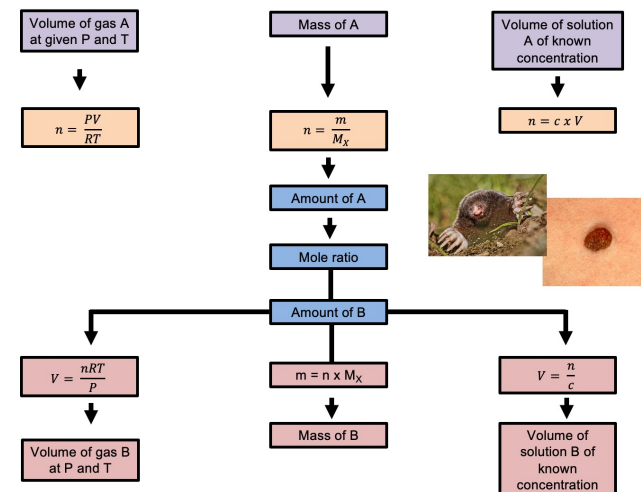
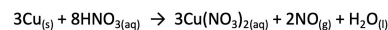


Gas Law Stoichiometry

- Gay Lussac's Law of Combining Volumes
- Avogadro's Hypothesis and the Law of Combining Volumes
- Fully-worked Practice Problems
- Reactions Involving Gases and Solutions
- More Practice Problems

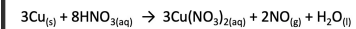


Check Your Understanding



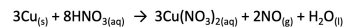
What volume of dry nitrogen monoxide gas would be produced from 25.0 g of copper metal at a temperature of 22°C and a pressure of 102 kPa?

Check Your Understanding



What volume of dry nitrogen monoxide gas would be produced from 25.0 g of copper metal at a temperature of 22°C and a pressure of 102 kPa?

Check Your Understanding



What volume of dry nitrogen monoxide gas would be produced from 25.0 g of copper metal at a temperature of 22°C and a pressure of 102 kPa?

2) Find n_{NO} using mole ratios

$$\frac{n_{\text{NO}}}{0.393 \text{ mol Cu}} = \frac{2 \text{ mol NO}}{3 \text{ mol Cu}}$$

$$n_{\text{NO}} = 0.262 \text{ mol}$$

	$3\text{Cu}_{(s)}$	$8\text{HNO}_{3(aq)}$	$3\text{Cu}(\text{NO}_3)_{2(aq)}$	$2\text{NO}_{(g)}$	$\text{H}_2\text{O}_{(l)}$
m	25.0 g				
M	63.55 g/mol				
n	0.393 mol			0.262 mol	
P				102 kPa	
V				?	
R				$8.31 \text{ kPa} \cdot \text{L} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$	
T				$22 + 273 = 295 \text{ K}$	

$$0.262 \text{ mol} / (8.31 \text{ kPa} \cdot \text{L} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}) (295 \text{ K})$$

$$103 \text{ kPa}$$

nitrogen monoxide gas will be produced.

Preview File

Please enjoy this preview of your Student Version of the presentation. Please note within this sample file:

- Some slides appear blank because they have been removed
- Student versions have portions of the text removed which is given in the teacher version and appear as _____ which the students are to fill in
- Other slides may have on them, this represents writing that has been removed on this sample

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Gay Lussac's Law of Combining Volumes

- The electrolysis of water results in the production of hydrogen and oxygen gas in a 2:1 ratio



- This volume production is predicted by the balanced equation
- If we look at the coefficients on the balanced equation, we can see that two water molecules become 2 hydrogen and 1 oxygen molecule
- _____

Avogadro's Hypothesis and the Law of Combining Volumes

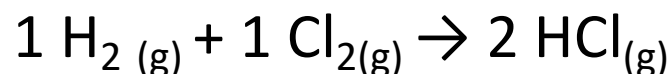
1 vol of hydrogen + 1 vol of chlorine $\rightarrow$ 2 vol of hydrogen chloride

If 1 volume contains n mol of gas, you can write:

$n(\text{mol})$ hydrogen + $n(\text{mol})$ chlorine $\rightarrow$ $2n(\text{mol})$ hydrogen chloride

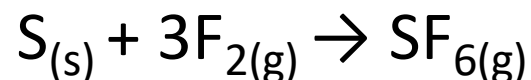
Divide each term by n and you get:

1 mol hydrogen + 1 mol chlorine $\rightarrow$ 2 mol hydrogen chloride



Check Your Understanding

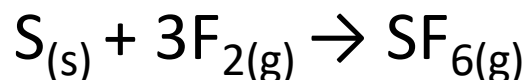
Sulphur burns in fluorine to form gaseous sulphur hexafluoride:



What volume of fluorine (F_2) is required to produce 125 mL of sulphur hexafluoride at the same pressure and temperature? **Use mole ratios**

Check Your Understanding

Sulphur burns in fluorine to form gaseous sulphur hexafluoride:



What volume of fluorine (F_2) is required to produce 125 mL of sulphur hexafluoride at the same pressure and temperature? **Use mole ratios**

$$\frac{V_{\text{F}_2}}{125 \text{ mL SF}_6} = \frac{3 \text{ mol F}_2}{1 \text{ mol SF}_6}$$

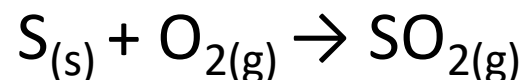
$$V_{\text{F}_2} = \frac{3 \text{ mol F}_2 \times 125 \text{ mL SF}_6}{1 \text{ mol SF}_6}$$

$$V_{\text{F}_2} = 375 \text{ mL}$$

Therefore, 375 mL of fluorine is required.

Check Your Understanding

Sulphur burns in oxygen to form sulphur dioxide:

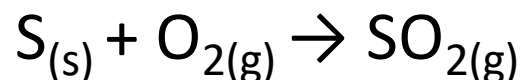


What volume of gas will be produced at SATP when 14.0 g of sulphur are burned in excess oxygen?

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Check Your Understanding

Sulphur burns in oxygen to form sulphur dioxide:



What volume of gas will be produced at SATP when 14.0 g of sulphur are burned in excess oxygen?

2) Find n_{SO_2} using mole ratios

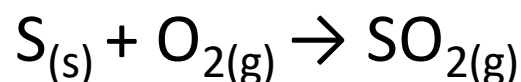
$$\frac{n_{\text{SO}_2}}{0.437 \text{ mol S}} = \frac{1 \text{ mol SO}_2}{1 \text{ mol S}}$$

$$n_{\text{SO}_2} = 0.437 \text{ mol}$$

	S	O ₂	SO ₂
m	14 g		
M	32.07 g/mol		
n	0.437 mol		0.437 mol

Check Your Understanding

Sulphur burns in oxygen to form sulphur dioxide:



What volume of gas will be produced at SATP when 14.0 g of sulphur are burned in excess oxygen?

3) Find V_{SO_2} through molar volume $\rightarrow V_m = V/n$

$$V = V_m \times n$$

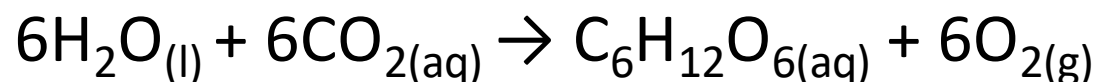
$$\begin{aligned} V &= (24.8 \text{ L/mol})(0.437 \text{ mol}) \\ &= 10.8 \text{ L} \end{aligned}$$

	S	O ₂	SO ₂
m	14 g		
M	32.07 g/mol		
n	0.437 mol		0.437 mol

Therefore, 10.8 L of sulphur dioxide will be produced at SATP.

Check Your Understanding

Oxygen gas is produced by the process of photosynthesis:



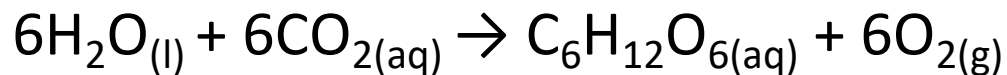
If a plant absorbs 0.12 g of carbon dioxide, what volume of oxygen gas (in mL) is produced at 15°C and 102 kPa pressure?

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Check Your Understanding

Oxygen gas is produced by the process of photosynthesis:



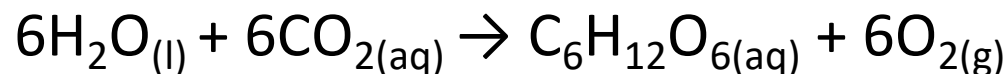
If a plant absorbs 0.12 g of carbon dioxide, what volume of oxygen gas (in mL) is produced at 15°C and 102 kPa pressure?

3) Find V_{O_2}

	$6\text{H}_2\text{O}_{(\text{l})}$	$6\text{CO}_{2(\text{aq})}$	$\text{C}_6\text{H}_{12}\text{O}_{6(\text{aq})}$	$6\text{O}_{2(\text{g})}$
m		0.12 g		
M		44.01 g/mol		
n		$2.7 \times 10^{-3} \text{ mol}$		
P				102 kPa
V				?
R				$8.31 \text{ kPa} \cdot \text{L} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$
T				$15 + 273 = 288 \text{ K}$

Check Your Understanding

Oxygen gas is produced by the process of photosynthesis:



If a plant absorbs 0.12 g of carbon dioxide, what volume of oxygen gas (in mL) is produced at 15°C and 102 kPa pressure?

$$PV = nRT$$

$$V_{\text{O}_2} = \frac{nRT}{P} = \frac{(2.7 \times 10^{-3} \text{ mol})(8.31 \text{ kPa} \cdot \text{L} \cdot \text{mol}^{-1} \cdot \text{K}^{-1})(288 \text{ K})}{102 \text{ kPa}}$$

$$= 6.3 \times 10^{-2} \text{ L}$$

$$= 63 \text{ mL}$$

Therefore, 63 mL of oxygen gas will be produced.

Reactions Involving Gases and Solutions

Look at the following slide which reviews the concepts of stoichiometry covered in all units so far....

Volume of gas A
at given P and T



$$n = \frac{PV}{RT}$$

Mass of A



$$n = \frac{m}{M_x}$$

Volume of solution
A of known
concentration



$$n = c \times V$$

**The Moral of the
story ... FIND
THE MOLE!**

Amount of A



Mole ratio

Amount of B

$$V = \frac{nRT}{P}$$



Volume of gas B
at P and T

$$m = n \times M_x$$

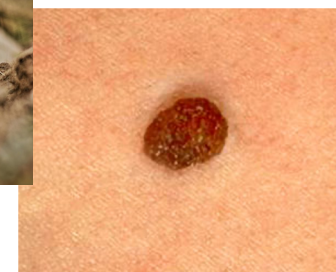


Mass of B

$$V = \frac{n}{c}$$

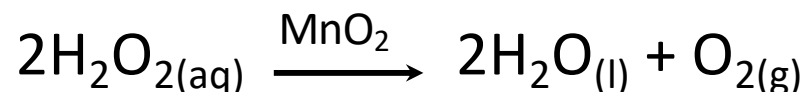


Volume of
solution B of
known
concentration



Check Your Understanding

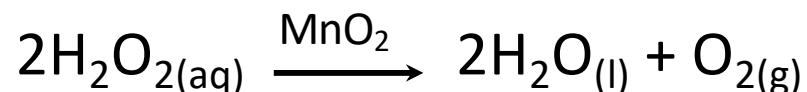
In the presence of manganese (IV) oxide, hydrogen peroxide decomposes to form oxygen gas and water:



What volume of oxygen gas will be produced at 21°C and 103 kPa from 125 mL of 6.00 mol•L⁻¹ hydrogen peroxide solution?

Check Your Understanding

In the presence of manganese (IV) oxide, hydrogen peroxide decomposes to form oxygen gas and water:



What volume of oxygen gas will be produced at 21°C and 103 kPa from 125 mL of 6.00 mol•L⁻¹ hydrogen peroxide solution?

1) Find n_{O_2} given the mass $\rightarrow n = c \times V$

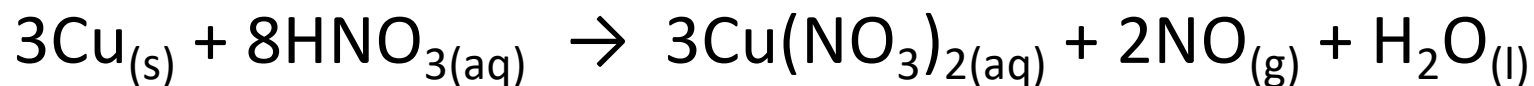
$$\begin{aligned} n &= (6.00 \text{ mol/L})(0.125 \text{ L}) \\ &= 0.750 \text{ mol} \end{aligned}$$

	$2\text{H}_2\text{O}_{2(\text{aq})}$	$2\text{H}_2\text{O}_{(\text{l})}$	$\text{O}_{2(\text{g})}$
c	6.00 mol/L		
n	0.750 mol		
V	0.125 L		?
P			103 kPa
R			8.31 kPa•L•mol ⁻¹ •K ⁻¹
T			21 + 273 = 294 K

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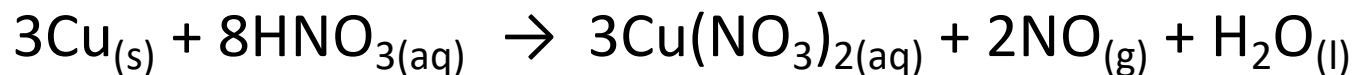
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Check Your Understanding



What volume of dry nitrogen monoxide gas would be produced from 25.0 g of copper metal at a temperature of 22°C and a pressure of 102 kPa?

Check Your Understanding



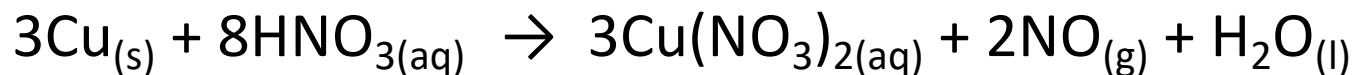
What volume of dry nitrogen monoxide gas would be produced from 25.0 g of copper metal at a temperature of 22°C and a pressure of 102 kPa?

1) Find n_{Cu} given the mass $\rightarrow n = m/M$

	$3\text{Cu}_{(s)}$	$8\text{HNO}_{3(aq)}$	$3\text{Cu}(\text{NO}_3)_{2(aq)}$	$2\text{NO}_{(g)}$	$\text{H}_2\text{O}_{(l)}$
m	25.0 g				
M	63.55 g/mol				
n	0.393 mol				
P				102 kPa	
V				?	
R				$8.31 \text{ kPa}\cdot\text{L}\cdot\text{mol}^{-1}\cdot\text{K}^{-1}$	
T				$22 + 273 = 295 \text{ K}$	

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Check Your Understanding



What volume of dry nitrogen monoxide gas would be produced from 25.0 g of copper metal at a temperature of 22°C and a pressure of 102 kPa?

2) Find n_{NO} using mole ratios

$$\frac{n_{\text{NO}}}{0.393 \text{ mol Cu}} = \frac{2 \text{ mol NO}}{3 \text{ mol Cu}}$$

$$n_{\text{NO}} = 0.262 \text{ mol}$$

	$3\text{Cu}_{(s)}$	$8\text{HNO}_{3(aq)}$	$3\text{Cu}(\text{NO}_3)_{2(aq)}$	$2\text{NO}_{(g)}$	$\text{H}_2\text{O}_{(l)}$
m	25.0 g				
M	63.55 g/mol				
n	0.393 mol			0.262 mol	
P				102 kPa	
V				?	
R				$8.31 \text{ kPa} \cdot \text{L} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$	
T				$22 + 273 = 295 \text{ K}$	

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