

First Trimester Exam

10th Grade

Chemistry

December, 2007

Read every question carefully and answer the questions based on what you are asked.

Do not leave any question blank and show your work.

You may not leave the exam early; even if you are finished, review the test until the end of the designated time.

Show your work on the paper and make sure you write units.

Please do not ask any unnecessary questions during the test.

Alireza Shirazian

Part (I)

- 1) Classify each of the following elements as an alkali metal, an alkaline-earth metal, transition metal, metalloid, halogen, or noble gas, actinide or lanthanide based on its position in the periodic table:
 - uranium _____
 - gold _____
 - krypton _____
 - calcium _____
- 2) How many valence electrons does each of the following elements have?
 - Helium _____
 - xenon _____
 - selenium _____
 - potassium _____
- 3) Which of the following ions are likely to be formed?
 - N^{+5} _____
 - F^{-1} _____
 - He^{+} _____
 - Mg^{+2} _____
- 4) Explain why oxygen is a fairly reactive element while neon is not.
- 5) Explain why beryllium loses electrons when forming ionic bonds, while sulfur gains electrons.
- 6) Explain why fluorine and chlorine have similar reactivities (the word "valence" should be somewhere in your answer!)

Part (II)

Name the following compounds. Remember, they may be either ionic or covalent compounds, so make sure you use the right naming method!

- 1) LiBr _____
- 2) Na₂O _____
- 3) CaSO₄ _____
- 4) Be(NO₃)₂ _____
- 5) NO _____
- 6) Fe₂O₃ _____

Write the formulas for the following compounds. Remember, they may be either ionic or covalent compounds, so make sure you use the right method!

- 7) sodium sulfide _____
- 8) sulfur dioxide _____
- 9) ammonium hydroxide _____
- 10) iron (II) phosphate _____
- 11) dinitrogen pentoxide _____
- 12) titanium (IV) oxide _____

Part (III)

7) Write the Lewis structures and shapes of the following molecules. Please note that each of these have only ONE central atom



Part (IV)

- 1) Define the law of conservation of mass and the law of conservation of energy and explain how the equation $E=mc^2$ relates them
- 2) Name the experiments carried out by Thomson and Rutherford and explain what important discoveries are credited to them
- 3) Uranium has three common isotopes. If the abundance of U-234 is 0.01%, the abundance of U-235 is 0.71%, and the abundance of U-238 is 99.28%, what is the average atomic mass of uranium?
- 4) Distinguish between the law of multiple proportions and the law of definite proportions.
- 5) Suppose 6.2×10^1 Kg of water at 329 K loses 980 kJ of heat (energy). If the specific heat of water is 4.18 J/g.K, then calculate the final temperature (*please note that the final temperature should be lower than 329K in this case*)

Part (V)

- 1) What is the percent composition of each of the elements in magnesium sulfate heptahydrate ($\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$)?
- 2) If 125 grams of magnesium sulfate heptahydrate ($\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$) is completely dehydrated (loses all 7 water molecules), how many grams of magnesium sulfate will remain?
- 3) How many grams are in 0.02 moles of beryllium iodide, BeI_2 ?
- 4) How many moles are in 9.83×10^4 mg of aluminum hydroxide, $\text{Al}(\text{OH})_3$?
- 5) If aluminum hydroxide is completely separated into the ions forming it, how many molecules of aluminum would there be in 9.83×10^4 mg of the compound? How many molecules of OH would we have?

- 6) How many grams are in 2.3×10^{-4} moles of calcium phosphate, $\text{Ca}_3(\text{PO}_3)_2$?
- 7) How many grams are there in 2.3×10^{24} atoms of silver?
- 8) How many grams are there in 7.4×10^{23} molecules of AgNO_3 ?
- 9) How many moles of Ag are there in 7.4×10^{23} molecules of AgNO_3 ?
- 10) How many molecules are there in 244 grams of $\text{Cu}(\text{NO}_3)_2$?
- 11) Given Ba = 58.81%, S = 13.73% and O = 27.46% , find the empirical formula.

12) The empirical formula of a compound is N_2O_5 ; find the molecular formula if the molecular mass is 324g. Then find the percent composition of N and O in the compound.

13) What is the empirical formula and molecular (true) formula of a compound composed of 85.7% C and 14.3% H if the molar mass is 42 grams per mole?

14) Define mole:

Part (VI)

- 1) Write the abbreviated ground state electron configurations and orbital system for the following:
 - a) A Halogen in the 5th period

 - b) An Alkaline-earth metal in 7th period

 - c) The element in group 6 and period 5

- 2) Answer the following questions:
 - a) If an atom has 13 electrons, how many different principle energy levels of this element will contain electrons in ground state? (show work)

 - b) Suppose the energy levels in eV for an element are given as:
 $n_3 = -1.5$, $n_4 = -0.85$, $n_5 = -0.54$
Explain energy change as an electron goes from n_5 to n_3 :

 - c) Which quantum numbers define the shape of an orbital and the spin state respectively?

 - d) If Lutetium has an electron configuration of $[\text{Xe}]6s^25d^14f^{14}$; what is the electron configuration of Lutetium ion Lu^{3+} ?

 - e) Write an electron configuration for Lutetium in excited state:

 - f) What is the maximum number of sublevels in 2nd principle energy level?

Part (VII)

- 1) If an element has a mass number of 237 and an atomic number of 93, then how many electrons, protons and neutrons does the element have?
- 2) Rank the following elements by increasing atomic radius: carbon, aluminum, oxygen, potassium.
- 3) Rank the following elements by increasing electronegativity: sulfur, oxygen, neon, aluminum, fluorine.
- 4) Consider the following compounds: CaO, CaSe, CaS, CCl₄, CaF₂, CF₄, CBr₄
 - a) Order the compounds in order of increasing bond length
 - b) Order the compounds in order of increasing bond strength
 - c) Order the compounds in order of increasing melting and boiling points
 - d) Order the compounds in order of increasing bond energy
 - e) Order the compounds in order of increasing ionic character of the bond
- 5) Consider light rays with wavelengths of 300 nm, 520 nm, 675 nm, and 700 nm
 - a) Order the rays in increasing light energy
 - b) Which light ray is most likely of blue color and which one is red?

- 6) Compare the melting and boiling points of ionic compounds, covalent compounds and network solids(covalent network crystals):
- 7) Compare electrical conductivity (under which conditions do they conduct electricity) of ionic compound, metallic compounds and network solids (covalent network crystals):
- 8) Classify each of the following compounds as covalent (in which case you must write whether they are non-polar or polar molecules), ionic, metallic and network solid:
- a) NH_3
 - b) Cl_2
 - c) Diamond
 - d) H_2O
 - e) CCl_4
 - f) CHCl_3
 - g) CsBr
 - h) BaCl_2
- 9) Vanadium has a density of $5.96 \frac{\text{g}}{\text{dm}^3}$:
- A) Convert this density to mg/m^3
 - B) Calculate, with correct significant figures (in g/dm^3) the volume of a sample of Vanadium with mass of 14.00g:

Extra Credit Questions:

- 1) Write the electron configuration of Gold
- 2) Summarize Dalton's atomic model and identify which of his definitions are considered incorrect today (and give the reason for them being incorrect)
- 3) If the radius of an atom is 57 picometers, then find the volume of the atom in cubic meters (the formula for volume of a sphere is $V = \frac{4}{3} \pi r^3$):
- 4) Calculate the percent composition of each element in $\text{Cu}_2(\text{OH})_2\text{CO}_3$
- 5) A 5.024 mg of a compound yields 13.90 mg of CO_2 and 6.048 mg of H_2O . What is the empirical formula of this compound? (note: first find percent compositions)
- 6) What is the empirical formula of a compound composed of 34.91% O, 15.32% Si, 49.76% Zr?
- 7) What is the hybridization of CH_4 ?