

Semester 1 Final Exam Study Guide

Unit 1 – Introduction to chemistry, matter & change

SCIENTIFIC MEASUREMENT

1. _____ All of the following measurements have three significant figures *except* _____.
 - a. 90800 kg
 - b. 1.02×10^3 mL
 - c. 2.00 cm
 - d. **0.002 mm (only 1 SF)**

2. _____ All of the following are true *except* _____.
 - a. significant figures are digits in a measurement that have been measured, plus one estimated digit.
 - b. all non-zero digits in a measurement are significant
 - c. inexact numbers have an infinite number of significant figures
 - d. **the estimated interval is the smallest position that you can read on a non-electronic measuring device (ELECTRONIC DEVICES USE SIG FIGS TOO!)**

3. _____ When multiplying or dividing measured quantities, the answer _____.
 - a. **can have no more significant figures than there are in the measurement with the smallest number of significant figures.**
 - b. is always rounded to reflect the number of significant figures in the measurement with the smallest number of digits to the right of the decimal point.
 - c. can have no more digits to the right of the decimal point than there are in the measurement with the smallest number of digits to the right of the decimal point. **this is the rule for addition and subtraction!**

4. _____ When 0.254 m **(3 SF)** is multiplied by 5.0 m **(2 SF)** the answer, with correct significant figures is .
 - a. 1.27 m^2
 - b. **1.3 m^2 $1.27 \rightarrow 1.3 \text{ m}^2$ (2SF)**
 - c. 1 m^2
 - d. 1.2700 m^2

5. _____ When 0.987 m **(3 digits after the decimal)** is added to 2.4 m **(1 digit after the decimal)** the answer, with correct significant figures is _____.
 - a. **3.4 m $3.387 \rightarrow 3.4 \text{ m}$ (1 digit after the decimal)**
 - b. 3.387 m
 - c. 3 m
 - d. 3.3870 m

6. _____ The appropriate conversion for converting 15.2 mm into nm is ____.

a. $\frac{15.2\text{mm}}{\frac{10^3\text{m}}{1\text{mm}}} \frac{1\text{nm}}{10^9\text{m}}$ **base unit should be 1**

b. $\frac{15.2\text{mm}}{\frac{10^3\text{m}}{10\text{mm}}} \frac{10^9\text{nm}}{1\text{m}}$ **base unit should be 1**

c. $\frac{15.2\text{mm}}{\frac{1\text{m}}{10^3\text{mm}}} \frac{10^9\text{nm}}{1\text{m}}$

d. $\frac{15.2\text{mm}}{\frac{1\text{m}}{10^6\text{mm}}} \frac{10^9\text{nm}}{1\text{m}}$ **there are 10^3 mm in 1 m**

7. _____ 2.87 km is equal to ____.

a. 0.00287 m **= 2870 m (nope!)**

b. 2.87×10^6 mm

c. 2.87×10^9 nm **= 2.87×10^{12} nm (nope!)**

d. only a and b

e. a, b, and c

8. _____ What is the density of an object having a mass of 14 g and a volume of 37 cm³?

a. **0.38 g/cm^3 = $0.3783 \rightarrow 0.38 \text{ g/cm}^3$**

b. 2.6 g/cm^3

c. 5.3 g/cm^3

9. _____ The density of gold is 19.3 g/cm³. What would be the mass, in grams, of 25 cm³ of gold?

a. **480 g d=m/v 19.3 x 25 = m 482.5 → 480 g**

b. 1.3 g

c. 0.77 g

d. none of the above

10. _____ A solid cube with a mass of 7.84 g has the following dimensions, 23.5 cm by 2.54 m by 6.25 × 10⁻³ mm. Its density is ____.

a. 0.476 g/cm^3

b. **2.10 g/cm^3 Volume of cube = LxWxH → 23.5cm x 2.54m x 6.25x10⁻³ mm**

c. 21.0 g/cm^3 **→ 23.5cm x 254cm x 6.25x10⁻⁴ cm = 3.730625cm³**

d. 2.14 g/cm^3 **d=m/v 7.84/3.730625cm³ = 2.1015 → 2.10g/cm³**

SIGNIFICANT DIGITS

Identify the following as true (T) or false (F). Place your answers on the lines provided to you.

11. **True** zeros that begin a number are never significant
 12. **True** zeros between two non-zero numbers are always significant
 13. **True** zeros that end a number and are to the right of a decimal are always significant
 14. **False** zeros that end a number and are to the left of a decimal are always significant
 15. **True** all non-zero numbers are always significant
16. The mass and volume of various objects of the same substance were graphed. A best-fit line was drawn in. Calculate the slope using two points from the best fit line (i.e. not the origin (0,0)). Could the objects be made of cork (0.295 g/cm³)? Explain your answer.

Slope of a line: $\frac{y_1 - y_2}{x_1 - x_2} = \frac{\text{Rise}}{\text{Run}} = \frac{\text{Mass}}{\text{Volume}} = \text{density}$

Pick two points on the graph and plug them into the slope equation:

(26.00mL , 8.000g) and (5.000mL , 1.500g)

$$\frac{8.000g - 1.500g}{26.00mL - 5.000mL} = \frac{6.500g}{21.00mL} = 0.309523809 \rightarrow 0.3095g/mL$$

Yes! This substance could be cork. The density of cork is 0.295 g/cm³. The slope of the line (the density) was calculated to be 0.3095 g/mL, this is close enough to assume that the material is cork.

17. Write 500 m with 3 significant figures. **5.00 x 10² m OR 500. m**
18. An object has a mass of 3.1 g and a volume of 0.25 mL. Calculate its density.

$$d = \frac{m}{v} = \frac{3.1g}{0.25mL} = 12.4 \rightarrow 12g/mL$$

19. What is the sum 30.8 cm **(1 digit after the decimal)** and 9.20 cm **(2 digits after the decimal)**?

$$30.8\text{ cm} + 9.20\text{ cm} = 40.00 \rightarrow 40.0\text{ cm}$$

20. Convert 123.6 kg to μg . **This is a two-step conversion.**
Here are the factors your would need to use: (1 kg = 10³ g) and (1 g = 10⁶ μg)

$$123.6\text{ kg} \left(\frac{10^3 g}{1 kg} \right) \left(\frac{10^6 \mu g}{1 g} \right) = 1.236 \times 10^{11} \mu g$$

21. Convert 4.7 nm to mm. **This is a two-step conversion.**
Here are the factors your would need to use: (1 m = 10⁹ nm) and (1 m = 10³ mm)

$$4.7\text{ nm} \left(\frac{1 m}{10^9 nm} \right) \left(\frac{10^3 m}{1 m} \right) = 4.7 \times 10^{-6} \text{ mm}$$

22. A state record holder ran the 100 meter dash at a rate of 0.9 m/s. What is this in miles per hour?
This is a three-step conversion with complex units (like density) and conversion factors that you are not entirely familiar with.
Here are the conversion factors your would need to use:

First: (1 mile = 1609.34 m) to convert meters to miles.

Then convert seconds to hours: (60 sec = 1 min) (60 min = 1 hr)

$$\left(\frac{0.9 \text{ m}}{1 \text{ sec}}\right) \left(\frac{1 \text{ mile}}{1609.34 \text{ m}}\right) \left(\frac{60 \text{ sec}}{1 \text{ min}}\right) \left(\frac{60 \text{ min}}{1 \text{ hr}}\right) = \underline{2.01} \rightarrow \underline{2 \text{ mi/hr}}$$

23. Convert 9.08 mg/kL to ng/L. **This is a 3-step conversion with complex units.**

Here are the conversion factors you need to use:

First: (1 g = 10³ mg) then (1 g = 10⁹ ng)

Second: (10³ L = 1 kL)

$$\left(\frac{0.9 \text{ mg}}{1 \text{ kL}}\right) \left(\frac{1 \text{ g}}{10^3 \text{ mg}}\right) \left(\frac{10^9 \text{ ng}}{1 \text{ g}}\right) \left(\frac{1 \text{ kL}}{10^3 \text{ L}}\right) = \underline{9080 \text{ ng/L}}$$

Unit 2 – Atomic Structure and Counting Particles

COMPOUND VS. ELEMENT

24. _____ What is one difference between a compound and an element?

- a. Compounds consists of more than one phase
- b. Compounds only contains one type of atom
- c. Compounds can be separated by chemical means**
- d. Compounds are located on the Periodic Table

25. *Identify the following pure substances as elements (E) or compounds (C). Place your answers on the line provided to you.*

C carbon dioxide, CO₂

C caffeine, C₈H₁₀N₄O₂

E mercury, Hg

C methane, CH₄

E hydrogen, H

ATOMIC STRUCTURE

26. _____ The mass number of an atom is equal to the number of ____.

- a. electrons only **(mass is too small)**
- b. neutrons only
- c. protons only **atomic #**
- d. protons plus neutrons**

27. _____ The atomic number of an atom is equal to the number of ____.

- a. electrons only
- b. neutrons only
- c. protons only**
- d. protons plus neutrons **mass #**

28. _____ What does the number 1 in hydrogen-1 represent

- a. protons
- b. neutrons

- c. electrons
d. mass number
29. _____ Which of the following statements best summarizes the subatomic structure of an atom?
- a. electrons occupy a dense nucleus, protons and neutrons surround the nucleus
 - b. protons reside in the nucleus and have a negative charge **p+ are positive**
 - c. neutrons are not very massive and occupy the region surrounding the nucleus **n⁰ have mass**
 - d. protons and neutron occupy a dense nucleus, electrons surround the nucleus**
30. _____ All atoms of the same element have the same ____.
- a. number of protons (atomic #)**
 - b. number of neutrons
 - c. mass number
31. _____ Dalton hypothesized that all atoms of the same element are identical. However, due to the existence of ____ this statement had to be modified.
- a. ions
 - b. isotopes same # but diff # of n⁰**
 - c. electrons
 - d. neutrons
32. _____ If 23 grams of compound A reacts with 17 grams of compound C to form compound AC, you should expect to receive ____ of compound AC.
- a. 23 grams
 - b. 17 grams
 - c. 40 grams**
 - d. 6 grams
33. _____ The isotope $^{14}_6\text{C}$ has ____.
- a. 14 electrons
 - b. 8 neutrons**
 - c. 14 protons
 - d. 6 neutrons
34. _____ The isotope $^{131}_{53}\text{I}$ has ____.
- a. 53 electrons
 - b. 53 protons
 - c. 78 neutrons
 - d. all are true**
35. _____ The standard isotope notation for Uranium-238 is ____.
- a. $^{92}_{238}\text{U}$
 - b. $^{146}_{92}\text{U}$

c. $^{238}_{92}\text{U}$

36. _____ Which of the following are isotopes?

a) $^{74}_{38}\text{A}$, $^{75}_{39}\text{A}$, $^{74}_{37}\text{A}$

b) $^{74}_{38}\text{A}$, $^{75}_{39}\text{A}$, $^{79}_{37}\text{A}$

c) $^{74}_{38}\text{A}$, $^{75}_{38}\text{A}$, $^{77}_{38}\text{A}$

7 DIFF ATOMIC # = DIFF ELEMENTS

37. _____ Which of the following is NOT a part of Dalton's atomic theory?

a) All elements are composed of atoms.

b) Atoms are always in motion.

c) Atoms of the same element are identical.

d) Atoms that combine do so in simple whole-number ratios.

38. _____ Element A consists of two isotopes. Isotope 1 has an abundance of 90% and a mass of 10 amu. Isotope 2 has an abundance of 10% and a mass of 12 amu. The atomic mass for this element is _____.

a) 10.2 amu

b) 1020 amu

c) 10.8 amu

$$(0.90)(10\text{amu}) + (0.10)(12\text{amu}) = 10.2\text{amu}$$

39) _____ Which of the following representative particles is an atom?

a) CO_2

b) NaCl

c) Ag

d) I^-

40) _____ Which of the following representative particles is an ion?

a) CO_2

b) NaCl

c) Ag

d) I^-

Directions: Identify the following as true (T) or false (F). Place your answers on the lines provided to you.

41. True An atomic mass unit is defined as exactly $1/12^{\text{th}}$ the mass of a carbon-12 atom

42. False The atomic mass is the arithmetic mean of the naturally occurring isotopes weighted average

43. True Rutherford used indirect evidence to propose a model of the atom gold foil experiment

44. False Isotopes differ by atomic number only

45. True The mass number of an atom is equal to the number of protons plus neutrons

46. True The protons in the nucleus of an atom are given by the atomic number

UNIT 2 SHORT ANSWER: (use a separate sheet of paper for your answers, if needed)

47. 9. Consider potassium.

a. Give its atomic number. What does it represent? # OF PROTONS

b. Provide its atomic mass. What does it represent? What is it based on? # OF (p+) + (n⁰)

c. Compare an atom of potassium to an atom of strontium in terms of their masses.

MASS #
39.10
K
ATOMIC #
19 POTASSIUM

87.62
Sr
STRONTIUM
38

39.10amu < 87.62 amu
Sr HAS A LARGER MASS

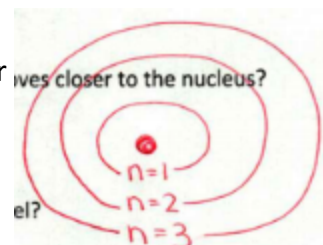
48. Calculate the number of neutrons in silver-108.
 $^{108}_{47}\text{Ag}$ $108 - 47 = 61 \text{ NEUTRONS}$
49. What is the symbol for the isotope, carbon-14?
 $^{14}_6\text{C}$
50. Copper has two isotopes. Copper-63 has a mass of 62.93 amu and is 60.06% abundant. Copper-65 has a mass of 64.93 amu and is 39.94% abundant. Calculate the atomic mass of copper from this data. Show your math.

$$\frac{(62.93 \text{ amu})(60.06) + (64.93 \text{ amu})(39.94)}{100} = 63.73 \text{ amu}$$

Unit 3 - Electrons in the Atom

QUANTUM MECHANICAL MODEL, ELECTRON CONFIGURATION, & ORBITAL DIAGRAMS

51. _____ How does the energy of an electron change when the electron moves closer to the nucleus?
 a) **It decreases** c) It stays the same
 b) It Increases d) It doubles
52. _____ How many energy sublevels are in the second principal energy level?
 a) 1 c) 3
 b) **2 s+p sublevels** d) 4
53. _____ Stable electron configurations are likely to contain _____.
 a) **filled energy sublevels** c) unfilled s orbitals
 b) fewer electrons than unstable configurations d) electrons with a clockwise spin
54. _____ The outer orbital of the Bohr diagram for calcium will have _____ electrons
 a) **2** c) 5
 b) 4 d) 6



ELECTROMAGNETIC WAVES, ENERGY, & LIGHT

55. _____ Which color of light has the shortest wavelength?
 a) Yellow c) Blue
 b) Green **d) Violet**
56. _____ Emission of light from an electron occurs when an electron _____.
 a) **drops from a higher to a lower energy level**
 b) jumps from a lower to a higher energy level
 c) moves within its atomic orbital
 d) falls into the nucleus

$$\downarrow \lambda = \uparrow f$$

ic orbital λ RELEASED
 WHEN e^- MOVES
 FROM EXCITED TO GROUND
 STATE

57. _____ What is the approximate frequency of a photon having an energy of $5 \times 10^{-24} \text{ J}$?

- a) **$8 \times 10^9 \text{ Hz}$** c) $3 \times 10^{-58} \text{ Hz}$
b) $3 \times 10^{-57} \text{ Hz}$ d) $1 \times 10^{-10} \text{ Hz}$

$$E = hf$$
$$5 \times 10^{-24} \text{ J} = 6.626 \times 10^{-34} \text{ J} \cdot \text{s} \cdot f$$

58. _____ In which of the following sets is the symbol of the element, the number of protons, and the number of electrons given correctly representing a neutral atom?

- a) **In, 49 p, 49e** c) Cs, 55p, 132.9e
b) Zn, 30p, 60e d) F, 19p, 19e

SAME # OF p^+
+ e^-

UNIT 3 SHORT ANSWER: (use a separate sheet of paper for your answers, if needed)

59. Given a frequency of $3.08 \times 10^{14} \text{ Hz}$, calculate the wavelength in nanometers (nm). Is this radiation visible to the naked eye? Why or why not? **-NO, NOT IN VISIBLE LIGHT WAVELENGTH**

$$c = \lambda f \text{ so } \lambda = \frac{c}{f} = \frac{3.00 \times 10^8 \text{ m/s}}{3.08 \times 10^{14} \text{ Hz}} = 9.74 \times 10^{-7} \text{ m} \left(\frac{1,000,000,000 \text{ nm}}{1 \text{ m}} \right) = 974 \text{ nm}$$

Unit 4 - Periodic Table and Trends

PERIODIC TRENDS

60. _____ How does the atomic radius change across a chemical period in the Periodic Table?

- a) **It tends to decrease** c) It first increases, then decreases
b) It tends to increase d) It first decreases, then increases

61. _____ How does the electronegativity change across a chemical period in the Periodic Table?

- c) It tends to decrease c) It first increases, then decreases
d) **It tends to increase** d) It first decreases, then increases

62. _____ How does the ionization energy change across a chemical period in the Periodic Table?

- a) It tends to decrease c) It first increases, then decreases
b) **It tends to increase** d) It first decreases, then increases

63. _____ What determines whether an element is a metal?

- a) the magnitude of its charge c) when it is a Group A element
b) the molecules that it forms **d) its position in the Periodic Table**

64. _____ Which of the following elements has the smallest atomic radius?

- a) sulfur c) bromine
b) selenium **d) chlorine**

65. _____ Which of the following elements has the smallest electronegativity?

- c) sulfur c) bromine
d) **selenium** d) chlorine

66. _____ Which of the following elements has the largest ionization energy?
a) sulfur c) bromine
b) selenium **d) chlorine**
67. _____ Which of the following elements has the smallest ionic radius?
a) sulfide (S^{2-}) **c) bromide (Br^-)**
b) nitride (N^{3-}) d) oxygen (O)
68. _____ How does the shielding effect change across a chemical period in the Periodic Table?
a) It tends to decrease **c) It doesn't change at all**
b) It tends to increase d) It first decreases, then increases
69. _____ How does the effective nuclear charge change across a chemical period in the Periodic Table?
a) It tends to decrease c) It first increases, then decreases
b) **It tends to increase** d) It first decreases, then increases

ORGANIZATION OF THE PERIODIC TABLE

70. _____ Which of the following elements is in the same period as phosphorus on the periodic table?
a) nitrogen(N) c) oxygen (O)
b) carbon (C) **d) magnesium (Mg)**
71. _____ Which of the following elements is in the same group as manganese (Mn) on the periodic table?
a) radium (Ra) **c) Rhenium (Re)**
b) Sulfur (S) d) Calcium (Ca)
72. _____ Which of the following elements is in the alkaline earth family?
a) nitrogen(N) c) oxygen (O)
b) Sodium (Na) **d) magnesium (Mg)**
73. _____ Which of the following elements is in the halogen family?
a) **bromine (Br)** c) boron (B)
b) Xenon (Xe) d) Sodium (Na)
74. _____ What is the charge of the nucleus of a cobalt (Co) atom?
a) **27** c) 0
b) 31.93 d) 58.93

UNIT 4 SHORT ANSWER: (use a separate sheet of paper for your answers, if needed)

75. Why does the number of shielding electrons remain constant left to right across a period?

As you move from left to right across a period, you are adding electrons, but you are adding them to the same energy level, so the number of core electrons never changes.

76. Why is fluorine (F) more electronegative than oxygen (O)?

The effective nuclear charge of F is larger than O.

77. Why does ionization energy increase from left to right on the periodic table?

The effective nuclear charge increases -- As you move across a period you add valence electrons to the atom's outermost energy level. The more electrons you add, the closer the atom is to filling its outer shell, making it more difficult to remove the electrons.

78. Rank the following elements in order of INCREASING atomic radius: Oxygen (O), Fluorine(F), Chlorine (Cl), Sulfur (S)

F < O < Cl < S

79. Rank the following elements in order of DECREASING electronegativity: Barium (Ba), Calcium (Ca), Magnesium (Mg), Strontium (Sr)

Mg > Ca > Sr > Ba

80. Rank the following in order of INCREASING radius: Chloride (Cl⁻), Argon (Ar), Potassium Ion (K⁺)

K⁺ < Ar < Cl⁻

81. How does the effective nuclear charge, shielding effect, ionization energy, atomic radius, and electronegativity change down a group and across a period on the Periodic Table?

24. How does the effective nuclear charge, shielding effect, ionization energy, atomic radius, and electronegativity change down a group and across a period on the Periodic Table?

	ENC	SE	IE	AR	EN
L → R PERIOD	↑	CONSTANT	↓	↓	↑
T → B GROUP	↓	↑	↓	↑	↓

82. Explain the periodic trends of atomic radii and ionic radii down a group and across a period.

ANIONS = LARGER RADIUS

CATIONS = SMALLER RADIUS

Unit 5: Covalent Bonding and IMFs

MOLECULAR NOMENCLATURE

83. _____ The correct name for the compound SF_6 is ____.
- a) monosulfide hexafluoride **c) sulfur hexafluoride**
b) sulfur (IV) fluoride d) sulfur fluoride
84. _____ The Lewis dot structure for phosphorus will have ____ dots around P
- a) 15 c) 3
b) **5** d) 17
85. _____ In naming a binary molecular compound, the number of atoms of each element present in the molecule is indicated by _____
- a) roman numerals c) **prefixes**
b) superscripts d) suffixes
86. _____ Binary molecular compounds are formed from ____.
- a) a cation and an anion c) two metals
b) two metalloids **d) two nonmetals**

VSEPR THEORY & POLARITY **Yellow highlights = answer to the question.** *Other colors = answers to questions 93-95*

87. Which compound below has a linear molecular structure?
- a. OF_2 (see #95) **b. CO_2** (see #95) c. PF_3 (see #94) d. SO_2 (see #94)
88. Which compound below has a bent molecular structure?
- a. $(\text{NO}_2)^{1+}$ (see #95) b. $(\text{NH}_4)^{1+}$ (see #95) **c. SCl_2** (see #94) d. CH_4 (see #95)
89. Which compound below has polar bonds and is a polar molecule?
- a. CH_4 (see #95) **b. H_2O** c. N_2 (see #95) d. CO_2 (see #95)
90. Which compound below has polar bonds and is a nonpolar molecule?
- a. **CO_2** b. CH_4 (see #95) c. NH_3 (see #93) d. HF (see #94)
91. Which compound below has a lone pair of electrons on the central atom?
- a. **NF_3** b. CS_2 (see #94) c. BF_3 (see #95) d. CH_4 (see #95)
92. Which compound below has a bond angle of 120° ?
- a. CCl_4 (see #95) **b. BH_3** c. H_2O d. $(\text{NH}_4)^{1+}$ (see #95)

UNIT 5 SHORT ANSWER (use a separate sheet of paper for your answers, if needed)

- 93) Place a **blue circle** around the compounds listed in questions 87-92 that are completely soluble in water (H_2O)
- "Like dissolves like" means that any substance that has identical IMFs to water will be soluble. Water has LDFs, dipole-dipole forces and hydrogen bonds. The following compound from #87-92 have identical IMFs to water: NH_3**

- 94) Place a **red circle** around the compounds listed in questions 87-92 that are **partially** soluble in water (H_2O)
Partially soluble would be a compound that has some of the same IMFs as water but not identical to water... these would be: PF_3 , SO_2 , SCl_2 , HF , and CS_2 (these are molecules that have LDFs and dipole-dipole forces)
- 95) Place a **box** around the compounds listed in questions 87-92 that are soluble in oxygen gas (O_2)
"Like dissolves like" means that any substance that has identical IMFs to oxygen gas will be soluble. O_2 has LDFs only. The following compound from #87-92 have identical IMFs to O_2 : OF_2 , CO_2 , NO_2^{1+} , NH_4^{1+} , CH_4 , N_2 , BF_3 , CCl_4 , and BH_3 . It is important to note that the answer would identical if I had asked "which molecules are insoluble in water" because these molecules all have unlike IMFs compared to H_2O .

UNIT 5.5 - CALCULATING FORMULAS

SHORT ANSWER (*use a separate sheet of paper for your answers, if needed*)

- 96) What is the molar mass of NaCl ? **58.44 g/mol**
 What is the molar mass of carbon tetrachloride (CCl_4)? **153.81 g/mol**
- 97) What is the percent composition of carbon (C) in carbon dioxide (CO_2)?
- 98) What is the percent composition of hydrogen (H) in sulfuric acid? (H_2SO_4)
- 99) A compound is found to consist of 2.89 g of calcium and 5.11 g of chlorine. What is the percent composition of calcium in the compound?
- 100) A 36.14 gram sample of ethanol (a compound) contains 34.8% of oxygen. What mass of oxygen is present in this sample of ethanol?
- 101) What is the empirical formula of a substance that consists of 0.910 g calcium, 0.636 g nitrogen, and 1.453 g oxygen?
- 102) What is the empirical formula of a substance that contains 3.09% hydrogen, 31.60% phosphorous, and 65.31% oxygen?
- 103) What is the molecular formula of a compound with the empirical formula CH_2O and molar mass of 60.06 g?
- 104) A compound with the empirical formula NO was found to have a total mass of 61.00 g. What is the molecular formula?

Unit 6: Ionic Compounds

IONIC NOMENCLATURE

105. _____ What type of ions have *-ide* endings?
- a) only polyatomic ions
 - b) **only monatomic ions**
 - c) only metal ions
106. _____ An *-ate* or *-ite* at the end of a compound name usually indicates that the compound contains ____.
- a) fewer electrons than protons
 - b) neutral molecules
 - c) only two elements
 - d) **a polyatomic anion**
107. _____ Which of the following compounds contain the Mn^{3+} ion?
- a) MnS
 - b) MnBr_2
 - c) **Mn_2O_3**
 - d) MnO
108. _____ Which element, when combined with oxygen is most likely to form an ionic compound?
- a) **sodium**
 - b) carbon
 - c) phosphorus
 - d) chlorine
109. _____ When a elements in the alkali metal family form ions they ____.
- a) **lose one electron**
 - b) lose two electrons
 - c) gain one electron
 - d) gain two electrons
110. _____ Atoms that gain electrons to achieve a full outer orbital of their Bohr diagram form ____ while atoms that lose electrons to achieve a full outer level form ____.
- a) cations, anions
 - b) **anions, cations**
 - c) isotopes, ions
 - d) ionic bonds, ionic bonds
111. _____ The chemical formula of a compound indicates ____.
- a) the type of atoms in the compound only
 - b) how the atoms are bonded together
 - c) how the atoms are arranged in 3-dimensional space
 - d) **the type and amount of each atom in the compound**
112. _____ Which of the following compounds is not ionic?
- a) NaOH
 - b) K_3PO_4
 - c) **CO_2**
 - d) K_3N

113. _____ Which of the following compounds will need a roman numeral when named?
- a) **Mn(OH)₂** c) SF₆
b) K₃PO₄ d) K₃N
114. _____ The correct name for the compound HI is ____.
- a) iodic acid
b) **hydroiodic acid**
c) hydrogen monoiodide
115. _____ The correct name for the compound Ti(SO₄)₂ is ____.
- a) titanium (II) sulfate
b) titanium (IV) sulfate
c) titanium disulfate
d) titanium sulfate
116. _____ Which of the following shows correctly an ion pair and the ionic compound the two ions form?
- a) Sn⁴⁺, N³⁻, Sn₄N₃ c) Cr³⁺, I¹⁻, CrI
b) Cu²⁺, O²⁻, Cu₂O₂ **d) Fe³⁺, O²⁻, Fe₂O₃**

Units 3, 5, and 6 - Mole Concept Calculations

117. _____ The _____ is the lowest whole-number ratio of atoms of the elements in a compound.

- a) molar mass
- b) empirical formula**
- c) molecular formula
- d) percent composition

118. _____ The molar masses of two different elements contain the same number of _____.

- a) grams
- b) atoms**
- c) molecules

119. _____ The molar masses of two different compounds contain the same number of _____.

- a) grams
- b) atoms
- c) molecules**

120. _____ How many atoms of carbon are in 4 molecules of C_2H_6 ?

- a) **8**
- b) 4.8×10^{24}
- c) 30
- d) 2

EACH MOLECULE
CONTAINS 2 ATOMS
OF C

121. _____ How many moles of He are in 4.25×10^{25} atoms of He?

- a) 2.56×10^{49} moles
- b) 7.25×10^{23} moles
- c) 70.6 moles**

$$4.25 \times 10^{25} \text{ ATOMS He} \left(\frac{1 \text{ mol He}}{6.022 \times 10^{23} \text{ ATOMS He}} \right)$$

122. _____ How many moles of Al are in 6.25 moles of Al_2O_3 ?

- a) 12.5 moles of Al**
- b) 3.13 moles of Al
- c) 6.25 moles of Al

$$6.25 \text{ mol } Al_2O_3 \left(\frac{2 \text{ mol Al}}{1 \text{ mol } Al_2O_3} \right)$$

Mixed Short Answer. Show your math where appropriate.

123) Calculate the mass of 1.00 mole (*Hint: molar mass*) of each of the following substances. What is the specific name for these quantities?

- | | |
|---------------------------------|--|
| a) H_3PO_4 | Phosphoric acid; Molar mass = 98.00 g/mol |
| b) $(\text{NH}_4)_2\text{SO}_4$ | Ammonium sulfate; Molar mass = 132.17 g/mol |
| c) B_4O_8 | Tetraboron Octaoxide; Molar mass = 171.24 g/mol |
| d) SeI_3 | Selenium Triiodide; Molar mass = 459.67 g/mol |
| e) Pb_3N_2 | Lead (III) Nitride; Molar mass = 649.60 g/mol |

124) Find the number of particles in each substance:

- a) 3.00 mol tin

$$3.00 \text{ mol Sn} \left(\frac{6.02 \times 10^{23} \text{ atoms Sn}}{1 \text{ mol Sn}} \right) = 1.81 \times 10^{24} \text{ atoms Sn}$$

- b) 6.25 g Cd

$$6.25 \text{ g Cd} \left(\frac{1 \text{ mol Cd}}{112.41 \text{ g Cd}} \right) \left(\frac{6.02 \times 10^{23} \text{ atoms Sn}}{1 \text{ mol Sn}} \right) = 3.3471221 \times 10^{22} \rightarrow 3.35 \times 10^{22} \text{ atoms of}$$

- c) 43.5 g gold (II) phosphate

$$43.5 \text{ g Au}_3(\text{PO}_4)_2 \left(\frac{1 \text{ mol Au}_3(\text{PO}_4)_2}{780.85 \text{ g Au}_3(\text{PO}_4)_2} \right) \left(\frac{6.02 \times 10^{23} \text{ atoms Au}_3(\text{PO}_4)_2}{1 \text{ mol Au}_3(\text{PO}_4)_2} \right) = 3.35365 \times 10^{22} \rightarrow 3.35 \times 10^{22} \text{ atoms of Au}_3(\text{PO}_4)_2$$

125) What is the formula for hydrophosphoric acid? **H_3P**

Phosphoric acid? **H_3PO_4**

Molecular chlorine? **Cl_2**

Chloride? **Cl^-**

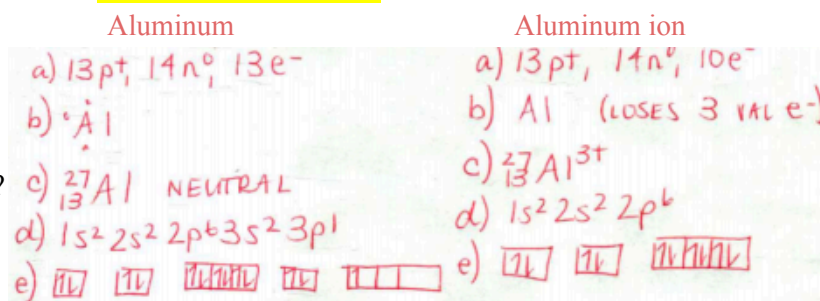
126) Name Cl_2O_7 . Classify its bonding type: ionic or molecular/covalent (polar/nonpolar, if applicable)

Dichlorine heptoxide; molecular bond - cannot determine polarity

127) What is the formula for tin (IV) phosphate? Classify its bonding type. **$\text{Sn}_3(\text{PO}_4)_4$; ionic bond**

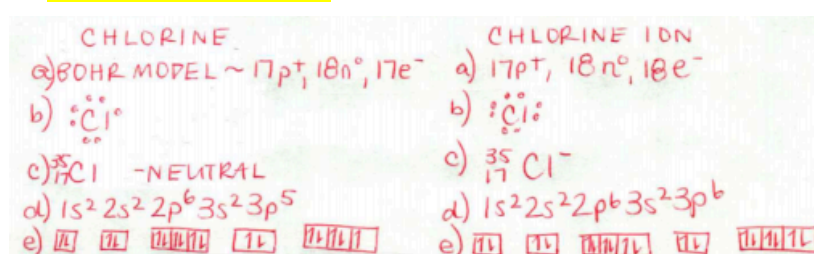
128) Consider an atom of aluminum vs an aluminum ion? **SEE IMAGE BELOW**

- Draw their Bohr models (include electrons, protons, and neutrons).
- Draw their Lewis electron dot structures. (Hint: valence electrons only)
- Write the ion symbol. Is it a cation or anion?
- Write both of their orbital diagrams
- Write both of their electron configurations.



129) Consider an atom of chlorine vs an ion of chlorine. **SEE IMAGE BELOW**

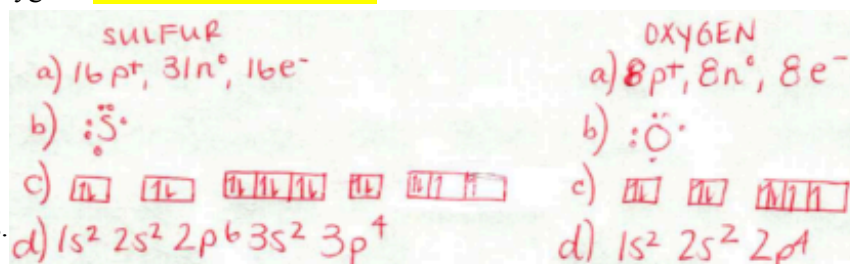
- Draw their Bohr models (include electrons, protons, and neutrons).
- Draw their Lewis electron dot structures. (Hint: valence electrons only)
- Write the ion symbol. Is it a cation or anion?
- Write both of their orbital diagrams
- Write both of their electron configurations.



- 130) Predict the compound that results from the combination of the substances in #3 and #4.
- Show the Lewis dot structure for this compound
 - Name the bond type. (**ionic**, acidic, molecular/covalent)
 - Write the chemical name and formula for this compound. **Aluminum chloride; AlCl_3**

- 131) Consider an atom of sulfur and an atom of oxygen. **SEE IMAGE BELOW**

- Draw their Bohr models (include electrons, protons, and neutrons).
- Draw their Lewis electron dot structures. (Hint: valence electrons only)
- Write both of their orbital diagrams
- Write both of their electron configurations.



- 132) Predict the compound that results from the combination of the substances in #6.
- Name the bond type. (ionic, acidic, **molecular/covalent**)
 - Write the chemical name and formula for this compound.

