

CHM 101 - Stoichiometry Worksheet: Mastering Mole & Mass Conversions

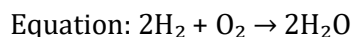


💡 Tips & Tricks to Make Stoichiometry Easy

- ✓ Always start with a balanced chemical equation! You need the correct molar ratios to perform conversions.
- ✓ Use the Mole Roadmap:
 - Mole → Mole (Use the coefficients from the balanced equation)
 - Mole → Gram (Multiply by molar mass)
 - Gram → Mole (Divide by molar mass)
 - Gram → Gram (Convert to moles first, then to grams of the desired substance)
- ✓ Set up dimensional analysis so that units cancel out!
- ✓ Use Avogadro's number (6.022×10^{23} particles/mole) when dealing with molecules or atoms.

Part 1: Mole to Mole Conversions

Example 1:



Question: How many moles of H_2O are produced when 5 moles of H_2 react with excess O_2 ?

Solution:

1. Use the balanced equation to determine the mole ratio:
 - 2 moles H_2 produce 2 moles H_2O (1:1 ratio)
2. Set up the conversion:

$$(5 \text{ moles H}_2) \times \left(\frac{2 \text{ moles H}_2\text{O}}{2 \text{ moles H}_2} \right)$$

$$(5 \text{ moles H}_2) \times \left(\frac{2 \text{ moles H}_2\text{O}}{2 \text{ moles H}_2} \right) = \mathbf{5 \text{ moles H}_2\text{O}}$$

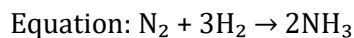
(Cancel out like terms gives you the final units of what you were looking for.)

3. Final Answer: 5 moles of H_2O .

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Example 2:



Question: How many moles of NH_3 are produced when 4 moles of N_2 react?

Solution:

1. Use the balanced equation to determine the mole ratio:

- 1 mole N_2 produces 2 moles NH_3 (1:2 ratio)

2. Set up the conversion:

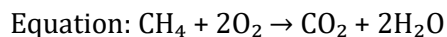
$$(4 \text{ moles } \text{N}_2) \times \left(\frac{2 \text{ moles } \text{NH}_3}{1 \text{ mole } \text{N}_2} \right)$$

$$(4 \text{ moles } \text{N}_2) \times \left(\frac{2 \text{ moles } \text{NH}_3}{1 \text{ mole } \text{N}_2} \right) = \mathbf{8 \text{ moles of } \text{NH}_3}$$

3. Final Answer: 8 moles of NH_3 .

Part 2: Mole to Gram Conversions

Example 1:



Question: How many grams of CO_2 are produced from 3 moles of CH_4 ?

Solution:

1. Find the molar mass of CO_2 :

- C = 12.01 g/mol, O = 16.00 g/mol $\times 2 \rightarrow 44.01$ g/mol

2. Use mole ratio from the balanced equation:

- 1 mole CH_4 produces 1 mole CO_2 (1:1 ratio)

3. Set up the conversion:

$$(3 \text{ moles } \text{CH}_4) \times \left(\frac{1 \text{ mole } \text{CO}_2}{1 \text{ mole } \text{CH}_4} \right) \times \left(\frac{44.01 \text{ g } \text{CO}_2}{1 \text{ mole } \text{CO}_2} \right)$$

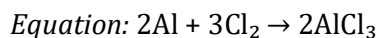
$$(3 \text{ moles } \text{CH}_4) \times \left(\frac{1 \text{ mole } \text{CO}_2}{1 \text{ mole } \text{CH}_4} \right) \times \left(\frac{44.01 \text{ g } \text{CO}_2}{1 \text{ mole } \text{CO}_2} \right) = \mathbf{132.03 \text{ g } \text{CO}_2}$$

4. Final Answer: 132.03 g CO_2 .

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Example 2:



Question: How many grams of AlCl_3 are produced from 4 moles of Al?

Solution:

1. Find the molar mass of AlCl_3 :
 - o $\text{Al} = 26.98 \text{ g/mol}$, $\text{Cl} = 35.45 \text{ g/mol} \times 3 \rightarrow 133.33 \text{ g/mol}$
2. Use the mole ratio from the balanced equation:
 - o 2 moles Al produce : 2 moles AlCl_3 (1:1 ratio)

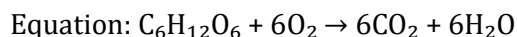
3. Set up the conversion:

$$4 \text{ moles Al} \times \left(\frac{2 \text{ moles AlCl}_3}{2 \text{ moles Al}} \right) \times \left(\frac{133.33 \text{ g AlCl}_3}{1 \text{ mole AlCl}_3} \right) = \mathbf{533.32 \text{ g AlCl}_3}$$

4. **Final Answer:** 533.32 g AlCl_3 .

Part 3: Gram to Mole Conversions

Example 1:



Question: How many moles of $\text{C}_6\text{H}_{12}\text{O}_6$ are in 180 g?

Solution:

1. Find the molar mass of $\text{C}_6\text{H}_{12}\text{O}_6$:
 - $\text{C} = 12.01 \text{ g/mol} \times 6$, $\text{H} = 1.008 \text{ g/mol} \times 12$, $\text{O} = 16.00 \text{ g/mol} \times 6 \rightarrow 180.16 \text{ g/mol}$
2. Set up the conversion:

$$(180 \text{ g C}_6\text{H}_{12}\text{O}_6) \times \left(\frac{1 \text{ mole C}_6\text{H}_{12}\text{O}_6}{180.16 \text{ g C}_6\text{H}_{12}\text{O}_6} \right)$$

$$(180 \text{ g C}_6\text{H}_{12}\text{O}_6) \times \left(\frac{1 \text{ mole C}_6\text{H}_{12}\text{O}_6}{180.16 \text{ g C}_6\text{H}_{12}\text{O}_6} \right) = \mathbf{1 \text{ mole C}_6\text{H}_{12}\text{O}_6}$$

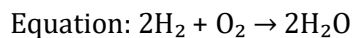
3. Final Answer: 1 mole of $\text{C}_6\text{H}_{12}\text{O}_6$.

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Part 4: Gram to Gram Conversions

Example 1:



Question: How many grams of H_2O are produced from 10 g of H_2 ?

Solution:

1. Find the molar masses:

- $\text{H}_2 = 2.02 \text{ g/mol}$, $\text{H}_2\text{O} = 18.02 \text{ g/mol}$

2. Use the mole ratio from the balanced equation:

- 2 moles H_2 produce 2 moles H_2O (1:1 ratio)

3. Convert grams of H_2 to moles:

$$(10 \text{ g H}_2) \times \left(\frac{1 \text{ mole H}_2}{2.02 \text{ g H}_2}\right) = 4.95 \text{ moles H}_2$$

4. Convert moles of H_2 to grams of H_2O :

$$(4.95 \text{ moles H}_2) \times \left(\frac{2 \text{ moles H}_2\text{O}}{2 \text{ moles H}_2}\right) \times \left(\frac{18.02 \text{ g H}_2\text{O}}{1 \text{ mole H}_2\text{O}}\right) = \mathbf{89.14 \text{ g H}_2\text{O}}$$

5. Final Answer: 89.14 g H_2O .