

chemistry stoichiometry problem sheet 2 answer key

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Introduction

Stoichiometry is the backbone of chemical calculations, allowing students to predict how much of one substance is produced or consumed when another reacts. Whether you're tackling a high school chemistry test or a university laboratory assignment, a clear grasp of stoichiometric concepts is essential. This article focuses on a frequently requested resource: the **chemistry stoichiometry problem sheet 2 answer key**. We'll walk through the typical problems you'll encounter, explain the reasoning behind each solution, and highlight common pitfalls so you can master the material confidently.

What is Stoichiometry?

In chemistry, **stoichiometry** refers to the quantitative relationships between reactants and products in a balanced chemical equation. It tells you how many moles of each substance are involved and, by extension, how many grams, liters, or molecules you'll need or obtain. The term comes from the Greek words *stoicheion* (element) and *metron* (measure).

Key Principles

- Law of Conservation of Mass: Mass is neither created nor destroyed in a chemical reaction.
- Mole Concept: A mole is a fixed number of entities (Avogadro's number, 6.022×10^{23}).
- Balanced Equations: The number of atoms for each element must be equal on both sides.
- Stoichiometric Ratios: Derived directly from the coefficients of a balanced equation.

Why Stoichiometry Matters

Mastering stoichiometry enables you to:

- Predict product yields and determine limiting reactants.
- Design efficient industrial processes and laboratory experiments.
- Interpret analytical data and solve real world chemistry problems.

Units and Conversions

Stoichiometry calculations often involve converting between grams, moles, and volumes. Familiarity with these conversions is crucial:

1. Grams to moles: $\text{moles} = \text{grams} / \text{molar mass}$
2. Moles to grams: $\text{grams} = \text{moles} \times \text{molar mass}$
3. Moles to volume (ideal gas at STP): $\text{volume} = \text{moles} \times 22.4 \text{ L}$

Approaching a Stoichiometry Problem

Follow a systematic process to avoid mistakes:

1. Read the problem carefully. Identify the given quantities and what needs to be found.
2. Write and balance the chemical equation. This is the foundation for all subsequent calculations.

3. Convert all given quantities to moles. Use molar masses or ideal gas constants as needed.
4. Use stoichiometric ratios. Relate moles of the known substance to the substance of interest.
5. Determine the limiting reactant. The reactant that produces the smallest amount of product limits the reaction.
6. Calculate the desired quantity. Convert back to grams, liters, or another unit if required.
7. Check your answer. Verify that the units are correct and that the answer makes sense in the context of the problem.

Problem Sheet 2 Overview

Problem sheet 2 typically contains a mix of questions ranging from simple mole to gram conversions to multi step limiting reactant problems. Below, we present a selection of representative problems followed by a detailed answer key. Each solution demonstrates the reasoning process, ensuring you can apply the same logic to similar questions.

Sample Problem 1

"A 10.0 g sample of magnesium reacts with excess oxygen to form magnesium oxide (MgO). How many grams of MgO are produced?"

Solution 1

1. Balanced equation: $2 \text{Mg} + \text{O}_2 \rightarrow 2 \text{MgO}$
2. Molar mass of Mg = 24.31 g/mol; MgO = 40.30 g/mol.
3. Convert Mg to moles: $10.0 \text{ g} \div 24.31 \text{ g/mol} = 0.411 \text{ mol}$.
4. Use stoichiometric ratio: 2 mol Mg produce 2 mol MgO. 1 mol Mg produces 1 mol MgO.
5. Moles of MgO = 0.411 mol.
6. Convert to grams: $0.411 \text{ mol} \times 40.30 \text{ g/mol} = 16.6 \text{ g}$.
7. Answer: 16.6 g of MgO.

Sample Problem 2

"If 5.0 g of sodium chloride (NaCl) reacts with excess sulfuric acid, how many grams of sodium sulfate (Na₂SO₄) can be produced?"

Solution 2

1. Balanced equation: $2 \text{NaCl} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2 \text{HCl}$
2. Molar masses: NaCl = 58.44 g/mol; Na₂SO₄ = 142.04 g/mol.
3. Moles of NaCl: $5.0 \text{ g} \div 58.44 \text{ g/mol} = 0.0856 \text{ mol}$.
4. Stoichiometric ratio: 2 mol NaCl produce 1 mol Na₂SO₄. 0.0856 mol NaCl produce 0.0428 mol Na₂SO₄.
5. Mass of Na₂SO₄: $0.0428 \text{ mol} \times 142.04 \text{ g/mol} = 6.07 \text{ g}$.
6. Answer: 6.07 g of Na₂SO₄.

Sample Problem 3

"A mixture of 4.0 g of aluminum (Al) and 2.0 g of silicon (Si) reacts with excess oxygen to form aluminum oxide (Al₂O₃) and silicon dioxide (SiO₂). Identify the limiting reactant and calculate the mass of the product(s) formed."

Solution 3

1. Balanced equations:



2. Si: $\text{Si} + \text{O}_2 \rightarrow \text{SiO}_2$

- Al: $4.0 \text{ g} \div 26.98 \text{ g/mol} = 0.148 \text{ mol}$.
- Si: $2.0 \text{ g} \div 28.09 \text{ g/mol} = 0.0712 \text{ mol}$.

- Al_2O_3 : 2 /mol Al produce 1 /mol Al_2O_3 !' 0.148 /mol Al produce 0.074 /mol Al_2O_3 .
- SiO_2 : 1 /mol Si produce 1 /mol SiO_2 , !' 0.0712 /mol Si produce 0.0712 /mol SiO_2 ,.
- Al_2O_3 : 0.074 /mol $\times$ /101.96 /g /mol $\{^1 /''\text{H} /7.55$ /g.
- SiO_2 : 0.0712 /mol $\times$ /60.08 /g /mol $\{^1 /''\text{H} /4.28$ /g.

Sample Problem 4

"A 12.5 g sample of potassium nitrate (KNO_3) decomposes upon heating to produce potassium nitrite (KNO_2) and oxygen gas (O_2). How many grams of oxygen gas are released?"

Solution 4

1. Balanced decomposition: $2 \text{KNO}_3 \rightarrow 2 \text{KNO}_2 + \text{O}_2$,
2. Molar mass of $\text{KNO}_3 = 101.10$ /g /mol $\{^1$.
3. Moles of KNO_3 : $12.5 \text{ g} / \div /101.10 \text{ g} / \text{mol} \{^1 /''\text{H} /0.1237$ /mol.
4. Stoichiometric ratio: 2 /mol KNO_3 produce 1 /mol O_2 , !' 0.1237 /mol KNO_3 produce 0.06185 /mol O_2 ,.
5. Molar mass of $\text{O}_2 = 32.00$ /g /mol $\{^1$.
6. Mass of O_2 : $0.06185 \text{ /mol} \times /32.00 \text{ g} / \text{mol} \{^1 /''\text{H} /1.98$ /g.
7. Answer: 1.98 /g of O_2 is released.

Comprehensive Answer Key for Problem Sheet 2

Below is a full answer key for the typical problems found in problem sheet 2. Each answer includes the final numeric value and a brief explanation of the key steps involved.

1. $\text{Mg} + \text{O}_2 \rightarrow \text{MgO}$ – 16.6 /g MgO (see Solution 1).

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