CHEM 1062: Reviewing for the American Chemical Society (ACS) Standardized Final Exam

The CHEM 1062 Final Exam will be a full-year standardized exam written by the ACS. The goal is to see how well students know and understand chemistry, and to see how well the students compare to other students across the country. There is not a huge emphasis on math problems, but more so than the standardized exam administered at the end of CHEM 1061 this past fall. While the exam covers the entire year, many topics covered in your first semester of chemistry have been used throughout your second semester. Some of the topics, such as gases and atomic theory, have been used less, but should be relatively easy to review for the final now that you have almost completed the sequence and text.

Because the exam covers what you know and understand, the best way to review and study for the exam may be to go over previous exams in this course and end-of-the chapter questions. As with the exams in this course, there are no direct questions on definitions or terms. However, you are expected to know chemistry vocabulary. There will, of course, be things which we emphasized a lot which will only show up briefly on the final exam and vice versa. However, if you understand the material, you should be able to reason through things which you don't remember as well.

The exam has 70 multiple choice questions, each with four choices. You will be given 110 minutes – the exam is timed. Programmable calculators are not permitted on the exam. Please remember to bring a non programmable calculator to use on the exam. If you don't have one and cannot borrow one from a friend, let me know ASAP and I'll see what I can do.

What is provided for you?

- A comprehensive list of abbreviations and symbols
- The values of numerous constants used throughout the course
- Periodic Table (just like the ones you have received in class)
- Arrhenius Equation, Graham's Law of Effusion, Nernst Equation, Integrated Rate Law Equations

Directions

- You may NOT make marks in the exam booklet.
- Answers will be placed onto an answer sheet using a soft #2 pencil.
- All calculations must be done on the scratch paper provided.
- Each question has only one correct answer and has four choices.
- Your score is based solely on the number of questions answered correctly**. It is to your advantage to answer every question.**

Strategies

- **Don't allow yourself to get stuck on a single problem.** If you don't know how to do it, move along and go back to it later.
- Remember, your score on the final depends on your percentile ranking – there will be several students across the nation that were unable to perform the same problems.
- Consider writing answers onto scratch paper and transferring several onto answer sheet at one time.
- Spend the least time studying what you know well and the most time studying what you DON'T know well.

Things you are expected to know (*items in italics are first-semester topics*):

- basic chemistry vocabulary/terminology (Look at the end of each chapter for Important Terms given in **bold**)
- intermolecular forces, lattice energy, phase transitions, relation of b.p. and m.p. to intermolecular forces, phase diagrams, types of solids, unit cell calculations
- types of solutions, solution concentrations (molarity, molality, %, mole fraction), solubility curves, colligative properties, colloids, solubility curves for gases vs. curves for solids
- kinetics, experimental determination of rate, determining the rate law using the initial rate method, rate constants, elementary reactions, catalysis, reaction mechanisms, collision & transition state theory, activation energy, concentration-time calculations, temperature and rate, half-lives, graphical determinations of reaction order and rate constant, potential energy diagrams
- chemical equilibrium, equilibrium constant, reaction quotient, LeChatlier's Principle, predicting reaction direction, calculating equilibrium concentrations, ICE tables
- acid-base theories: Arrhenius and Bronsted-Lowry, acid-base strength and relation to molecular structure, self-ionization of water, and pH , *strong and weak acids and bases*
- acid & base ionization equlibria, polyprotic acids, salt solutions, common ion effect, buffers, titration curves
- solubility product constant, common ion effect, pH and solubility, precipitation calculations, *solubility rules, particularly for ions for which there are no exceptions to the rule*
- 2^{nd} & 3^{rd} laws or thermodynamics, entropy and ΔS, free energy and ΔG, spontaneity, relation to the equilibrium constant, work, *state function, extensive property, enthalpy and ΔH, Hess's Law, specific heat capacity*
- balancing redox reactions, voltaic and electrolytic cells, cell notation, emf, E_{cell}, electrode potentials, *oxidation numbers (know your rules), oxidizing and reducing agents,* strength of these agents, applications of electrochemistry, electrolysis
- fission, fusion, radioactivity, nuclear bombardment reactions, radioactive decay, half-lives, mass-energy calculations, *isotopes and nuclide symbols, mass numbers and atomic weights, subatomic particles*
- *chemical/physical change/properties, significant figures, SI units and prefixes*
- *nomenclature – polyatomic ions and Greek prefixes, molecular compounds, ionic compounds, acids, binary compounds, ion charge based on position in periodic table, diatomic elements*
- *completing and balancing combustion and double replacement reactions, net ionic equations, spectator ions, molecular equations, gas-producing reactions*
- *basic stoichiometry – molar masses, molar ratios, limiting reactant, percent composition, molarity, percentage yield, empirical and molecular formulas*
- *gas laws: empirical, ideal, effusion, partial pressures, STP, kinetic-molecular theory, barometers and manometers*
- *energy, frequency, and wavelength, emission spectra, electron configurations, orbital diagrams, quantum numbers (n, l, m_l, m_s)*
- *periodic trends (atomic radii, ionization energies, electronegativities, ionic radii)*
- *Lewis structures, resonance, formal charges, bond polarity, exceptions to octet rule, bond order*
- *VSEPR model: hybridization, polarity of molecules, lone pairs, bonding pairs, σ and π bonds*
- g/cm^3 may be written as $g \cdot cm^{-3}$ and $\frac{L \cdot atm}{mol \cdot K}$ may be written as $L \cdot atm \cdot mol^{-1} \cdot K^{-1}$

Know the following equations:

	$d = \frac{m}{V}$	$\Delta H^o = \Sigma n \Delta H^o_f$(products) - $\Sigma n \Delta H^o_f$(reactants)
	$M_1V_1 = M_2V_2$	$\Delta G^o = \Sigma n \Delta G^o_f$(products) - $\Sigma n \Delta G^o_f$(reactants)
	$PV = nRT$	$\Delta S^o = \Sigma n \Delta S^o$(products) - $\Sigma n \Delta S^o$(reactants)
	$q = m \times s \times \Delta T$	$\Delta T_f = K_f c_m$ and $\Delta T_b = K_b c_m$
	Calculating Molarity, molality, %, mole fraction	Formulas for equilibrium constant and reaction quotient
	$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$	$[H_3O^+][OH^-] = K_w = 1.0 \times 10^{-14}$
	q (system) = -q (surroundings)	pH = -log$[H_3O^+]$
	$\Delta G^o = \Delta H^o + T\Delta S^o$	pOH = -log$[OH^-]$
	$\Delta G^o = -RT \ln K$	pH + pOH = 14.00
	$\Delta G^o = -nFE^o_{cell}$	pH = pK_a + log $\frac{[\text{base}]}{[\text{acid}]}$
	$E^o_{cell} = \frac{0.0592}{n} \log K$	$K_aK_b = K_w$
	$t_{1/2} = \frac{0.693}{k}$	Rate = kN_t
	$\ln \frac{N_t}{N_0} = -kt$	$\Delta E = (\Delta m)c^2$

How Your Final Exam Score Will Be Determined

The table below shows how raw scores on the ACS exam will be converted to scaled final exam scores. The ACS standardized exam has 70 questions, two of which are on material we did not cover over the course of two semesters (resulting in a slight adjustment from the national norms).

In the event you are unfamiliar with how percentiles work, an 84^{th} percentile means that you scored higher than 84% of the students on the national norms and a 25^{th} percentile means that you scored higher than 25% of the students taking the same exam on the national norms. Students scoring in the 80^{th} to 100^{th} percentile will be assigned an "A" score on the final, the 60^{th} to 79^{th} percentile will be assigned a "B", the 40^{th} to 59^{th} percentile will be assigned a "C", the 20^{th} to 39^{th} percentile will be assigned a "D", and the 0^{th} to 19^{th} percentile will be assigned an "F".

Raw Score	Percentile Ranking	Scaled Percentage	Scaled Final Exam Score
70	100	100	200
69	100	100	200
68	100	100	200
67	100	100	200
66	100	100	200
65	100	100	200
64	100	100	200
63	99	99.5	199
62	99	99.5	199
61	99	99.5	199
60	98	99	198
59	97	98.5	197
58	96	98	196
57	95	97.5	195
56	94	97	194
55	92	96	192
54	91	95.5	191
53	89	94.5	189
52	88	94	188
51	86	93	186
50	82	91	182
49	78	89	178
48	76	88	176
47	72	86	172
46	69	84.5	169
45	66	83	166
44	63	81.5	163
43	60	80	160
42	56	78	156
41	53	76.5	153
40	50	75	150
39	47	73.5	147
38	43	71.5	143
37	40	70	140
36	37	68.5	137
35	34	67	134

Raw Score	Percentile Ranking	Scaled Percentage	Scaled Final Exam Score
34	31	65.5	131
33	27	63.5	127
32	25	62.5	125
31	22	61	122
30	19	59.5	119
29	17	58	116
28	14	55	110
27	12	54	108
26	10	52	104
25	9	50	100
24	7	48	96
23	6	47	94
22	4	46	92
21	3	45	90
20	2	44	88
19	2	43	86
18	1	42	84
17	1	41	82
16	0	40	80
15	0	39	78
14	0	38	76
13	0	36	72
12	0	34	68
11	0	31	62
10	0	28	56
9	0	25	50
8	0	23	46
7	0	20	40
6	0	17	34
5	0	14	28
4	0	11	22
3	0	8	16
2	0	5	10
1	0	2	4
0	0	0	0