

Stoichiometry - Titrations

1. 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?
2. 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.
3. How many grams of calcium hydroxide are required to neutralize 50.0 mL of a 1.00 M sulfuric acid solution?
4. Calculate the mass of ammonium hydroxide necessary to neutralize 30.0 mL of a 0.0500 M nitric acid solution.
5. What volume of 0.250 M phosphoric acid is required to neutralize 30.0 mL of a 1.50 M barium hydroxide solution?
6. 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.
7. 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?
8. Calculate the volume of 0.750 mol/L sulfuric acid needed to neutralize completely 20.00 g of sodium hydroxide.
9. 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

 a) Calculate the molarity of the vinegar in each trial.
 b) Calculate the average molarity of vinegar for the three trials.
 c) Calculate the mass of acetic acid in each trial.
 d) Calculate the mass percentage of acetic acid in vinegar for each trial. Assume that the solution has a density of 1.00 g/mL.
 e) 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?
10. A titration of 15.0 mL of household ammonia (NH_4OH) required 40.0 mL of a 1.00 mol/L hydrochloric acid solution. Calculate the concentration of the household ammonia.
11. 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.
12. Calculate the mass of pure sodium carbonate required to react completely with 20.00 mL of 0.250 mol/L hydrochloric acid.
13. 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?
14. 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.
15. 17.5 g of NaOH is dissolved in enough water to make 500.0 cm³ of solution. What volume of 0.625 M HBr would be required to neutralize 50.0 cm³ of the NaOH solution?
16. A solution was prepared by dissolving 25.9 g of sodium hydroxide in enough water to make 500.0 cm³ of solution. 25.0 cm³ of this solution was titrated with 17.6 cm³ of hydrochloric acid. What is the concentration of the hydrochloric acid solution?
17. A solution was prepared by taking 8.60 cm³ of 18.0 M H_2SO_4 and diluting it to a volume of 750.0 cm³. 28.7 cm³ of this solution was required to completely neutralize 25.0 cm³ of a KOH solution. What is the molarity of the base?
18. 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?
19. 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
20. 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 g 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?
21. Tartaric acid, $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$, 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.
22. 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^{-2} mol/L hydrobromic acid. It requires 48.8 mL of the acid solution for neutralization. What is the molarity of the calcium hydroxide solution?