Lesson: How to do Stoichiometry Problems

Summary
In this lesson, students learn templates for performing stoichiometry problems. They then put the methods to the test with a practice worksheet.

Grade Level
High school

Objectives
By the end of this lesson, students should be able to
- perform mole-mole, mole-mass, and mass-mass stoichiometry problems.

Chemistry Topics
This lesson supports students’ understanding of
- Stoichiometry

Time
Teacher Preparation: 30 minutes
Lesson: one class period

Materials
- Student handout

Safety
There are no special safety considerations for this activity.

Teacher Notes
- In this lesson, students receive a handout with templates that outline how to perform different types of stoichiometry problems.
- Work through examples of each with the students before giving them problems to work through on their own.
- Included is a practice worksheet for students. The final answer is provided on the worksheet so students can verify their answers, but the answer key shows the work required to arrive at the final answer.
FOR THE STUDENT
Lesson

How to do Stoichiometry Problems

Conversions:
1 mole = mass on periodic table (P.T.)
1 mole = \(6.022 \times 10^{23}\) particles (Avogadro’s number)
1 mole = 22.4 L of a gas at STP (standard temperature and pressure)

*(One example of each step problems)*

A balanced equation is necessary for the *mole ratio*!

2 Step example
**Mole to Mole**

\[
\text{(Balanced Equation)}
\]

\[
\text{Moles given} \times \frac{\text{moles of unknown}}{\text{moles of given}} = \text{moles of unknown}
\]

3 Step example
**Mole to Mass**

\[
\text{(Balanced Equation)} \quad \text{(Conversion)}
\]

\[
\text{Moles given} \times \frac{\text{moles of unknown}}{\text{moles of given}} \times \frac{\text{P.T. mass unknown}}{1\text{mole of unknown}} = \text{P.T. mass unknown}
\]

**Mass to Moles**

\[
\text{(Conversion)} \quad \text{(Balanced Equation)}
\]

\[
\text{Mass given} \times \frac{1\text{mole of given}}{\text{P.T. mass given}} \times \frac{\text{moles of unknown}}{\text{moles of given}} = \text{moles of unknown}
\]

4 Step example
**Mass to Mass**

\[
\text{(Conversion)} \quad \text{(Balanced Equation)} \quad \text{(Conversion)}
\]

\[
\text{Mass given} \times \frac{1\text{mole of given}}{\text{P.T. mass given}} \times \frac{\text{moles of unknown}}{\text{moles of given}} \times \frac{\text{P.T. mass unknown}}{1\text{mole of unknown}} = \text{P.T. mass unknown}
\]
Stoichiometry Practice
Using the tips you just learned about to solve a stoichiometry problem, answer each of these problems. Show all work and consider significant figures. The final answer is provided for you in (bold) so you can immediately check to know whether you solved the problem correctly. If you didn’t arrive at the correct answer, try the problem again. You will need a periodic table to complete this activity.

1. Calculate the number of moles of nitrogen dioxide (NO₂) produced when 3.0 moles of oxygen are produced in the decomposition of nitric acid by light? (12 mol NO₂)
   \[4 \text{ HNO}_3 \rightarrow 4 \text{ NO}_2 + 2 \text{ H}_2\text{O} + \text{O}_2\]

2. Calculate the number of moles of Na₂CS₃ produced from 0.60 moles of CS₂ by the following reaction. (0.40 mol Na₂CS₃)
   \[3 \text{ CS}_2 + 6 \text{ NaOH} \rightarrow 2 \text{ Na}_2\text{CS}_3 + \text{Na}_2\text{CO}_3 + 3 \text{ H}_2\text{O}\]

3. How many grams of Si₃N₄ can be produced from 0.46 moles of N₂? (32 g Si₃N₄)
   \[3 \text{ Si} + 2 \text{ N}_2 \rightarrow \text{Si}_3\text{N}_4\]

4. How many moles of NO can be produced from 0.680 g of NH₃ according to the following reaction? (.0399 mol NO)
   \[4 \text{ NH}_3 + 5 \text{ O}_2 \rightarrow 4 \text{ NO} + 6 \text{ H}_2\text{O}\]

5. How many moles of SO₂ are required to convert 6.8 g of H₂S according to the following reaction? (0.10 g SO₂)
   \[2 \text{ H}_2\text{S} + \text{SO}_2 \rightarrow 3 \text{ S} + 2 \text{ H}_2\text{O}\]

6. How many grams of carbon is required to produce 9.460 grams of SiC? (8.500 g C)
   \[\text{SiO}_2 + 3 \text{ C} \rightarrow \text{SiC} + 2 \text{ CO}\]

7. How many grams of HClO₃ can be produced from 7.2 g of ClO₂ according to the following reaction? (7.5 g HClO₃)
   \[6 \text{ ClO}_2 + 3 \text{ H}_2\text{O} \rightarrow 5 \text{ HClO}_3 + \text{HCl}\]

8. How many molecules of H₂O₂ are required to react with 11.0 g of N₂H₄ according to the following reaction? (1.45 x 10²⁴ H₂O₂)
   \[7 \text{ H}_2\text{O}_2 + \text{N}_2\text{H}_4 \rightarrow 2 \text{ HNO}_3 + 8 \text{ H}_2\text{O}\]