

Ch. 8: Chemical Reactions

(1) Molecular Formula

- (A) The following are empirical formulas and molecular weights for five compounds. What are their molecular formulas?

Compound	Molecular Weight (g/mol)	Molecular Formula
NaS_2O_3	270.4	
$\text{C}_3\text{H}_2\text{Cl}$	147.0	
C_2HCl	181.4	
Na_2SiO_3	732.6	
NaPO_3	305.9	

(2) Empirical Formula

- (A) Arsenic reacts with oxygen to form a compound that is 75.7% arsenic and 24.3% oxygen, by weight. What is the empirical formula of this compound?
- (B) A substance was found to be composed of 60.8% sodium, 28.5% boron, and 10.5% hydrogen. What is the empirical formula of the compound?
- (C) The addictive substance in cigarette smoke, Nicotine, is extracted from the dried leaves of the tobacco plant. Nicotine is composed of 74.0% carbon, 8.7% hydrogen, and 17.3% nitrogen, and its molecular weight is 162.23 g/mol. What are the empirical and molecular formulas of nicotine?

(3) [Stoichiometry: Problem #1](#)

Chemical analysis* of the smoke generated by a popular brand of cigarettes yielded the following data.

Constituent	Concentration (mg/cig)
Nicotine	0.5
CO (carbon monoxide)	7
Tar (particulate matter)	6

* www.ash.org.uk/html/regulation/html/tartables.html#_Toc505880434

- (A) If a person smokes 5 cigarettes per day, what mass of CO₂ is produced from the nicotine in one year? Assume that 95% of the nicotine (i.e. 9.5 mg) in each cigarette is combusted, that no carbon monoxide is produced, and that the only combustion products are CO₂ (g), NO₂ (g), and H₂O(l).
- (B) If a person smokes 5 cigarettes per day, what mass of tar is produced in one year?

(4) [Stoichiometry: Problem #2 - \(Prob. 8-84\)](#)

Propane burns according to the following equation.



- (a) How many moles of CO₂ are produced from the combustion of 0.450 mole of C₃H₈? How many moles of H₂O are produced? How many moles of O₂ are needed?
- (b) What mass of H₂O is produced if 0.200 mol of CO₂ is also produced?
- (c) What mass of C₃H₈ is required to produce 1.80 g of H₂O?
- (d) What mass of C₃H₈ is required to react with 160 g of O₂?
- (e) What mass of CO₂ is produced by the reaction of 1.20×10^{23} molecules of O₂?

- (f) How many moles of H₂O are produced if 4.50×10^{22} molecules of CO₂ are produced?

(5) [Stoichiometry: Problem #3](#)

Calculate the mass of CO₂ produced from one tank of gasoline. Assume that the gasoline is 100% octane (C₈H₁₈) and that the only combustion products are CO₂ and H₂O. Assume also that the size of the tank is 20 gallons and that the density of gasoline is 0.60 g/ml.

(6) [Limiting Reactant - Problem #1](#)

Identify the limiting reactant for each combination in the table given the following reaction equation.



mols C₂H₄ (g)	mols O₂ (g)	Limiting reactant
3	8	
3	9	
3	10	
0.5	3	
1	3	
1.5	3	

(7) [Limiting Reactant - Problem #2](#)

Ethylene, C₂H₄, burns in air to form CO₂ and H₂O. How many grams of CO₂ will be formed when a mixture containing 2.80 g C₂H₄ and 6.25 g O₂ is ignited? The reaction equation is

