

How Much Acetic Acid Is There in Vinegar?

<http://www.epicurious.com/expert-advice/how-to-turn-wine-into-vinegar-article>

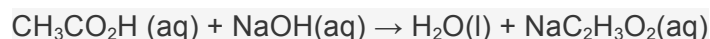
Vinegar has been made and used for thousands of years. Artifacts with traces of it dating from ~3000 BC have been found in Egypt. It has many uses, but now it is mainly used in cooking for pickling, salad dressings, sauces, mustard, ketchup, mayonnaise, chutneys, and marinades. It is often used as a condiment. Its shelf life allows it to last indefinitely without refrigeration, and it is also used in industrial, medicinal, and domestic applications, such as a general household cleaner.

Vinegar is an aqueous solution consisting of about 5-20% acetic acid, CH_3COOH , a weak acid and weak electrolyte, which does not ionize completely. It is produced from enzymatic reactions of bacteria with ethanol, which is commonly produced from the fermentation of sugars from a wide variety of natural plant sources. Acetic acid's taste has historically been regarded as something not very pleasant, although it should more correctly be classified as "sour", as all acids are generally regarded.



The allegorical Chinese composition on the left, *The Vinegar Tasters* (三酸圖, *The Three Sours*; 嘗醋翁, *The Vinegar Tasting Old Men*; 嘗醋圖, 尝醋图), is a traditional theme from ancient Chinese painting. It depicts the three founders of China's major religious / philosophical schools of thought: Confucianism, Buddhism, and Taoism. The three men are dipping their fingers in a vat of vinegar and tasting it; one man reacts with a sour expression, one reacts with a bitter expression, and one reacts with a sweet expression. The three men are Confucius, Buddha, and Lao Tzu, respectively. Confucianism was regarded to view life as sour, in need of rules to correct the degeneration of the people; Buddhism was regarded to view life as bitter, dominated by pain and suffering; and Taoism was regarded to view life's force as all-encompassing and having an unquestionable goodness when in harmony with nature. Another interpretation of the painting is that, since the three men are gathered around one vat, the "three teachings" are actually embodied in one overarching philosophy.

Experimental Procedure:



A standardized sodium hydroxide solution of known concentration will be quantitatively reacted with the acetic acid in vinegar using phenolphthalein as a color indicator to determine the amount of acid in an unknown commercial vinegar sample. This type of experiment is referred to as titration. Titrating the vinegar will provide experimental data to calculate the molarity, and the mass percent of the acetic acid content.

As instructed, pipet a fixed volume of sample into an Erlenmeyer flask, add an approximately equal amount of de-ionized water and 2 drops of phenolphthalein solution. Fill a buret with a standard solution of sodium hydroxide. Add the sodium hydroxide solution slowly to the flask while swirling it until a faint pink color remains and does not disappear with swirling. Record all of your amounts in the table on the reverse side of the handout. Repeat the titration. (Trial #2) Average the volumes of sodium hydroxide used and complete the calculations.

Answer the Post Lab Questions:

<http://chemconnections.org/general/chem120/solutions-mixes.106.html#questions>

Name: _____

Unknown # _____

Acetic Acid Titration<http://chemconnections.org/general/chem120/solutions-mixes.106.html>

<https://www.youtube.com/watch?v=9DkB82xLvNE>

meniscus

39 mL

40 mL

39.31 mL

buret containing base

flask containing vinegar + indicator

Record the Unknown #.

Record the Molarity of the NaOH standard solution.

Record the *initial and final buret readings*.

Calculate the Molarity (M) of the acetic acid in vinegar which is equal to:

$$M_{\text{NaOH}} \times \text{Volume}_{\text{NaOH}} / \text{Volume}_{\text{vinegar}}$$

Complete the table. Clearly show your calculations for the Molarity and percent acetic acid in your unknown vinegar using dimensional analysis with correct units and attach the calculations.

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	Trial 1	Trial 2	Average
Volume of Vinegar (mL)			
Final buret reading (mL)			
Initial buret reading (mL)			
Volume of NaOH (mL) used			
Molarity NaOH			
Molarity (M) (calc.)			
Mass of acetic acid (grams)			
% acetic acid			

Names: _____

Post Lab Questions: Acetic Acid Titration

<http://chemconnections.org/general/chem120/solutions-mixes.106.html#questions>

1. If the maximum concentration of a saturated sodium chloride solution is 5.9M, how many liters of water would a Peruvian salt farmer need to process in order to produce one 50.0 kilogram bag of salt. (Assume that there are no other salts present. Show your calculation.)
2. If the Peruvian water has a TDS of 10.0 grams per liter of water, would it be within the safe limits of drinking water by U.S. standards? (Explain your answer.)
3. The following table includes chemicals that may be found in tap water. Complete the table for allowable limits.

	<i>Allowable Limit</i>
Nitrate	
Fluoride	
Mercury	
Lead	

4. What were the highest tested levels of lead in Flint Michigan's drinking water during the crisis?
5. What was the length of time that Flint residents were exposed to higher than allowable levels of lead?
6. What are the neurological effects of lead exposure particularly on children and infants?