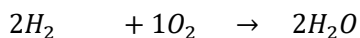


C11 - 4.1 - Stoichiometry Moles <-> Moles <-> Mass <-> Volume Notes

Stoichiometry: the relationship between amount of reactants used in a chemical reaction and amounts of products produced by the chemical reaction.

Reactants → Products



Assume Coefficient = # of Moles or # of Molecules

2 : 1 : 2

Molar Ratio

2 mol H₂ : 1 mol O₂ : 2 mol H₂O

$$\frac{2 \text{ mol H}_2}{1 \text{ mol O}_2}$$

$$\frac{2 \text{ mol H}_2}{2 \text{ mol H}_2\text{O}}$$

$$\frac{1 \text{ mol O}_2}{2 \text{ mol H}_2\text{O}}$$

How many moles of O₂ are required to react with 20 moles of H₂?

$\frac{\text{reactant}}{\text{reactant}}$

2 mol H₂ : 1 Mole O₂

20 mol H₂ : 10 Moles O₂

OR

$$\# \text{ moles O}_2 = 20 \text{ moles H}_2 \times \frac{1 \text{ moles O}_2}{2 \text{ mol H}_2} = 10 \text{ moles O}_2$$

Choose the fraction to cross off the units you don't want and get the units you do.

$$\text{Given units} \times \frac{\text{desired units}}{\text{given units}}$$

2 : 1 : 2

20 : 10 : 20

How many moles of H₂ are required to produce 14 moles of H₂O?

$\frac{\text{reactant}}{\text{product}}$

$$\# \text{ mol H}_2 = 14 \text{ mol H}_2\text{O} \times \frac{2 \text{ mol H}_2}{2 \text{ mol H}_2\text{O}} = 14 \text{ mol H}_2$$

2 : 1 : 2

14 : 7 : 14

$$\begin{array}{l} \times \frac{3}{2} \text{ or } 1.5 \\ \curvearrowright \\ 2 : 3 \\ \curvearrowright \\ \times \frac{2}{3} \text{ or } 0.666 \dots \end{array}$$

What mass of H₂O is produce by reacting 10 moles of O₂?

$$\text{mass H}_2\text{O} = 10 \text{ mol O}_2 \times \frac{2 \text{ mol H}_2\text{O}}{1 \text{ mol O}_2} \times \frac{18 \text{ g H}_2\text{O}}{\text{mol H}_2\text{O}} = 360 \text{ g H}_2\text{O}$$

OR

$$20 : 10 : 20 \quad 20 \text{ mol H}_2\text{O} \times \frac{18 \text{ g H}_2\text{O}}{\text{mol H}_2\text{O}} = 360 \text{ g H}_2\text{O}$$

What mass of H₂O is produced by reacting 10 grams of O₂?

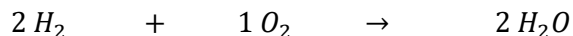
$$\text{mass H}_2\text{O} = 10 \text{ g O}_2 \times \frac{1 \text{ mol O}_2}{32 \text{ g O}_2} \times \frac{2 \text{ mol H}_2\text{O}}{1 \text{ mol O}_2} \times \frac{18 \text{ g H}_2\text{O}}{\text{mol H}_2\text{O}} = 2.81 \text{ g H}_2\text{O}$$

What mass of H₂O is produced by reacting 2 L of O₂ at STP?

$$\text{mass H}_2\text{O} = 2 \text{ L O}_2 \times \frac{1 \text{ mol O}_2}{22.4 \text{ L O}_2} \times \frac{2 \text{ mol H}_2\text{O}}{1 \text{ mol O}_2} \times \frac{18 \text{ g H}_2\text{O}}{\text{mol H}_2\text{O}} = 3.21 \text{ g H}_2\text{O}$$

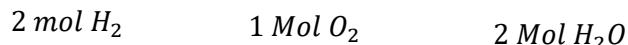
C11 - 4.2 - Excess Mass Notes

10 g Hydrogen gas reacts with 8 g Oxygen gas to produce Water.



①

Mole Ratio



②

③ $10 \text{ g } H_2 \times \frac{1 \text{ mol}}{2 \text{ g } H_2} = 5 \text{ mol } H_2$

Convert to Moles

④ $8 \text{ g } O_2 \times \frac{1 \text{ mol}}{32 \text{ g } O_2} = 0.25 \text{ mol } O_2$

Find g H₂O produced

	<i>Excess</i>		
<i>Moles based on H₂</i>	5 mol H ₂	2.5 mol O ₂	
	Have	Need	
			<i>We have 0.25 mol O₂ which needs 0.5 mol H₂ but we have 5 mol H₂. H₂ is in Excess.</i>
	<i>Need</i>	<i>Have</i>	
<i>Moles based on O₂</i>	0.5 mol H ₂	0.25 mol O ₂	0.5 mol H ₂ O
		<i>Limiting</i>	↑
		⑤	Use Limiting Reagent
			<i>We have 5 mol H₂ which needs 2.5 mol O₂ but we only have 0.25 mol O₂. O₂ is Limiting.</i>

Find Limiting Reagent

⑥ $0.5 \text{ mol } H_2O \times \frac{18 \text{ g } H_2O}{\text{mol}} = 9 \text{ g } H_2O$

Find amount in Excess

⑦ $5 \text{ mol } H_2 - 0.5 \text{ mol } H_2 = 4.5 \text{ mol } H_2$

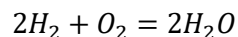
Have – Used = Excess Left Over

Or find out how much each reactant produces and the one that produces less is limiting.

C11 - 4.3 - Percent Yield/Percent Purity p.136

$$\text{Percent Yield} = \frac{\text{mass of product obtained}}{\text{mass of product expected}} \times 100\%$$

$$\text{Percent Purity} = \frac{\text{mass of pure reactant}}{\text{mass of impure reactant}} \times 100\%$$



If 20 g of O_2 is reacted with an excess of H_2 , 7.4 g of H_2O is formed.
What is the percentage yield?

$$\text{mass H}_2\text{O} = 20 \text{ g O}_2 \times \frac{1 \text{ mol O}_2}{32 \text{ g O}_2} \times \frac{1 \text{ mol H}_2\text{O}}{1 \text{ mol O}_2} \times \frac{18 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 11.25 \text{ g H}_2\text{O}$$

$$\text{Percent Yield} = \frac{\text{mass of product obtained}}{\text{mass of product expected}} \times 100\%$$

$$\text{Percent Yield} = \frac{7.4 \text{ g H}_2\text{O}}{11.25 \text{ g H}_2\text{O}} \times 100\%$$

$$\text{Percent Yield} = 65.8\%$$
