

## Stoichiometry - Titrations

- What is the molarity of a sodium hydroxide solution if 25.0 mL is required to neutralize 40.0 mL of a 1.50 M solution of sulfuric acid?
- Calculate the volume of a 6.00 M solution of nitric acid necessary to neutralize 30.0 mL of a 4.00 M solution of potassium hydroxide.
- How many grams of calcium hydroxide are required to neutralize 50.0 mL of a 1.00 M sulfuric acid solution?
- Calculate the mass of ammonium hydroxide necessary to neutralize 30.0 mL of a 0.0500 M nitric acid solution.
- What volume of 0.250 M phosphoric acid is required to neutralize 30.0 mL of a 1.50 M barium hydroxide solution?
- Determine the molarity of a sulfuric acid solution if 30.0 mL is used to neutralize 40.0 mL of a 0.500 M potassium hydroxide solution.
- What is the molarity of a phosphoric acid solution if 25.0 mL of the solution is necessary to neutralize 30.0 mL of a 0.500 M potassium hydroxide solution?
- Calculate the volume of 0.750 mol/L sulfuric acid needed to neutralize completely 20.00 g of sodium hydroxide.
- In a laboratory experiment involving the neutralization of vinegar (acetic acid solution) using 0.500 mol/L sodium hydroxide, the following data were collected:
 

	<u>Volume of Vinegar</u>	<u>Volume of Base</u>
Trial 1	10.00 mL	17.59 mL
Trial 2	15.27 mL	28.39 mL
Trial 3	20.14 mL	36.58 mL

  - Calculate the molarity of the vinegar in each trial.
  - Calculate the average molarity of vinegar for the three trials.
  - Calculate the mass of acetic acid in each trial.
  - Calculate the mass percentage of acetic acid in vinegar for each trial. Assume that the solution has a density of 1.00 g/mL.
  - Calculate the average percentage of acetic acid in vinegar for the three trials. If the correct percentage is 5.40%, what is the percent error? Which trial gave the best results?
- A titration of 15.0 mL of household ammonia (NH<sub>4</sub>OH) required 40.0 mL of a 1.00 mol/L hydrochloric acid solution. Calculate the concentration of the household ammonia.
- Determine the mass of the precipitate of lead(II) sulfate which is produced by the reaction of 30.0 mL of 0.750 M lead(II) nitrate with excess sulfuric acid.
- Calculate the mass of pure sodium carbonate required to react completely with 20.00 mL of 0.250 mol/L hydrochloric acid.
- What volume of 0.250 M silver nitrate is required to precipitate all the chloride ion as silver chloride in a solution made by dissolving a sample of rock salt which has a mass of 0.300 g and is known to be 99.0% pure sodium chloride?
- If 1.25 g of pure calcium carbonate requires 25.50 mL of a hydrochloric acid solution for complete reaction, calculate the molarity of the acid.
- 17.5 g of NaOH is dissolved in enough water to make 500.0 cm<sup>3</sup> of solution. What volume of 0.625 M HBr would be required to neutralize 50.0 cm<sup>3</sup> of the NaOH solution?
- A solution was prepared by dissolving 25.9 g of sodium hydroxide in enough water to make 500.0 cm<sup>3</sup> of solution. 25.0 cm<sup>3</sup> of this solution was titrated with 17.6 cm<sup>3</sup> of hydrochloric acid. What is the concentration of the hydrochloric acid solution?
- A solution was prepared by taking 8.60 cm<sup>3</sup> of 18.0 M H<sub>2</sub>SO<sub>4</sub> and diluting it to a volume of 750.0 cm<sup>3</sup>. 28.7 cm<sup>3</sup> of this solution was required to completely neutralize 25.0 cm<sup>3</sup> of a KOH solution. What is the molarity of the base?
- What volume of 1.50 M hydrochloric acid solution is required to react completely with a 0.500 g sample of iron(II) sulfide ore if the ore contains 95.0% iron(II) sulfide?
- Hydrogen sulfide gas will react with a lead solution to give a precipitate of lead(II) sulfide. If hydrogen sulfide is bubbled into 50.0 mL of a 0.125 M lead(II) acetate solution, calculate the following:
  - the mass of hydrogen sulfide required for complete reaction
  - the volume of hydrogen sulfide gas at STP required for complete reaction
  - the mass of lead(II) sulfide produced
- Some sulfuric acid is spilled on a lab bench. It can be neutralized by sprinkling sodium bicarbonate on it and then mopping up the resultant solution. The sodium bicarbonate reacts with the sulfuric acid as follows:
 
$$2\text{NaHCO}_3(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{Na}_2\text{SO}_4(\text{aq}) + 2\text{H}_2\text{O}(\text{l}) + 2\text{CO}_2(\text{g})$$
 Sodium bicarbonate is added until the fizzing due to the formation of carbon dioxide gas stops. If 35 of 6.0 mol/L sulfuric acid were spilled, what is the minimum mass of sodium bicarbonate that must be added to the spill to neutralize the acid?
- Tartaric acid, H<sub>2</sub>C<sub>4</sub>H<sub>4</sub>O<sub>6</sub>, is often present in wines and precipitates from solution as the wine ages. A solution containing an unknown concentration of the acid is titrated with sodium hydroxide. It requires 22.62 mL of 0.2000 M sodium hydroxide solution to titrate 40.00 mL of the tartaric acid solution. Write a balanced equation and calculate the molarity of the tartaric acid solution.
- A sample of solid calcium hydroxide is stirred in water at 30°C for a long time, until the solution contains as much dissolved calcium hydroxide as it can hold. A 100.0 mL sample of this solution is withdrawn and titrated with 5.00 × 10<sup>-2</sup> mol/L hydrobromic acid. It requires 48.8 mL of the acid solution for neutralization. What is the molarity of the calcium hydroxide solution?