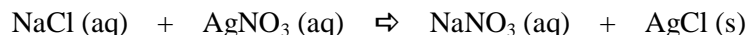


Pre-AP Chemistry
Unit #11—Solutions
Solution Stoichiometry Formulas

Liters to Grams

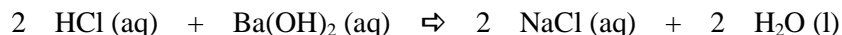
What mass of NaCl is needed to precipitate the silver ions from 2.0 L of 0.100 M AgNO₃ solution?



$$\frac{2 \text{ L soln AgNO}_3}{1 \text{ L soln AgNO}_3} \left| \frac{0.100 \text{ mol AgNO}_3}{1 \text{ L soln AgNO}_3} \right| \left| \frac{1 \text{ mol NaCl}}{1 \text{ mol AgNO}_3} \right| \left| \frac{58.443 \text{ g NaCl}}{1 \text{ mol NaCl}} \right| = 11.689 \text{ g NaCl}$$

Grams to Liters

How many liters of 0.120 M HCl are needed to completely neutralize 15.0 grams of Ba(OH)₂?



$$\frac{15.0 \text{ g Ba(OH)}_2}{171.334 \text{ g Ba(OH)}_2} \left| \frac{1 \text{ mol Ba(OH)}_2}{171.334 \text{ g Ba(OH)}_2} \right| \left| \frac{2 \text{ mol HCl}}{1 \text{ mol Ba(OH)}_2} \right| \left| \frac{1 \text{ L soln HCl}}{0.120 \text{ mol HCl}} \right| = 1.459 \text{ L soln HCl}$$

Milliliters to Grams

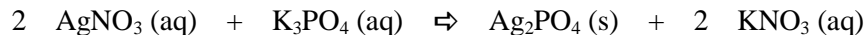
How many grams of NaOH are needed to neutralized 20.0 mL of 0.150 M H₂SO₄ solution?



$$\frac{20 \text{ mL soln H}_2\text{SO}_4}{1000 \text{ mL soln H}_2\text{SO}_4} \left| \frac{1 \text{ L soln H}_2\text{SO}_4}{1000 \text{ mL soln H}_2\text{SO}_4} \right| \left| \frac{0.150 \text{ mol H}_2\text{SO}_4}{1 \text{ L soln H}_2\text{SO}_4} \right| \left| \frac{2 \text{ mol NaOH}}{1 \text{ mol H}_2\text{SO}_4} \right| \left| \frac{39.997 \text{ g NaOH}}{1 \text{ mol NaOH}} \right| = 0.240 \text{ g NaOH}$$

Grams to Milliliters

How many milliliters of 0.650 M silver nitrate need to mix with 0.750 grams of potassium phosphate for the reaction to go to completion?



$$\frac{0.750 \text{ g K}_3\text{PO}_4}{212.264 \text{ g K}_3\text{PO}_4} \left| \frac{1 \text{ mol K}_3\text{PO}_4}{212.264 \text{ g K}_3\text{PO}_4} \right| \left| \frac{2 \text{ mol AgNO}_3}{1 \text{ mol K}_3\text{PO}_4} \right| \left| \frac{1 \text{ L soln AgNO}_3}{0.650 \text{ mol AgNO}_3} \right| \left| \frac{1000 \text{ mL soln AgNO}_3}{1 \text{ L soln AgNO}_3} \right| = 10.872 \text{ mL soln AgNO}_3$$

Moles to Liters

How many liters of 0.500 M HCl are needed to react completed with 0.100 mol of Pb(NO₃)₂ to form the precipitant?



$$\frac{0.100 \text{ mol Pb(NO}_3)_2}{1 \text{ mol Pb(NO}_3)_2} \left| \frac{2 \text{ mol HCl}}{1 \text{ mol Pb(NO}_3)_2} \right| \left| \frac{1 \text{ L soln HCl}}{0.500 \text{ mol HCl}} \right| = 0.400 \text{ L soln HCl}$$

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Liters to Moles

Sodium bicarbonate is added to a sulfuric acid spill on the lab bench. If 4 L of 6.0 M H₂SO₄ was spilled, how many moles of sodium bicarbonate will be needed to neutralize the acid on the lab bench?



$$\frac{4 \text{ L soln H}_2\text{SO}_4}{1 \text{ L soln H}_2\text{SO}_4} \times \frac{6.0 \text{ mol H}_2\text{SO}_4}{1 \text{ L soln H}_2\text{SO}_4} \times \frac{2 \text{ mol NaHCO}_3}{1 \text{ mol H}_2\text{SO}_4} = 48.000 \text{ mol NaHCO}_3$$

Moles to Milliliters

How many milliliters of 0.100 M HNO₃ is needed to neutralize 0.445 moles of Ca(OH)₂?



$$\frac{0.445 \text{ mol Ca}(\text{OH})_2}{1 \text{ mol Ca}(\text{OH})_2} \times \frac{2 \text{ mol HNO}_3}{1 \text{ mol Ca}(\text{OH})_2} \times \frac{1 \text{ L soln HNO}_3}{0.100 \text{ mol HNO}_3} \times \frac{1000 \text{ mL soln HNO}_3}{1 \text{ L soln HNO}_3} = 8900.000 \text{ mL soln HNO}_3$$

Milliliters to Moles

Sodium bicarbonate is added to a sulfuric acid spill on the lab bench. If 25 mL of 6.0 M H₂SO₄ was spilled, how many moles of sodium bicarbonate will be needed to neutralize the acid on the lab bench?



$$\frac{25 \text{ mL soln H}_2\text{SO}_4}{1000 \text{ mL soln H}_2\text{SO}_4} \times \frac{1 \text{ L soln H}_2\text{SO}_4}{1000 \text{ mL soln H}_2\text{SO}_4} \times \frac{6.0 \text{ mol H}_2\text{SO}_4}{1 \text{ L soln H}_2\text{SO}_4} \times \frac{2 \text{ mol NaHCO}_3}{1 \text{ mol H}_2\text{SO}_4} = 0.300 \text{ mol NaHCO}_3$$

Milliliters to Milliliters

A 25 mL of a 0.100 M HBr solution is titrated with a 0.200 M NaOH solution. How many milliliters of the NaOH solution are required to reach the equivalence point for the chemical reaction?

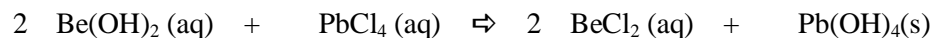


$$\frac{25 \text{ mL soln HBr}}{1000 \text{ mL soln HBr}} \times \frac{1 \text{ L soln HBr}}{1000 \text{ mL soln HBr}} \times \frac{0.100 \text{ mol HBr}}{1 \text{ L soln HBr}} \times \frac{1 \text{ mol NaOH}}{1 \text{ mol HBr}} \times \frac{1 \text{ L soln NaOH}}{0.200 \text{ mol NaOH}} \times \frac{1000 \text{ mL soln NaOH}}{1 \text{ L soln NaOH}} = 12.50 \text{ mL soln NaOH}$$

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Milliliters to Liters

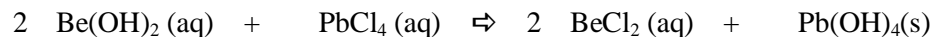
How many liters of 0.550 M beryllium hydroxide will complete react with a 25.00 mL solution of 2.5 M lead (IV) chloride?



$$\frac{25.0 \text{ mL soln PbCl}_4}{1000 \text{ mL soln PbCl}_4} \times \frac{1 \text{ L soln PbCl}_4}{1 \text{ L soln PbCl}_4} \times \frac{2.5 \text{ mol PbCl}_4}{1 \text{ L soln PbCl}_4} \times \frac{2 \text{ mol Be(OH)}_2}{1 \text{ mol PbCl}_4} \times \frac{1 \text{ L soln Be(OH)}_2}{0.550 \text{ mol Be(OH)}_2} = 0.227 \text{ L soln Be(OH)}_2$$

Liters to Milliliters

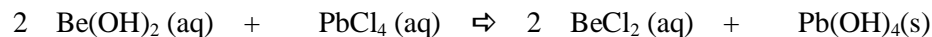
How many milliliters of 0.550 M beryllium hydroxide will complete react with a 0.05 L solution of 2.5 M lead (IV) chloride?



$$\frac{0.05 \text{ L soln PbCl}_4}{1 \text{ L soln PbCl}_4} \times \frac{2.5 \text{ mol PbCl}_4}{1 \text{ L soln PbCl}_4} \times \frac{2 \text{ mol Be(OH)}_2}{1 \text{ mol PbCl}_4} \times \frac{1 \text{ L soln Be(OH)}_2}{0.550 \text{ mol Be(OH)}_2} \times \frac{1000 \text{ mL soln Be(OH)}_2}{1 \text{ L soln Be(OH)}_2} = 454.545 \text{ mL soln Be(OH)}_2$$

Liters to Liters

How many liters of 0.550 M beryllium hydroxide will complete react with a 0.05 L solution of 2.5 M lead (IV) chloride?



$$\frac{0.05 \text{ L soln PbCl}_4}{1 \text{ L soln PbCl}_4} \times \frac{2.5 \text{ mol PbCl}_4}{1 \text{ L soln PbCl}_4} \times \frac{2 \text{ mol Be(OH)}_2}{1 \text{ mol PbCl}_4} \times \frac{1 \text{ L soln Be(OH)}_2}{0.550 \text{ mol Be(OH)}_2} = 0.455 \text{ L soln Be(OH)}_2$$

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Limiting Reactants for Solution Stoichiometry

1. *Convert values from unit of measure to moles.*
2. *Convert moles of one reactant to another reactant using Mole Ratios.*
3. *Determine Limiting Reactant.*
4. *Determine Theoretical Yield/Maximum Yield/Maximum Amount of all Products for the reaction.*

A solution of 100.0 mL of 0.200 M potassium hydroxide is mixed with a solution of 200.0 mL of 0.150 M nickel (II) sulfate. What is the limiting reactant for the reaction? How much precipitant forms from the reaction?



KOH	= $\frac{100.0 \text{ mL soln KOH}}{1000 \text{ mL soln KOH}}$	= $\frac{1 \text{ L soln KOH}}{1000 \text{ mL soln KOH}}$	= $\frac{0.200 \text{ mol KOH}}{1 \text{ L soln KOH}}$	=	0.020 mol KOH	=	$\frac{1 \text{ mol NiSO}_4}{2 \text{ mol KOH}}$	=	0.010 mol NiSO ₄
					AVAILABLE				NEEDED
NiSO ₄	= $\frac{200.0 \text{ mL soln NiSO}_4}{1000 \text{ mL soln NiSO}_4}$	= $\frac{1 \text{ L soln NiSO}_4}{1000 \text{ mL soln NiSO}_4}$	= $\frac{0.150 \text{ mol NiSO}_4}{1 \text{ L soln NiSO}_4}$	=	0.030 mol NiSO ₄	=	$\frac{2 \text{ mol KOH}}{1 \text{ mol NiSO}_4}$	=	0.060 mol KOH

$$\frac{0.020 \text{ mol KOH}}{1 \text{ mol KOH}} \times \frac{1 \text{ mol Ni(OH)}_2}{1 \text{ mol KOH}} \times \frac{92.707 \text{ g Ni(OH)}_2}{1 \text{ mol Ni(OH)}_2} = 1.854 \text{ g Ni(OH)}_2$$