

## Experiment 9

### Determination of a Solution

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#### Pre-Lab Assignment

Before coming to lab:

- Read the lab thoroughly.
- Answer the pre-lab questions that appear at the end of this lab exercise.
- Read and review Introduction 2: Writing Scientific Lab Reports

#### Purpose

An experiment will be designed to determine the concentration of commercial ammonia ( $\text{NH}_3$ ).

#### Background

The steps of the Scientific Method include observation, hypothesis, and development of scientific law and theory. To test a hypothesis, experiments must be designed that are repeatable, accurate and precise, and can gather conclusive data that can prove, disprove, or improve the hypothesis to formulate it into scientific law.

Most hypotheses do not come with prewritten procedures. Laboratory scientists must research in scholarly articles and journals about work on the topic has been previously done and then use this information to inspire the design of their own novel experiments. Learning how to develop your own procedure based on research and prior knowledge is an essential skill. It may seem daunting at first, but even seasoned researchers spend much of their time in lab undergoing trial and error to develop a workable experiment.

A laboratory researcher must keep detailed records of what they did in lab both for themselves and so they can share what they have learned with others. Scientific reports are written and published so that other researchers can replicate the results as well as expand upon the studies done to increase the overall knowledge of the scientific community. They should concisely and clearly describe the procedure, data, and results in a way that others would be able to follow and understand. There is an accepted format for writing scientific reports. Refer to the Introduction: Scientific Report Writing in this lab manual for review.

Commercial ammonia ( $\text{NH}_3$ ) is primarily sold as a cleaning product. It is an aqueous solution of ammonia diluted to a particular concentration. You will need to determine this concentration in units of molarity (M) precisely and accurately. It may take many trials and much tweaking and adjustment to develop a solid procedure and procure your data. Stay flexible and open-minded, as even inconclusive results can often point you in the right direction. Record everything you do in lab so that you know what worked and what did not. You will be preparing a full lab report detailing your successful procedure, data, and results that needs to be written clearly enough that another ChemV01AL student could follow the instructions and understand the explanations.

## Procedure

Design your own procedure including sample calculations to determine the molarity of  $\text{NH}_3$  in commercial ammonia. This procedure must be approved by your instructor before you can begin experimentation. It will most likely change as you work in lab. You will also need to decide what data to record. Include the finalized procedure, your data, and conclusions in your formal lab report.

Your completed lab report will be turned in as your data sheet and post-lab assignment.

Consider:

- Think carefully about what data you will need to collect. As always, show all your work clearly and fully for one trial in a way that a fellow ChemV01AL student could follow.
- Commercial ammonia and standardized hydrochloric acid ( $\text{HCl}(\text{aq})$ ) will be provided. It will be helpful to write down the balanced chemical equation for the reaction expected to take place. As an indicator, bromocresol green will be used. You will need to research the desired endpoint for analyses done with this indicator.
- Commercial ammonia is too concentrated to measure safely, so you will need to dilute it first before testing it. To do this, 250 mL volumetric flasks and 25.00 mL pipettes will be provided.
- A good analysis should use no less than 10 mL and no more than 50 mL of  $\text{HCl}(\text{aq})$  to neutralize per trial.
- Precise experiments should always include multiple, matching trials.
- Your final answer should also report a measure of its accuracy.

## Experiment 9—Pre-Lab Assignment

**Name:** \_\_\_\_\_

1. Design a preliminary procedure including sample calculations to individually determine the molarity of  $\text{NH}_3$  in commercial ammonia. Use your knowledge of the chemicals, their properties, and the laboratory techniques learned thus far in this course. Any chemicals and equipment that you require will be provided in the lab. This procedure must be approved by your instructor before you can begin experimentation.