

# AP Chemistry Summer Practice/Review Problems

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## Properties of Matter Practice Problems

**Directions:** Identify the following changes as physical or chemical changes

1. Baking soda reacts with vinegar to produce carbon dioxide. \_\_\_\_\_
2. The copper sheath on the Statue of Liberty turns green. \_\_\_\_\_
3. Addition of salt melts ice on the highway. \_\_\_\_\_
4. Steam condenses on the windowpane. \_\_\_\_\_
5. Epoxy resin cures and hardens. \_\_\_\_\_
6. Sugar dissolves in a cup of coffee. \_\_\_\_\_
7. Natural gas burns in a furnace. \_\_\_\_\_

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## Sig Fig Practice Problems

**Directions:**

How many significant figures are in the following numbers? Write your answer in the space provided. Additionally, put each number in scientific notation making sure to retain the correct number of sig figs.

**Example:** 5,280 = 3 sig figs,  $5.28 \times 10^3$

1. 2,000 = \_\_\_\_\_
2. 15 = \_\_\_\_\_
3. 6,589,000 = \_\_\_\_\_
4. 70,400,000,000. = \_\_\_\_\_
5. 0.00263 = \_\_\_\_\_
6. 0.00589 = \_\_\_\_\_
7. 0.006 = \_\_\_\_\_
8. 0.400 = \_\_\_\_\_
9. 0.08060 = \_\_\_\_\_
10. 500,000. = \_\_\_\_\_
11. 0.0000000105 = \_\_\_\_\_
12. 0.006087 = \_\_\_\_\_

**Directions:**

Evaluate the following expressions. Express the answers in scientific notation with the correct number of significant figures and the correct units.

13.  $0.0045 \text{ in} + 1.0098 \text{ in} + 0.987 \text{ in} + 23.08 \text{ in} =$   
\_\_\_\_\_
14.  $(3.5 \text{ cm}^3 \times 2.0 \text{ g}\cdot\text{cm}^{-3}) + (7.33 \text{ cm}^3 \times 1.67 \text{ g}\cdot\text{cm}^{-3}) =$   
\_\_\_\_\_
15.  $2.703 \text{ g} / (1.376 \text{ cm} \times 2.45 \text{ cm} \times 3.78 \text{ cm}) =$   
\_\_\_\_\_

### Dimensional Analysis (Unit Conversions) Practice Problems

**Directions:** Complete the following metric conversions using dimensional analysis. Show all work.

- 8,768 mg into g
- 1342 mL into L
- 400 cm<sup>3</sup> into m<sup>3</sup>
- $3.26 \times 10^{-6}$  km into mm
- 3600 sq. in. into sq. ft.
- If one pound is 453.59 grams, how many grams are there in one ounce? How many ounces are there in one kilogram?

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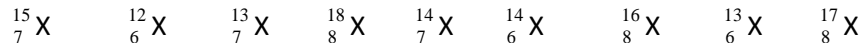
### Subatomic Particles Practice

**Directions:** Use the information in the chart and a periodic table to complete the rest of the boxes

ELEMENT	ATOMIC #	MASS #	NEUTRONS	PROTONS	ELECTRONS
	4				
Nitrogen					
		108			
				54	
			8		
					40
Calcium					
	34				
		52			

### Isotopes and Average Atomic Mass Practice

1. Which of the following atoms are isotopes of the same element? Identify the elements of these isotopes and describe the number of protons and neutrons in the nucleus for each of isotope.



2. There are three naturally occurring isotopes of neon:

Neon-20	Mass = 19.9924 amu	Abundance = 90.84%
Neon-21	Mass = 20.9940 amu	Abundance = 0.260%
Neon-22	Mass = 21.9914 amu	Abundance = 8.90%

- a. Without calculation, what is the approximate atomic mass of neon?
- b. Calculate the actual atomic mass of neon using the data in the table.
3. Uranium has an atomic mass equal to 238.0289 amu. It consists of two isotopes: uranium-235 with an isotopic mass of 235.044 amu and uranium-238 with an isotopic mass of 238.051 amu. Calculate the % abundance of the uranium-235 isotope. (Hint: use a system of equations...)

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### Periodic Table Practice Problems

1. From amongst the elements sodium, chlorine, nickel, argon, calcium, uranium, and oxygen, select the alkali metal, the alkaline earth metal, the transition metal, the actinide, the halogen, the noble gas, and the chalcogen (Group 6A).

### Naming and Writing Practice Problems

1. Write the formulas for the ionic substances below:

- a. potassium bromide \_\_\_\_\_
- b. calcium carbonate \_\_\_\_\_
- c. magnesium iodide \_\_\_\_\_
- d. lithium oxide \_\_\_\_\_
- e. aluminum sulfate \_\_\_\_\_
- f. ammonium chlorate \_\_\_\_\_
- g. beryllium phosphate \_\_\_\_\_

2. Name the following ionic substances:

- a.  $(\text{NH}_4)_2\text{SO}_4$  \_\_\_\_\_
- b.  $\text{Co}_2(\text{SO}_4)_3$  \_\_\_\_\_
- c.  $\text{NiSO}_4$  \_\_\_\_\_
- d.  $\text{AlPO}_4$  \_\_\_\_\_
- e.  $\text{KHCO}_3$  \_\_\_\_\_
- f.  $\text{Ca}(\text{NO}_3)_2$  \_\_\_\_\_

3. Name the following binary molecular compounds of the nonmetals:

- a.  $\text{CS}_2$  \_\_\_\_\_
- b.  $\text{SF}_6$  \_\_\_\_\_
- c.  $\text{IF}_5$  \_\_\_\_\_
- d.  $\text{N}_2\text{H}_4$  \_\_\_\_\_
- e.  $\text{PCl}_5$  \_\_\_\_\_
- f.  $\text{Cl}_2\text{O}_7$  \_\_\_\_\_
- g.  $\text{SiCl}_4$  \_\_\_\_\_
- h.  $\text{GeH}_4$  \_\_\_\_\_
- i.  $\text{P}_4\text{O}_{10}$  \_\_\_\_\_
- j.  $\text{S}_4\text{N}_4$  \_\_\_\_\_

4. What are the formulas for the following binary compounds?

a. Silicon dioxide \_\_\_\_\_

b. boron trifluoride \_\_\_\_\_

c. xenon tetroxide \_\_\_\_\_

d. dinitrogen pentoxide \_\_\_\_\_

e. bromine trifluoride \_\_\_\_\_

f. carbon tetrachloride \_\_\_\_\_

g. silicon monocarbide \_\_\_\_\_

h. phosphorus tribromide \_\_\_\_\_

i. disulfur dichloride \_\_\_\_\_

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### Writing and Balancing Equations Practice

1. Write balanced chemical equations corresponding to each of the following descriptions – make sure you use proper naming and writing rules to write the formulas for each substance!

a. Solid calcium carbide reacts with water to form an aqueous solution of calcium hydroxide and acetylene gas ( $C_2H_2$ ).

b. When solid potassium chlorate is heated, it decomposes to form solid potassium chloride and oxygen gas.

c. Solid zinc metal reacts with sulfuric acid to form hydrogen gas and an aqueous solution of zinc sulfate.

d. When liquid phosphorus trichloride is added to water, it reacts to form aqueous phosphorous acid and aqueous hydrochloric acid.

e. When hydrogen sulfide gas is passed over solid hot iron (III) hydroxide, the resultant reaction produces solid iron (III) sulfide and gaseous water.

f. Magnesium solid reacts with chlorine gas

g. Barium carbonate decomposes into barium oxide and carbon dioxide gas when heated.

h. The hydrocarbon styrene  $C_8H_8(l)$  is combusted in air

i. Silver oxide decomposes into silver metal and oxygen gas when heated.

## Formula Weights (Molar Mass) and Percent Composition Practice

- Determine the formula weights for the following compounds.
    - $\text{HNO}_3$
    - $\text{KMnO}_4$
    - $\text{Ca}_3(\text{PO}_4)_2$
    - Phosphorus trichloride
  - Find the percent composition of carbon in  $\text{C}_2\text{H}_2$
  - Find the percent composition of oxygen in  $\text{C}_6\text{H}_8\text{O}_6$
  - What is the percent by mass of nitrogen in ammonium nitrate?
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## Mole Conversions Practice

- How many moles are present in 128 grams of sulfur dioxide?
- What is the mass of 3 moles of oxygen gas?
- If 5 moles of a metallic element have a mass of 200 grams, which element is it?
- What is the molar mass of methane ( $\text{CH}_4$ )?
- What is the mass of 9 moles of fluorine gas molecules?
- The mass of 6 moles of a particular gas is equal to 102 grams. What is its molar mass?
- How many grams are there in one mole of benzene ( $\text{C}_6\text{H}_6$ )?
- How many molecules are there in 6 moles of TNT (tri-nitro-toluene:  $\text{CH}_3\text{C}_6\text{H}_2(\text{NO}_2)_3$ )?
- What is the molar mass of TNT?
- How many grams are in 23 moles of iron?
- How many moles are in 24 grams of carbon?
- What is the mass of  $5.234 \times 10^{30}$  silicon atoms?

### Empirical and Molecular Formulas Practice Problems

1. A compound was analyzed and found to contain 76.57% carbon, 6.43% hydrogen, and 17.00% oxygen by mass. Calculate the empirical formula of the compound. If the molar mass of the compound is 94.11g/mol, what is the molecular formula of the compound?
2. A compound was analyzed and found to contain 53.30% carbon, 11.19% hydrogen, and 35.51% oxygen by mass. Calculate the empirical formula of the compound. If the molar mass of the compound is 90.12 g/mol, what is the molecular formula of the compound?
3. Find empirical and molecular formulas of caffeine, which contains 49.5% carbon, 5.15% hydrogen, 28.9% nitrogen, 16.5% oxygen. It has a molar mass of 195 g.

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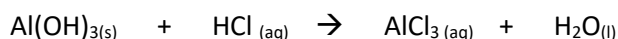
### Stoichiometry Practice Problems

1. Hydrofluoric acid, HF<sub>(aq)</sub>, cannot be stored in glass bottles because compounds called silicates in the glass are attacked by the HF<sub>(aq)</sub>. Sodium silicate (Na<sub>2</sub>SiO<sub>3</sub>) for example, reacts as follows:



- a. How many moles of HF are needed to react with 0.300 mole of Na<sub>2</sub>SiO<sub>3</sub>?
- b. How many grams of NaF form when 0.500 mol of HF reacts with excess Na<sub>2</sub>SiO<sub>3</sub>?
- c. How many grams of Na<sub>2</sub>SiO<sub>3</sub> can react with 0.800 g of HF?

2. Several brands of antacids use  $\text{Al}(\text{OH})_3$  to react with stomach acid, which contains primarily  $\text{HCl}$ :

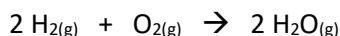


- Balance the equation above.
  - Calculate the number of grams of  $\text{HCl}$  that can react with 0.500 g of  $\text{Al}(\text{OH})_3$ .
  - Calculate the number of grams of  $\text{AlCl}_3$  and the number of grams of  $\text{H}_2\text{O}$  formed when 0.500 g of  $\text{Al}(\text{OH})_3$  reacts.
3. A solid iron ore sample contains iron (III) oxide together with other substances. Reaction of the ore with carbon monoxide produces solid iron metal and carbon dioxide gas.
- Write a BALANCED equation for this reaction.
  - Calculate the number of grams of carbon monoxide that can react with 0.350 kg of iron (III) oxide.
  - Calculate the number of grams of iron and the number of grams of carbon dioxide formed when 0.350 kg of iron (III) oxide reacts.

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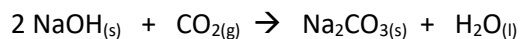
### Limiting Reactant and % Yield Practice

1. Hydrogen and oxygen gases react to form according to the reaction below:



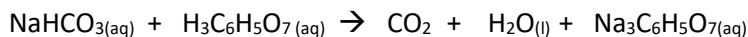
- Determine the limiting reactant if 13 g of  $\text{H}_2$  reacts with 80. g of  $\text{O}_2$ .
- How many grams of water will be produced (see your answer above – only one of these is the correct one)?
- In a separate experiment, 12.5 g of water is produced from 23.1 g of hydrogen gas and 25.4 g of oxygen gas. What is the percent yield for this experiment?

2. Sodium hydroxide reacts with carbon dioxide as follows:



- What is the limiting reactant when 1.85 mol of NaOH and 1.00 mole of CO<sub>2</sub> are allowed to react?
- How many moles of Na<sub>2</sub>CO<sub>3</sub> can truly be produced in part a?
- How many moles of the excess reactant remain after the completion of the reaction?

3. The fizz produced when an Alka-Seltzer tablet is dissolved in water is due to the reaction between sodium bicarbonate (NaHCO<sub>3</sub>) and citric acid (H<sub>3</sub>C<sub>6</sub>H<sub>5</sub>O<sub>7</sub>):



- In a certain experiment 1.00 g of sodium bicarbonate and 1.00 g citric acid are allowed to react. What is the limiting reactant?
- How many grams of carbon dioxide will form?
- How many grams of the excess reactant remain after the limiting reactant is completely consumed?