

# OTHS Chemistry PreAP – Fall Final Review

## 0-Lab Safety

Review all Katy ISD Science Safety rules – available on [www.falconchem.weebly.com](http://www.falconchem.weebly.com)

## 1-2 Measurement and Matter

*Describe the characteristics of matter and its properties, the changes it undergoes both physically and chemically, and classify matter and apply the law of conservation of mass. Energy is the driving force of all changes in matter. Apply the Laws of Conservation of Mass and Energy in a chemical reaction. Investigate heat transfer in physical processes. Introduce various calculations, including specific heat.*

### Measurement

**Vocab/Information:** density, mass, weight, length, temperature, precision, accuracy, significant figure rules, conversion factor, dimensional analysis, correct rounding based on last significant digit, measuring techniques

**Calculations/Skills:** determining # significant figures, converting #'s into scientific notation & ordinary notation, rounding using significant figures, metric conversions, density, percent error, reading lab equipment values with correct sigfigs.

### **Questions:**

- How many significant figures are in each of these numbers?  
a. 50050                                      b. 0.0004000                                      c.  $5.2040 \times 10^{-3}$
- Round off each of the numbers in question number 1 to three significant figures.
- Calculate the answers below using significant figure rules.  
a.  $8.7 \text{ g} + 15.43 \text{ g} + 19 \text{ g}$                                       b.  $4.32 \text{ cm}^2 \times 1.7 \text{ cm}$   
c.  $853.2 \text{ L} - 627.443 \text{ L}$                                       d.  $38.742 \text{ cm}^3$  divided by  $0.421 \text{ cm}$
- Express the answer to each problem below using scientific notation.  
a.  $5.3 \times 10^{-1} \text{ m} + 1.30 \times 10^1 \text{ m}$                                       b.  $(1.04 \times 10^{-3} \text{ cm})(2.300 \text{ cm})$
- Conversion problems using dimensional analysis.  
a. 4.9 cm to km                                      b. 355 g to dg                                      c. 32.0 g to mg
- A student measures the density of a solid to be  $7.67 \text{ g/cm}^3$  but the density should be  $7.324 \text{ g/cm}^3$ . What is his percent error?

$$\frac{|\text{accepted value} - \text{experimental value}|}{\text{accepted value}} \times 100$$

- What is the density of a substance with a mass of 12.9 g and a volume of  $13.98 \text{ cm}^3$ ?
- If the volume of a piece of clay is  $19.1 \text{ cm}^3$  and it has a density of  $2.20 \text{ g/cm}^3$ , what is its mass?
- A farmer wishes to buy a gift for his wife. The gift is worth 4 horses. At the local market, 3 horses are worth 5 cows, 1 cow is worth 4 hogs, and 3 hogs are worth 4 goats. How many goats must the farmer trade for this gift? (You can't trade part of a goat)
- What is the average speed in miles per hour of a sprinter who is able to run 100. m in 10.1 sec? Use dimensional analysis. (1 mile = 1.609 km)

### Matter

**Vocab/Information:** solution, chemical change, chemical property, physical change, physical property, intensive and extensive physical properties, heterogeneous, homogeneous, malleable, ductile, element, compound, mixture, solid, liquid, gas, law of conservation of mass

### Heat

**Vocab/Information:** heat, types of energy (kinetic, potential, chemical (bond), thermal), conduction, convection, radiation

### Questions:

1. Is the following extensive or intensive: boiling point, mass
2. Identify each of the following as conduction, convection or radiation:
  - a. A hot air balloon rising
  - b. Warming yourself in front of a fire
  - c. Frying food
  - d. Burning your hand on an iron
3. Which energy conversion is taking place when you build a campfire?
  - A. electrical to thermal & mechanical
  - B. chemical to electromagnetic & thermal
  - C. mechanical to electrical & chemical
  - D. nuclear to chemical & electrical

## 3-Atomic Structure and Nuclear Chemistry

Summarize the development of atomic structure and theory. This unit includes the introduction of the behavior of unstable atoms

### Atomic

**Vocab/Information:** proton, electron, neutron, atom, nucleus, mass # (A), atomic # (Z), atomic mass, isotope, masses of  $e^-/p^+/n^0$ , shorthand notation, law of conservation of mass, Dalton's Theory, experiments conducted by Rutherford and Thompson, the chronological development of the atomic model over time, calculate average atomic mass, determine the mass # (A) and atomic number (Z) of unknowns.

### Questions:

1. A sample of silver as it occurs in nature has the following isotopes with their percents: silver-107 at 52.00% and silver-108 at 48.00%. What is the average atomic mass of silver?
2. How does carbon - 13 differ from carbon - 12? How are they alike?

\*\*Complete the tables below:

| element | # p+ | # e- | # n <sup>0</sup> | atomic # | mass # of most abundant isotope |
|---------|------|------|------------------|----------|---------------------------------|
|         |      |      |                  | 21       |                                 |
|         |      | 16   |                  |          |                                 |
|         | 14   |      |                  |          |                                 |

| word format | symbol format    | atomic # | mass # | # p+ | # e- | # n <sup>0</sup> |
|-------------|------------------|----------|--------|------|------|------------------|
| carbon -13  |                  |          |        |      |      |                  |
|             |                  | 92       | 238    |      |      |                  |
|             | <sup>74</sup> Ge |          |        |      |      |                  |

## Nuclear

**Vocab/Information:** radioactivity, fission, fusion, emission, nuclide, beta – particle, beta + particle (positron), alpha particle, gamma ray, half-life (define only), emission.

Give real-life examples of fission and fusion reactions, decay series, average atomic mass calculations. Define the charge of emitted particles

**Questions:**

1. Give the symbol(s) and charge for the alpha particle, beta particle and gamma ray.
2. What type of shielding is needed for each type of radiation? Describe skin penetrance for each.
3. In the decay of Californium – 252, Lead – 208 forms after 19 different decays over millions of years. The first five decays in the sequence are:  $\alpha$ ,  $\alpha$ ,  $\alpha$ ,  $\beta^-$ ,  $\beta^-$ . What nuclide remains when these 5 decays are complete?
4. Complete the following reactions:
  - a. alpha decay of thorium-231
  - b. beta – decay of vanadium-53
  - c. beta + decay of nitrogen 12

## 4-Electrons

*Using quantum theory, electron configurations, orbital diagrams, and Lewis structures explain the arrangement of electrons in an atom. Relate the movement of electrons within atoms to the electromagnetic spectrum and calculate relationships between energy, frequency, and wavelength of the light emitted.*

**Vocab/Information:** electromagnetic radiation, speed of light, wave behavior vs. particle behavior, photoelectric effect, energy level, sublevel, orbital, spin, valence electrons, quantum, photon, Heisenberg Uncertainty Principle, Pauli exclusion principle, Hund's Rule, Aufbau Principle, # sublevels / energy level, # electrons / energy level, # electrons / sublevel, Planck, Bohr model of the atom, periodic table blocks (s p d f), ground state, excited state, electron configuration, orbital notation, noble gas (shortcut/core notation), # unpaired and paired electrons, frequency and wavelength of waves, energy of a photon

**Questions:**

- 1) Determine the frequency of light with a wavelength of 89 nm. ( $1 \text{ m} = 1 \times 10^9 \text{ nm}$ , riiiiigggh!)
- 2) Calculate the wavelength of light having a frequency of  $3.4 \times 10^6 \text{ s}^{-1}$ .
- 3) The wavelength of a beam of light is  $2.40 \times 10^{-3} \text{ cm}$ . What is the energy of one of its photons?
- 4) Write complete electron configurations for each of the following elements:
  - a) zinc
  - b) nitrogen
  - c) lithium
  - d) argon
- 5) Write noble gas configurations for the following elements:
  - a) cadmium
  - b) polonium
  - c) scandium
  - d) boron
- 6) Write electron dot notation (Lewis Dot structures) for the following:
  - a) cesium
  - b) oxygen
  - c) krypton
  - d) arsenic
- 7) Write the orbital notation for each of the following elements:
  - a) radium
  - b) neptunium
  - c) arsenic
  - d) silver
- 8) Determine the number of paired and unpaired electrons for each of the following:
  - a) molybdenum
  - b) sulfur
  - c) strontium
- 9) What happens when an atom absorbs energy? What happens when an atom releases energy it has absorbed?
- 10) What is the relationship between frequency and wavelength? Between frequency and energy?

## 5-Periodic Table

Use the historical development of the periodic table to identify and explain periodic trends, properties of chemical families, and the nature of bonding.

**Vocab/Information:** Mendeleev/Moseley's periodic tables, periodicity, period, group, family, atomic radius, ionic radius, electronegativity, first ionization energy, second ionization energy, reactivity (for metals and nonmetals), representative elements, inert, effective nuclear charge ( $Z_{\text{eff}}$ ), shielding, valence electrons, metallic/nonmetallic character, electron-electron repulsion

**Application:** identify trends using the periodic table, identify elements based on clues

### **Problem Solving:**

1. Give the location and one identifying trait of each of the following types of elements: halogens, alkaline earth metal, alkali metal, metalloid, noble gases, transition metal, nonmetal, inner transition metal
2. Explain the trend in a group and period using shielding, electron-electron repulsion and  $Z_{\text{eff}}$  nuclear charge. Then, indicate the direction of increasing values for each.
  - a. electronegativity
  - b. atomic radius
  - c. first ionization energy
  - d. reactivity of metals and reactivity of nonmetals
3. What happens to the size of an atom when it becomes an anion? When it becomes a cation?

## 6-Nomenclature

Nomenclature includes the naming and writing of formulas using the IUPAC system for ionic and molecular compounds and acids and bases.

**Vocab/Information:** anion, cation, ion, polyatomic ion, ionic compound, covalent (molecular) compound, acid, hydrate, transition metal, representative element, alkali metal, alkaline earth metal, nonmetal, monovalent, multivalent, charge, oxidation number, periodic table of elements

**Application:** naming and writing formulas for covalent (molecular), ionic, acid and hydrate compounds.

### **Questions:**

1. Name the following compounds:
  - a.  $\text{CrO}$
  - b.  $\text{MgH}_2$
  - c.  $\text{Al}_2\text{S}_3$
  - d.  $\text{HCl}_{(\text{aq})}$
  - e.  $\text{Li}_3\text{N}$
  - f.  $\text{CaCr}_2\text{O}_7$
  - g.  $\text{H}_2\text{SO}_{4(\text{aq})}$
  - h.  $\text{P}_2\text{O}_8$
  - i.  $\text{BaCl}_2 \cdot \text{H}_2\text{O}$
2. Write formulas for the following compounds:
  - a. cobalt (II) nitrite
  - b. aluminum sulfate
  - c. silicon tetrabromide
  - d. mercury (I) arsenate
  - e. nitric acid
  - f. acetic acid
  - g. magnesium sulfate heptahydrate
  - h. hydrosulfuric acid
  - i. sodium peroxide
  - j. barium hypochlorite

### **Elements & Ions**

Identify and use the elements and polyatomic ions you had to have memorized.

## 7-Mole Concepts:

The student will be able to calculate basic mole conversions, percent composition, empirical formula, molecular formula, and determination of hydrate mass in a sample.

**Vocab/Information:** mole, particle, atom, formula unit, molecule, Avogadro's number, mole ration, molar mass (gram formula mass, molecular mass), empirical formula, molecular formula, percent composition, percent by mass

**Calculations:**

- 1) In 16.0 g of ammonium chlorate find...
  - a) the number of moles of nitrogen.
  - b) the number of atoms of hydrogen
  - c) the number of ammonium ions.
- 2) Calculate the mass in grams of  $3.01 \times 10^{23}$  formula units of  $\text{Sr}(\text{OH})_2$ .
- 3) 12.5 g of  $\text{CO}_2$  gas would occupy how many liters?
- 4) Calculate the mass in grams of 2.23 mol of nitrogen molecules (Be careful, nitrogen is diatomic!)
- 5) Find the percentage by mass of nitrogen in calcium nitrate.
- 6) Calculate the percentage composition of all elements in iron (III) oxide.
- 7) Calculate the empirical formula for the following three iron ores.
  - (a) Fe 77.7 %; O 22.3%
  - (b) Fe 72.4 %; O 27.6%
  - (c) Fe 70.0 %; O 30.0%
- 8) An organic compound is found to contain 92.25% carbon, 7.75% hydrogen. If the molecular mass is 78 g/mol, what is the molecular formula?
- 9) There are two oxides of phosphorus. Calculate the empirical and molecular formulas from the following data:
  - a) P 56.4%, O 43.7%, molecular mass 220 g/mol
  - b) P 43.6% O 56.4% molecular mass 284 g/mol

## 8. Chemical Reactions

- Know indications of chemical reactions
- Balance chemical equations.
- Understand that balancing chemical equations is an application of the law of conservation of matter.
- Characterize reactions as synthesis, decomposition, double replacement, single replacement, or combustion
- Use memorized reaction types to predict the products of all types of reactions we have studied.

*Questions:* Write the reaction and **Predict** products. Balance.

1. aluminum metal and nitrogen react
2. magnesium chloride powder and oxygen
3.  $\text{C}_6\text{H}_6 + \text{O}_2 \rightarrow$
4. solid magnesium sulfide is heated
5. zinc hydroxide flakes decompose