

Name _____

Sample Exam 1
Chemistry 118

Part I- Multiple Choice Please choose the **single** correct answer.

- Which of the following statements is *false*?
 - Atoms of the same element can have different numbers of neutrons.
 - Atoms of the same element can have different numbers of protons.
 - Atoms of the same element can have different mass numbers.
 - Atoms of two different elements can have the same number of neutrons.
- Which of the following is *not* part of Dalton's atomic theory?
 - All matter is composed of indivisible atoms.
 - Atoms of different elements differ in size and properties.
 - Isotopes of the same element have different chemical properties.
 - A chemical reaction occurs when atoms recombine in whole number ratios.
- Which of the following has the longest wavelength?
 - X rays
 - microwaves
 - green light
 - UV light
- A Lewis dot structure for this atom has five electrons around the symbol. Which of the following could be the atom?
 - phosphorus
 - xenon
 - aluminum
 - boron
- These two elements follow a "duet" rather than an octet rule. What are they?
 - helium and neon
 - hydrogen and helium
 - sodium and chloride
 - this is a trick question: all elements follow an octet rule.
- Which of the following descriptions is true of ionic compounds?
 - individual molecules are formed
 - the non-directional nature of the attractive forces results in an extended crystal structure
 - their properties are similar to the compounds that compose them
 - they are generally formed when nonmetals react with other nonmetals
- How many moles are in 237 g (about a cup) of H_2O ?
 - 13.2 moles
 - 4270 moles
 - 0.0760 moles
 - 6.02×10^{23} moles
- Which of the following is most likely to lose electrons in an ionic compound?
 - oxygen (O)
 - hydrogen (H)
 - lead (Pb)
 - carbon (C)

9. An experiment was performed to find the number of moles of hydrochloric acid in a sample with the following results:

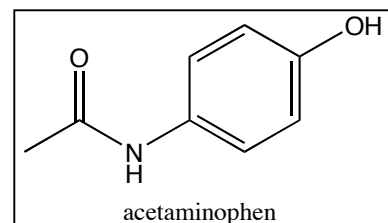
Trial	Moles
1	1.51
2	1.49
3	1.50

The actual number of moles was later determined to be 1.00. The above results are:

- a) both accurate and precise
 - b) accurate but imprecise
 - c) precise but inaccurate
 - d) both inaccurate and imprecise
10. Aspirin has the formula $C_9H_8O_4$. A compound is isolated from sea urchins that also has the formula $C_9H_8O_4$. What can you conclude?
- a) Sea urchins produce aspirin.
 - b) Sea urchins *might* produce aspirin, but this isn't sufficient evidence that they do.
 - c) Because aspirin is a fairly small molecule, it is probably present in all living organisms.
 - d) Even if this sea urchin compound is not aspirin, it is likely to be good for headaches since it has the same chemical formula as aspirin.
11. Which of the following statements best describes what happens when chocolate melts?
- a) This is a physical change, and the molecules move farther apart.
 - b) This is a chemical change, and the molecules move farther apart.
 - c) This is a physical change, and the molecules move closer together.
 - d) This is a chemical change, and the molecules move closer together.
12. Which of the following would be balanced coefficients for the following equation:
- $$X \text{ Al} + Y \text{ O}_2 \rightarrow Z \text{ Al}_2\text{O}_3$$
- a) 1, 1, 1
 - b) 4, 3, 2
 - c) 12, 10, 6
 - d) 16, 12, 8
13. Which of the following pairs of compounds illustrates the law of multiple proportions?
- a) SO, SO₂
 - b) CO, CaCO₃
 - c) H₂SO₄, H₂S
 - d) H₂O, C₁₂H₂₂O₁₁
14. Substance **A** absorbs blue light, and substance **B** absorbs yellow light. Which of the following is true?
- a) The energy gap between the ground and excited states is greater for **A** than **B**.
 - b) The energy gap between the ground and excited states is smaller for **A** than **B**.
 - c) **A** must have more electrons than **B**.
 - d) **A** must be a noble gas.

15. What is the molar mass of acetaminophen, shown here?

- a) 151 g/mol b) 48 g/mol
 c) 120 g/mol d) 132 g/mol



Part II- Short Answer

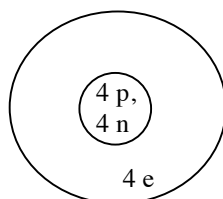
1. Circle all the chemical changes below.

- Food is metabolized to release energy.
- A red substance is decomposed by heat to mercury and oxygen.
- Sodium dropped in water forms sodium hydroxide and hydrogen gas.
- Water boils on the stove.
- A hydrogen balloon ignites in the presence of oxygen to form water.
- Salt dissolves in water.

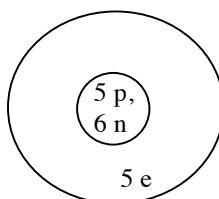
2. Fill in the missing information (as indicated by “?”) in the following table.

Atom	He-4	An isotope of He-4 with 2 more neutrons	? S-34
# protons	? 2	? 2	? 16
#neutrons	? 2	? 4	? 18
#electrons	? 2	? 2	16
mass number	? 4	? 6	34

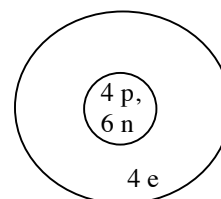
3. Use the models below for this question. (p= protons; n = neutrons; e = electrons)



Atom 1



Atom 2



Atom 3

a) What is the relationship between **Atom 1** and **Atom 3**? (One word is sufficient.)

Isotopes

b) Write each of the atoms above in the shorthand notation that describes the most common isotope of hydrogen as H-1.

Atom 1: Be-8

Atom 2: B-11

Atom 3: Be-10

c) Briefly comment on the proportions of these atoms as they are depicted here.

The nucleus is far too big relative to the electron cloud.

d) How many valence electrons does **Atom 2** have?

3

4. Circle any of the following formulas that could be real compounds.

Mg₂O

CsCl

BeN

CaF₂

CH₅

5. For each of the following compounds,

a) Circle the correct type of bonding.

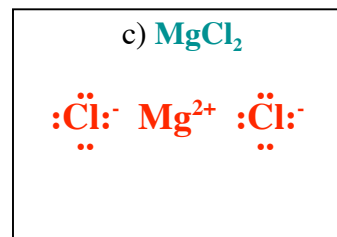
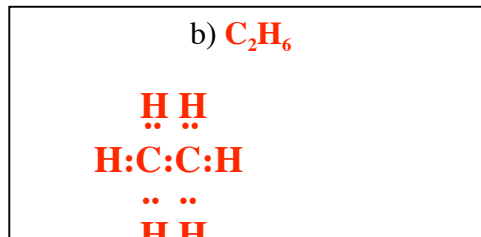
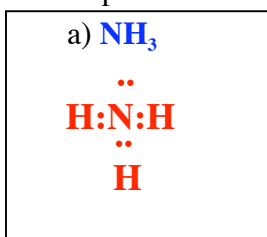
b) Predict whether the compound dissolves significantly in water.

(Electronegativity values are as follows: C = 2.5; H = 2.1; N = 3.0; Cl = 3.0; Mg = 1.2)

	a) Type of bonding?			b) Dissolves in water?	
NH ₃	ionic	polar covalent	nonpolar covalent	Yes	No
C ₂ H ₆	ionic	polar covalent	nonpolar covalent	Yes	No
MgCl ₂	ionic	polar covalent	nonpolar covalent	Yes	No

Note: I took both answers here.

6. Draw the Lewis dot structures for each of the compounds in the previous question in the boxes provided.



7. Classify each of the following as an element, compound, or mixture (circle).

Blood

element

compound

mixture

Salt

element

compound

mixture

Gold

element

compound

mixture

Glass

element

compound

mixture

Part III- Problems. You must clearly show your work for full credit.

1. The most common isotopes of copper are ^{63}Cu and ^{65}Cu .

a) From the periodic table, which one is more abundant? (Circle) ^{63}Cu ^{65}Cu

b) Calculate the expected percentages of each in a sample of naturally occurring copper. (Assume that only these two isotopes exist).

Average atomic mass is 63.5 (from periodic table).

$x = \text{fraction of Cu-63}; y = \text{fraction of Cu-65.}$ $x + y = 1.0$, so $x = 1.0 - y$

$x(63) + y(65) = 63.5$ or $63(1.0 - y) + 65y = 63.5$

$63 - 63y + 65y = 63.5$ or $2y = 0.5$

so $y = 0.25; x = 0.75$

25% Cu-65 and 75% Cu-63

2. Aluminum metal is produced from the ore bauxite, which contains aluminum oxide [Al_2O_3], by reaction with carbon. The other product is carbon dioxide.

a) Write a balanced equation for this reaction.



b) What is the molar mass of aluminum oxide?

$$2 \times 26.98 \text{ g/mol} + 3 \times 16.00 \text{ g/mol} = 101.96 \text{ g/mol}$$

c) How many grams of pure aluminum could be produced from 999 g of aluminum oxide?

$$999 \text{ g Al}_2\text{O}_3 \times 1 \text{ mol}/101.96 \text{ g} \times 4 \text{ mol Al}/2 \text{ mol Al}_2\text{O}_3 \times 26.98 \text{ g Al/mol Al} = 529 \text{ g}$$

d) If you have 100 grams of carbon and 100 grams of aluminum oxide, which one is the limiting reagent?

The balanced equation tells us that for every 2 moles of aluminum oxide ($2 \text{ mol} \times 101.96 \text{ g/mol} = 204 \text{ g}$), we need 3 moles C ($3 \text{ mol} \times 12.01 \text{ g/mol} = 36.03 \text{ g}$). Thus, we need almost 6 times as much aluminum oxide than carbon by mass. Aluminum oxide is therefore the limiting reagent.

3. Given the data table below, calculate the following:

Sample	Mass (g)	Volume (cm^3)
Unknown coin 1	6.589	0.900
Unknown coin 2	6.881	1.000

a) the density of unknown coin 1

$$6.589 \text{ g}/0.900 \text{ cc} = 7.32 \text{ g/cc}$$

b) the average density of both coins

$$(7.32 \text{ g/cc} + 6.881 \text{ g/cc})/2 = 7.10 \text{ g/cc}$$

4. Your friend is abroad this semester in London. She reports that the temperature there is 4°C . You know that the conversion to Fahrenheit involves multiplying by 1.8 and adding 32°F . What is the London temperature in Fahrenheit with the correct number of significant figures?

$$4^{\circ}\text{C} \times 1.8 + 32^{\circ}\text{C} = 39.2^{\circ}\text{C} \text{ but we have one 1 significant figure. Thus, } 40^{\circ}\text{C}.$$