

Name: _____ Date: _____

Stoichiometry Siege: Crush Quantitative Analysis for 11th Grade

Calculate theoretical yields and identify limiting reagents to optimize industrial chemical synthesis during this high-stakes reaction simulation.

1. A metallurgical engineer reacts 150.0 g of iron(III) oxide (Molar Mass = 159.7 g/mol) with excess carbon monoxide. If the process yields 88.5 g of liquid iron, what is the percent yield of the reaction? ($\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$)

- A. 78.2%
- B. 84.4%
- C. 59.0%
- D. 92.1%

2. In the combustion of octane ($2\text{C}_8\text{H}_{18} + 25\text{O}_2 \rightarrow 16\text{CO}_2 + 18\text{H}_2\text{O}$), the ratio of moles of oxygen consumed to moles of water produced is _____.

- A. 25:18
- B. 1.39:1
- C. 9:25
- D. 18:25

3. True or False: In a reaction where 2 moles of A react with 3 moles of B, if you start with equal masses of A and B, the substance with the higher molar mass is always the limiting reactant.

- A. True
- B. False

4. A chemist reacts 0.40 moles of Aluminum with 0.40 moles of Chlorine gas to form Aluminum Chloride ($2\text{Al} + 3\text{Cl}_2 \rightarrow 2\text{AlCl}_3$). Identify the limiting reactant and the moles of product formed.

- A. Al is limiting; 0.40 moles AlCl_3 formed
- B. Cl_2 is limiting; 0.27 moles AlCl_3 formed
- C. Cl_2 is limiting; 0.40 moles AlCl_3 formed
- D. Al is limiting; 0.27 moles AlCl_3 formed

5. To synthesize 10.0 grams of Silver Chloride via the reaction $\text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3$, the minimum mass of Sodium Chloride (58.44 g/mol) required is _____ grams.

- A. 4.08
- B. 7.21
- C. 5.84
- D. 1.43

6. In the decomposition of Potassium Chlorate ($2\text{KClO}_3 \rightarrow 2\text{KCl} + 3\text{O}_2$), what volume of O_2 gas is produced at STP from 122.5 g of KClO_3 (Molar Mass = 122.5 g/mol)?

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- A. 22.4 L
- B. 11.2 L
- C. 33.6 L
- D. 44.8 L

7. True or False: The empirical formula of a compound can be determined using only the percent composition by mass and the molar masses of the constituent elements.

- A. True
- B. False

8. If a gaseous hydrocarbon is 85.6% carbon and 14.4% hydrogen by mass, and has a molar mass of 42.1 g/mol, its molecular formula is _____.

- A. CH₂
- B. C₂H₄
- C. C₃H₆
- D. C₄H₈

9. Analyze the reaction: $4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$. If 2.0 moles of NH₃ and 2.0 moles of O₂ react, how many moles of the excess reactant remain?

- A. 0.4 moles NH₃
- B. 0.5 moles O₂
- C. 1.6 moles NH₃
- D. 0.2 moles O₂

10. True or False: In a balanced chemical equation, the total number of moles of reactants must always equal the total number of moles of products.

- A. True
- B. False