

## **Final Exam Review (Math and Concepts)**

### *Chapter 1: The Chemical World*

1. Which statement most resembles a scientific theory?
  - a. When the pressure on a sample of oxygen gas is increased by 10%, the volume of the gas is decreased by 10%
  - b. The volume of a gas is inversely proportional to pressure.
  - c. A gas is composed of small particles in constant motion
  - d. A gas sample has a mass of 15.8g and a volume of 10.5 L
  
2. Which statement best defines chemistry?
  - a. The science that studies solvents, drugs, and insecticides
  - b. The science that studies the connections between the properties of matter and the particles that compose matter.
  - c. The science that studies air and water pollution
  - d. The science that seeks to understand processes that occur only in chemical laboratories.
  
3. Which of the following is considered a hypothesis (as opposed to an observation)\*
  - a. The Washington Monument is 555 feet tall
  - b. Birds can fly because they have hollow bones
  - c. Fresh lava from a volcano is hot
  - d. Spiders have 8 legs
  
4. Which statement about the scientific method is TRUE?\*

  - a. The scientific method emphasizes scientific laws as the way to understand the world
  - b. The scientific method emphasizes reason as the way to understand the world
  - c. The scientific method emphasizes observation and experimentation as the way to understand the world
  - d. The scientific method emphasizes observation and reason as the way to understand the world

### *Chapter 2: Measurement and Problem Solving*

1. The 2016 U.S population was estimated to be 323,000,000 people. Express this number in scientific notation.
  
  
  
  
  
  
  
  
  
2. The radius of a carbon atom is approximately 0.00000000070m. Express this number in scientific notation.

3. The radius of a dust speck is  $4.5 \times 10^{-3}\text{mm}$ . What is the correct value of this number in decimal notation (i.e, express this number without using scientific notation)?

4500mm

0.045mm

0.0045mm

0.00045mm

4. How many significant figures are in each number?

a. 0.0035

b. 1.080

c. 2371

d.  $2.97 \times 10^5$

e. 1 dozen = 12

f. 100.00

g. 100,000

5. Perform each calculation to the correct number of significant figures.

a.  $3.897 \times (782.3 - 451.88)$       b.  $(4.58 \div 1.239) - 0.578$

6. List all the important units of conversion.

7. A recipe for making creamy pasta sauce calls for 0.75L of cream. Your measuring cup measures only in cups. How many cups of cream should you use? (4 cups = 1 quart)

8. One lap of a running track measures 255m. To run 10.0km, how many laps should you run?

9. A prescription medication requires 11.5 mg per kg of body weight. Convert this quantity to the number of grams required per pound of body weight and determine the correct dose (in g) for a 145-lb patient.
  
10. The average annual per person crude oil consumption in the United States is 15,615m<sup>3</sup>. What is this value in cubic inches?
  
11. The gasoline in an automobile gas tank has a mass of 60.0kg and a density of 0.752 g/cm<sup>3</sup>. What is its volume in cm<sup>3</sup>?

### *Chapter 3: Matter and Energy*

1. Describe the difference between physical and chemical changes. Highlight some common examples.
  
2. Classify each property as physical or chemical
  - a. The tendency of copper to turn green when exposed to air
  - b. The tendency of automobile paint to dull over time
  - c. The tendency of gasoline to evaporate quickly when spilled
  - d. The low mass (for a given volume) of aluminum relative to other metals

3. Classify each property as physical or chemical
  - a. The explosiveness of hydrogen gas
  - b. The bronze color of copper
  - c. The shiny appearance of silver
  - d. The ability of dry ice to sublime (change from solid directly to vapor)
4. A candy bar contains 225 Cal of nutritional energy. How many joules does it contain?

5. Classify each change as exothermic or endothermic
  - a. Wood burning in a fire
  - b. Ice melting

6. Convert each of the following.
  - a.  $-25^{\circ}\text{C}$  to Kelvins
  - b. 310 K to Fahrenheit

7. Discuss specific heat capacity.

8. Gallium is a solid metal at room temperature but melts at  $29.9^{\circ}\text{C}$ . If you hold gallium in your hand, it melts from your body heat. How much heat must 2.5g of gallium absorb from your hand to raise the temperature of the gallium from  $25.0^{\circ}\text{C}$  to  $29.9^{\circ}\text{C}$ ? The specific heat capacity of gallium is  $0.372\text{ J/g }^{\circ}\text{C}$

### *Chapter 4: Atoms and Elements*

1. Discuss the parts of the Atomic Theory.
  
  
  
  
  
  
  
  
  
  
2. An atom composed of which of these particles would have a mass of approximately 12 amu and be charge-neutral?
  - a. 6 protons and 6 electrons
  - b. 3 protons, 3 neutrons, and 6 electrons
  - c. 6 protons, 6 neutrons, and 6 electrons
  - d. 12 neutrons and 12 electrons
  
  
  
  
3. Classify each element as a metal, nonmetal, or metalloid
  - a. Ba
  - b. I
  - c. O
  - d. Te
  
  
  
  
4. Discuss the difference between ions and isotopes.
  
  
  
  
  
  
  
  
  
  
5. Determine the charge of each ion.
  - a. A magnesium ion with 10 electrons
  - b. A sulfur ion with 18 electrons
  - c. An iron ion with 23 electrons
  
  
  
  
6. Which pair of ions has the same total number of electrons.
  - a.  $\text{Na}^+$  and  $\text{Mg}^{2+}$
  - b.  $\text{F}^-$  and  $\text{Cl}^-$
  - c.  $\text{O}^-$  and  $\text{O}^{2-}$
  - d.  $\text{Ga}^{3+}$  and  $\text{Fe}^{3+}$

7. What are the atomic number, mass, and symbols for the chlorine isotope with 18 neutrons?
8. If an atom has a mass number of 27 has 14 neutrons, it is an isotope of which element?
9. Gallium has two naturally occurring isotopes: Ga-69 with mass 68.9256 amu and a natural abundance of 60.11% and Ga-71 with mass of 70.9247 and a natural abundance of 39.89%. Calculate the atomic mass of Gallium.
10. Magnesium has three naturally occurring isotopes with masses of 23.99, 24.99, and 25.98 amu and a natural abundance of 78.99%, 10.00%, and 11.01%. Calculate the atomic mass of Magnesium.

## Chapter 5: Molecules and Compounds

- Write a chemical formula for each compound and name each.
  - The compound containing two aluminum atoms to every three oxygen atoms
  - The compound containing three oxygen atoms to every sulfur atom
  - The compound containing four chlorine atoms to every carbon atom
- Determine the number of each type of atom in  $\text{Mg}_3(\text{PO}_4)_2$
- Write a formula for the ionic compound that forms from aluminum and oxygen and name the compound.
- Provide the compound name for the following compounds:  
 $\text{MgO}$   
 $\text{Ca}(\text{NO}_3)_2$   
 $\text{NaCl}$   
 $\text{CaBr}_2$
- Name the following compounds containing polyatomic ions.  
 $\text{KNO}_3$                        $\text{NH}_4\text{NO}_3$   
 $\text{Fe}(\text{OH})_2$

6. Naming the following acids:



7. Calculate the formula mass of carbon tetrachloride, CCl<sub>4</sub>

8. Which substance has the greatest formula mass?

- a. O<sub>2</sub>
- b. O<sub>3</sub>
- c. H<sub>2</sub>O
- d. H<sub>2</sub>O<sub>2</sub>

*Chapter 6: Chemical Composition*

1. A silver ring contains 65 silver atoms. How many moles of silver are in the ring?

2. Calculate the number of moles of sulfur in 57.8 g of sulfur.

3. How many aluminum atoms are in an aluminum can with a mass of 16.2 g?

4. Calculate the mass (in grams) of 1.75 mol of water.



5. Determine the number of moles of O in 1.7 mol of  $\text{CaCO}_3$
6. Carvone ( $\text{C}_{10}\text{H}_{14}\text{O}$ ) is the main component of spearmint oil. It has a pleasant aroma and mint flavor. Carvone is added to chewing gum, liqueurs, soaps, and perfumes. Calculate the mass of carbon in 55.4 g of carvone.
7. Calculate the mass percent of Cl in freon-114 ( $\text{C}_2\text{Cl}_4\text{F}_2$ ).
8. A 3.24-g sample of titanium reacts with oxygen to form 5.40 g of the metal oxide. What is the empirical formula of the metal oxide?
9. Naphthalene is a compound containing carbon and hydrogen that is used in mothballs. Its empirical formula is  $\text{C}_5\text{H}_4$  and its molar mass is 128.16 g/mol. What is its molecular formula?

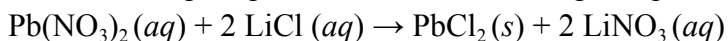
### *Chapter 7: Chemical Reactions*

1. Which changes involve a chemical reaction? Explain your answers.
  - a. Ice melting upon warming
  - b. An electric current passes through water, resulting in the formation of hydrogen and oxygen gas that appears as bubbles rising in the water.
  - c. Iron rusting
  - d. Bubbles forming when a soda can is opened.
  
2. Write a balanced equation for the combustion reaction between liquid octane (C<sub>8</sub>H<sub>18</sub>), a component of gasoline, and gaseous oxygen to form gaseous carbon dioxide and gaseous water.
  
  
  
  
  
  
  
  
  
  
3. Write a balanced equation for the reaction of solid aluminum with aqueous sulfuric acid to form aqueous aluminum sulfate and hydrogen gas.
  
  
  
  
  
  
  
  
  
  
4. Balance the chemical equation.  
$$\text{Fe}(s) + \text{HCl}(aq) \rightarrow \text{FeCl}_3(aq) + \text{H}_2(g)$$
  
  
  
  
  
  
  
  
  
  
5. Is each compound soluble or insoluble?  
AgBr  
  
CaCl<sub>2</sub>  
  
Pb(NO<sub>3</sub>)<sub>2</sub>  
  
PbSO<sub>4</sub>

6. Write an equation for the precipitation reaction that occurs (if any) when solutions of sodium carbonate and copper (II) chloride are mixed.

7. Write an equation for the precipitation reaction that occurs (if any) when solutions of lithium nitrate and sodium sulfate are mixed.

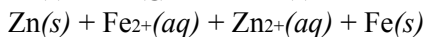
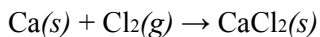
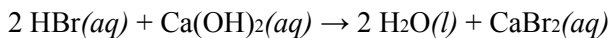
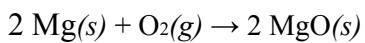
8. Consider this precipitation reaction occurring in aqueous solution.



Write a complete ionic equation and a net ionic equation for the reaction.

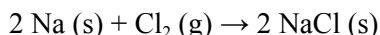
9. Write a molecular and a net ionic equation for the reaction between aqueous  $\text{HNO}_3$  and aqueous  $\text{Ca}(\text{OH})_2$

10. Which of these are redox reactions?



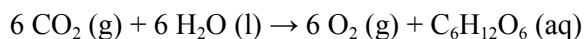
## Chapter 8: Quantities in Chemical Reactions

1. Sodium Chloride, NaCl, forms in this reaction between sodium and chlorine.



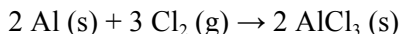
How many moles of NaCl result from the complete reaction of 3.4 mol of Cl<sub>2</sub>? Assume that there is more than enough Na.

2. In photosynthesis, plants convert carbon dioxide and water into glucose (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>) according to the reaction:



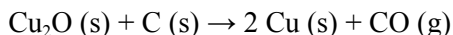
How many grams of glucose can be synthesized from 58.5 g of CO<sub>2</sub>? Assume that there is more than enough water present to react with all of the CO<sub>2</sub>.

3. Consider this reaction:



If you begin with 0.552 mol of aluminum and 0.887 mol of chlorine, what is the limiting reactant and theoretical yield of AlCl<sub>3</sub> in moles?

4. Consider this reaction:



When 11.5 g of C reacts with 114.5 g of Cu<sub>2</sub>O, 87.4 g of Cu are obtained. Determine the limiting reactant, theoretical yield, and percent yield.

*Chapter 9: Electrons in Atoms and the Periodic Table*

1. Describe the electromagnetic spectrum and draw the entirety of the spectrum with corresponding labels.

2. Describe in detail the relationship between frequency and wavelength.

3. Provide the electron configuration for the following elements on the periodic table:

Ca

Co

Cd

Zn

S

4. How many and what subshells are there in  $n=3$

5. Write an orbital diagram for the following elements:

O

Fe

Se

Ti

6. Choose the element with the higher ionization energy from each pair.

a. Mg or P

b. As or Sb

c. N or Si

d. O or Cl

7. Which of the listed elements is most metallic?

a. Al

b. N

c. P

d. O

*Chapter 10: Chemical Bonding*

1. Write the Lewis Structure of the compound MgO.
2. Write the Lewis structure for CO<sub>2</sub>. What is its molecular shape?
3. Predict the molecular geometry of PCl<sub>3</sub> and [NO<sub>3</sub>]<sup>-</sup>
4. Write the Lewis structure for the following compounds, state their molecular geometry and their bond angles.

