LESSON MAKER PRO

Reaction Math Lab

Predict reaction results from solution concentrations

HIGH SCHOOL · CHE.8.7

CHE.8.7 "Use mathematical and computational analysis to predict the results of reactions using the concentration of solutions (i.e., solution stoichiometry)."

NAME _____ **DATE** _____

FROM VOLUME TO PRODUCT

Molarity tells you how many moles of solute are in one liter of solution. Convert milliliters to liters, then multiply molarity by volume to find moles. Use the balanced equation to find moles of another substance in the reaction.

WORKED EXAMPLE

How many moles of $CaCO_3$ form when 40 mL of 0.30 M Na_2CO_3 reacts with excess $CaCl_2$? $Na_2CO_3 + CaCl_2 \rightarrow CaCO_3 + 2NaCl$

1. Convert the volume: 40 mL = 0.040 L.
2. Find moles of Na_2CO_3: 0.30 mol/L × 0.040 L = 0.012 mol.
3. The equation gives a 1:1 mole ratio of Na_2CO_3 to $CaCO_3$.

Answer: 0.012 mol $CaCO_3$

PRACTICE 6 problems

1 How many moles of NaOH react completely with 20 mL of 0.50 M HCl? $HCl + NaOH \rightarrow NaCl + H_2O$

ANSWER _____

2 How many moles of $BaSO_4$ form when 50 mL of 0.20 M $BaCl_2$ reacts with excess Na_2SO_4? $BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$

ANSWER _____

3 How many moles of KOH react completely with 80 mL of 0.25 M H_2SO_4? $H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$

ANSWER _____

4 How many moles of $Mg(OH)_2$ react completely with 25 mL of 0.60 M HCl? $2HCl + Mg(OH)_2 \rightarrow MgCl_2 + 2H_2O$

ANSWER _____

5 What volume of 0.10 M HNO_3 neutralizes 60 mL of 0.15 M NaOH? Give your answer in milliliters. $HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$

ANSWER _____

6 A 25 mL sample of 0.20 M $Ca(OH)_2$ is neutralized by 50 mL of HCl. What is the HCl concentration? $Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$

ANSWER _____

APPLY IT Show your work

1 In a lab, you test the citric acid in a sports drink. Suppose a 20 mL sample contains 0.10 M citric acid. What volume of 0.20 M NaOH would react completely with it? Give your answer in milliliters. $C_6H_8O_7 + 3NaOH \rightarrow Na_3C_6H_5O_7 + 3H_2O$

WORK SPACE

ANSWER _____

2 A science class tests a road-salt runoff sample. A 25 mL sample contains 0.20 M NaCl. How many moles of solid AgCl form when the sample reacts with excess $AgNO_3$? $NaCl + AgNO_3 \rightarrow AgCl + NaNO_3$

WORK SPACE

ANSWER _____

CHALLENGE One step up

You mix 25 mL of 0.20 M $MgCl_2$ with 60 mL of 0.10 M $AgNO_3$. How many moles of AgCl form, and how many moles of the excess reactant remain? Show which reactant limits the reaction. $MgCl_2 + 2AgNO_3 \rightarrow 2AgCl + Mg(NO_3)_2$

WORK SPACE AND ANSWER

Reaction Math Lab

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	How many moles of NaOH react completely with 20 mL of 0.50 M HCl? $HCl + NaOH \rightarrow NaCl + H_2O$	**0.010 mol NaOH**
2	How many moles of $BaSO_4$ form when 50 mL of 0.20 M $BaCl_2$ reacts with excess Na_2SO_4? $BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$	**0.010 mol $BaSO_4$**
3	How many moles of KOH react completely with 80 mL of 0.25 M H_2SO_4? $H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$	**0.040 mol KOH**
4	How many moles of $Mg(OH)_2$ react completely with 25 mL of 0.60 M HCl? $2HCl + Mg(OH)_2 \rightarrow MgCl_2 + 2H_2O$	**0.0075 mol $Mg(OH)_2$**
5	What volume of 0.10 M HNO_3 neutralizes 60 mL of 0.15 M NaOH? Give your answer in milliliters. $HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$	**90 mL HNO_3**
6	A 25 mL sample of 0.20 M $Ca(OH)_2$ is neutralized by 50 mL of HCl. What is the HCl concentration? $Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$	**0.20 M HCl**

PART 2 · APPLY IT

1. **30 mL NaOH** The sample contains 0.10 × 0.020 = 0.002 mol citric acid, which requires 0.006 mol NaOH. At 0.20 M, that is 0.030 L, or 30 mL.
2. **0.0050 mol AgCl** The sample contains 0.20 × 0.025 = 0.0050 mol NaCl. The 1:1 mole ratio produces 0.0050 mol AgCl.

CHALLENGE

$AgNO_3$ is limiting. The mixture forms 0.0060 mol AgCl, and 0.0020 mol $MgCl_2$ remains. Initially, there are 0.0050 mol $MgCl_2$ and 0.0060 mol $AgNO_3$. The $AgNO_3$ reacts with 0.0030 mol $MgCl_2$.

Accept equivalent decimal forms and answers in liters when the prompt does not require milliliters. In the challenge, students must identify $AgNO_3$ as limiting.