

Module 8.6: Solution Stoichiometry

Background

- [Measuring Titratable Acidity in Wine](#) (LO 8.6.2)
 - Description: A short video demonstrating how to determine acidity in wine. Shows some footage of the wine-making process and mentions tartaric acid, an acid that most students probably haven't heard of before.
 - License: By [YVCCWine](#), licensed under a standard YouTube license

Learning Objectives

By the end of this sub-module, students should be able to:

- LO 8.6.1 Combine the concepts of reaction stoichiometry and molarity to compute various quantities about rxns in aqueous solns
- LO 8.6.2 Interpret titration data to quantify solutes in various samples

Prior Knowledge Review

- [Chem I Module 7.2: Stoichiometry and Chemical Reactions](#) (LO 7.2.1 - 7.2.3)
 - Description: Students should review module 7.2, where they learn how to interpret and balance chemical equations and do stoichiometric calculations.
- [Chem I Module 8.1: Aqueous Solutions](#) (LO 8.1.2)
 - Description: Students must remember that ionic compounds, strong acids, and strong bases completely dissociate in solution.
- [Chem I Module 8.2: Precipitation Reactions](#) (LO 8.2.4)
 - Description: Students must be able to write a balanced chemical equation for a pptn rxn.
- [Chem I Module 8.3: Acid-Base Reactions](#) (LO 8.3.4)

- Description: Students must be able to write a balanced chemical equation for an acid-base rxn.
- [Chem I Module 8.5: Molarity](#) (LO 8.5.2-8.5.3)
 - Description: Students must understand how to use molarity as a conversion factor.

Instructional Materials

Textbook Sections

- OpenStax: Chemistry Atoms First 2e
 - [7.5 Quantitative Chemical Analysis](#) (8.6.1, 8.6.2)
- LibreText: Brown, LeMay, and Bursten
 - [4.6 Soln Stoichiometry and Chemical Analysis](#) (8.6.1, 8.6.2)

Videos Resources

- [Stoichiometry of Pptn Rxns](#) (LO 8.6.1)
 - Description: In the video clip (31:56-40:43), aqueous solutions of $\text{Ca}(\text{NO}_3)_2$ and Na_2SO_4 are mixed and students are asked to find the g of CaSO_4 ppt that form. This video helps students to integrate the skills of writing net ionic equations, concentration, stoichiometry, and limiting reagents.
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- [Stoichiometry of Acid-Base Rxns](#) (LO 8.6.1, 8.6.2)
 - Description: In this video clip (29:52-43:37), two soln stoichiometry problems involving acid-base neutralization rxns are worked. The instructor provides a step-by-step method and applies it to both problems. The first problem asks for the volume of acid needed to neutralize a given solution of base. The second problem (36:10) is more complex, in that it asks for the concentration of excess H^+ or OH^- left over after neutralization. Here, students must integrate limiting reactants in order to solve the problem. The video helps students to solve simple and complex problems using a methodical approach.

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- [Acid-Base Titrations](#) (LO 8.6.2)
 - Description: In this video clip (24:03-29:51), the performance of acid-base titrations is described. The glassware needed is shown and the general idea is explained. No calculations are performed. At 28:50, the instructor explains indicators at a level of detail that may not be needed for this course, but well-explained anyway.
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Activities and Assessments

Study Guides / Worksheets

- [Acid-Base Soln Stoichiometry and Titration](#) (LO 8.6.1-8.6.2)
 - Description: This reading guide can accompany section 7.5 in the OpenStax *Atoms First 2e* text. Includes a video tutorial on soln stoichiometry.
 - Teaching Tip: Students may use this to take notes as they read the text or during a synchronous class meeting in a flipped format.
 - License: By Montgomery College, licensed under CC BY 4.0.
- [Acid-Base Rxns and Soln Stoichiometry](#) (LO 8.6.1-8.6.2)
 - Description: This worksheet begins by asking students to write the products of acid-base reactions and concludes with quantitative problems.
 - Teaching Tip: Use these as formative assessment, homework, or in-class (synchronous) problem-solving exercises.
 - Answer Key: Acid-Base Rxns and Soln Stoichiometry [Answer Key](#)
 - License: By Tria Skirko, licensed under a [Creative Commons Attribution 3.0 Unported License](#).
- [Acid-Base and Pptn Soln Stoichiometry](#) (LO 8.6.1-8.6.2)
 - Description: Three soln stoichiometry problems are included in this worksheet.

- Teaching Tip: Use these as formative assessment, homework, or in-class (synchronous) problem-solving exercises.
- License: By Washington State Colleges, Creative Commons Attribution 3.0 United States License.
- [Acid-Base Rxns, Soln Stoichiometry, Titration](#) (LO 8.6.1-8.6.2)
 - Description: A variety of acid-base questions and problems beginning with the definition of acids and bases, conjugate acids and bases, predicting the products of acid-base reactions, and ending with two quantitative titration problems.
 - Teaching Tip: Given the variety of problems on this worksheet, use as summative assessment of acids and bases.
 - Answer Key: Acid-Base Rxns, Soln Stoichiometry, Titration [Answer Key](#)
 - License: License: By Tria Skirko, licensed under a [Creative Commons Attribution 3.0 Unported License](#).
- [Acid-Base Soln Stoichiometry and Titrations](#) (LO 8.6.1-8.6.2)
 - Description: Three soln stoichiometry problems are provided. The third problem is quite challenging, as it requires students to use two chemical rxns. Answers are provided at the end of the worksheet.
 - Teaching Tip: Use these as formative assessment, homework, or in-class (synchronous) problem-solving exercises.
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- [Acid-Base, Pptn Soln Stoichiometry Problems](#) (LO 8.6.1-8.6.2)
 - Description: Five problems on acid-base titrations and one on pptn stoichiometry. Each problem is divided into parts that guide students through the problem-solving process.
 - Teaching Tip: Use this worksheet as formative assessment, homework, or in-class (synchronous) problem-solving exercises.
 - License: By Dr. Jordan Poler at the University of North Carolina Charlotte, licensed under a Creative Commons license 3.0.
- CY-UIUC: [Pptn Acid-Base Soln Stoichiometry Problems](#) (LO 8.6.1-8.6.2)

- Description: This worksheet begins with a review of solubility rules and continues with soln stoichiometry for pptn and acid-base reactions. Each question has several parts that guide students through the problem.
- Teaching Tip: Use as formative assessment or in-class (synchronous) problem-solving exercise.
- Answer Key: Worksheet [Answer Key](#)
- License: By Dr. Christine Yerkes and the Department of Chemistry at the University of Illinois Urbana-Champaign ([Dr. Yerkes' website](#)) used with permission. Please attribute upon use.

Textbook Exercises

- OpenStax: Chemistry Atoms First 2e [7.5 Quantitative Chemical Analysis](#) (LO 8.6.1, 8.6.2)
 - Description: End-of-chapter exercises that address both learning objectives in this module. Answers to odd-numbered questions are provided.
 - Teaching Tip: Use these as formative assessment, homework, or in-class (synchronous) problem-solving exercises.
- LibreText: Brown, LeMay, and Bursten: [4.6 Soln Stoichiometry and Chemical Analysis](#) (LO 8.6.1, 8.6.2)
 - Description: End-of-chapter exercises that address all LOs in this module, with an emphasis on titration.
 - Teaching Tip: Use these as formative assessment, homework, in-class (synchronous) problem-solving exercises, or as a test review.