

4 • Chemical Equations and Stoichiometry

Station 1 – COMBUSTION EQUATIONS

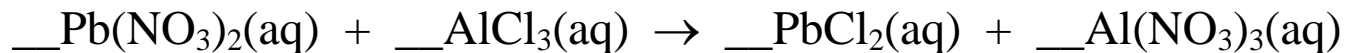
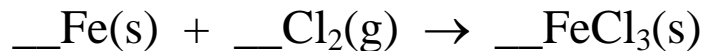
Write balanced equations for the complete combustion of the following fuels:

| Fuel | Combustion Equation |
|-------------|---------------------|
| C_3H_8 | |
| C_6H_{14} | |
| CH_3OCH_3 | |

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Station 2 – BALANCING EQUATIONS

Balance the following chemical equations:



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From the statement, decide whether each substance should be labeled with (s), (l), (g), or (aq):

| |
|--|
| Pure rubbing alcohol is C_3H_7OH (). |
| Copper metal is Cu (). |
| A solution of cupric chloride is $CuCl_2$ (). |
| Melted iron is Fe (). |
| Salt water is $NaCl$ (). |
| Helium is He (). |
| Dry ice is CO_2 (). |
| Steam is H_2O (). |

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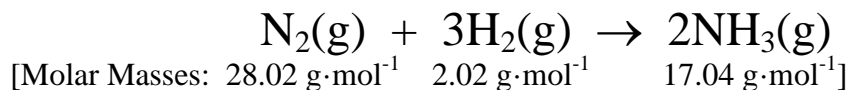
Determine the molecular formula given the following information:

| Empirical Formula | Molecular Formula | Molar Mass |
|-------------------|-------------------|--|
| CH_2 | | $84.18 \text{ g} \cdot \text{mol}^{-1}$ |
| NO_2 | | $92.02 \text{ g} \cdot \text{mol}^{-1}$ |
| $NaSO_2$ | | $174.14 \text{ g} \cdot \text{mol}^{-1}$ |
| PCl_3 | | $137.32 \text{ g} \cdot \text{mol}^{-1}$ |

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Station 5 – STOICHIOMETRY

Solve the following general stoichiometry problems: (Show work beautifully.)



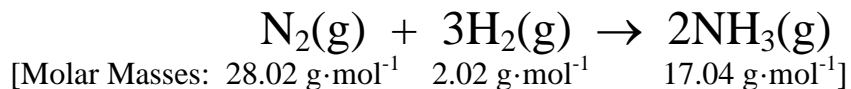
Calculate the mass of ammonia, NH₃, formed when 45.0 L N₂(g) reacts with excess H₂(g) at STP.

What mass of H₂ is needed to completely react with 10.0 grams of N₂?

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Station 6 – LIMITING REACTANT PROBLEMS

Solve the following problem:



What mass of NH₃ is formed when 135.00 g N₂ reacts with 32.00 g H₂?

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Station 7 – LABORATORY PROBLEM

Using the following data, determine the best ratio of the chemical reaction:



Various mixtures of X and Y were mixed. A thermometer was used to record the temperature of the mixture. The **highest temperature reached** for each mixture was recorded in the table below.

Circle the mixture in the data table that released the **most** heat.

Determine the **stoichiometric ratio** for X and Y (write in the coefficients in the equation above).

| Volume X (mL) | Volume Y (mL) | Max Temp Measured (°C) |
|---------------|---------------|------------------------|
| 0 | 100 | 20.0°C |
| 20 | 80 | 25.0°C |
| 40 | 60 | 30.0°C |
| 60 | 40 | 35.0°C |
| 80 | 20 | 27.5°C |
| 100 | 0 | 20.0°C |

In the mixture of 20 mL X and 80 mL Y, _____ was the limiting reactant.

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Station 8 – PERCENT YIELD

Solve the following problem:

Hydrogen gas was generated according to the equation: $Zn(s) + 2HCl(aq) \rightarrow H_2(g) + ZnCl_2(aq)$

When 25.00 grams of Zn metal reacted with excess HCl 7.50 L $H_2(g)$ was collected at STP.

The **theoretical yield** of $H_2(g)$ for this reaction is: (show work)

The **percentage yield** for this reaction is: (show set-up)

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Station 9 – CHEMICAL ANALYSIS

Solve the following problem:

A compound composed of carbon and hydrogen is analyzed by combustion.

When a 4.297 g sample of the compound is burned, 12.57 g CO₂ and 7.72 g H₂O are formed.

What is the **empirical formula** of the compound? _____

The molar mass of the compound is found to be about 30 g·mol⁻¹.

The **molecular formula** for the compound is _____

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