Competencies for CHEM 1110: summary

KEY:

text (Chang)	**delivery method**	**evaluation method**
x.y where	l = lecture	T = lecture test
x = chapter	n = notes	Lx = lab number x (labs are also delivery methods)[1]
y = section	v = video tape or internet streaming video available	F = final exam
		CI = critical item question or lecture test

old item	**Performance/Task:** The student will:	text sections	delivery method	eval. method
	General			
1	Know the definitions and characteristics of "science" and "chemistry."	1.2	l/n/v	T
2	Be able to describe the scientific method and the distinctions between "hypothesis", "theories" and "laws"	1.3	l/n/v	T
3	Know the definitions of: "substance" , "homogeneous mixture", "heterogeneous mixture", "element" and "compound"	1.4	l/n/v	T
4	Be able to distinguish between the three major phases of matter, solids, liquids and gases by their specific properties	1.5	l/n/v	T
	Unit Conversions			
5	Know the SI base units and unit symbols for mass, length, temperature, amount, time and charge and the unit prefixes M, k, c, m, µ, and n	1.7	l/n/v	T/L2
6	Know and be able to apply the principles of quantity calculus (i.e. unit factor.)	1.9	l/n/v	T/L2
7	Know how to interconvert between temperature in degrees celcius and temperature in kelvins	1.8	l/n/v	T
8	Know the equation which defines density and be able to use it in calculations.	1.7	l/n/v	CI/L3
	Significant Figures			
9	Know what is meant by significant figures (or digits) and how to express this properly in a written number.	1.8	l/n/v	T/L2
10	Know how to determine the correct number of significant figures when adding, subtracting, multiplying and dividing quantities.	1.8	l/n/v	T/L2
	Introduction to Atomic and Molecular Structure			
11	Know the characteristics of charge and mass of protons, neutrons and electrons.	2.2	l/n/v	T
12	Know the composition and general construction of atoms and how in general atoms are related to elements, isotopes and compounds.	2.2	l/n/v	T/L4
13	Be able to write and interpret the nuclear symbol conventions, eg. ^{2}H,	2.3	l/n/v	T

14	Be able to distinguish between ionic and covalent compounds and be able to write their chemical symbolism	2.5, 2.6	l/n/v	T
15	Be able to describe and recognize an acid or base by the Arrhenius definition	2.7	l/n/v	T
16	Be able to name simple common ionic and covalent compounds .	2.7	l/n/v	T
Avogadro's Number, N_A, Molar Mass, M, and Moles, n				
17	Be able to obtaining the molar masses, M, from the periodic chart.	2.6, 3.1	l/n/v	CI/L4
18	Be able to interconvert between moles and grams and numbers of atoms or molecules.	3.2, 3.3	l/n/v	CI/L4
19	Be able to interconvert between a molecular or ionic formula and percent composition and from percent composition to empirical formula.	3.5, 3.6	l/n/v	T/L4
20	Know what is meant in chemistry by % and how to calculate or interconvert.	3.5	l/n/v	T/L2
Reaction Stoichiometry				
21	Know what is meant by a chemical reaction and the symbolism used to describe a reaction	3.7	l/n/v	CI/L4
22	Be able to do reaction stoichiometry problems if given a reaction.	3.8, 4.6	l/n/v	T/L5
23	Be able to do a limiting reactant stoichiometry problem.	3.9	l/n/v	T/L5
24	Know the definition of percent yield and be able to do problems involving percent yield	3.10	l/n/v	T/L5
Solutions, Solution Reactions and Solution Stoichiometry				
25	Be able to describe the properties of solutions, both electrolytic and non-electrolytic	4.1	l/n/v	T
26	Be able to recognize a precipitation reaction	4.2	l/n/v	T
27	Know what spectator ions are and how to identify them	4.2	l/n/v	T
28	Be able to recognize an "overall reaction" and be able to describe its usefulness for measurement purposes.	4.2	l/n/v	T
29	Be able to write and recognize net ionic reactions and be able to describe its usefulness for chemical reactions.	4.2	l/n/v	T
30	Be able to describe the Bronsted-Lowery acid-base reaction and identify the conjugate pairs	4.3, LM	l/n/v	T
31	Know the rule for oxidation number and be able to assign oxidation numbers to atoms in compounds	4.4, LM	l/n/v	T
32	Be able to name compounds by the IUPAC convention based upon oxidation numbers.	LM	l/n/v	T
33	Know the definition of molarity and be able to interconvert from grams or moles of solute and liters of solvent to molarity	4.5	l/n/v	CI/L6 /L11
34	Be able to calculate concentrations in a solution dilution problem	4.5	l/n/v	CI/L6 /L11
35	Be able to do calculations involved with titrations.	4.7, 4.8	l/n/v	CI/L11 /L12
Naming and Oxidation Numbers				

36	Know the rules for determining oxidation numbers and be able to apply them.	4.4	l/n/v	T
37	Know the definition of and be able to recognize a redox reaction.	4.4	l/n/v	T
38	Know the rules for naming compounds by the IUPAC convention and be able to apply them.	L	l/n/v	T
The Perfect Gas Law				
4	Be able to distinguish the three major states of matter and know their properties (repeat)	5.1	l/n/v	T
39	Know the definition of pressure	5.2	l/n/v	T
40	Be able to use the subset of gas laws: Boyle's law, Charles' law, Amontons' law, Gay-Lussac's law, Avogadro's principle combined gas law and the Dumas method.	5.3	l/n/v	L13/ L14/CI
41	Be able to use the ideal gas law to solve problems	5.4	l/n/v	13/ L14/T
42	Know the definition of STP and the significance/use of the value 22.4 L/mol at STP.	5.4	l/n/v	T/L13
Combining the Perfect Gas Law with Stoichiometry Problems				
43	Be able to use the ideal gas equation in combination with reaction stoichiometry	5.5	l/n/v	T/L13 /CI
Dalton's Law				
44	Be able to derive Dalton's Law from the ideal gas law.	5.6	l/n/v	T/L13 /L14
45	Know the definition of mole fraction and be able to calculate it and interconvert it to other units.	5.6	l/n/v	T
46	Be able to use Dalton's Law in problem solving.	5.6	l/n/v	T/L13 /L14
47	Be able to work with vapor pressure together with Dalton's Law.	5.6	l/n/v	T/L13
Kinetic Molecular Theory				
48	Be able to describe the situation where there are independent particles as a gas and derive the expression for the molecular kinetic energy.	5.7	l/n/v	T/L9
Graham's Law				
49	Be able to derive Graham's law from kinetic molecular theory, i. e. the relationship between kinetic energy and temperature.	5.7	l/n/v	T
50	Be able to use Graham's law for various practical examples.	5.7	l/n/v	T/L10
van der Waal's Equation				
51	Be able to perform calculations using the van der Waal's equation and know the significance of the van der Waal's constants.	5.8	l/n/v	T
Theory of Atomic Structure				
52	Know what is meant by "Quantum" and be able to describe the fundamental differences between classical and quantum physics	7.1	l/n/v	T
53	Be able to describe the dual nature of matter, giving some examples of this dual nature	7.4	l/n/v	T

54	Be able describe and to give reasons for quantum numbers	7.5	l/n/v	T
55	Know what is meant by energy levels and the meaning of the four quantum numbers for an electron in an atom	7.6	l/n/v	T/L7
56	Know the selection rules for the quantum numbers of electrons in an atom.	7.6	l/n/v	T/L7
57	Know how to designate the quantum numbers by the letter designation, i. e. the electron configurations.	7.6, 7.7	l/n/v	T/L7
58	Be able to use the aufbau principle based on the hydrogen atom to give the electron configuration for any atom in its ground state..	7.8, 7.9	l/n/v	T/L7
59	Know the order of the high stability configurations and Hund's rule.	7.8	l/n/v	T/L7
Periodic Trends				
60	Know the periodic trends, the exceptions to the trends, and the logic behind both for inozation energy, electron affinity, atomic and ionic radius.	8.3-8.5	l/n/v	T
61	Know the definition of electronegativity and the periodic trends for it.	9.5	l/n/v	T
62	Be able to describe the peroxides and superoxides in terms of oxidation number and ions formed	8.6	l/n/v	T
Bond Structure				
63	Know the definition of valence electrons and how to tell how many there are for a particular atom	8.2	l/n/v	T/L7
64	Be able to use the Lewis dot structures of ionic and covalent molecules and ions using valence electrons. Know and be able to apply the rules for Lewis dot formulas give in the lab manual	9.2-9.9	l/n/v	T/L8
65	Know the definitions of an ionic and covalent compounds and how each is formed..	9.2, 9.4	l/n/v	T/L8
66	Be able to explain the reason for the formation of ionic or covalent compounds based on the tendency to obtain highly stable electron configuations	9.3	l/n/v	T
67	Be able to describe the bonding involved in a covalent compound including the possibility of double and triple bonding.	9.4, 10.5	l/n/v	T
68	Know the definition of lone or unshare electron pair and how to show this in the Lewis dot structure	9.4	l/n/v	T/L8
69	Be able to predict whether a compound is ionic or covalent based upon electronegativity and periodic table position.	9.5	l/n/v	T/L8
70	Be able to distinguish between hydrogen compounds with H having an oxidation number -1 and those with +1	9.5	l/n/v	T
71	Be able to recognize the presence of resonance and symbolize it.	9.8	l/n/v	T
Molecular Geometry				
72	Know the rules for creating hybrid orbials and be able to apply them to determine electron geometry	10.1	l/n/v	T/L8
73	From the molecular structure, be able to determine if a molecule is	9.5, 10.2	l/n/v	T/L8

	polar and, if so, what the orientation of the dipole is			
74	From the hybrid orbitals and the lone electron pairs, be able to predict the electronic and molecular geometry	10.3,10.4	l/n/v	T/L8
75	Know the definition of sigma and pi bonds and the physical appearance and how these might affect geometry (including hindered rotation)	10.5	l/n/v	T/L8
Ionic Bonding				
76	Know the definition of ionic compound formation and be able to describe what an ionic compound is	5.1-5.5	l/n/v	T
77	Be able to explain the reason for the formation of ionic or covalent compounds based on the tendency to obtain highly stable configurations.	?	l/n/v	T
78	Be able to decide whether a compound is ionic or covalent; that is, know how to tell by electronegativity difference or Periodic Table positions.	5.10	l/n/v	T
79	Be able to distinguish between the hydrogen compounds with -1 oxidation number, the hydrides, and +1, the nonmetal hydrogen compounds.	5.3, 4.3	l/n/v	T
80	Be able to write combination reactions of non-metals (including H) with metals to give principal oxidation number.	5.2-5.5	l/n/v	T
81	Be able to give the formula for the normal oxides for groups 1, 2, 3 and 13 metals.	5.6	l/n/v	T
82	Be able to describe the peroxides and superoxides in terms of oxidation number and the ions formed.	5.6	l/n/v	T
Intermolecular Forces and the Condensed Phases				
83	Be able to describe the condences phases and be able to contrast between the three states of matter.	11.1	l/n/v	T
84	Be able to describe and rank the various inter-particle forces. (London, dipole/ionc-dipole/ionic, dipole-induced dipole, "hydrogen bond")	11.2	l/n/v	T
85	Be able to describe and explain the relative boiling points and melting points from the inter-particle forces	11.2	l/n/v	T
Solid State				
86	Be able to describe some simple crystal structures for solids and do calculations based on these structures.	11.4	l/n/v	T
87	Be able to identify types of solids and describe the inter-particle forces for each type. (ionic, metallic, covalent, molecular)	11.6	l/n/v	T
Phase Diagrams				
88	Know meaning and location of the regions, boundaries and points in a phase diagram (including the supercritical fluid.)	11.8	l/n/v	T
89	Be able to describe the equalibria involved for each phase boundary and point.	11.8	l/n/v	T
90	Be able to do calculations based on the Clausius-Clapeyron equation and the associated van't Hoff plot	11.8	l/n/v	T

91	Be able to do calculations to obtain the total enthapy using heat capacities and heats of phase changes	11.8	l/n/v	T
92	Be able to describe a system that is in dynamic equilibrium.	11.8	l/n/v	T
	Electrolytic Solutions			
93	Know the general characteristic of electrolytic and non-electrolytic solutions and the molecular dynamics involved	12.1,12.2	l/n/v	T
94	Given enthapies of solution, be able to describe the temperature effects involved in solubility.	12.4	l/n/v	T
95	Know the definitions of and be able to interconvert between molarity, percent concentration, molality and mole fraction.	12.3	l/n/v	T/L1
96	Be able to do calculations based upon Henry's law	12.5	l/n/v	T/L
	Colligative Properties and Mole Fraction**			
97	Know the definition of colligative properties and the dependence upon mole fraction.	12.6	l/n/v	T,L15
98	Be able to calculate mole fraction and molality (based upon particle concentrations.)	12.6	l/n/v	T,L15
99	Be able use Raoult's law in calculations.	12.6	l/n/v	T
100	Be able calculate freezing point depression and boilint point elevation.	12.6	l/n/v	T,L15
101	Be able calculate osmotic pressure.	12.6	l/n/v	T
102	Know how to modify the colligative property calculations with the total concentration for electrolytic solutions	12.7	l/n/v	T
Colloids				
103	Be able to describe the various properties of colloid systems	12.8	l/n/v	T

[1]For more details about the CHEM 1110 Laboratories see:
http:/www.genchem.net/competencies/lab1comp.html