



Chem 20 Unit D: Qualitative changes in Chemical Reactions

Solution and Gas Stoichiometry




Baaai us!

"Did you say stoichiometry? Wow!"



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Dr. Martyn Poliakoff
Proudly Presents:

The Periodic Table Movie of the Day!!!

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POS Checklist:

- calculate the quantities of reactants and/or products involved in chemical reactions, using gravimetric, solution or gas stoichiometry.
- identify limiting and excess reagents in chemical reactions

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Review of Gravimetric Stoich:

Step 1: Write out the balanced equation.
Step 2: Write out information under the eqn.
Step 3: Calculate the number of moles of the known chemical.
Step 4: Calculate the number of moles of the unknown using the ratio "unknown over known".
Step 5: Solve the ratio.
Step 6: Convert this moles to mass.

We can use these same basic steps to do stoich with solutions or gases.

The only difference between gravimetric and solution/gas stoich is how you calculate the number of moles.

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Its like I tell my MP10's...

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Gas Stoich examples: pg 298 #3

A typical Alberta home heated with natural gas (assume methane, $\text{CH}_4(\text{g})$) consumes 2.00 ML of natural gas during the month of December. What volume of oxygen at SATP is required to burn 2.00 ML of methane at 0°C and 120 kPa?

Step 1: Write out the balanced equation.

$$\text{CH}_4(\text{g}) + 2 \text{O}_2(\text{g}) \longrightarrow \text{CO}_2(\text{g}) + 2 \text{HOH}(\text{l})$$

$V = 2.000 \text{ 000 L}$ $V = ?$
 $T = 0^\circ\text{C} = 273 \text{ K}$ $T = 298 \text{ K}$
 $P = 120 \text{ kPa}$ $P = 100 \text{ kPa}$

Step 2: Write out information under the eqn.

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Step 3: Calculate the number of moles of the known chemical.

$$PV = nRT \quad n = \frac{PV}{RT} \quad n = \frac{(120 \text{ kPa})(2 \times 10^6 \text{ L})}{(8.314 \text{ kPa L/mol K})(273 \text{ K})}$$

$$= 105740 \text{ mol}$$

Recall: Ideal Gas Law!


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Step 4: Calculate the number of moles of the unknown using the ratio "unknown over known".

$$\frac{\text{unknown}}{\text{known}} = \frac{2}{1} = \frac{n}{105740 \text{ mol}} \quad n = \underline{211480 \text{ mol}}$$

Step 5: Solve the ratio.

Cross multiply and divide!



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Step 6: Convert this moles to ~~moles~~ ^{volume}.

$$PV = nRT$$

$$V = \frac{nRT}{P} = \frac{(211480 \text{ mol})(8.314 \text{ kPa L/mol K})(298 \text{ K})}{(100 \text{ kPa})}$$

$$V = \underline{5.24 \times 10^6 \text{ L}}$$

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pg 298 # 4

Ammonia reacts with sulfuric acid to form the important fertilizer ammonium sulfate. What mass of ammonium sulfate can be produced from 75.0 kL of ammonia at 10°C and 110 kPa?

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Solution Stoich examples: page 303 #1

Some antacid products contain aluminum hydroxide to neutralize excess stomach acid. Determine the volume of 0.10 mol/L stomach acid (assume $\text{HCl}_{(\text{aq})}$) that can be neutralized by 912 mg of aluminum hydroxide in an antacid tablet.

Step 1: Write out the balanced equation. Step 2: Write out information.

Step 3: Calculate the number of moles of the known chemical. $c = \frac{n}{V}$

Step 4: "unknown over known". Step 5: Solve the ratio.

Step 6: Convert this moles to ~~moles~~ ^{volume}.

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pg 303 #3

Analysis shows that 9.44 mL of 50.6 mmol/L $\text{KOH}_{(\text{aq})}$ is needed to completely react with 10.00 mL of water from an acidic lake. Determine the amount concentration of acid in the lake water, assuming that the acid is sulfuric acid.

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Practice: Page 299 #6 and 7
Page 303 #4 and 5

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