

## Chemistry Stoichiometry Problem Sheet 2 Answer Key

Chemistry Stoichiometry Problem Sheet 2 Answer Key Chemistry Stoichiometry Problem Sheet 2 Answer Key This answer key provides detailed solutions and explanations for the problems presented in Chemistry Stoichiometry Problem Sheet 2 The problems focus on key concepts in stoichiometry including Mole conversions Converting between grams moles and particles atoms molecules or formula units Balancing chemical equations Ensuring the number of atoms of each element is equal on both sides of the equation Stoichiometric calculations Using mole ratios from balanced equations to determine the amount of reactants or products involved in a reaction Limiting reactants Identifying the reactant that limits the amount of product that can be formed Percent yield Calculating the efficiency of a reaction based on the actual yield obtained compared to the theoretical yield

**Problem 1 Mole Conversions**

a How many moles are in 250 g of sodium chloride NaCl Solution 1 Molar mass Find the molar mass of NaCl Na 2299 g/mol Cl 3545 g/mol 5844 g/mol 2 Conversion Use the molar mass to convert grams to moles 250 g NaCl 1 mol NaCl 5844 g NaCl 0.427 mol NaCl

b How many grams are in 0.750 mol of carbon dioxide CO<sub>2</sub> Solution 1 Molar mass Find the molar mass of CO<sub>2</sub> C 12.01 g/mol 2O 16.00 g/mol 44.01 g/mol 2 Conversion Use the molar mass to convert moles to grams 0.750 mol CO<sub>2</sub> 44.01 g CO<sub>2</sub> 1 mol CO<sub>2</sub> 330 g CO<sub>2</sub>

c How many particles are in 150 mol of water H<sub>2</sub>O Solution 1 Avogadro's number Use Avogadro's number 6.022 x 10<sup>23</sup> particles/mol to convert moles to particles 150 mol H<sub>2</sub>O 6.022 x 10<sup>23</sup> molecules H<sub>2</sub>O 1 mol H<sub>2</sub>O 9.03 x 10<sup>23</sup> molecules H<sub>2</sub>O

**Problem 2 Balancing Chemical Equations**

Balance the following chemical equation CH<sub>4</sub> + O<sub>2</sub> → CO<sub>2</sub> + H<sub>2</sub>O Solution 1 Count atoms On the reactant side we have 1 C 4 H and 2 O On the product side we have 1 C 2 H and 3 O 2 Adjust coefficients To balance the equation we need to adjust the coefficients in front of each molecule CH<sub>4</sub> + 2O<sub>2</sub> → CO<sub>2</sub> + 2H<sub>2</sub>O 3 Recount atoms Now we have 1 C 4 H and 4 O on both sides of the equation

**Problem 3 Stoichiometric Calculations**

Consider the balanced equation 2Na + Cl<sub>2</sub> → 2NaCl

a How many grams of sodium chloride NaCl can be produced from 500 g of sodium Na Solution 1 Molar mass Find the molar masses of Na 22.99 g/mol and NaCl 58.44 g/mol 2 Convert grams to moles 500 g Na 1 mol Na 22.99 g Na 0.217 mol Na 3 Use mole ratio The balanced equation shows a 2:2 mole ratio between Na and NaCl This means 0.217 mol Na will produce 0.217 mol NaCl 4 Convert moles to grams 0.217 mol NaCl 58.44 g NaCl 1 mol NaCl

127 g NaCl b How many grams of chlorine gas  $\text{Cl}_2$  are required to react completely with 100 g of sodium Na

**Solution 1** Convert grams to moles  $100 \text{ g Na} \times \frac{1 \text{ mol Na}}{22.99 \text{ g Na}} = 4.35 \text{ mol Na}$

2 Use mole ratio The balanced equation shows a 2:1 mole ratio between Na and  $\text{Cl}_2$  This means 4.35 mol Na will react with 2.17 mol  $\text{Cl}_2$

3 Convert moles to grams  $2.17 \text{ mol Cl}_2 \times 70.90 \text{ g Cl}_2 / 1 \text{ mol Cl}_2 = 154 \text{ g Cl}_2$

**Problem 4 Limiting Reactants** Suppose 200 g of magnesium Mg reacts with 300 g of oxygen  $\text{O}_2$  according to the following balanced equation  $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$

a Which reactant is the limiting reactant

**Solution 1** Convert grams to moles  $200 \text{ g Mg} \times \frac{1 \text{ mol Mg}}{24.31 \text{ g Mg}} = 8.23 \text{ mol Mg}$

$300 \text{ g O}_2 \times \frac{1 \text{ mol O}_2}{32.00 \text{ g O}_2} = 9.38 \text{ mol O}_2$

2 Determine limiting reactant Mg to MgO ratio 2 moles Mg : 2 moles MgO

$\text{O}_2$  to MgO ratio 1 mole  $\text{O}_2$  : 2 moles MgO

12 Calculate moles of MgO produced  $8.23 \text{ mol Mg} \times \frac{2 \text{ mol MgO}}{2 \text{ mol Mg}} = 8.23 \text{ mol MgO}$

$9.38 \text{ mol O}_2 \times \frac{2 \text{ mol MgO}}{1 \text{ mol O}_2} = 18.76 \text{ mol MgO}$

The limiting reactant is Mg as it produces less MgO

b How many grams of magnesium oxide MgO can be produced

**Solution 1** Use limiting reactant Since Mg is the limiting reactant we use its moles 8.23 mol to calculate MgO production

2 Convert moles to grams  $8.23 \text{ mol MgO} \times 40.30 \text{ g MgO} / 1 \text{ mol MgO} = 332 \text{ g MgO}$

**Problem 5 Percent Yield** In a reaction 150 g of sodium chloride NaCl is theoretically expected However only 125 g of NaCl is actually produced What is the percent yield

**Solution 1** Percent yield formula

$\text{Percent yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$

2 Plug in values Percent yield  $125 \text{ g} / 150 \text{ g} \times 100 = 83.3\%$

**Conclusion** This answer key provides a comprehensive understanding of the concepts and calculations involved in stoichiometry By working through these problems and understanding the 4 explanations you can gain a strong foundation in solving stoichiometry problems in chemistry Remember to Always balance chemical equations before performing any stoichiometric calculations Use mole ratios from balanced equations to determine the amounts of reactants and products involved Identify the limiting reactant to determine the maximum amount of product that can be formed Calculate percent yield to assess the efficiency of a reaction Stoichiometry is a crucial aspect of chemistry enabling us to predict and analyze chemical reactions With practice and a solid understanding of the concepts you can master this important skill

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