.3 Chemistry – First Semester Review

Final Exam

a. Be in class 5 minutes early. First bell is at 1.5 you'll have no more than 2 hours.
b. Remember the exam is 25% of your semester grade.
c. Bring your calculator, or you may borrow a calculator while the supply lasts.
d. You will be provided with a Scantron pencil, a periodic table, and electronegativeities and a list of equations used in the semester, uncommon conversions and activity series.

(I) Matter & changes (introduction)

- this is the chapter that you took notes on during the 1st week of school, "big" parts of this include:
  - definitions of bold-lettered terms (some you see below)
  - chemical changes vs. physical changes
  - definition of matter; mixtures vs. pure substances
  - scientific method

(II) Measurements

- metric units & conversions
- unit analysis
- precision, accuracy, and sensitivity
- significant figures, rules for calculations
- fundamental and derived units
- % error calculations

(III) Atomic structure

- finding p^+, n^0 , and e^- for atoms and locations of each
- isotopes and average atomic mass calculations
- Avogadro's number
- what atomic mass means (#p^+ + #n°, comparison to C-12, grams per mole of an element)
- mass to moles to # of atoms calculations
- element names and symbols
- properties of light and how e- structure relates to that
- λ, ν, E calculations for light (c and h and equations will be given)
- electron configuration and orbital diagram of elements including previously mentioned exceptions and noble gas shortcuts
- e- configurations for ions, predicting likely ion charges for elements

(IV) Periodic Table

- regions on the periodic table and their general properties, period vs. group/family
- trends on the periodic table (electronegativity, ionization energy, and atomic radius/size)
- how atomic size changes when atoms become ions
- finding valence electrons & predicting likely ion charges

(V) Compounds

- how bonding happens; ionic, covalent, polar covalent, metallic, network
- finding bond type using electronegativity
- general properties of different bonding types
- ionic compound naming and formulas
- determining formula mass and using it for conversions
- % composition, % to formula, empirical and molecular formula calcs
- Lewis dot diagrams for cov. compounds, including ions and resonance

- VSEPR designations (ABE) and molecular geometry
- determining overall polarity for covalent covalent compounds
- intermolecular attractions: H-bonding, dipole-dipole, dispersion (London) forces and why these occur

(VI) Reactions

- writing and balancing chemical equations
- recognizing reaction types
- predicting products for reactions including using activity series for single replacement and solubility rules for double replacement
- CHOPS NAAAA (solubility)
- writing ionic and net ionic equations
- stoichiometry (regular and limiting reactant problems)

1. Identify the following terms: (Don't spend a lot of time writing definitions, but rather be able to use them in context of chemistry and the relationship of one to another or theory use in problem solving) density, solids, liquids, gases, energy, atom, element, compound, diatomic, monatomic, endothermic, exothermic, molecule, formula unit, precipitate, crystalline, Quantum Theory—energy levels (shells), sublevels, orbitals; isotope, mass number ($p^+ + n^0$ for one isotope) , atomic number, atomic mass (average), nucleus, group or family, period, stable octet, the Octet Rule, ion, polyatomic ions, Hund's Rule, polar (dipole) molecule,), wavelength (lambda - λ), frequency (nu - ν), hydrate, anhydrous, photon, Planck's constant - h,

2. Differentiate the following;
a. physical and chemical properties
b. mixtures and compounds
c. metals, nonmetals, and metalloids
d. physical, chemical, and nuclear changes
e. quantitative and qualitative analysis
f. representative elements, transition elements, and inner transition (rare earth) elements
g. alkali metals, alkaline earth metals, halogens, noble (inert) gases
h. periodic group/family and periodic period/series
i. active nonmetal and active metal (also as related to ionization energy/electronegativity)
j. metallic, ionic, and covalent
k. polar and nonpolar covalent bonding
l. inter- and intra- molecular forces
m. types of crystalline solids and their properties—ionic, metallic, macromolecular (covalent network), and molecular

3. Review the metric and SI systems, and unit analysis changing from metric to English

4. What is the atomic theory?

5. Identify all of the relationships relating the following characteristics of electromagnetic radiation: Energy, frequency, and wavelength.

6. Be able to read the periodic table for the type of element and the trends in the properties of the elements, and know the chemical similarities that exist for the members of the same families.

7. what does a s orbit look like? a p orbital?

8. Give the VSEPR formulas (ABE), for compound or ions with each of the following shapes and relate the shape to molecular polarity:
a. linear b. bent c. triangular (trigonal) planar d. triangular pyramidal e. tetrahedral

Problems:

1.Convert each of the following quantities to the units indicated:
a. 14.7 cm = _______ mm   b. 227 g = _______ pounds   c. 2.64 qt = _______ L

2. The approximate diameter of a given type of atom is 3.0 A. Express this in feet. (Note: 1m = $1x10^{10}$A)

3. Convert the following: a. 40.0^oF = ________ K   b. 300. K = _________^oF

4. The density of solid calcium sulfate is 2.45 g/mL. What volume will 1.00 mole of this compound occupy?

5. How many significant digits (figures) are there in the following numbers?
a. 70400 cm   b. 7040. cm   c. 65.00 mg   d. 0.05600 g   e. 0.00005600 kg

6. Write the above numbers in scientific notation.

7. How many significant digits will there be in each of the following answers? What are the correct units in each example?   a. 7.6985 g/ (235.0 cm x 45.2 cm)
b. 45 mL x 760. mm / 745 mm   c. 21.53 mm + 4.897 cm

8. What is the energy of the electromagnetic radiation with a wavelength of 662 nm?

9. Find the average atomic mass of an element if 51.83% of the atoms occur in nature have mass 106.905 u and 48.17% of the atoms have mass 108.905 u.

10. What are the numbers of electrons, protons, and neutrons for each of the following?

a. $^{32}_{16}S$ b. $^{48}_{22}Ti$ c. $^{127}_{53}I$

11. Make the conversions indicated below:

a. 1 mole of $Al_2(SO_4)_3$= ________ g $Al_2(SO_4)_3$

b. 120 g CO_2= ________ moles CO_2

c. 0.0372 mole CO= _________ molecules CO

12. How many sublevels are found in each of the energy levels 1.2.3.4 and 5)?
How many orbitals are in each sublevel and energy level?

13. What are the electron configuration and orbital diagram for: K, Fe, Sn, and Ag?

14. What is the electron configuration for an element of atomic number = 14?
Identify the element. Draw the electron dot (Lewis dot)?

15. What elements are identified by the following expressions?
a. $[Ar]3d^{10}4s^23p^6$ b. $[Xe]\ 4f^{14}5d^{10}6s^26p^2$

16. Write the electron configuration (electron dot) for: a. Sr   b. Sr^{2+} c. Br   d. Br^{-1}

17. Consider the various trends observable and periodic properties, predict the following:

a. the largest atom a. N or O   b. Na or P   c. C or Si   d. K or Cs

b. the largest ion   a. Li^{+1} or Na^{+1} b. Na^{+1}, Mg^{+2} or Al^{+3} c. O^{2-} or S^{2-}

c. the largest, atom or ion   a. Cl^{-1} or Cl   b. K^{+1} or K

d. the highest electronegativity   a. Na or Mg   b. Mg or Ca   c. F or Ne   d. O or S

18. What <u>type of bond</u> would form if atoms of the following elements combined?
a. Mg and O b. P and H c. Cl and P d. Na and F

19. Draw the Lewis structure for each of the following and indicate the molecular shape of each. Identify whether the molecule is symmetric or not, and if it is polar or not.

a. SO_2 b. CO_2 c. CCl_4 d. HCI e. H_2O f. NH_3

20. Determine the formula weight for H_3PO_4

21. What is the percent composition of the above compound?

22. Cluster problem. a. What is the percent of water in $ZnC_2O_4 \cdot 2H_2O$?
b. If experimental data showed the percentage of water to be 21.0%, what is the percentage error? c. What is the name of the compound?

23. Write the name for each of the compounds. a. CBr_4 b. Ag_2SO_4 c. $Fe(NO_3)_2$
d. CuI_2 e. $AlPO_4$ f. $SbBr_3$ g. P_4O_{10}

24. Write correct formulas for each compound: a. potassium bicarbonate
b. lead (ll) sulfate c. Lead (IV) iodide d. sodium nitrite e. mercury (l) sulfite
f. trinitrogen pentachloride

25. The analysis of a compound shows 21.21% N, 6.06% H, 24.24% S, and 48.48% O. Find the simplest (empirical) formula. If the formula weight is 132, what is the true molecular formula?

26. How many kilograms of iron may be recovered from 1000. kg of Fe_2O_3?
27. How many grams of sodium hydroxide are needed to react with hydrogen sulfate in preparing 60.0 g of sodium sulfate? Water is the other product.

28. Complete and balance each of the following equations. Identify the type of chemical reaction.
a. Ca (s) + $CuSO_4$ (aq)→
b. K (s) + H_2O (l)→
c. $Al_2(SO_4)_3$ (aq) + NaOH (aq)→
d. $CaCO_3$ (s) + HCI (aq)→ carbon dioxide + water + calcium chloride
e. Na_2S (s) + $Ca(C_2H_3O_2)_2$ (aq)→ sodium acetate + calcium sulfide
f. magnesium (s) + hydrochloric acid (aq) →
g. ammonium hydroxide (aq) + $HC_2H_3O_2$ (aq) →
h. calcium (s) + chlorine (g) →
i. C_2H_6 + _____ →

29. Given the reaction: 2HCl (g) → H_2(g) + Cl_2(g) a. How many grams of H_2 will be produced from 146 grams of HCI? b. How many molecules of H_2? c. How many moles of Cl_2?

30. How many grams of hydrogen fluoride are produced by reacting excess hydrogen with 38.0 g of fluorine?

31. Cluster problem.
Given the reaction: $CaCO_3$ (s) + 2 H_3PO_4 (aq) → $Ca_3(PO_4)_2$ (s) +3 CO_2 (g) + 3 H_2O (l)
a. If a 50.0 g sample of calcium carbonate is allowed to react with 35.0 g of phosphoric acid, which reactant would be the limiting reagent?
b. How many grams of calcium phosphate could be produced?
c. How many moles of excess reagent would be left at the end of the reaction?