

THE MOLE AND AVOGADRO'S NUMBER

Name _____

One mole of a substance contains Avogadro's Number (6.02×10^{23}) of molecules.

How many molecules are in the quantities below?

1. 2.0 moles

2. 1.5 moles

3. 0.75 mole

4. 15 moles

5. 0.35 mole

How many moles are in the number of molecules below?

1. 6.02×10^{23}

2. 1.204×10^{24}

3. 1.5×10^{20}

4. 3.4×10^{26}

5. 7.5×10^{19}

GRAM FORMULA MASS

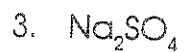
Name _____

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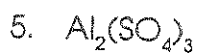
Determine the gram formula mass (the mass of one mole) of each compound below.

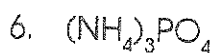




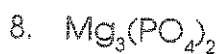


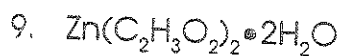




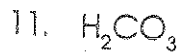


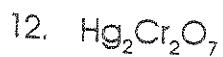




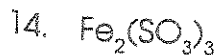


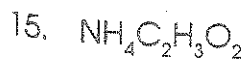












MOLES AND MASS

Name _____

Determine the number of moles in each of the quantities below.

1. 25 g of NaCl	_____
2. 125 g of H ₂ SO ₄	_____
3. 100. g of KMnO ₄	_____
4. 74 g of KCl	_____
5. 35 g of CuSO ₄ •5H ₂ O	_____

Determine the number of grams in each of the quantities below.

1. 2.5 moles of NaCl	_____
2. 0.50 moles of H ₂ SO ₄	_____
3. 1.70 moles of KMnO ₄	_____
4. 0.25 moles of KCl	_____
5. 3.2 moles of CuSO ₄ •5H ₂ O	_____

THE

For g
volum

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

THE MOLE AND VOLUME

Name _____

4

For gases at STP (273 K and 1 atm pressure), one mole occupies a volume of 22.4 L. What volume will the following quantities of gases occupy at STP?

1. 1.00 mole of H_2

2. 3.20 moles of O_2

3. 0.750 mole of N_2

4. 1.75 moles of CO_2

5. 0.50 mole of NH_3

6. 5.0 g of H_2

7. 100. g of O_2

8. 28.0 g of N_2

9. 60. g of CO_2

10. 10. g of NH_3

MIXED MOLE PROBLEMS

Name _____

Solve the following problems.

1. How many grams are there in 1.5×10^{25} molecules of CO_2 ?

2. What volume would the CO_2 in Problem 1 occupy at STP?

3. A sample of NH_3 gas occupies 75.0 liters at STP. How many molecules is this?

4. What is the mass of the sample of NH_3 in Problem 3?

5. How many atoms are there in 1.3×10^{22} molecules of NO_2 ?

6. A 5.0 g sample of O_2 is in a container at STP. What volume is the container?

7. How many molecules of O_2 are in the container in Problem 6? How many atoms of oxygen?

10-3 Review and Reinforcement

Empirical and Molecular Formulas

On the line at the left, write the letter of the term that best matches each description below. Each letter can be used once, more than once, or not at all.

a. percentage composition b. empirical formula c. molecular formula

- _____ 1. shows the simplest whole-number ratio of the atoms of the elements in a compound
- _____ 2. shows the actual number of atoms of each element in a molecular compound
- _____ 3. is determined by comparing the molar mass of the compound with the molar mass of the empirical formula
- _____ 4. relates the mass of each element in a compound to the entire mass of the compound
- _____ 5. can be used to determine the empirical formula
- _____ 6. must sum to 100 percent for all elements in a compound

Solve each of the following problems as directed. Show all your work.

7. A sample of iron oxide has a mass of 1.596 g. On analysis, it was found to contain 1.116 g of iron and 0.48 g of oxygen. Find the percentage composition of this compound.
8. Find the percentage composition of a compound that contains 17.6 g of iron and 10.3 g of sulfur. The total mass of the compound is 27.9 g.
9. Find the percentage composition of a compound containing 32.0 g of bromine and 4.9 g of magnesium.
10. A compound was analyzed and was found to contain 9.8 g of nitrogen, 0.7 g of hydrogen, and 33.6 g of oxygen. What is the empirical formula of the compound?

DETERMINING EMPIRICAL FORMULAS

Name _____

What is the empirical formula (lowest whole number ratio) of the compounds below?

1. 75% carbon, 25% hydrogen

2. 52.7% potassium, 47.3% chlorine

3. 22.1% aluminum, 25.4% phosphorus, 52.5% oxygen

4. 13% magnesium, 87% bromine

5. 32.4% sodium, 22.5% sulfur, 45.1% oxygen

6. 25.3% copper, 12.9% sulfur, 25.7% oxygen, 36.1% water



10-3 Practice Problems

1. Find the percentage composition of a compound that contains 1.94 g of carbon, 0.48 g of hydrogen, and 2.58 g of sulfur in a 5.00-g sample of the compound.
2. A sample of an unknown compound with a mass of 0.847 g has the following composition: 50.51 percent fluorine and 49.49 percent iron. When this compound is decomposed into its elements, what mass of each element would be recovered?
3. Find the percentage composition of a compound that contains 2.63 g of carbon, 0.370 g of hydrogen, and 0.580 g of oxygen in a 3.58-g sample of the compound.
4. A sample of an unknown compound with a mass of 2.876 g has the following composition: 66.07 percent carbon, 6.71 percent hydrogen, 4.06 percent nitrogen, and 23.16 percent oxygen. What is the mass of each element in this compound?
5. Find the percentage composition of a compound that contains 2.7369 g of chlorine, 0.4116 g of oxygen, and 0.7971 g of phosphorus in a 3.9460-g sample of the compound.
6. Find the percentage composition of a compound that contains 1.51 g of chromium, 1.13 g of potassium, and 1.62 g of oxygen in a 4.26-g sample of the compound.
7. A sample of a compound that has a mass of 0.432 g is analyzed. The sample is found to be made up of oxygen and fluorine only. Given that the sample contains 0.128 g of oxygen, calculate the percentage composition of the compound.
8. What is the percentage composition of a carbon-oxygen compound, given that a 95.2-g sample of the compound contains 40.8 g of carbon and 54.4 g of oxygen?
9. What is the percentage composition of a sulfur-chlorine compound, given that a 30.9-g sample of the compound contains 9.63 g of sulfur and 21.3 g of chlorine?
10. Determine the empirical formula of a compound containing 2.644 g of gold and 0.476 g of chlorine.
11. Determine the empirical formula of a compound containing 0.928 g of gallium and 0.412 g of phosphorus.
12. Determine the empirical formula of a compound containing 1.723 g of carbon, 0.289 g of hydrogen, and 0.459 g of oxygen.

(Empirical & Molecular Formulas)

16. Find the empirical formula of a compound, given that the compound is found to be 47.9 percent zinc and 52.1 percent chlorine by mass.
17. Find the empirical formula of a compound, given that a 48.5-g sample of the compound contains 1.75 g of carbon and 46.75 g of bromine.
18. Determine the empirical formula of a compound containing 20.23 percent aluminum and 79.77 percent chlorine.
19. Determine the empirical formula of a compound containing 24.74 percent potassium, 34.76 percent manganese, and 40.50 percent oxygen.
20. Determine the empirical formula of a compound containing 4.288 g of carbon and 5.712 g of oxygen.
21. Determine the empirical formula of a compound containing 2.16 g of aluminum, 3.85 g of sulfur, and 7.68 g of oxygen.
22. Determine the empirical formula of a compound containing 3.611 g of calcium and 6.389 g of chlorine.
23. Find the molecular formula of a compound that contains 42.56 g of palladium and 0.80 g of hydrogen. The molar mass of the compound is 216.8 g/mol.
24. Octane, a compound of hydrogen and carbon, has a molar mass of 114.26 g/mol. If one mole of the compound contains 18.17 g of hydrogen, what is its molecular formula?
25. Find the molecular formula of a compound that contains 30.45 percent nitrogen and 69.55 percent oxygen. The molar mass of the compound is 92.02 g/mol.
26. Find the molecular formula of a compound, given that a 212.1-g sample of the compound contains 42.4 g of hydrogen and 169.7 g of carbon and the molar mass is 30.0 g/mol.
27. A compound is known to have a molar mass of 391.5 g/mol. Find the molecular formula of the compound, given the results of an analysis of a 310.8-g sample that revealed that the sample contains only boron and iodine. The mass of the iodine in the sample is found to be 302.2 g.
28. Find the molecular formula of a compound that contains 56.36 g of oxygen and 43.64 g of phosphorus. The molar mass of the compound is 283.9 g/mol.

COMPOSITION OF HYDRATES

Name _____

10

A hydrate is an ionic compound with water molecules loosely bonded to its crystal structure. The water is in a specific ratio to each formula unit of the salt. For example, the formula $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ indicates that there are five water molecules for every one formula unit of CuSO_4 . Answer the questions below.

1. What percentage of water is found in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$?

2. What percentage of water is found in $\text{Na}_2\text{S} \cdot 9\text{H}_2\text{O}$?

3. A 5.0 g sample of a hydrate of BaCl_2 was heated, and only 4.3 g of the anhydrous salt remained. What percentage of water was in the hydrate?

4. A 2.5 g sample of a hydrate of $\text{Ca}(\text{NO}_3)_2$ was heated, and only 1.7 g of the anhydrous salt remained. What percentage of water was in the hydrate?

5. A 3.0 g sample of $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$ is heated to constant mass. How much anhydrous salt remains?

6. A 5.0 g sample of $\text{Cu}(\text{NO}_3)_2 \cdot n\text{H}_2\text{O}$ is heated, and 3.9 g of the anhydrous salt remains. What is the value of n?
