

S C H O O L O F T O M O R R O W

(Staying **APART** is the best way to stay **UNITED**)

ADDIS ABABA

Grade 9th Daily lesson 3 & 4

DLP-3

4.6 STOICHIOMETRY

:is the quantitative relationship between reactants and products in a balanced chemical equation

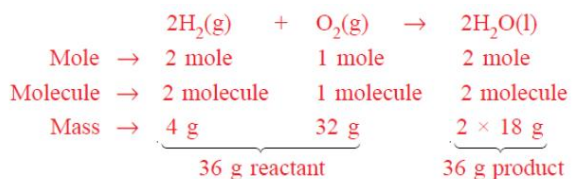
: is the study of the amount or ratio of moles, mass, energy and volumes (for gases) of reactants and products.

- Stoichiometric calculations are based on the following *two major principles*.
 - a) *The composition of any substance in the chemical equation should be expressed by a definite formula.*
 - b) *The law of conservation of mass must be obeyed (the mass of reactants equals the mass of products).*

4.6.1 Molar Ratios in Balanced Chemical Equation

From a balanced chemical equation, it is possible to determine the:

- *number of moles of each reactant and product;*
- *relative mass of each of the reactants and products*



Calculations based on chemical equations (*stoichiometric problems*) are classified into *mass-mass problem*, *volume-volume problems* and *mass-volume problems*.

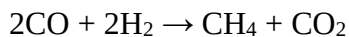
Questions (CW-3)

1. What is conserved in the given chemical equation? $\text{H}_{2(\text{g})} + \text{Cl}_{2(\text{g})} \rightarrow 2\text{HCl}(\text{g})$
 - a. *mass only*
 - b. *mass, moles, and molecules only*
 - c. *mass and moles only*
 - d. *mass, moles, molecules, and volume*

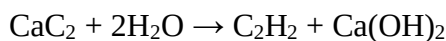
2. What is conserved in the reaction shown below? $N_{2(g)} + 3F_{2(g)} \rightarrow 2NF_{3(g)}$
 - a. atoms only
 - b. mass and atoms only
 - c. mass only
 - d. moles only
3. In a chemical reaction, the mass of the products _____.
 - a. is less than the mass of the reactants
 - b. is greater than the mass of the reactants
 - c. is equal to the mass of the reactants
 - d. has no relationship to the mass of the reactants
4. In the reaction $2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$, what is the ratio of moles of oxygen used to moles of $CO_{2(g)}$ produced?
 - a. 1:1
 - b. 1:2
 - c. 2:1
 - d. 2:2
5. Which of the following is true about the total number of reactants and the total number of products in the reaction shown below? $C_5H_{12(l)} + 8O_{2(g)} \rightarrow 5CO_{2(g)} + 6H_2O_{(g)}$
 - a. 9 moles of reactants chemically change into 11 moles of product.
 - b. 9 grams of reactants chemically change into 11 grams of product.
 - c. 9 liters of reactants chemically change into 11 liters of product.
 - d. 9 atoms of reactants chemically change into 11 atoms of product.

Questions (CW-4)

1. Why do you think a balanced chemical equation is needed in solving stoichiometric calculations?
2. What mass of CH_4 formed when 8.3 moles of CO react with hydrogen according to following equation?

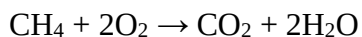


3. Calculate the mass of calcium carbide that is needed to produce 100cm^3 of acetylene according to this equation.



4. What volume of oxygen reacts with carbon monoxide to produce 0.5 mole of carbon dioxide at STP?

5. If 46.0 g of CH₄ reacts with 32.0g of O₂, according to the following reaction,



- which substance is the limiting reactant?
- how many grams of it remain unreacted?
- how many grams of CO₂ would be produced?

DLP-4

4.6.2 Mass–Mass Relationships

In mass-mass problems, the mass of one substance is given, and the mass of the second substance is determined from the same reaction.

- There are two methods for solving such types of problems:

i. Mass-ratio method

ii. Mole-ratio method

i) The mass-ratio method

The mass of one substance is determined from the given mass of the other substance using the following steps.

Step 1: Write the balanced chemical equation.

Step 2: Place the given mass above the corresponding formula, and x above the formula of the substance whose mass is to be determined.

Step 3: Write the total molar mass of the substances below the formula of each substance. (*Total molar mass is the molar mass of the substance multiplied by its coefficient*).

Step 4: Set up the proportion.

Step 5: Solve for the unknown mass, x.

E.g. How many grams of calcium chloride are formed when 15 g of calcium metal reacts with hydrochloric acid? **Solution:**→



Step 4: $\frac{15\text{ g}}{40\text{ g}} = \frac{x}{111\text{ g}}$

Step 5: $x = 41.63\text{ g}$

Therefore, 41.63 g of CaCl_2 is produced.

Questions (HW-3)

1. The equation below shows the decomposition of lead nitrate. How many grams of oxygen are produced when 11.5 g NO_2 is formed?



- a. 1.00 g
- b. 2.88 g
- c. 2.00 g
- d. 32.0 g

2. Iron (III) oxide is formed when iron combines with oxygen in the air. How many grams of Fe_2O_3 are formed when 16.7 g of Fe reacts completely with oxygen?



- a. 12.0 g
- b. 47.8 g
- c. 23.9 g
- d. 95.6 g

3. Aluminum reacts with sulfuric acid to produce aluminum sulfate and hydrogen gas. How many grams of aluminum sulfate would be formed if 250 g H_2SO_4 completely reacted with aluminum?

- a. 0.85 g
- b. 450 g
- c. 290 g
- d. 870 g

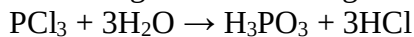
4. Mercury can be obtained by reacting mercury (II) sulfide with calcium oxide. How many grams of calcium oxide are needed to produce 36.0 g of Hg?



- a. 1.80 g
 - b. 10.1 g
 - c. 7.56 g
 - d. 13.4 g
5. How many grams of sodium hydroxide will be needed to react with 150 grams of HNO_3 ?

Questions (HW-4)

1. If 3 moles of calcium are reacted with 3 moles of oxygen, then
 - a. which substance is the limiting reactant?
 - b. how many moles of CaO are formed?
2. What is the percentage yield of a reaction in which 200g PCl_3 reacts with excess water to form 128g HCl according to the following reaction?



3. When 56.6g of calcium and 30.5g of nitrogen gas undergo a reaction that has a 90% yield, what mass of calcium nitride is formed?
4. How many grams of CaCO_3 are needed to react with 15.2 g of HCl in according to the following equation?



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