

## Chemistry Stoichiometry Problem Sheet 2 Answer Key

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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 gmol Cl 3545 gmol

5844 gmol

**2 Conversion** Use the molar mass to convert grams to moles

250 g NaCl 1 mol NaCl 5844 g NaCl

0427 mol NaCl

b How many grams are in 0750 mol of carbon dioxide CO<sub>2</sub>

**Solution 1** Molar mass Find the molar mass of CO<sub>2</sub>

C 1201 gmol O 1600 gmol

4401 gmol

**2 Conversion** Use the molar mass to convert moles to grams

2 0750 mol CO<sub>2</sub> 4401 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** Avogadros number Use Avogadros number 6022 x 10<sup>23</sup> particlesmol to convert moles to particles

150 mol H<sub>2</sub>O 6022 x 10<sup>23</sup> molecules H<sub>2</sub>O

1 mol H<sub>2</sub>O 903 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 Re-count 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 2299 g/mol and NaCl 5844 g/mol 2 Convert grams to moles 500 g Na 1 mol Na 2299 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 5844 g NaCl 1 mol NaCl 127 g NaCl b How many grams of chlorine gas Cl<sub>2</sub> are required to react completely with 100 g of sodium Na Solution 1 Convert grams to moles 100 g Na 1 mol Na 2299 g Na 0.0435 mol Na 2 Use mole ratio The balanced equation shows a 2:1 mole ratio between Na and Cl<sub>2</sub> This means 0.0435 mol Na will react with 0.0217 mol Cl<sub>2</sub> 3 Convert moles to grams 0.0217 mol Cl<sub>2</sub> 7090 g Cl<sub>2</sub> 1 mol Cl<sub>2</sub> 154 g Cl<sub>2</sub> Problem 4 Limiting Reactants Suppose 200 g of magnesium Mg reacts with 300 g of oxygen O<sub>2</sub> 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 g Mg 1 mol Mg 2431 g Mg 0.0823 mol Mg 300 g O<sub>2</sub> 1 mol O<sub>2</sub> 3200 g O<sub>2</sub> 0.0938 mol O<sub>2</sub> 2 Determine limiting reactant Mg to MgO ratio 2 moles Mg 2 moles MgO 1:1 O<sub>2</sub> to MgO ratio 1 mole O<sub>2</sub> 2 moles MgO 1:2 Calculate moles of MgO produced 0.0823 mol Mg 2 mol MgO 2 mol Mg 0.0823 mol MgO 0.0938 mol O<sub>2</sub> 2 mol MgO 1 mol O<sub>2</sub> 1.876 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 0.0823 mol to calculate MgO production 2 Convert moles to grams 0.0823 mol MgO 4030 g MgO 1 mol MgO 332 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 Percent yield =  $\frac{\text{actual yield}}{\text{theoretical yield}} \times 100$  2 Plug in values Percent yield =  $\frac{125 \text{ g}}{150 \text{ g}} \times 100 = 83.3$  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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