

Southern New Mexico-West Texas Chemistry Olympiad Competition Instructions for the Titration Experiment (Individual Event)

March 31st, 2012

Summary: The titration experiment in the 2011 Chemistry Olympiad competition is an acid-base titration. A phosphoric acid solution of unknown concentration (in the 0.1 M to 0.3 M range) will be titrated with a sodium hydroxide solution of known concentration (approximately 0.1 M) with the purpose of determining the concentration of the phosphoric acid solution.

Since phosphoric acid is a triprotic acid with pK_a values of 2.1, 7.2, and 12, the neutralization occurs in three distinct steps. Neutralization of the first ionizable proton occurs at low pH, the second at intermediate pH, and neutralization of the final proton at high pH. If an acid-base indicator such as methyl orange, that changes color in the pH range of 3 – 4, is employed in the titration, then the neutralization of only the first proton is monitored. If, on the other hand, an indicator like phenolphthalein which changes color in the pH range of 9 – 10 is employed, the neutralization of two ionizable protons is monitored.

In this experiment, the students will be supplied with the following:

- a burette
- a pipette
- flasks
- a standardized sodium hydroxide solution (~ 0.1 M in concentration)
- a phosphoric acid solution of unknown concentration (~0.1 to 0.3 M concentration range)
- a solution of methyl orange indicator
- a solution of phenolphthalein indicator

The students are allowed to use either or both of the indicators supplied in performing a titration to determine the phosphoric acid solution concentration. Measured concentrations will be reported to three significant figures with ***winner's judged on the basis of the accuracy of their calculated phosphoric acid concentrations.*** The event is not timed, but must be completed within the total time allotted for the experiment.