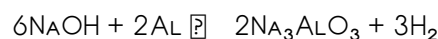


HOW MANY MOLES OF ALUMINUM ARE REQUIRED TO PRODUCE 495.0 GRAMS OF H₂? $6\text{NaOH} + 2\text{Al} \rightarrow 2\text{Na}_3\text{AlO}_3 + 3\text{H}_2$

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UNDERSTANDING THE RELATIONSHIP BETWEEN CHEMICAL REACTIONS AND QUANTITIES OF REACTANTS AND PRODUCTS IS FUNDAMENTAL IN CHEMISTRY. ONE COMMON QUESTION STUDENTS AND PROFESSIONALS ASK IS: HOW MANY MOLES OF ALUMINUM ARE NEEDED TO PRODUCE A SPECIFIC AMOUNT OF HYDROGEN GAS? IN THIS CASE, WE ARE ASKED TO DETERMINE HOW MANY MOLES OF ALUMINUM ARE REQUIRED TO PRODUCE 495.0 GRAMS OF H₂ BASED ON THE BALANCED CHEMICAL EQUATION:



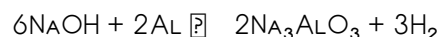
THIS ARTICLE WILL GUIDE YOU STEP-BY-STEP THROUGH THE PROCESS OF CALCULATING THE REQUIRED MOLES OF ALUMINUM, ILLUSTRATING THE IMPORTANCE OF STOICHIOMETRY IN CHEMICAL REACTIONS, AND PROVIDING USEFUL TIPS FOR SOLVING SIMILAR PROBLEMS.

UNDERSTANDING THE CHEMICAL EQUATION

BEFORE WE DIVE INTO THE CALCULATIONS, IT'S ESSENTIAL TO UNDERSTAND THE REACTION INVOLVED.

THE BALANCED REACTION

THE CHEMICAL EQUATION PROVIDED IS:



THIS INDICATES THAT:

- 6 MOLES OF SODIUM HYDROXIDE (NaOH) REACT WITH
- 2 MOLES OF ALUMINUM (Al) TO PRODUCE
- 2 MOLES OF SODIUM ALUMINATE (Na₃AlO₃) AND
- 3 MOLES OF HYDROGEN GAS (H₂).

KEY POINT

THE MOLE RATIO BETWEEN ALUMINUM AND HYDROGEN GAS IS 2:3. THIS RATIO IS CRUCIAL FOR OUR CALCULATIONS BECAUSE IT TELLS US HOW MANY MOLES OF ALUMINUM ARE NEEDED TO PRODUCE A CERTAIN AMOUNT OF HYDROGEN.

STEP 1: CONVERT GRAMS OF H₂ TO MOLES

THE FIRST STEP IS TO CONVERT THE GIVEN MASS OF HYDROGEN GAS INTO MOLES.

CALCULATING MOLES OF H₂

THE MOLAR MASS OF HYDROGEN (H₂) IS APPROXIMATELY:

- HYDROGEN ATOMIC MASS: 1.008 g/mol
- THEREFORE, H₂ MOLAR MASS: $2 \times 1.008 = 2.016$ g/mol

NOW, CONVERT 495.0 GRAMS OF H₂ TO MOLES:

$$\begin{aligned}\text{Moles of H}_2 &= \text{Mass of H}_2 / \text{Molar mass of H}_2 \\ &= 495.0 \text{ g} / 2.016 \text{ g/mol} \\ &\approx 245.83 \text{ mol}\end{aligned}$$

RESULT: APPROXIMATELY 245.83 MOLES OF HYDROGEN ARE PRODUCED.

STEP 2: USE MOLE RATIO TO FIND MOLES OF ALUMINUM

USING THE BALANCED CHEMICAL EQUATION, WE RELATE MOLES OF ALUMINUM TO MOLES OF HYDROGEN:

- 2 MOL AL PRODUCE 3 MOL H₂

REARRANGED AS:

- MOLES OF AL = (MOLES OF H₂) $\times$ (2 MOL AL / 3 MOL H₂)

APPLYING THE VALUES:

$$\begin{aligned}\text{Moles of Al} &= 245.83 \text{ mol H}_2 \times (2 \text{ mol Al} / 3 \text{ mol H}_2) \\ &= 245.83 \times (2/3) \\ &\approx 163.89 \text{ mol Al}\end{aligned}$$

RESULT: APPROXIMATELY 163.89 MOLES OF ALUMINUM ARE REQUIRED TO PRODUCE 495.0 GRAMS OF HYDROGEN GAS.

STEP 3: SUMMARIZE AND INTERPRET THE RESULTS

TO PRODUCE 495.0 GRAMS OF H₂, YOU NEED ABOUT 163.89 MOLES OF ALUMINUM. THIS NUMBER REFLECTS THE STOICHIOMETRIC REQUIREMENT DICTATED BY THE BALANCED CHEMICAL EQUATION.

ADDITIONAL TIPS FOR CHEMICAL STOICHIOMETRY CALCULATIONS

1. ALWAYS BALANCE THE CHEMICAL EQUATION

A BALANCED EQUATION ENSURES THE MOLE RATIOS ARE CORRECT, WHICH IS ESSENTIAL FOR ACCURATE CALCULATIONS.

2. CONVERT MASSES TO MOLES FIRST

USE MOLAR MASSES TO CONVERT ALL GIVEN QUANTITIES INTO MOLES BEFORE APPLYING RATIOS.

3. USE MOLE RATIOS CAREFULLY

ALWAYS REFER TO THE COEFFICIENTS IN THE BALANCED EQUATION TO SET UP YOUR CONVERSION FACTORS.

4. CONVERT BACK TO MASS IF NEEDED

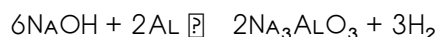
IF THE PROBLEM ASKS FOR GRAMS, CONVERT MOLES BACK TO GRAMS USING MOLAR MASS.

COMMON QUESTIONS RELATED TO THIS TOPIC

- HOW DO I DETERMINE THE MOLES OF A REACTANT NEEDED FOR A SPECIFIC AMOUNT OF PRODUCT?
- WHAT IS THE IMPORTANCE OF THE MOLE RATIO IN CHEMICAL REACTIONS?
- HOW CAN I CONVERT BETWEEN GRAMS AND MOLES IN STOICHIOMETRY PROBLEMS?

CONCLUSION

CALCULATING THE AMOUNT OF ALUMINUM NEEDED TO PRODUCE A GIVEN AMOUNT OF HYDROGEN GAS INVOLVES UNDERSTANDING THE CHEMICAL REACTION, BALANCING THE EQUATION, CONVERTING GRAMS TO MOLES, AND APPLYING MOLE RATIOS. IN THIS CASE, APPROXIMATELY 163.89 MOLES OF ALUMINUM ARE REQUIRED TO PRODUCE 495.0 GRAMS OF H₂ ACCORDING TO THE REACTION:



MASTERING THESE STEPS ENHANCES YOUR ABILITY TO SOLVE A WIDE RANGE OF STOICHIOMETRY PROBLEMS AND DEEPENS YOUR UNDERSTANDING OF CHEMICAL REACTIONS IN PRACTICAL APPLICATIONS.

REFERENCES

- GENERAL CHEMISTRY TEXTBOOKS ON STOICHIOMETRY
- MOLAR MASS CALCULATIONS AND PERIODIC TABLE DATA

REMEMBER: ALWAYS DOUBLE-CHECK YOUR CALCULATIONS AND ENSURE THE CHEMICAL EQUATION IS PROPERLY BALANCED BEFORE PROCEEDING. WITH PRACTICE, SUCH STOICHIOMETRY PROBLEMS BECOME EASIER AND MORE INTUITIVE!

FREQUENTLY ASKED QUESTIONS

HOW MANY MOLES OF ALUMINUM ARE REQUIRED TO PRODUCE 495.0 GRAMS OF H_2 IN THE REACTION $6NaOH + 2Al \rightarrow 2Na_3AlO_3 + 3H_2$?

FIRST, CALCULATE MOLES OF H_2 : MOLAR MASS OF $H_2 = 2 \text{ g/mol}$, SO $495.0 \text{ g} / 2 \text{ g/mol} = 247.5 \text{ mol}$. FROM THE BALANCED EQUATION, 3 MOL H_2 ARE PRODUCED PER 2 MOL AL, SO MOLES OF AL NEEDED $= (2/3) \times 247.5 \text{ mol} = 165 \text{ mol}$.

WHAT IS THE MOLAR RATIO OF ALUMINUM TO HYDROGEN GAS IN THE REACTION?

THE MOLAR RATIO OF ALUMINUM TO HYDROGEN GAS IS 2:3, MEANING 2 MOLES OF AL PRODUCE 3 MOLES OF H_2 .

HOW DO YOU CALCULATE THE AMOUNT OF ALUMINUM NEEDED TO GENERATE A SPECIFIC AMOUNT OF H_2 ?

DETERMINE THE MOLES OF H_2 PRODUCED, THEN USE THE MOLAR RATIO FROM THE BALANCED EQUATION TO FIND THE MOLES OF AL REQUIRED. FINALLY, CONVERT MOLES OF AL TO GRAMS IF NEEDED.

IF 165 MOLES OF ALUMINUM ARE REQUIRED, WHAT IS THE MASS OF ALUMINUM NEEDED?

THE MOLAR MASS OF AL IS APPROXIMATELY 26.98 g/mol . SO, $165 \text{ mol} \times 26.98 \text{ g/mol} \approx 4451.7 \text{ grams}$ OF ALUMINUM.

DOES THE REACTION INVOLVE ANY OTHER REACTANTS BESIDES ALUMINUM AND NaOH FOR HYDROGEN PRODUCTION?

IN THE GIVEN REACTION, NaOH ACTS AS A REACTANT BUT DOES NOT PRODUCE H_2 DIRECTLY; HYDROGEN GAS IS PRODUCED FROM ALUMINUM REACTING IN THE BASIC SOLUTION.

WHAT IS THE SIGNIFICANCE OF BALANCING THE CHEMICAL EQUATION IN DETERMINING THE AMOUNT OF REACTANTS NEEDED?

BALANCING ENSURES THE CORRECT MOLAR RATIOS ARE USED, WHICH IS ESSENTIAL FOR ACCURATELY CALCULATING THE AMOUNT OF ALUMINUM REQUIRED TO PRODUCE A SPECIFIC AMOUNT OF H_2 .

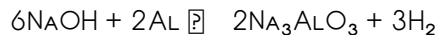
CAN THIS METHOD BE APPLIED TO OTHER REACTIONS PRODUCING GASES TO DETERMINE REACTANT QUANTITIES?

YES, THIS METHOD OF USING MOLAR RATIOS FROM BALANCED EQUATIONS IS WIDELY APPLICABLE FOR CALCULATING REACTANT QUANTITIES IN GAS-PRODUCING REACTIONS.

ADDITIONAL RESOURCES

HOW MANY MOLES OF ALUMINUM ARE REQUIRED TO PRODUCE 495.0 GRAMS OF H₂?

UNDERSTANDING THE RELATIONSHIP BETWEEN CHEMICAL REACTIONS AND STOICHIOMETRY IS FUNDAMENTAL FOR CHEMISTS, STUDENTS, AND ANYONE INTERESTED IN THE SCIENCE OF MATERIALS. WHEN TASKED WITH DETERMINING HOW MANY MOLES OF ALUMINUM ARE NEEDED TO PRODUCE A SPECIFIC AMOUNT OF HYDROGEN GAS, SUCH AS 495.0 GRAMS, IT'S ESSENTIAL TO APPROACH THE PROBLEM SYSTEMATICALLY. THIS GUIDE WILL WALK YOU THROUGH THE STEPS NEEDED TO SOLVE THIS PROBLEM, BASED ON THE BALANCED CHEMICAL EQUATION:



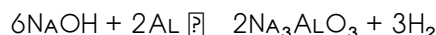
INTRODUCTION TO THE PROBLEM

IN MANY CHEMICAL REACTIONS, ESPECIALLY THOSE INVOLVING GASES, CALCULATING THE REQUIRED AMOUNTS OF REACTANTS INVOLVES UNDERSTANDING THE MOLAR RELATIONSHIPS DICTATED BY THE BALANCED CHEMICAL EQUATION. HERE, WE'RE ASKED: HOW MANY MOLES OF ALUMINUM ARE REQUIRED TO PRODUCE 495.0 GRAMS OF H₂?

THIS PROBLEM INTEGRATES CONCEPTS OF MOLAR MASS, STOICHIOMETRY, AND CHEMICAL BALANCING. BY THE END OF THIS GUIDE, YOU'LL HAVE A CLEAR STEP-BY-STEP METHOD TO DETERMINE THE AMOUNT OF ALUMINUM NEEDED.

UNDERSTANDING THE BALANCED CHEMICAL EQUATION

BEFORE DIVING INTO CALCULATIONS, IT'S CRUCIAL TO ANALYZE THE CHEMICAL REACTION:



KEY POINTS:

- THE REACTION INVOLVES ALUMINUM REACTING WITH SODIUM HYDROXIDE.
- HYDROGEN GAS (H₂) IS PRODUCED AS A PRODUCT.
- THE STOICHIOMETRIC COEFFICIENTS INDICATE THE MOLAR RATIOS.

MOLAR RATIOS FROM THE EQUATION:

- 2 MOLES OF ALUMINUM PRODUCE 3 MOLES OF HYDROGEN GAS.
- THEREFORE, THE MOLAR RATIO OF AL TO H₂ IS 2:3.

STEP 1: CONVERT THE GIVEN MASS OF HYDROGEN TO MOLES

THE FIRST STEP IS TO CONVERT THE MASS OF HYDROGEN GAS INTO MOLES, BECAUSE STOICHIOMETRY OPERATES ON MOLAR QUANTITIES.

MOLAR MASS OF H₂:

- HYDROGEN (H): APPROXIMATELY 1.008 g/mol
- THEREFORE, MOLAR MASS OF H₂ = 2 × 1.008 g/mol ≈ 2.016 g/mol

CALCULATION:

$$\begin{aligned} \text{Moles of H}_2 &= \frac{\text{Mass of H}_2}{\text{Molar Mass of H}_2} = \frac{495.0 \text{ g}}{2.016 \text{ g/mol}} \end{aligned}$$

$$\begin{aligned} & \backslash[\\ & \backslash\text{TEXT}\{\text{MOLES OF H}\}_2 \backslash\text{APPROX } 245.83\backslash, \backslash\text{TEXT}\{\text{MOL}\} \\ & \backslash] \end{aligned}$$

STEP 2: USE THE MOLAR RATIO TO FIND MOLES OF ALUMINUM

FROM THE BALANCED EQUATION, THE MOLAR RATIO OF ALUMINUM TO HYDROGEN GAS IS:

$$\begin{aligned} & \backslash[\\ & \backslash\text{FRAC}\{2\backslash, \backslash\text{TEXT}\{\text{MOL AL}\}\}\{3\backslash, \backslash\text{TEXT}\{\text{MOL H}\}_2\} \\ & \backslash] \end{aligned}$$

CALCULATION:

$$\begin{aligned} & \backslash[\\ & \backslash\text{TEXT}\{\text{MOLES OF AL}\} = \backslash\text{TEXT}\{\text{MOLES OF H}\}_2 \backslash\text{TIMES } \backslash\text{FRAC}\{2\backslash, \backslash\text{TEXT}\{\text{MOL AL}\}\}\{3\backslash, \backslash\text{TEXT}\{\text{MOL H}\}_2\} \\ & \backslash] \end{aligned}$$

$$\begin{aligned} & \backslash[\\ & \backslash\text{TEXT}\{\text{MOLES OF AL}\} = 245.83 \backslash\text{TIMES } \backslash\text{FRAC}\{2\}\{3\} \backslash\text{APPROX } 163.89\backslash, \backslash\text{TEXT}\{\text{MOL}\} \\ & \backslash] \end{aligned}$$

RESULT: APPROXIMATELY 163.89 MOLES OF ALUMINUM ARE REQUIRED TO PRODUCE 495.0 GRAMS OF H₂.

STEP 3: OPTIONAL - CONVERT MOLES OF ALUMINUM TO MASS

IF YOU NEED TO KNOW THE MASS OF ALUMINUM REQUIRED:

MOLAR MASS OF ALUMINUM:

- ALUMINUM (AL): APPROXIMATELY 26.98 g/mol

CALCULATION:

$$\begin{aligned} & \backslash[\\ & \backslash\text{TEXT}\{\text{MASS OF AL}\} = \backslash\text{TEXT}\{\text{MOLES OF AL}\} \backslash\text{TIMES } \backslash\text{TEXT}\{\text{MOLAR MASS OF AL}\} \\ & \backslash] \end{aligned}$$

$$\begin{aligned} & \backslash[\\ & \backslash\text{TEXT}\{\text{MASS OF AL}\} = 163.89 \backslash\text{TIMES } 26.98 \backslash\text{APPROX } 4,423.4\backslash, \backslash\text{TEXT}\{\text{G}\} \\ & \backslash] \end{aligned}$$

APPROXIMATELY 4.42 KILOGRAMS OF ALUMINUM ARE NEEDED.

ADDITIONAL CONSIDERATIONS

1. PURITY OF REACTANTS

IN PRACTICAL SCENARIOS, REACTANTS ARE RARELY 100% PURE. ADJUSTMENTS SHOULD BE MADE BASED ON THE PURITY OF ALUMINUM AND OTHER CHEMICALS USED.

2. REACTION CONDITIONS

REACTION CONDITIONS SUCH AS TEMPERATURE, PRESSURE, AND THE PRESENCE OF CATALYSTS CAN INFLUENCE THE YIELD. THE ABOVE CALCULATIONS ASSUME A PERFECT, 100% YIELD.

3. SAFETY AND HANDLING

PRODUCING HYDROGEN GAS INVOLVES FLAMMABLE AND EXPLOSIVE RISKS. PROPER SAFETY PROCEDURES MUST BE FOLLOWED DURING LABORATORY OR INDUSTRIAL PROCESSES.

SUMMARY OF KEY STEPS

- CONVERT THE GIVEN MASS OF H_2 TO MOLES:

$$495.0 \text{ g} \div 2.016 \text{ g/mol} \approx 245.83 \text{ mol } H_2$$

- USE THE MOLAR RATIO FROM THE BALANCED EQUATION:

$$2 \text{ mol Al} / 3 \text{ mol } H_2$$

- CALCULATE MOLES OF AL:

$$245.83 \text{ mol } H_2 \times (2 \text{ mol Al} / 3 \text{ mol } H_2) \approx 163.89 \text{ mol Al}$$

- OPTIONAL: CONVERT MOLES OF AL TO MASS:

$$163.89 \text{ mol} \times 26.98 \text{ g/mol} \approx 4,423.4 \text{ g Al}$$

FINAL THOUGHTS

THIS PROBLEM ILLUSTRATES THE POWER OF STOICHIOMETRY IN CHEMICAL CALCULATIONS. WHETHER FOR ACADEMIC PURPOSES, INDUSTRIAL APPLICATIONS, OR RESEARCH, UNDERSTANDING HOW TO RELATE QUANTITIES OF REACTANTS AND PRODUCTS IS FUNDAMENTAL. REMEMBER TO ALWAYS DOUBLE-CHECK YOUR MOLAR RATIOS AND ENSURE YOUR UNITS ARE CONSISTENT THROUGHOUT THE CALCULATIONS.

BY MASTERING THESE STEPS, YOU'LL BE WELL-EQUIPPED TO HANDLE SIMILAR PROBLEMS INVOLVING GAS PRODUCTION, REACTANT REQUIREMENTS, OR REACTION YIELDS WITH CONFIDENCE.

KEYWORDS: MOLES OF ALUMINUM, HYDROGEN GAS PRODUCTION, STOICHIOMETRY, BALANCED CHEMICAL EQUATION, REACTION CALCULATIONS, CHEMICAL MOLAR RATIOS

[How Many Moles Of Aluminum Are Required To Produce 495 0 Grams Of H2 6naoh 2ai Gt 2na3alo3 3h2](#)

How Many Moles Of Aluminum Are Required To Produce 495 0 Grams Of H2 6naoh 2ai Gt 2na3alo3 3h2

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