

Virtual Lab: Acid and Base

Titration is commonly used in analytical chemistry to determine the concentration of certain acids or bases during the production of certain biofuels, pharmaceutical drugs, and many other commercial products. It is also used within the home to determine the pH of the water in an aquarium to ensure the optimal conditions for many fish and other aquatic organisms.

In this assessment, you will perform a titration to determine the concentration of an unknown weak monoprotic acid.

Instructions

Your task is to perform a titration to determine the concentration of your unknown acid. You will use the following simulation to conduct your titration:

ChemCollective: Unknown Acid and Base Problem

Purpose

To determine the molar concentration of a weak monoprotic acid by performing a titration using a strong base of known volume and concentration

Hypothesis

Develop a testable hypothesis that will be verified or falsified by your procedure. It should state how you think the dependent variable will respond to a change in the independent variable, as well as a possible **explanation** for the change.

Materials

ChemCollective Virtual Lab Simulation: Unknown Acid and Base Problem

Procedure

1. Open the simulation.
2. In the Stockroom, there are three tabs: Solutions, Glassware, and Tools. Select the **Solutions** tab. In the list of solutions, select **Unknown Acid 0.1 L**. This will place 100.00 mL of the unknown acid in an Erlenmeyer flask on the lab workbench. Return to the Stockroom.
3. In the **Solutions** list, click on **Indicators**. Choose the **Phenolphthalein Indicator Solution** from the list. The indicator will turn pink when you have passed the endpoint

Note: When the colour of the solution changes to pink, you have passed the endpoint. However, this gives you a very good idea where the endpoint is. It is the volume just before the solution changes colour.

4. Select and hold the bottle of phenolphthalein, and move it over on top of the Unknown Acid flask. A measurement box will appear. **Add 5.00 mL of indicator** solution to the flask containing the unknown acid. Right-click on the indicator bottle, and choose **Remove** to remove it from the workbench. Return to the Stockroom.

5. In the **Solutions** list, choose a **Strong Base** from the list of solutions. Make note of the type of base, the volume, and molar concentration. Return to the Stockroom.
6. In the **Glassware list**, select **Other**. From the drop-down list, choose the **50.00 mL burette**. This will place it on the lab workbench.
7. Select and hold the flask containing the base, and move it over on top of the burette. A measurement box will appear. **Add 50.00 mL of the base** to the burette. Record the initial burette reading.
8. Select and hold the burette containing the base, and move it over on top of the flask containing the unknown acid. A measurement box will appear. Begin by adding base to the unknown acid at **5.00 mL increments** (watch the pH readings in the panel at left). Record each increment of base added to the unknown acid along with the corresponding pH. As you approach the endpoint (i.e. neutral pH), **reduce** the amount to **1.00 mL increments**, and eventually, **reduce** it to **0.50 mL increments**. When the solution turns pink, you have gone past the endpoint. Record the final burette volume reading using the measurement before the solution turns pink.

Note: should the solution turn bright pink, you will have overshoot the endpoint and will need to begin the lab again. Click on the **Edit** button to choose **Clear Workbench** to start again.

Communicating Your Results

Communicate your results in a lab report. Your lab report should include the following sections: purpose, materials, procedure, observations, results, discussion, and conclusion. Your results and discussion section of your report should include the following:

- Your results section should include your volume and pH data, as well as a titration graph. Place the volume of base on the x-axis and the pH of the unknown acid solution on the y-axis. Use your data to calculate the molar concentration of the unknown acid. Show all of your calculations.
- Your discussion section should state your conclusions. Describe in sentences what you found and the significance of it. For example, how does the titration graph change as you reach the endpoint? What limitations were there to this experiment? How might you modify the procedure in the future to be more accurate or precise? Why is determining the concentration of an unknown useful? Answer these and any other questions that you had while you conducting the titration.

Formal Lab Report

Laboratory reports are required any time a scientist (and science student) conducts a laboratory activity or does primary research (that is, where you get your own data without looking it up anywhere). Two types of primary research are possible in science: experimental and descriptive studies.

In an experiment, you formulate a hypothesis (i.e., an educated guess) about an observation you've made in nature. The hypothesis gives you a basis for testing your observation in a controlled manner. If it is a good hypothesis, the results will lead you to either accept or reject the hypothesis as stated.

In a descriptive study, you collect data but are not testing a hypothesis. For example, if you dissect a frog, you are collecting qualitative data on what you observed during the dissection. The qualitative data might consist of both written descriptions and diagrams.

In both types of laboratory activities, your formal lab report should follow the same basic format that follows.

General Guideline

- Use the following headings in your lab report: Question, Hypothesis, Materials, Procedure, Observations, Results, Discussion, Conclusion.
- You must write in the passive tense (i.e., the plant stem **was cut** longitudinally with a scalpel; not I **cut** the plant stem longitudinally with a scalpel).
- You may use any size font you like on your title page.
- You should use bold, italics and/or underlining to emphasize your headings.
- Do not write your whole report in any emphatic style.
- The body of your lab report should be typed in Times New Roman or a similar font.
- The body of your lab report should be in size 11 or 12 font.
- The body of your lab report should be single spaced (except headings).
- Use spell check and grammar check, and proof read your work to ensure you have not made any spelling or grammatical errors.
- You are responsible for saving your work and should be able to supply a copy upon request.

Title Page

This page is separate from the body of your lab report and should include the following pieces.

- Title of the experiment
- Course name and course code
- Your name
- Date the experiment was performed
- Your teacher's name (spelled correctly)

Questions

- Identify the problem.
- State the causal question (if applicable).

Hypothesis

- What do you predict will happen?
- Do some background research.
- Make an educated guess about what result you expect to produce from your experiment.

Material

- List all materials needed to perform your experiment.

Procedure

- List the step-by-step instructions required to perform your lab.
- Be sure this is a numbered list.
- Include the variables you tested (i.e., dependent, independent, control).

Observation

- Do not state your results or provide an analysis of your experiment.
- Link your observations to the relevant step of the procedure.
- Describe only what you observed during the lab. For example, if you noticed the formation of a gas during a chemical experiment that couldn't be measured but may be important to your discussion of the lab, note it.

Result

- Simply record the experimental results you collected in tables and graphs (if applicable).
- Do not analyse or discuss your results in this section.
- If calculations were necessary, show your work here.

Discussion

This will be the largest section of your lab report where you discuss the patterns and/or trends in your results and evaluate the experimental procedure.

- **Part 1:** Provide a background summary of the science involved in the experiment. Write this summary as if it were for someone who is unfamiliar with the basic science and purpose of the lab.
- **Part 2:** Provide a brief summary of the patterns or trends you see in your results. Include some quantitative data to support your evaluation of the results. Discuss whether or not your results support the hypothesis and if it is to be accepted or rejected.
- **Part 3:** Include an error analysis (if possible). This does not include human error. Was there something in the procedure or materials that may have had an effect on your results? Can you modify the procedure and/or materials to obtain better results? If you cannot provide an answer to these questions, do not include this section in your lab report.

Conclusion

- Provide a short statement of your results.
- Look back at initial your initial question, and use your results to answer it if possible.
- If your results lead to further questions, state them here.

Reference

- You must cite all your sources in APA formatting.