

CHM 1046 Final Exam Study Sheet (With Chem I Concepts) Revision 12/12/06

An understanding of the following concepts is necessary if you wish to do well on the final exam. The questions on the exam will include all of these concepts. The types of problems you need to be able to do are shown in the next section.

1. Groups I and II on the periodic table (PT) include elements in which electrons are being added to the outer s orbitals of the atom. Groups III - VIII electrons are being added to p orbitals. Transition metals - electrons in d orbitals. Rare earth metals - electrons into f orbitals.
2. Stoichiometry calculations can only be done using a balanced chemical equation.
3. The speed of light (c) is equal to the wavelength (λ) times the frequency (ν or f).
4. Electromagnetic radiation comes in packets of energy called photons.
5. Planck's constant (h) is a proportionality constant identical for all types of EMR.
6. Energy changes within atoms occur in jumps of discrete amounts of energy called quanta.
7. Anions are larger than their corresponding atoms, cations are smaller than their corresponding atoms.
8. As you go down a group in the PT, atoms tend to get larger. As you go across a period, atoms tend to become smaller.
9. As you go down a group in the PT, atoms tend to have the same outer electron configuration. Going across a period represents the gradual filling of the outer energy level.
10. The greater the electronegativity difference between two atoms bonded together, the more ionic the character of the bond between the atoms.
11. Periodic trends arise from the electron configurations of the atoms of the PT.
12. STP is 760 mmHg and 0°C (273K). Standard temperature for enthalpy and electrochemical cells is 25°C .
13. A good way to describe covalent bonds is to consider an overlap of the orbitals of the atoms.
14. How do we name an ionic compound?
15. At room temperature, atoms on the Periodic Table in black are solids, those in blue are liquid, and those in red are gases.
16. Subscripts to the right of a chemical formula indicate the physical state of the substance in the reaction.
17. Equal moles of gases contain equal numbers of molecules.
18. Periods on the PT represent the gradual filling of the outermost energy level of the atoms. The period number of the element gives this energy level.
19. How do you name a covalent compound?
20. If you heat a gas at constant pressure the volume will increase.
21. The average speed of the molecules of a gas is directly proportional to the temperature.
22. How do you balance a chemical equation?
23. The Group A number on the PT is equal to the number of valence electrons on the atom.
24. Elements 6 - 10 do not normally violate the octet rule.
25. The product of pressure and volume at a constant temperature is a constant (Boyle's Law).
26. The light produced by excited atoms comes in a series of specific colors or spectral lines.

27. The formula weight or molecular weight is the sum of the atomic masses (atomic weights) of all atoms in the chemical formula.
28. The electron cloud around an atom is responsible for most chemical and physical properties except for mass and density.
29. How do you name polyatomic ions and the acids derived from them?
30. The highest electronegativities are found in elements near fluorine on the PT.
31. Atoms can share one, two, or three electron pairs.
32. An acid plus a base makes a salt plus water.
33. The half-life of a radioactive element cannot be affected by chemical or physical means.
34. The mass of one mole of an element is equal to the atomic weight in grams.
35. Attaching a metal with a larger negative standard reduction potential to another metal can protect the second metal from corrosion (cathodic protection).
36. The voltage of a battery is determined by the components of the redox reaction, the capacity is determined by the quantity of the components.
37. How does the loss of each of the radioactive particles affect the composition of the nucleus?
38. Oxidation takes place at the anode, reduction takes place at the cathode.
39. How do we write the cell notation of an electrochemical cell.
40. What is the meaning of the Standard Reduction Potential and how does it relate to oxidation and the number of electrons that an atom loses?
41. What is meaning of the Nernst Equation and how is it used?
42. Isomers are compounds with the same molecular formula but a different arrangement of the atoms (look it up).
43. The greatest dipole moment (polarity) is caused by the most uneven distribution of electronegative atoms in a compound.
44. Carbon forms four bonds and hydrogen forms only one bond. (Lewis structures)
45. What is an organic acid, ester, ether, and aldehyde?
46. Explain the relationship between hydrogen bonding and physical properties like boiling point. The greater the electronegativity difference between the atom and the hydrogen bonded to it, the greater the strength of hydrogen bonds it may form.
47. In one half-life of a radioactive element, one half of the atoms will release their radioactivity and change to a new element. After two half-lives one fourth remains, etc.
48. A balanced nuclear equation accounts for all protons, neutrons, and particles.
49. In a cubic crystal like NaCl, each ion is surrounded by six ions of the opposite charge.
50. How do you calculate the molecular weight from unit cell data?
51. When a solute is dissolved in a liquid the vapor pressure of the liquid is decreased.
52. The total vapor pressure of a solution is equal to the sum of the vapor pressures of each component in the mixture multiplied by the mole fraction of that component.
53. A Bronstead acid is a proton donor and a Bronstead base is a proton acceptor.
54. In a solution of a salt of a weak acid in water, the weaker the conjugate acid the higher the pH of the resulting solution (if all concentrations are equal).
55. What is the pH of a solution of a strong base at a given concentration.
56. When determining the number of moles in a certain number of grams of a hydrated ionic compound, one must include the weight of the water in the formula weight of the compound.

57. Assuming the ions separate completely, the freezing point depression of a solution of a salt that separates into two ions will be twice the depression of an equal concentration of a substance that does not ionize.
58. How do you calculate the molarity of a solution?
59. As one goes down a Group on the right side of the periodic table, the strength of the conjugate acid of the ion increases. As the number of oxygen atoms in a polyatomic ion decreases, the strength of the conjugate acid of the ion also decreases.
60. A Lewis acid is an electron pair acceptor, a Lewis base is an electron pair donor.
61. In an equilibrium gas reaction, an increase in pressure will shift the equilibrium in the direction that favors the fewest number of molecules.
62. The K_{sp} of a substance is equal to the product of the concentrations of the ions formed raised to the power of the coefficient of each term in the balanced equation. (Problem)
63. Given the K_a of a weak acid and the concentration of the acid in aqueous solution, determine the hydrogen ion concentration or pH.
64. Calculate a K_a of a weak acid given the pH and concentration of a solution.
65. How do you write the expression for the K_c of a gas phase reaction?
66. Moles of metal times #e⁻/mole times Faraday's constant equals Coulombs (Faradays).
67. Balance a REDOX equation in acidic or alkaline solution.
68. What happens at the anode and cathode in an electrolytic cell?
69. Coulombs equals amperes times seconds.
70. The total potential of a cell is equal to the difference in the potentials of the two half-reactions occurring in the cell.
71. The more negative a standard reduction potential is the more likely the substance is to be oxidized. A substance with a higher positive reduction potential can oxidize another substance with a lower positive or negative reduction potential.
72. What are the meanings of all the terms in the Arrhenius Equation?
73. The enthalpy change of a reaction can be calculated by subtracting the bond energies of the products from the bond energies of the reactants. Bonds formed - bonds broken.
74. The molar heat capacity is the amount of heat necessary to raise the temperature of one mole of a substance 1°C.
75. The more random the system the higher the entropy.
76. Use Hess's Law to determine the enthalpy change of a reaction given standard enthalpy changes of other reactions that can be combined to give the reaction you desire.
77. Given kinetic data, how do you determine the rate equation for the reaction?
78. Recognize a few complex ions that are commonly formed.
79. Almost the entire mass of an atom is contained within the nucleus, electrons contribute an insignificant amount to the total mass of an atom.
80. Pure covalent bonds occur when there is equal sharing between atoms. Polar covalent bonds occur when the sharing is not equal.
81. Oxidation is the loss of electrons from an atom or group of atoms, reduction is the gain.
82. The oxidation number of a free element is zero. The oxidation number of a monoatomic ion is the charge of the ion. The oxidation number of oxygen is -2 except in peroxides (-1). The oxidation number of H is +1 except in hydrides (-1). The sum of the oxidation numbers of all atoms in a compound is zero. The sum of the oxidation numbers of all atoms in an ion is equal to the charge of the ion.
83. The oxidizing agent in a reaction gets reduced, the reducing agent gets oxidized.

84. The amount of heat necessary to raise the temperature of an object one degree Celsius is called the heat capacity. The amount necessary to raise the temperature of one gram of a substance one degree Celsius is called the specific heat.
85. $PV=nRT$
86. Ionic compounds = a metal plus a nonmetal, electrons are transferred, ions are formed.
Covalent compounds = nonmetals sharing electrons.
87. Molar concentration = moles of solute / liters of solution
88. Hess's Law states that the total enthalpy change (ΔH) of a reaction is independent of the path from reactants to products.
89. The atomic number is equal to the number of protons in the nucleus.
90. The number of neutrons in the nucleus of an atom is equal to the mass number minus the atomic number.
91. The mass number is equal to the sum of protons and neutrons in the nucleus.
92. The mass of an atom is equal to the gram atomic mass divided by Avagadro's number.
93. The average speed of the particles of a gas increases as the temperature increases.
94. Standard pressure is equal to 1 atm, 760 T, 760 mmHg, 101,325 Pa, and 14.7 lbs/in².
95. According to the Pauli Exclusion Principle no two electrons on any single atom can have the same four quantum numbers.
96. An acid plus a base yields a salt plus water.
97. Noble gases have complete outer s and p orbitals.
98. When an atom absorbs a photon of EMR its energy increases by an amount exactly equal to the energy of the absorbed photon (quantum leap).
99. Fluorine has the highest electronegativity (EN), Francium the lowest EN.
100. The formula weight (formula mass or molar mass) of an ionic compound is the sum of the atomic masses of all of the atoms contained in the empirical formula of the compound.
101. Boyle's Law says that the product of volume and pressure for a fixed amount of an ideal gas at a fixed temperature is a constant number. $PV=k$
102. A small "aq" shown to the right of a formula in a chemical equation indicated that the chemical compound is dissolved in water.
103. The first bond between any two atoms results from the "end-to-end" overlap of orbitals and is called a sigma (σ) bond. Multiple bonds arise from the "side-to-side" overlap of unhybridized orbitals and are called pi (π) bonds.
104. C, N, O, and F will not violate the octet rule to form stable compounds. Any violation results in a highly unstable species that immediately reacts to form a new species with an octet.
105. Two repulsions = sp hybridization = linear electronic arrangement (EA) = 180°
Three repulsions = sp² hybridization = trigonal planar EA = 120°
Four repulsions = sp³ hybridization = tetrahedral EA = 109.5°
Five repulsions = dsp³ hybridization = trigonal bipyramidal EA = 120° & 90°
Six repulsions = d²sp³ hybridization = octahedral EA = 90°
106. If the central atom has no unshared electron pairs then the EA and the shape are the same.
If there are unshared electron pairs, the shape and the EA will be different.
107. H₂, N₂, O₂, F₂, Cl₂, Br₂, and I₂ are all diatomic elements.
108. Given a chemical reaction written out in words and an amount of one of the reactants (in grams or moles), determine the number of grams or moles of one of the products produced.

109. Given the total pressure of a mixture of gases and the number of moles of each component, determine the partial pressure of any given component.
110. Given an unbalanced equation, determine the coefficient for a given product or reactant in the balanced equation.
111. Given the volume of a gas collected over water at a given pressure and temperature, determine the volume of the dry gas at STP.
112. Given the number of moles and volume in liters, determine the molarity of a solution.
113. Determine the mass of one atom of a given element.
114. $1 \text{ mole} = 1 \text{ molar mass} = \text{Avogadro's number of objects}$: Given one component of the relationship, determine any one of the other two.
115. $PV = nRT$: Given all but one variable, solve for the value of that variable.

You are expected to know how to write formulas of chemical compounds. Of course you should know the symbols of the common elements. You should know how to determine the valence of elements and should know the formulas and valences of the common polyatomic ions. You should also know the valence of transition elements such as Fe, Cu, Ag and for Hg, Pb, and Sn. Many of the problems on the exam use the names of compounds and not the formulas. You must write a balanced equation to solve the problem so if you don't know the symbols and polyatomic ions you will be in trouble.

Because the study sheet above was prepared directly from the rough draft of the final exam, any student who does not spend a substantial portion of their study time trying to make sure they completely understand the concepts above will be doing themselves a grave disservice. The items above cover the concepts you will need to answer all the questions on the final exam. However, the questions themselves may be worded differently from the way they appear on this sheet. Not all concepts on this sheet may appear as questions on the final exam, but any question that does appear on the exam will have also appeared on this sheet.