

## GENERAL CHEMISTRY II, CHEM 2100 – SPRING 2013

*If you took Chemistry 1050 and 2050, you should realize that these courses go at half the rate of Chemistry 2100, so in Chem 2100 you will have to work twice as hard as you did in Chem 1050 and 2050.*

- Required Texts:
- *Chemistry, The Central Science*, Brown, LeMay and Bursten, Prentice Hall Pub., 2011, 12<sup>th</sup> Edition
  - *Experiments in General Chemistry*, M. N. Kobraik, Ed., **Third** edition. Kendall/Hunt, Dubuque, IA, 2012

- Required Items:
- Scientific calculator (**Graphing calculators are not allowed on exams**)
  - Lock for lab drawer
  - Safety goggles (supplied in lab kit); matches; dish detergent, paper towels
  - Small bound notebook for lab

- Recommended Items:
- Lab coat or apron.
  - Study Guide to Brown, LeMay and Bursten, James C. Hill, 12th Ed., Prentice Hall
  - Solutions to Exercises in Brown, LeMay and Bursten, R. Wilson, 12th Ed., Prentice Hall

### Online Supplements and Info:

[http://chemscript.brooklyn.cuny.edu/web/doc/2013\\_Spring\\_Syllabus\\_Chem2100.pdf](http://chemscript.brooklyn.cuny.edu/web/doc/2013_Spring_Syllabus_Chem2100.pdf)

(syllabus on line)

<http://academic.brooklyn.cuny.edu/chem/howell/practice.htm> (old BC tests and exams)

<http://chemscript.brooklyn.cuny.edu/web/index.php> (Chemistry Department Homepage)

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See also the Pre-Health Professions Handbook at  
[http://www.brooklyn.cuny.edu/web/aca\\_honors/110901\\_PreHealthProfessionsHandbook.pdf](http://www.brooklyn.cuny.edu/web/aca_honors/110901_PreHealthProfessionsHandbook.pdf)

### LECTURE TESTS: Note that these are during common hours

- **FIRST TEST: Thursday, March 14, 12:30 – 2:00 PM**, Covers Recitations 1–5
- **SECOND TEST: Thursday, April 25, 12:30 – 2:00 PM**, Covers Recitations 6–10  
**NO** Makeup exams are given for Lecture Tests. We mean it. Graphing calculators are not allowed on exams. See pages 3-4 for recitation assignments.

**FINAL EXAM: MAY 24 (Friday), 8:00 AM – 10:00 (or 10:15) AM**, rooms TBA

**NOTE:** On Thurs Feb. 14, TUESDAY classes meet. On Wed Feb 20, MONDAY classes meet.

**Academic dishonesty is prohibited in the City University of New York.**

Cheating, plagiarism, internet plagiarism and obtaining unfair advantages are violations of policies of academic integrity and are punishable by penalties, failing grades, suspension and expulsion. For more information about CUNY policy on academic integrity see

**[http://www.brooklyn.cuny.edu/web/abo\\_initiatives/110901\\_AcademicIntegrity.pdf](http://www.brooklyn.cuny.edu/web/abo_initiatives/110901_AcademicIntegrity.pdf)**

**Student Disability Services**

In order to receive disability-related academic accommodations students must first be registered with the Center for Student Disability Services. Students who have a documented disability or suspect they may have a disability are invited to set up an appointment with the Director of the Center for Student Disability Services, Ms. Valerie Stewart-Lovell at 718-951-5538. If you have already registered with the Center for Student Disability Services please provide your professor with the course accommodation form and discuss your specific accommodation with him/her.

**Lab Exemptions:** If you are repeating the course you may be able to obtain a lab exemption by filing a lab exemption request form in the Chemistry Department office (359 NE). Students who receive lab exemptions **MUST attend recitation and take the recitation quizzes**. Whether a lab-exempt student re-takes the lab quizzes is up to the student. If you re-take the lab quizzes, we will use whichever lab quiz grade is higher, the previous one or the new one. Lab exemptions are not available after Feb. 8.

**Drop Dates:** Friday Feb. 15 is the last day to drop a course without a grade.

**Friday, April 12** is the last day to apply for non penalty withdrawal (*i.e.*, W grade). See your lab instructor or the course coordinator for advice. **To withdraw, you MUST file a form in the Registrar's Office (either electronically or in person) and go to the stockroom to CHECK OUT from the laboratory.**

**GRADING:**

Your final grade will be determined as follows:

- 30% Two lecture tests
- 20% Minimum of five recitation quizzes\*
- 18% Laboratory reports and performance
- 7% Two laboratory quizzes
- 25% Final Exam

*\*The lecturer may adjust recitation quiz and lab quiz grades in sections where the recitation or lab quiz average is substantially too high or too low in relation to the lecture exam averages.*

**Errata for Kobrak, "Experiments in General Chemistry, 3rd. ed.,"**

Experiment 13, page 143:

In the "Net Ionic Equations" text box, the second equation should have 2 nitrate ions on the right-hand side. That is, the second term on the right-hand side should read "2 NO<sub>3</sub><sup>-</sup>" not "NO<sup>-</sup>"

Experiment 14

Page 126: In Figure 14-3, the left-most product at the bottom of the figure should read "Mg(NH<sub>4</sub>)PO<sub>4</sub>", not "Mg(PO<sub>4</sub>)<sub>2</sub>" as currently written.

**Chemistry 2100 Lecture Schedule**

Unless specific sections are indicated, you are responsible for the whole chapter.

For best results read the assigned material before lecture.

Lecture #	Topics	Assigned Reading
1, 2	Chemical Kinetics	Chapter 14 Sections 14.1–14.3, 14.5–14.7 (omit Arrhenius Equation p. 578 bottom to p. 581 top.
3, 4	Chemical Equilibrium	Chapter 15
5, 6	Acids and Bases	Chapter 16 (omit Section 16.10). Appendix A.2-logarithms
7, 8	Aqueous Equilibria, Acid-Base	Chapter 17, Sections 17.1–17.3
9 – 11	Aqueous Equilibria, Precipitation	Chapter 17, Sections 17.4–17.7
12, 13	Entropy and Free Energy	Chapter 19
14	Oxidation-Reduction	Chapter 4, p.131–134 Chapter 20, Sections 20.1, 20.2
15, 16, 17	Electrochemistry Equivalents and Normality	Chapter 20, Sections 20.3–20.7, 20.9 See: page 7 of the syllabus
18	Transition Metals	Section 23.1
19, 20	Coordination Compounds	Chapter 23
21, 22	Hybrid Orbitals, Periodic Trends	Chapter 9, Sections 9.4–9.6 Chapter 22, Section 22.1
23, 24	Organic Chemistry	Chapter 12, Section 12.8 Chapter 24, Sections 24.1–24.6
25	Biochemistry	Chapter 24, Sections 24.7–24.10
26, 27	Nuclear Chemistry	Chapter 21
28	REVIEW	

**NOTE:** YOUR EXPERIENCE IN CHEM 1100 SHOULD HAVE TAUGHT YOU THAT HARD WORK AND LOTS OF STUDY ARE NECESSARY FOR SUCCESS.

TO PASS CHEM 2100 WITH A GOOD GRADE, YOU MUST STUDY AT LEAST 10 HOURS EACH WEEK. PLAN YOUR SCHEDULE ACCORDINGLY!

**Reading and Homework Assignments for Weekly Recitation Meetings**

<b>Meeting #</b>	<b>Assigned Material</b>
<b>Meeting 1</b> Read: Homework:	<b>Chemical Kinetics</b> Chapter 14 Sections 14.1–14.3 (omit Sec. 14.4) Chapter 14, Problems 2, 17, 19, 21, 23a,b,c, 25, 27, 30, 31 33, 34, 37
<b>Meeting 2</b> Read: Homework:	<b>Chemical Equilibrium</b> Chapter 14, Sections: 14.5–14.7 (omit Arrhenius Equation p. 578-580), and Chapter 15, Sections: 15.1–15.4 Chapter 14, Problems 53, 54, 57, 69, 70, 74, 77, 78. 81, 85, 87, 115 Chapter 15, Problems 8, 15, 17, 19, 23, 25, 31
<b>Meeting 3</b> Read: Homework:	<b>Acids and Bases</b> Chapter 15, Sections: 15.5–15.7, and Chapter 16, Sections 16.1–16.4, Appendix A.2 Chapter 15, Problems 34, 36, 37, 39, 43, 45, 51, 52. 57, 61, 63, 82 Chapter 16, Problems 13, 14, 15, 17, 19, 21 26, 27, 28, 29, 30, 34, 38
<b>Meeting 4</b> Read: Homework:	<b>Acid-Base Chemistry</b> Chapter 16, Sections 16.5–16.9, 16.11, Appendix A.2 Chapter 16; Probl. 41, 45, 49, 53, 57, 68, 71, 73, 77, 81, 82a, 97
<b>Meeting 5</b> Read: Homework:	<b>Acid-Base Chemistry, Aqueous Equilibria</b> Chapter 17, Section 17.1–17.3 Chapter 17, Problems 15, 17, 19, 23, 25, 27, 33, 34, 41, 43, 45
<b>Meeting 6</b> Read: Homework:	<b>Aqueous Equilibria and Precipitation</b> Chapter 17, Sections 17.4–17.7 Chapter 17, Problems 49, 51, 55, 56a, 60, 62
<b>Meeting 7</b> Read: Homework:	<b>Entropy and Free Energy</b> Chapter 19 Chapter 19, Probl. 11, 12, 25, 37, 41, 43, 53, 55, 57, 59, 65, 67, 69, 79, 82, 85
<b>Meeting 8</b> Read: Homework:	<b>Oxidation-Reduction, Electrochemistry</b> Chapter 4, p.131–137 and Chapter 20, Sections 20.1–20.5 Chapter 4, Problems 49, 50, 51 and Chapter 20, Problems 13, 14, 17, 21, 23, 25, 27, 37, 39, 42, 45, 49
<b>Meeting 9</b> Read: Homework:	<b>Electrochemistry</b> Chapter 20, Sections 20.6, 20.7, 20.9 Chapter 20, Problems 51, 53, 56a, 61, 63, 65, 67, 91, 92
<b>Meeting 10</b> Read: Homework:	<b>Transition Metals, Coordination Compounds</b> Chapter 23, Sections 23.1–23.5 Chapter 23 Problems 15, 16, 17, 23, 25, 35, 36a, e, 38, 39, 41, 43, 44b, c,

<b>Meeting 11</b> Read: Homework:	<b>Coordination Compounds, Hybrid Orbitals</b> Section 23.6, Sections 9.4, 9.5 Chapter 23 Problems, 50, 53,55, 59,60,61 Chapter 9, Problems 48,51,54,55,56
<b>Meeting 12</b> Read: Homework:	<b>Hybrid Orbitals, Periodic Trends</b> Chapter 9, Section 9.6 and Chapter 22, Section 22.1 Chapter 9, Problems 59,60,61,65,67 and Chapter 22, Problems 11,12,13,15,17b,18d
<b>Meeting 13</b> Read: Homework:	<b>Organic Chemistry, Biochemistry</b> Chapter 24 and Chapter 12, Section 12.8 Chapter 24, Problems 7,8,15,23,24,28 (omit naming), 35, 43, 44, 45, 46, 49a (omit naming) 59, 61, 71a, 78, 81, 85, and Chapter 12, Problems 75, 79a, 80b, 103
<b>Meeting 14</b> Read: Homework:	<b>Nuclear Chemistry</b> Chapter 21 Chapter 21, Probl.7,9,11,12d,17,28,30,33,34 (do this without using a formula),36,39,47,50a,57, 58a

NOTE: Your instructor has the option of scheduling a two-hour recitation session for the 14<sup>th</sup> meeting.

## Chemistry 2100 Laboratory

Before coming to laboratory, read the scheduled experiment and any other material assigned. Unless otherwise noted, page numbers refer to your laboratory manual. You must bring the lab manual to each lab class.

Brooklyn College recognizes the importance of reproductive hazard awareness and protection. During laboratory exercises students may be exposed to chemical reagents that may present specific risks to reproductive health, especially students who are pregnant. Therefore, it is strongly recommended that you do not take the following course if you are pregnant. If you become pregnant during the semester, please consult with your laboratory instructor.

**NOTE: SAFETY GOGGLES MUST BE WORN IN THE LABORATORY!** The goggles must be indirectly-vented to offer splash protection. New goggles are provided in your lab kit. **If your instructor observes you violating eye protection or other safety policies, you can be removed from the laboratory and/or given a 10% (or higher) penalty on your laboratory report grade.**

Scientific data requires special treatment. It must be recorded in non-erasable in your lab book immediately after a measurement is taken; partners cannot copy each others' data at a later time. **Altering or copying data outside of the laboratory represents academic dishonesty and will be prosecuted as such if observed.** Further, you will receive no credit for any lab report that includes data that are not your own. If your data are messy, you may copy them over onto a final report, but you must include your original data when you turn in your report.

Lab reports are due in lab the week after the experiment was concluded unless you obtain permission from your instructor. **Late lab reports are penalized 10% for each week or fraction of a week that they are late.** All lab reports not handed in will receive a grade of zero.

**Students who miss a laboratory:**

Multiple sections of Chemistry 2100 run, and students who miss a section of their assigned laboratory may make it up in another section as soon as possible. To do this, they must obtain a make-up card from the General Chemistry stockroom. (This card does NOT have to be signed by their regular laboratory instructor.) They then go to the lab period in which they wish to make up the experiment, identify themselves to the instructor in that section, and (if given permission) perform the work. After the experiment is complete, the instructor for that section must sign and date the make-up card. The signed make-up card must be given to the regular laboratory instructor as proof that the lab was made up.

If your lab instructor is **not** grading the lab reports and returning them to you, please **notify the lecturer.**

**PREPARATION FOR LABORATORY**

To help prepare you for lab, you are required to hand in before each lab (except the experiment in week 1) a sheet stating (a) what quantities are to be measured and (b) what quantities are to be calculated from the measurements. For an experiment where there are no measurements, just state briefly what you are to do and what you are to observe.

What you hand in should be no more than 4 to 5 lines long and must **not** include the detailed procedure of the experiment.

If you do not hand this in, your instructor will deduct 5% from your grade for that lab report.

**Schedule of Lab Experiments in Chemistry 2100** (See errata on page 2.)

**Meeting Laboratory Assignment**

- 1 Check in, Safety, and Qualitative Analysis Part I, Exper. 13.
- 2 Experiment 15 Rates of Reaction. **You MUST hand in the signed safety sheet and the safety quiz.** See the sheets at the end of the syllabus.
- 3 Experiment 16: *Colorimetric Equilibrium Study*
- 4 Experiment 14 *Qualitative Analysis II*
- 5 *Qualitative Analysis II*
- 6 *Qualitative Analysis II* (Get handout for week 7 exper. from stockroom.)
- 7 Handout from stockroom: *pH and Buffers*
- 8 Experiment 18: *Oxidation - Reduction*
- 9 Experiment 18: *Oxidation - Reduction*
- 10 Experiment 20: *Synthesis and Analysis of an Amminenickel(II) Complex Compound*
- 11 Experiment 20: *Synthesis and Analysis of an Amminenickel(II) Complex Compound*
- 12 Experiment 20: *Synthesis and Analysis of an Amminenickel(II) Complex Compound*
- 13 *Electrochemical Cells and Reduction Potentials*, Handout from stockroom
- 14 Check out. NO WORK PERMITTED

## EQUIVALENTS AND NORMALITY

**(1) Acid-Base Reactions.** One **equivalent** of an acid (or base) is an amount that supplies one mole of  $\text{H}^+$  or  $\text{OH}^-$  ions. For example, one equivalent of  $\text{HCl}$  is the same as one mole of  $\text{HCl}$ , but one equivalent of  $\text{H}_2\text{SO}_4$  is 0.5 moles of  $\text{H}_2\text{SO}_4$ . This is because each mole of  $\text{H}_2\text{SO}_4$  supplies two moles of  $\text{H}^+$  ions, and we only need 1/2 a mole of  $\text{H}_2\text{SO}_4$  to get one mole of  $\text{H}^+$ .

The **equivalent weight** is the mass of one equivalent. For example, the equivalent weight of  $\text{H}_2\text{SO}_4$  is one-half of its molar mass, namely 49 g/equiv.

The **normality** of a solution is the number of equivalents of the solute in the solution divided by the solution's volume in liters. As an example, consider a 3.0 M  $\text{H}_2\text{SO}_4(\text{aq})$  solution. This solution has 3 moles of  $\text{H}_2\text{SO}_4$  per liter, and since each mole of  $\text{H}_2\text{SO}_4$  is 2 equivalents of  $\text{H}_2\text{SO}_4$ , there are 6 equivalents of  $\text{H}_2\text{SO}_4$  per liter and the solution's normality is 6.0 N, where N stands for equivalents per liter.

Since one mole of  $\text{H}^+$  ions reacts with one mole of  $\text{OH}^-$  ions, **one equivalent of acid always reacts with one equivalent of base** in a titration (even though one mole of acid may not always react with one mole of base).

*Problem:* What is the molarity of a 0.04 N  $\text{Ba}(\text{OH})_2(\text{aq})$  solution?

**(2) Oxidation–Reduction Reactions.** One **equivalent** of an oxidizing or reducing agent is an amount that gains or loses one mole of electrons. For example, in the reaction  $2 \text{Al} + 3 \text{Zn}^{2+} \rightarrow 2 \text{Al}^{3+} + 3 \text{Zn}$ , one mole of  $\text{Zn}^{2+}$  gains two moles of electrons when it is reduced to  $\text{Zn}$  according to  $\text{Zn}^{2+} + 2\text{e}^- \rightarrow \text{Zn}$ , so one mole of  $\text{Zn}^{2+}$  is two equivalents and one equivalent of  $\text{Zn}^{2+}$  is 0.5 moles of  $\text{Zn}^{2+}$ .

The **equivalent weight** is the mass of one equivalent. For example, the equivalent weight of  $\text{Al}$  in the preceding reaction is one-third of its molar mass.

The **normality** of a solution is the number of equivalents of solute per liter of solution. In the preceding reaction, a 3.0 M  $\text{ZnSO}_4$  solution is 6.0 N, since one mole of zinc ion is two equivalents.

Since the number of moles of electrons gained and lost are equal in a balanced redox reaction, **one equivalent of oxidizing agent always reacts with one equivalent of reducing agent.**

*Problem:* (a) Find the normality of a 4.0 M  $\text{KMnO}_4(\text{aq})$  solution for a reaction in which one product is  $\text{Mn}^{2+}(\text{aq})$ . (b) Find the normality of a 4.0 M  $\text{KMnO}_4(\text{aq})$  solution for a reaction in which one product is  $\text{MnO}_2(\text{s})$ . Answers: (a) 20.0 N; (b) 12.0 N.