

Chemistry 20 - Unit D - Titration Analysis

Name: _____

- 1) Assume a hydrochloric acid solution is prepared by diluting commercial lab reagent solution (approximately 12 mol/L) by a factor of 20:1. For concentrated HCl(aq) solutions, complete the following:
- a) Explain why the label concentration is necessarily uncertain for concentrated solutions of gases dissolved in water. **Hint: Think about opening carbonated beverages.**

Answers will vary.

- b) Explain how the concentration changes each time the stock bottle is opened.

Answers will vary.

- 2) Sulfur impurities in fuels produce $\text{SO}_{2(g)}$ when the fuel is burned. This is a pollutant that contributes to acid deposition and is a serious respiratory irritant. To analyze the sulfur content in a fuel, the sample may be burned, and the $\text{SO}_{2(g)}$ may then be "dissolved" in water, which really means that it reacts with water to become sulfurous acid, $\text{H}_2\text{SO}_{3(aq)}$. The sulfurous acid can then be analyzed by titration with a standardized solution of $\text{NaOH}_{(aq)}$. If, on average, 12.0 mL of 0.110 mol/L $\text{NaOH}_{(aq)}$ reacts with 100 mL samples of $\text{H}_2\text{SO}_{3(aq)}$, what chemical amount of sulfur atoms was present in the 100 mL acid sample?

mols

$$n_s = 0.660 \text{ mmol}$$

or

$$6.60 \times 10^{-4} \text{ mol}$$

3) Ammonia is a very useful chemical; our society consumes it in huge quantities. Farmers use the pure substance in liquid form as a fertilizer. Pure liquid ammonia is called anhydrous, which means “without water,” to distinguish it from aqueous solutions. In solution, ammonia has an outstanding ability to loosen dirt, oil, and grease, so it is commonly used in premixed home cleaners such as window cleaning sprays, along with other ingredients. Aqueous ammonia is also sold in most stores for household use, to be diluted at home to make solutions for cleaning and wax stripping. Such solutions can legally be anywhere from 5% to 30% ammonia by weight.

A student wishing to find the concentration of ammonia in a commercial solution decides to do an analysis, titrating 10.00 mL samples of $\text{NH}_3(\text{aq})$ with a standardized solution of 1.48 mol/L $\text{HCl}_{(\text{aq})}$. Her first trials use more than 50 mL (a burette full) of the acid, so she throws out the results and prepares a new ammonia sample solution by diluting the original commercial solution 10:1, that is, increasing a volume tenfold to reduce the concentration to precisely one-tenth of the original value. Using Table 2, complete the Analysis of her investigation report.

Purpose

The purpose of this investigation is to use a titration design to analyze a solution of ammonia.

Problem

What is the amount concentration of the original ammonia solution?

Design

The original ammonia solution is diluted tenfold. Samples of diluted solution are titrated with a standard 1.48 mol/L solution of hydrochloric acid. The colour change of bromocresol green indicator from blue to yellow is used as the endpoint.

Table 2 Titration of 10.00 mL of $\text{NH}_3(\text{aq})$ with 1.48 mol/L $\text{HCl}(\text{aq})$

Trial	1	2	3	4
Final burette reading (mL)	15.0	29.1	43.0	14.4
Initial burette reading (mL)	0.3	15.0	29.1	0.4
Volume of $\text{HCl}_{(\text{aq})}$ added (mL)				
Colour at endpoint	Yellow	Green	Green	Green

a) Analyse the data. What is the concentration of the ammonia she has?

$$[\text{NH}_3] = 20.7 \frac{\text{mol}}{\text{L}}$$