

Chapter 10 Outline

Chemical Quantities

- **Section 10.1 – The Mole: A Measurement of Matter**

- You often measure the amount of something by _____, by _____, or by _____.
- A _____ (mol) of a substance is _____ representative particles of that substance.
- 6.02×10^{23} is called _____ number.
- 1 mole = _____
- A _____ refers to the species present in a substance: usually _____.
- Elements normally exist as _____, but 7 elements exist as _____ molecules: _____.

- **Sample Problem**

- How many moles is 2.80×10^{24} atoms of silicon?

- **Practice Problems**

- How many moles is 2.17×10^{23} representative particles of bromine?

- How many molecules are in 2.12 mol of propane? (m/c = molecules)

- **Sample Problem**

- How many atoms are in 1.14 mol SO_3 ?

- **Practice Problems**

- How many moles are in 4.65×10^{24} molecules of NO_2 ?

- How many atoms are in 4.33 mol magnesium sulfate?

- The _____ of an element expressed in grams is the mass of a _____ of the element.
- The mass of a _____ of an element is the _____.
- To calculate the _____ of a compound, find the number of _____ of each _____ in one mole of the compound. Then _____ the masses of the elements in the compound.

- **Sample Problem**

- What is the molar mass of PCl_3 ?

- **Practice Problems**

- What is the molar mass of sodium hydrogen carbonate?

- What is the mass of calcium nitrate?

- **Section 10.1 Assessment**

1. Describe the relationship between Avogadro's number and one mole of any substance.
2. How can you calculate the mass of a mole of a compound?
3. How many moles is 1.50×10^{23} molecules NH_3 ?
4. How many atoms are in 1.75 mol of CHCl_3 ?
5. What is the molar mass of CaSO_4 ?

- **Section 10.2 – Mole-Mass and Mole-Volume Relationships**

- You can use the _____ of a substance as a conversion factor to convert between _____ and mass.
- 1 mole =
- **Sample Problem**
- What is the mass of 9.45 mol of aluminium oxide?

- **Practice Problems**

- Find the mass, in grams, of 4.52×10^{-3} mol $\text{C}_{20}\text{H}_{42}$.
- Calculate the mass of 2.50 mol of iron (II) hydroxide.

- Calculate the number of moles in 75.0g of dinitrogen trioxide.
- _____ hypothesis states that equal _____ of gases at the same temperature and pressure contain equal numbers of particles.
- At _____, 1 mole of _____ gas occupies a volume of _____.
- STP = _____
- The _____ of a gas changes with _____ and pressure, so _____ can only be used if the gas is at _____.
- 1 mol =
- **Sample Problem**
- Determine the volume, in liters, of 0.60 mol of SO_2 gas at STP.
- **Practice Problems**
- What is the volume of 3.70 mol N_2 at STP?
- How many moles is in 127L of CO_2 at STP?
- Now you have ____ conversion factors for moles:
- 1 mol =

- 1 mol =

- 1 mol =

- **Section 10.2 Assessment**

1. What is the volume of one mole of any gas at STP?
2. How many grams are in 5.66 mol of calcium carbonate?
3. Find the number of moles in 508g of ethanol ($\text{C}_2\text{H}_5\text{OH}$).
4. Calculate the volume, in liters, of 1.50 mol chlorine at STP.
5. Three balloons filled with 3 different gaseous compounds each have a volume of 22.4L at STP. Would these balloons have the same mass or contain the same number of molecules? Explain.

- **Section 10.3 – Percent Composition and Chemical Formulas**

- The percent by mass (_____) of an element in a compound is the number of grams of the _____ divided by the mass in grams of the _____ multiplied by _____.
- % mass of element =

- **Sample Problem**

- When a 13.60g sample of a compound containing only magnesium and oxygen is decomposed, 5.40g of oxygen is obtained. What is the percent composition of this compound?

- **Practice Problems**

- A compound formed when 9.03g Mg combines completely with 3.48g N. What is the percent composition of this compound?
- When a 14.2g sample of mercury (II) oxide is decomposed into its elements by heating, 13.2g of Hg is obtained. What is the percent composition of this compound?
- If a _____ problem does not give you the exact masses of the elements, then you can use the _____ instead.
- Use the same _____ for percent composition.
- **Sample Problem**

- Calculate the percent composition of propane (C_3H_8).

- **Practice Problems**

- Calculate the percent composition of sodium hydrogen sulfate.

- Calculate the percent composition of NITROGEN in ammonium nitrate.

- The _____ is the actual formula for a molecular compound. It contains the _____ number of each type of atom.

- The _____ is the whole-number ratio of atoms in a _____.

- $C_6H_{12}O_6$ □

- Sometimes the _____ formula is the same as the _____ formula. Ex:
- To calculate the empirical formula, you follow ____ steps:

- Change % to _____.
- Convert grams to _____.
- _____ each number by the _____ answer.

- **Sample Problem**

- Calculate the empirical formula for a compound that is 67.6% Hg, 10.8% S, and 21.6% O.

- **Practice Problems**

- Calculate the empirical formula for the following:
- 94.1% O and 5.9% H

- 62.1% C, 13.8% H, and 24.1% N

- After step __, you should get _____ numbers that can be used as the _____.
- Sometimes you will get a number that ends in ____ or _____. Do _____ round these numbers.
- For _____, multiply all answers by _____.
- For _____, multiply all answers by _____.
- **Sample Problem**

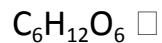
- A compound is analyzed and found to contain 25.9% nitrogen and 74.1% oxygen. What is the empirical formula of the compound?

- **Practice Problem**

- Determine the empirical formula for a compound that is 50.7% C, 4.2% H, and 45.1% O.

- An empirical and molecular formula differ by a _____, so their _____ also differ by the same whole-number multiple.

m.f. e.f.



180 g/mol □

- Whole-number multiplier =

- **Sample Problem**

- Calculate the molecular formula of a compound whose molar mass is 60g/mol and empirical formula is CH_4N .

- **Practice Problems**

- Find the molecular formula for antifreeze with a molar mass of 62 g/mol and an empirical formula of CH_3O .

- What is the molecular formula for a compound with a molar mass of 90 g/mol and an empirical formula of CH_2O ?

- **Section 10.3 Assessment**

1. How do you calculate the percent by mass of an element in a compound?
2. What information can you obtain from an empirical formula?
3. How is the molecular formula of a compound related to its empirical formula?

4. Calculate the percent composition of calcium acetate.

5. The compound methyl butanoate has a percent composition of 58.8% C, 9.8% H, and 31.4% O and its molar mass is 102 g/mol. What is its empirical and molecular formula?

6. Which of the following molecular formulas are also empirical formulas?

