

# Chapter 8 Quiz - Revision

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## Quiz Details

- **Date and Time:** Tuesday, September 30th, between 7:00 AM and 7:30 AM.
  - **Format:** Closed notes.
  - **Allowed Materials:** A clean, unmarked copy of the provided periodic table (“Periodic Table for testing.pdf”). Ensure there is no writing on it.
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## Key Topics on the Quiz

1. Balancing chemical equations and identifying the type of reaction (synthesis, decomposition, single exchange, double exchange, combustion).
  2. Calculating the molecular formula from a given empirical formula and molar mass.
  3. Calculating the theoretical yield of a product when one reactant is explicitly stated to be in excess.
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## Phase 1: Foundation & Review (Friday - Saturday)

- **Understand Reaction Types:** Review slides 12-17 in **Chapter 8 Powerpoint.pdf**. Focus on the definitions and general forms (e.g.,  $A + B \rightarrow AB$  for synthesis) for each reaction type.
- **Master Balancing Equations:** Review slides 6-11 in **Chapter 8 Powerpoint.pdf**. Pay close attention to the strategy of balancing compounds first and treating polyatomic ions as single units.
- **Review Stoichiometry Concepts:** Refresh your understanding of mole-to-mole and gram-to-gram conversions by reviewing slides 25-31 in **Chapter 8 Powerpoint.pdf**. This is the foundation for theoretical yield problems.

## Phase 2: Practice & Application (Saturday - Sunday)

- **Practice Balancing and Classifying:** Complete problems 1a through 1l on the first page of **Types of Chemical Reactions.pdf**. Check your answers against the solutions provided on the sheet. For extra practice, work through problems 6a, 6b, 6c, and 6e on page 4.
- **Practice Theoretical Yield:** Work through problem 4 from **Limiting Reagent Worksheet.pdf**. This problem is a perfect example of a theoretical yield calculation where one reactant is in excess. A detailed explanation is provided below.

- **Practice Molecular Formula Calculation:** The second half of the combustion analysis problem on slides 23-24 of [Chapter 8 Powerpoint.pdf](#) is an exact model for the type of question on the quiz. Focus on how to get from the empirical formula to the molecular formula.

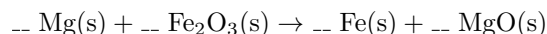
### Phase 3: Final Mastery (Monday)

- **Review Explanations:** Carefully read through the detailed explanations of the practice problems in the next section of this guide. Make sure you understand every step.
- **Self-Correction:** Re-attempt any problems you struggled with during Phase 2. Do not look at the answers until you have made a genuine effort to solve them yourself.
- **Final Preparation:** Print a clean, unmarked copy of [Periodic Table for testing.pdf](#). Put it with your backpack and other school materials so you don't forget it. Get a good night's sleep!

## Explanations of Practice Problems

### Topic 1: Balancing Equations & Identifying Reaction Types

**Problem:** From [Types of Chemical Reactions.pdf](#), problem 6c. Balance the reaction and state its type:

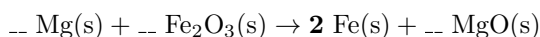


#### 1. Initial Atom Count:

- Reactants: Mg (1), Fe (2), O (3)
- Products: Fe (1), Mg (1), O (1)

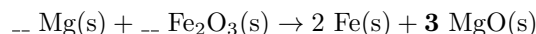
The equation is not balanced.

2. **Balance Iron (Fe):** There are 2 Fe atoms on the reactant side and 1 on the product side. Place a coefficient of **2** in front of Fe on the product side.



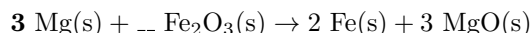
*New Count:* Reactants: Mg(1), Fe(2), O(3). Products: Fe(2), Mg(1), O(1).

3. **Balance Oxygen (O):** There are 3 O atoms on the reactant side and 1 on the product side. Place a coefficient of **3** in front of MgO.



*New Count:* Reactants: Mg(1), Fe(2), O(3). Products: Fe(2), Mg(3), O(3).

4. **Balance Magnesium (Mg):** Now there is 1 Mg atom on the reactant side and 3 on the product side. Place a coefficient of **3** in front of Mg.



*Final Count:* Reactants: Mg(3), Fe(2), O(3). Products: Fe(2), Mg(3), O(3). The equation is balanced! Note that the coefficient for Fe<sub>2</sub>O<sub>3</sub> is an implied **1**.

5. **Identify the Reaction Type:** In this reaction, an element (Mg) reacts with a compound (Fe<sub>2</sub>O<sub>3</sub>) and displaces another element (Fe) from the compound. This is the definition of a **Single Exchange** (or single replacement) reaction.

## Topic 2: Molecular Formula from Empirical Formula

**Problem:** Adapted from Chapter 8 Powerpoint.pdf, slide 24. A compound has the empirical formula  $\text{CH}_2\text{O}$  and a molar mass of approximately **180. g/mol**. What is its molecular formula?

1. **Calculate the Empirical Formula Mass:** First, find the mass of one mole of the empirical formula unit ( $\text{CH}_2\text{O}$ ) using the periodic table.

$$\text{C: } 1 \times 12.01 \text{ g/mol} = 12.01 \text{ g/mol}$$

$$\text{H: } 2 \times 1.01 \text{ g/mol} = 2.02 \text{ g/mol}$$

$$\text{O: } 1 \times 16.00 \text{ g/mol} = 16.00 \text{ g/mol}$$

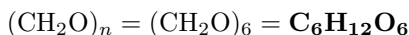
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$$\text{Total Empirical Mass} = \mathbf{30.03 \text{ g/mol}}$$

2. **Find the Whole-Number Multiplier (n):** The molecular formula is always a whole-number multiple of the empirical formula. To find this multiplier, divide the given molecular molar mass by the calculated empirical formula mass.

$$n = \frac{\text{Molecular Molar Mass}}{\text{Empirical Formula Mass}} = \frac{180 \text{ g/mol}}{30.03 \text{ g/mol}} \approx 5.99 \approx \mathbf{6}$$

3. **Determine the Molecular Formula:** Multiply the subscripts in the empirical formula by the whole-number multiplier ( $n=6$ ).

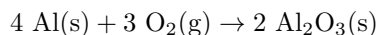


The molecular formula of the compound is  $\text{C}_6\text{H}_{12}\text{O}_6$ .

## Topic 3: Theoretical Yield with a Reactant in Excess

**Problem:** From Limiting Reagent Worksheet.pdf, problem 4b. "A chemist burns 160.0 g of Al in excess air to produce aluminum oxide,  $\text{Al}_2\text{O}_3$ ... Calculate the theoretical yield of this reaction."

1. **Write a Balanced Equation:** The reaction is aluminum combining with oxygen (from the air) to form aluminum oxide.



2. **Identify the Limiting Reactant:** The problem states that Al is burned in **excess air**. This means oxygen ( $\text{O}_2$ ) is the excess reactant. By definition, **aluminum (Al) is the limiting reactant**. The theoretical yield must be calculated based on the amount of Al.
3. **Convert Grams of Limiting Reactant to Moles:** Use the molar mass of Al (26.98 g/mol) to find the number of moles in 160.0 g of Al.

$$160.0 \text{ g Al} \times \frac{1 \text{ mol Al}}{26.98 \text{ g Al}} = 5.930 \text{ mol Al}$$

4. **Use Mole Ratio to Find Moles of Product:** Use the stoichiometric coefficients from the balanced equation to convert moles of Al to moles of  $\text{Al}_2\text{O}_3$ . The ratio is 4 moles of Al produce 2 moles of  $\text{Al}_2\text{O}_3$ .

$$5.930 \text{ mol Al} \times \frac{2 \text{ mol Al}_2\text{O}_3}{4 \text{ mol Al}} = 2.965 \text{ mol Al}_2\text{O}_3$$

5. **Convert Moles of Product to Grams:** Use the molar mass of  $\text{Al}_2\text{O}_3$  (101.96 g/mol) to find the mass of the product. This final mass is the theoretical yield.

$$2.965 \text{ mol Al}_2\text{O}_3 \times \frac{101.96 \text{ g Al}_2\text{O}_3}{1 \text{ mol Al}_2\text{O}_3} = \mathbf{302.3 \text{ g Al}_2\text{O}_3}$$

The theoretical yield of aluminum oxide is **302.3 grams**.

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