at the positive electrode.

(B) A gas will be evolved only at the negative electrode.

1. A brown color will appear in the solution near the negative electrode.
2. A metal will be deposited on the positive electrode.
3. None of the methods above will identify the polarities of the power supply terminals.

Question 7-10



Use the following answer choices to answer the questions below:

(A) Voltage increases.

(B) Voltage decreases but remains at zero.

(C) Voltage becomes zero and remains at zero

(D) No change in voltage occurs

(E) Direction of voltage change cannot be predicted without additional information

Which of the above occurs for each of the following circumstances?

7. A 50–milliliter sample of a 2-molar Cd(NO3)2 solution is added to the left beaker.

8. The silver electrode is made larger.

9. The salt bridge is replaced by a platinum wire.

10. Current is allowed to flow for 5 minutes

11. Cu*(s)* + 2 Ag+ 🡪 Cu2+ + 2 Ag*(s)*

If the equilibrium constant for the reaction above is 3.7x1015, which of the following correctly describes the standard voltage, *E°*, and the standard free energy change, *G°,* for this reaction?

(A) E° is positive and G° is negative.

(B) E° is negative and G° is positive.

(C) E° and G° are both positive.

(D) E° and G° are both negative.

(E) E° and G° are both zero

12. Which of the following species CANNOT function as an oxidizing agent?

(A) Cr2O72– (b) NO3– (C) I– (D) MnO4– (E) S

13. The nuclide  is the daughter nuclide resulting from the  decay of what parent nuclide?

a) 

b) 

c) 

d) 

e) 

Use the following to answer question 14:

When the U-235 nucleus is struck with a neutron, the Ce-144 and Sr-90 nucleii are produced along with some neutrons and electrons.

14. How many neutrons are emitted?

a) 2

b) 3

c) 4

d) 5

e) 6

Use the following to answer question 15:

The Fe-56 nucleus is known to be stable.

15. What is the most likely decay for the Fe-53 nucleus?

a)  decay

b) positron emission

c)  decay

d) -ray emission

e) two of these

16. Which reaction will produce an isotope of the parent nuclide?

a) 

b) 

c) 

d) 

e) 

17. Which statement is true about the following reaction?



a) Energy is absorbed in the reaction.

b) Energy is released in the reaction.

c) No energy change is associated with the reaction.

d) Not enough information is given to determine the energy change.

18. Which of the following is not a factor in determining the biological effects of radiation exposure?

a) the energy of the radiation

b) the age of the organism at which the exposure occurs

c) the penetrating ability of the radiation

d) the chemical properties of the radiation source

e) the ionizing ability of the radiation

19. The greatest radiation exposure for Americans comes from which of the following?

a) medical x rays

b) nuclear power plants

c) electrical transmission wires

d) industrial waste

e) the combination of the natural causes of radiation including cosmic rays

***II. Short Answer***

1. Sketch the galvanic cell for the reaction between Cu with Cu2+ and Mg with Mg2+. Label anode, cathode, charges, and direction of electron flow. Show the half cells and overall cell reaction. Calculate **E°**cell,ΔG, and K (assuming a temperature of 25°C) Write the line notation. Assume that all concentrations are 1.0 M.

21.Write oxidation states for each element in the compound

* 1. K4Fe(CN)6
  2. KMnO4
  3. SF4

1. Balance the redox reaction that occurs in an acidic solution.

Br-(aq) + MnO4-(aq) 🡪 Br2(l) + Mn2+(aq)

1. Balance the redox reaction that occurs in a basic solution.

NO2-(aq) + Al(s) 🡪 NH3(g) + AlO2-(aq)

1. Place the following in order of increasing strength as oxidizing agents.

Ca2+  Fe3+ Sn4+ Br2 H+

1. Is Ni2+ capable of oxidizing Fe2+? Explain.
2. Consider the cell described below:

Mn⎜Mn2+ (1.00 M) ⎜⎜ Cu2+ (1.00 M) ⎜Cu

This galvanic cell is constructed and allowed to react. After four hours, the [Mn2+] is measured and is found to be 0.25 mol/L. Calculate the cell potential at these conditions. (Assume T = 25°C and 1.0L cells)

1. Copper is electroplated from CuSO4 solution. A constant current of 4.00 A is applied by an external power supply. How long will it take to deposit 100 g of Cu?
2. What’s the difference between galvanic and electrolytic cells?

29. The half-life for the beta decay of potassium-40 is 1.3 x 109 years. What is the rate constant for this decay?

30. Describe the method of carbon-14 dating. What kinds of artifacts can be tested?

**CHEM 1312 Sample Exam: Equilibrium**

**Acids/Bases and Ksp**

***I. Multiple Choice***

1. Adding NaOH to a solution of acetic acid \_\_\_\_\_\_\_.

(a) increases [H+] (b) increases [C2H3O2-] (c) increases [HC2H3O2]

2. Given Ka for acetic acid (1.8x10-5), a buffer made of an equal number of moles of acetic acid and sodium acetate has a pH of ---.

(a) 4.74 (b) 1.8 (c) 3.74 (d) 9.26

3. Which of the following salts will form an acidic aqueous solution?

(a) KCl (b) CsF (c) NH4Br (d) NaCN

4. Which indicator should you use tin the titration of lactic acid with sodium hydroxide?

1. methyl red (color change @ pH=5)
2. litmus (color change @ pH=7)
3. phenolphthalein (color change @ pH=9)
4. any of these will work

5. What effect will the addition of NH3 have on the pH of an ammonium chloride solution?

(a) increase pH (b) decrease pH (c) no effect

6. The solubility of Cr(OH)3 is 1.26x10-8 at 25°C. What is the value of Ksp for Cr(OH)3?

(a) 6.8x10-31 (b) 1.6x10-16 (c) 2.0x10-24 (d) 6.3x10-26

7. Which of the following has the highest molar solubility?

(a) PbCrO4: Ksp=1.8x10-14 (b) Ag3PO4: Ksp=1.8x10-18 (c) PbI2: Ksp=8.7x10-9

8. The solubility of salts can be affected by other equilibria. What effect will the system, CO32- + H2O 🡪 HCO3- + OH- have on the solubility of ferrous hydroxide in that system?

(a) increased solubility (c) decreased solubility

(b) no change will occur (d) not enough information is given

9. Sodium chloride is added slowly to a solution that is 0.010M Cu+, Ag+, and Au+. The Ksp values for the chloride salts are 1.9x10-7, 1.6 x10-10, and 2.0x10-13 respectively. Which compound precipitates first?

(a) CuCl (b) AgCl (c) AuCl

10. Which of the following salts is more soluble in 1.0M H+ than in pure water?

(a) KCl (b) AgC2H3O2 (c) AgCl (d) NaNO3

***II. Short Answer***

11. The Ksp for silver sulfate is 1.2x10-5. Calculate the solubility of silver sulfate in

1. 0.1M silver nitrate
2. 0.2M potassium sulfate

12. Consider the titration of 40.0mL of 0.200M acetic acid by 0.100M KOH. Calculate the pH of the resulting solution after the following volumes of KOH have been added:

1. 0.0 mL
2. 10.0 mL
3. 40.0 mL
4. 80.0 mL
5. 100. mL

13. Will a precipitate form when 100.0mL of 0.020M lead (II) nitrate is added to 100.0mL of 0.020M NaCl? Provide evidence to support your conclusion.

14. An aqueous solution of lead (II) nitrate is added slowly to 1.0L of a solution containing 0.020 mol Cl- and 0.10 mol SO42- at 25°C. Assuming added solution does not affect the total volume and that Ksp for plumbous chloride is 1.6x10-5 and for lead (II) sulfate is 1.3x10-8…

1. Which salt precipitates first?
2. What is the concentration of lead ion in the solution when the first precipitate begins to form?

15. Sketch the pH curve for the titration of 250mL of 0.01M ammonia (Kb=1.8x10-5) with 0.01M HNO3. Determine the initial pH, the pH at the equivalence point and at half-way to the equivalence point, and label all of these on the graph.

**CHEM 1312 Sample Exam: Thermochemistry**

***I. Multiple Choice***

1. Which of the following is true (at standard state)?

(a) Heat of formation of hydrogen gas is 0.0 kJ.

(b) Heat of formation of H+(aq)  is 0.0 kJ.

(c) Standard entropy of hydrogen gas is 0.0 J/K.

(d) Standard entropy of H+(aq) is 0.0 J/K.

2. If ΔGo = 0 for a process, then which of the following statements about the

equilibrium constant is true?

(a) K = 1 (b) K = 0 (c) K > 1 (d) K < 1.

3. A cube of ice is added to some hot water in an insulated container, which is then sealed. There is no heat exchange with the surroundings. Which describes the system once it has shifted to a new equilibrium?

(I) The average kinetic energy of the liquid phase has decreased.

(II) The total energy of the system has decreased.

(III) The entropy of the system has increased.

(a) I only (c) I and II only (e) I and III only

(b) III only (d) I, II, and III

4. For which one of the following reactions would you expect the entropy change to be closest to zero?

(a) Zn(s) + 2 H+(aq) ----> Zn2+(aq) + H2(g) (c) 2 H2(g) + O2(g) ----> 2 H2O(l)+

(b) 2 H2(g) + O2(g) ----> 2 H2O(g) (d) N2(g) + O2(g) ----> 2 NO(g)

5. If 100.0 J of heat are added to 1.00 mole of Ne(g) at 30.0oC and constant pressure, how much will its temperature rise? (Sp. Heat Cap. of Ne = 0.904 J/gK)

(a) 2.3o (b) 5.5o (c) 10.0o (d) 30.0o (e) 42.8o

6. For a given reaction, the values for standard free energy change and the equilibrium constant are both measures of the extent to which a reaction proceeds. Which range includes the value for **ΔGo**  (at 298 K) in kilojoules, when the corresponding value for Keq is 1 x 10-5? (lnK = -11.5)

(a) less then 20 (d) 80 to 160

(b) 20 to 40 (e) greater than 160

(c) 40 to 80

8. Which describes the process of melting of ice at its normal melting point and 1 atmosphere of pressure?

**ΔH ΔS ΔG ΔH ΔS ΔG**

(a) + + + (f) + - +

(b) + + - (g) - + -

(c) + + 0 (h) + - -

(d) - - - (i) - + 0

(e) - - + (j) + - 0

(f) - - 0 (k) - + 0

***II. Short Answer***

1. State the First and Second Laws of Thermodynamics
2. (a) When liquid water is introduced into an evacuated vessel at 25oC, some of the water vaporizes. Predict how the enthalpy, entropy, free energy, and temperature change in the system during this process. Explain the basis for each of your predictions.

(b) When a large amount of ammonium chloride is added to water at 25oC, some of it dissolves and the temperature of the system decreases. Predict how the enthalpy, entropy, and free energy change in the system during this process. Explain the basis for each of your predictions.

(c) If the temperature of the aqueous ammonium chloride system in part (b) were to be increased to 30°C, predict how the solubility of the ammonium chloride would be affected. Explain the basis for each of your predictions.

1. Cl2(g) + 3 F2(g) ---> 2 ClF3(g)

ClF3 can be prepared by the reaction represented by the equation above. For ClF3 the standard enthalpy of for­mation, ΔH°f =, is -163.2 kilojoules/mole and the stan­dard free energy of formation, ΔG°f , is -123.0 kilo­joules/mole.

(a) Calculate the value of the equilibrium constant for the re­action at 298K.

(b) Calculate the standard entropy change, ΔS°, for the reac­tion at 298K.

(c) If ClF3 were produced as a liquid rather than as a gas, how would the sign and the magnitude of ΔS for the reac­tion be affected? Explain

4. C6H5OH(s) + 7 O2(g) 🡪 6 CO2(g) + 3H2O(l)

When a 2.000-gram sample of pure phenol, C6H5OH(s), is completely burned according to the equation above, 64.98 kilojoules of heat is released. Use the information in the table below to answer the questions that follow.

|  |  |  |
| --- | --- | --- |
| Substance | Standard Heat of Formation, H°f, at 25°C (kJ/mol) | Absolute Entropy, S°, at 25°C (J/mol-K) |
| C(graphite) | 0.00 | 5.69 |
| CO2(g) | -395.5 | 213.6 |
| H2(g) | 0.00 | 130.6 |
| H2O(l) | -285.85 | 69.91 |
| O2(g) | 0.00 | 205.0 |
| C6H5OH(s) | ? | 144.0 |

(a) Calculate the molar heat of combustion of phenol in kilojoules per mole at 25°C.

(b) Calculate the standard heat of formation, H°f, of phenol in kilojoules per mole at 25°C.

(c) Calculate the value of the standard free-energy change, G° for the combustion of phenol at 25°C.

(d) If the volume of the combustion container is 10.0 liters, calculate the final pressure in the container when the temperature is changed to 110°C. (Assume no oxygen remains unreacted and that all products are gaseous.)