

Review for Honors Chemistry Final Exam

[Units 1-7]

[Introductory Chemistry, Energy & Matter, Atomic Structure & Electronic Structure, The Periodic Table, Chemical Formulas & Bonding, Chemical Reactions, and The Mole]

Unit 1-Introductory Chemistry (Ch. 1-2)

1-1. List and describe the steps of the scientific method.

1-2. Define the terms "variable" and "experimental control".

1-3. Be able to compare the SI base and derived units.

1-4. Define the terms "mass" and "weight".

1-5. Know the metric prefixes on your metric (SI) table handout.

1-6. A milliliter = _____ cm^3 and a cubic meter = _____ L

1-7. Perform any of the SI conversions.

a. 95 cm = _____ dm

b. 34,600 μm = _____ dm

- 1-8.** Two students weighed the same sample on two different laboratory balances. The results were as follows (The actual mass of the sample is actually 12.1 g.):

<u>Balance A</u>	<u>Balance B</u>
12.11 g	12.1324 g
12.09 g	12.1222 g

Which balance is more precise?

Which balance is more accurate?

- 1-9.** Perform the calculations involving significant figures (digits).

- a. Identify the number of significant digits in each of the following measurements. Write the number in the space provided.

1. 520 mL _____

3. 10.002 ns _____

2. 0.0102 ms _____

4. 0.451 Pa _____

- b. Perform the following calculations, round off the answer to the correct number of significant digits, and include the appropriate units.

1. $72.60 \text{ m} + 0.0950 \text{ m} = \underline{\hspace{2cm}}$

2. $0.0890 \text{ cm} - 0.0666 \text{ cm} = \underline{\hspace{2cm}}$

3. $120 \text{ km}^2 \div 8.56 \text{ km} = \underline{\hspace{2cm}}$

- 1-10** Perform calculations involving density and percent error.

- a. If 1.35 g of aluminum occupies 0.500 cm^3 , what is the density of aluminum?

- b. Using chemical analysis, a student determines the atomic mass of titanium to be 49.20 g/mol. The periodic table lists its mass to be 47.88 g/mol. Calculate the student's percent error.

Unit 2-Energy & Matter (Ch. 1, 2, 3, 12 & 15)

- 2-1.** Define the term "energy".
- 2-2.** Compare the terms "kinetic energy" and "potential energy".
- 2-3.** Define the term calorie. What is the SI unit of energy?
- 2-4.** State the law of conservation of energy.
- 2-5.** Perform the calorie to Joule and Joule to calorie conversions on "2-1 Practice Problems".
- a. $64 \text{ J} = \underline{\hspace{2cm}} \text{ cal}$
- b. $47,500 \text{ cal} = \underline{\hspace{2cm}} \text{ J}$
- 2-6.** What is the SI scale for temperature?
- 2-7.** What is absolute zero?
- 2-8.** On the Kelvin scale, the lowest possible temperature has a value of what?
- 2-9.** Perform the temperature conversion on "2-2 Practice Problems" (See also pg. 35)
- a. $47 \text{ }^{\circ}\text{C} = \underline{\hspace{2cm}} \text{ K}$
- b. $212 \text{ K} = \underline{\hspace{2cm}} \text{ }^{\circ}\text{C}$
- 2-10.** The direction of heat flow is always from ? to ?.
- 2-11.** Distinguish between an exothermic and endothermic reaction.

- 2-12.** Perform the calorimetry calculations. How many calories (cal) of heat are needed to raise the temperature of 62.5 g of water from 7.25 °C to 81.4 °C? How many joules of heat is this equivalent to?
- 2-13.** Define the term "matter".
- 2-14.** List and describe the 4 states of matter.
- 2-15.** What is the difference between a chemical and physical change. Give an example of each.
- 2-16.** Who was the scientist who discovered the law of conservation of matter?
- 2-17.** Define the terms "element" and "compound".
- 2-18.** How is the symbol of an element written? Formula of a compound written?
- 2-19.** Define the term "mixture".

Unit 3-Atomic Structure & Electronic Structure (Ch. 4-5)

- 3-1.** Define the term "atom".
- 3-2.** What is the difference between the law of conservation of matter and the law of constant composition?
- 3-3.** What scientist came up with the "solar system" model of the atom? Describe this model.
- 3-4.** What scientist came up with the "plum pudding" model of the atom? Describe this model.
- 3-5.** List the 3 kinds of subatomic particles in an atom. What are the major characteristics of these particles?
- 3-6.** Define the terms "atomic number" and "mass number" of an atom.
- 3-7.** Define the terms "ion" and "isotope".
- 3-8.** Perform the "Atomic Structure" calculations.
- How many protons and electrons are present in a vanadium atom?
 - Write the chemical symbol for the ion with 12 protons and 10 electrons. Is this a cation or an anion?
 - How many protons, neutrons, and electrons are present in the astatine-213 atom?

d. How many protons, neutrons, and electrons are present in the $^{59}_{28}\text{Ni}^{2+}$ ion?

e. Write the **complete** chemical symbol for the ion with 84 protons, 125 neutrons, and 80 electrons.

3-9. Define and describe the 4 characteristics of all waves.

3-10. What is the speed of light?

3-11. Perform the calculations involving wavelength, frequency, and energy. (Using the wavelength and energy equations)

a. What is the frequency of a light wave with a wavelength of $3.2 \times 10^{-9} \text{ m}$?

b. What is the wavelength of a photon that has a frequency of $7.1 \times 10^{19} \text{ s}^{-1}$?

c. What is the energy of a photon that has a frequency of $4.0 \times 10^9 \text{ s}^{-1}$?

3-12. The Electromagnetic Spectrum: Know the general placement of the forms of radiation on Figure 5.5, pg. 139. Apply the terms frequency and energy to this. (Note: You were also given a handout of this.)

- 3-13.** Which scientist explained how quantization could be used to account for the line of spectra of elements?
- 3-14.** What scientist is credited with an "exclusion principle" named after himself?
- 3-15.** Compare the terms "ground state" and "excited state".
- 3-16.** Compare the shapes of "s" and "p" orbitals.
- 3-17.** Study Table 5-2 and be able to answer questions "like" the ones below.
- What sublevels are present in $n = 4$?
 - What sublevels are present in $n = 3$?
 - What is the total number of orbitals in $n = 3$?
 - What is the total number of orbitals in $n = 4$?
 - What is the maximum total number of electrons that could be held by the orbitals in $n = 1$?
 - What is the maximum total number of electrons that could be held by the orbitals in $n = 2$?
- 3-18.** The regions around the nucleus of an atom where electrons with a given energy are likely to be found are known as what?
- 3-19.** What information about electrons is given by the electron configuration of an atom?

3-20. Describe the 3 rules that govern the filling of atomic orbitals by electrons.

3-21. You should be able to write electron configurations, orbital diagrams, electron dot diagrams for atoms with atomic numbers from 1 to 20.

For each of the following elements, (a) write the electron configuration, (b) draw the orbital diagram, (c) state the number of unpaired electrons, and (d) draw the Lewis electron dot diagram.

a. magnesium

a. _____

b. _____

c. _____

d. _____

b. oxygen

a. _____

b. _____

c. _____

d. _____

Unit 4-The Periodic Table (Ch. 6)

- 4-1.** The scientist credited with the first periodic table of elements was _____.
- 4-2.** The "groups" in the periodic table are the _____.
- 4-3.** The "periods" in the periodic table are the _____.
- 4-4.** The elements in Group 1A, 2A, 7A, and 8A of the periodic table are called what?
- 4-5.** Compare the properties of metals, nonmetals, and semimetals.
- 4-6.** Those electrons that are largely responsible for an atom's chemical behavior are called what?
- 4-7.** Why are elements placed in certain "blocks" on the periodic table?
- 4-8.** What is represented by the abbreviated electron configuration of an atom of an element?
- 4-9.** In $[\text{Ar}]4s^1$ the symbol $[\text{Ar}]$ represents what?
- 4-10.** An element has the electron configuration $[\text{Ne}]3s^23p^2$. Determine this element's group.
- 4-11.** An element has the electron configuration $[\text{Ar}]4s^23d^{10}4p^5$. Determine this element's period number.

- 4-12.** Define the term "atomic radius" and describe the trend seen on the periodic table.
- 4-13.** When an atom gains or loses electrons, what happens to it?
- 4-14.** Define the term "ionization energy" and describe the trend seen on the periodic table.
- 4-15.** Define the term "electron affinity" and describe the trend seen on the periodic table.
- 4-16.** Define the term "electronegativity" and describe the trend seen on the periodic table.
- 4-17.** Based on its position on the periodic table, what common ion is likely to be formed by nitrogen (N)?
- 4-18.** Which family of metals on the periodic table are the most reactive metals?
- 4-19.** Which family of elements on the periodic table are the least reactive?
- 4-20.** In what block of the periodic table are the transition metals located?
- 4-21.** In what block of the periodic table are the inner transition metals located?
- 4-22.** Which block of the periodic table contains the semimetals?
- 4-23.** Which block of the periodic table contains the alkali metals?

- 4-24.** Suppose you have just discovered three new elements. Element 1 is a solid at room temperature, a good conductor of electricity, and lustrous. Element 2 is a gas at room temperature and a poor conductor of heat and electricity. Element 3 is a brittle solid at room temperature, a fair conductor of heat and electricity, and not ductile. Classify each of these elements as a metal, nonmetal, and semimetal.
- 4-25.** Four elements are represented by the letters J, K, L, and M. All of the elements are very active metals and have 1 valence electron. Element J is the most metallic and has electrons in 5 energy levels. Element M has a larger atomic radius than K or L but is smaller than J. Element L has a higher ionization energy than K. Identify the each of these elements by name.

Unit 5-Chemical Formulas & Bonding (Ch. 7-8)

- 5-1.** Define the terms "chemical formula" and "chemical symbol".
- .
- 5-2.** In the compound, $2\text{Be}_3(\text{PO}_4)_2$, there are _____ oxygen atoms.
- 5-3.** In the compound, $3(\text{NH}_4)_3\text{PO}_4$, there are _____ oxygen atoms.
- 5-4.** Which of the following compounds would you expect to be ionic?
- PO_2 , BrO_2 , BaO_2 , H_2O , ScO_2 , TmO_2
- 5-5.** How does a covalent bond differ from an ionic bond?

5-6. Compare the terms “empirical formula”, "molecular formula", and "structural formula".

5-7. List all of the elements that form diatomic molecules?

5-8. All compounds that are hydrated contain what chemically attached to them?

5-9. Define the term "acid".

5-10. All compounds possess this charge.

5-11. Write the names and formulas for the compounds on the "Formulas and Nomenclature" worksheet.

a. Write the formulas for the following compounds.

1. carbon monoxide

6. iron(III) oxide

2. sodium chloride

7. magnesium sulfate

3. carbon tetrachloride

8. sodium phosphate trihydrate

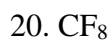
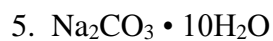
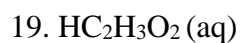
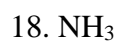
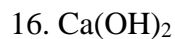
4. magnesium bromide

9. dinitrogen hexoxide

5. phosphoric acid

10. phosphorus trichloride

b. Write the names for the following compounds.



c. Write the Lewis structural formulas for the following compounds. Know how to draw a Lewis structural formula and calculate how many bonds, total valence electrons and unshared pairs (nonbonded) of electrons.

1. carbon monoxide

6. sulfur trioxide

2. carbon tetrachloride

7. sulfate ion

3. phosphorus trichloride

8. phosphate

4. water

9. NH_3 5. H_2S

10. ammonium ion

Unit 6-Chemical Equations (Ch. 9)

6-1. Define the terms "reactant" and "product".

6-3. In a chemical equation, the symbol that takes the place of the words "reacts with" is a(n)

6-4. In a chemical equation, the symbol that takes the place of the word "yields" is a(n)

6-5. Write word equations, and balanced formula equations for various reactions.
(See your notes for help in predicting reactions.)

- a.** Iron reacts with sulfuric acid to form iron(II) sulfate and hydrogen gas.
Word equation:

Balanced equation:

- b.** Sulfuric acid reacts with a solution of potassium hydroxide to produce aqueous potassium sulfate and water.
Word equation:

Balanced equation:

- c.** A solution of sodium hydroxide and oxygen gas are produced from a reaction between aqueous sodium peroxide and water.
Word equation:

Balanced equation:

- d.** Aqueous mercury(II) hydroxide reacts with phosphoric acid to produce an aqueous solution mercury(II) phosphate and water.
Word equation:

Balanced equation:

- e. Magnesium reacts with a solution of titanium(IV) chloride to produce aqueous magnesium chloride and titanium.

Word equation:

Balanced equation:

- f. Iron corrodes in the presence of air (oxygen gas) [**HINT: PREDICT PRODUCT(S)**]

Word equation:

Balanced equation:

- 6-6. In a chemical equation, the number of molecules of a given substance is indicated by what?

- 6-7. Compare synthesis, decomposition, single replacement and double replacement reactions.

Synthesis:

Decomposition:

Single replacement:

Double replacement:

- 6-8. The activity series ranks elements in order of what? How is this used to predict the products in single replacement reactions?

Unit 7-The Mole (Ch. 10,11 & 13)

- 7-1. The atomic mass of individual atoms is generally expressed in which unit?

- 7-2. The scale for expressing atomic masses is based on the mass of _____.

- 7-3.** The sum of the atomic masses in any compound is the compound's _____.
- 7-4.** How many atoms are in a sample of an element whose mass in grams is numerically equal to the atomic mass?
- 7-5.** The number of atoms of an element equal to the number of atoms in exactly 12.0 grams of carbon-12 is called a(n) _____.
- 7-6.** The lowest whole-number ratio of elements in an ionic compound is called a(n) _____.
- 7-7.** What kind of substance is represented by a formula unit?
- 7-8.** What is the symbol for Avogadro's number? What is the value of this number?
- 7-9.** In what units is molar mass typically expressed?
- 7-10.** The mass in grams of 6.02×10^{23} formula units of a substance is called its _____.
- 7-11.** The quantity of items in a mole has been given a special name in honor of what scientist?
- 7-12.** Be able to locate the atomic mass for an element on the periodic table.
- 7-13.** Be able to perform calculations involving atomic mass, formula mass and molar mass. [Hint: WATCH YOUR UNITS (formula mass and molar mass have different units)!!]
- a.** What is the atomic mass of selenium?
- b.** Calculate the formula mass of tin(II) phosphate.
- c.** Calculate the molar mass of hydrochloric acid.

- 7-14.** State and explain “Avogadro’s Hypothesis” about gases.
- 7-15.** What temperature is defined as "standard" temperature?
- 7-16.** What pressure is defined as "standard" pressure?
- 7-17.** What is the molar volume of a gas at standard temperature and pressure?
- 7-18.** What does the volume of a gas depend on (3 things)?
- 7-19.** Be able to perform any of the molar conversions and identify the conversion factors needed to perform those calculations. (See “Molar Conversions” handout.)
- a.** Calculate the number of moles of carbon dioxide (CO_2) in 138 g CO_2 .
 - b.** A container with a volume of 7.5 L contains how many moles of air at STP?
 - c.** A sample of water vapor contains 2.5×10^{19} molecules of water. How many moles of water vapor are in the sample?

7-20. Be able to calculate % Comp., Emp. Formulas & Molecular Formulas.

a. What is the percent composition BaCl₂ and H₂O in BaCl₂ • 2H₂O?

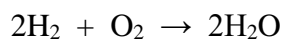
b. What is the empirical formula of a compound that is 25.9% nitrogen and 74.1% oxygen?

c. What is the molecular formula of diethyl oxalate, a solvent used in some perfumes, if the empirical formula is C₃H₅O₂ and the molar mass is 146.14 g/mol?

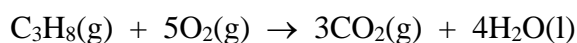
7-21. In a balanced chemical equation, the coefficients represent the relative numbers of what? (**Think!**)

7-22. In a balanced chemical equation, the molar ratio of two reactants is determined from what?

7-23 Prove that the law of conservation of mass is obeyed for the reaction below in terms of atoms, moles and mass?



- 7-24** Be able to perform any of the Stoichiometry calculations and solve *Limiting Reactant problems when appropriate (See “Stoichiometry” handout). Use the following balanced chemical equation to answer the following problems.



- a. How many molecules of propane are given in the equation?
- b. How many moles of carbon dioxide gas would be produced from 1.89 mol of oxygen?
- c. How many moles of water would be produced from 7.35 g of propane?
- *d. What mass of water would be produced when 16.3 g of propane and 25.0 g of oxygen react?
- e. How many liters of oxygen are required to produce 74.2 g of water?
- f. How many liters of carbon dioxide would be produced from 5.4 L of propane?