Experiment 10 – Vinegar Analysis (Titrations)

Pre-Lab Hints

1. Find NaOH moles by multiplying liters by mol/L. Moles of acetic acid are the same value. Multiply moles by 60.0 g/mol to get mass of acetic acid. Then, divide mass by 5.00 % to get total mass of vinegar. Divide total mass by density to get volume in ml.
2. a. Review step 1 of Technique 16A (Measuring Volume) in the Laboratory Techniques section near the front of your lab manual. Also, review Figure T.16b.
   b. Review steps 2 and 4 of Technique 16C (Titrating a Liquid).
   c. Review step 4 of Technique 16C, as well as Figure T.16k.
   Read footnote 2 at the end of the Experimental Procedure also.
3. Multiply sample mass by 0.50 % (not 5.0 %) to get citric acid mass.
   Divide citric acid mass by its molar mass to get moles of acid and base (both are same).
   Divide moles by the NaOH mol/L to get its volume.
4. The intensity of the color is a function of the amount of indicator only.
   Explain why different experiment trials would have different intensities of color.
5. B5. Liters times molarity gives moles of NaOH, which is 1:1 with acetic acid moles.
   B7. Multiply moles by 60.0 g/mol to get mass of acetic acid.
   B8. Divide acetic acid mass by total vinegar mass to get %.
   Skip 5b (both parts).

Procedure Notes

- Read Technique 16 (Measuring Volume) thoroughly.
  Pay particular attention to the photos.
  You will need to accurately operate both a buret and a pipet in this experiment.
- Note that the buret reads **0 ml at the top**, and 50 ml at the bottom, so that the amount dispensed increases as the liquid's surface (meniscus) becomes lower.
- Read volume measurement to nearest 0.05 ml at the bottom of the meniscus.
- Be sure to allow both rinse water and titrant to flow through the buret tip, and that there are no air bubbles trapped in the tip.
- Titrant may initially be dispensed in 1-2 ml increments. When color change begins to persist, dispense titrant slowly. Ideally, dispense dropwise near endpoint.
- Do not overshoot the endpoint. If extra titrant was dispensed beyond the endpoint, there will be no way to determine the actual endpoint, and your calculations will be inaccurate. Also, there will be no indication that extra titrant was dispensed after the initial color change. Ideally, dispense dropwise near endpoint.
- Initially draw liquid above calibration line on pipet, then use index finger to drain excess liquid until bottom of meniscus is at the calibration line. Dispense by gravity flow only. Do not force remaining drop from tip, because the pipet is calibrated to include this drop.
- Remember that moles H^{+1} = moles OH^{-1} at the stoichiometric point for a titration.
- Moles of OH^- are the same after dilution, and moles = (mol/L) × (L) for a solution.
  Therefore, to determine molar concentrations for titrations, use moles = $M_AV_A = M_BV_B$.
  This is similar to the equation for dilution, where moles = $M_1V_1 = M_2V_2$.

Procedure Notes (continued)

- After completing the experiment, rinse the buret, and place it on the stand, upside-down with the stop-cock open.
- Skip the standard deviation steps on the report sheet.
- **Provide calculations** on a separate sheet of paper.

Lab Questions

1. Explain what happens to the moles of H^{+1} in the flask when you add boiled, deionized water to rinse the wall of the flask during the titration. Explain what happens to the moles of OH^{-1} needed from the buret to neutralize the acid after adding the water. What is the overall effect on the calculated acetic acid % of your sample?

2. Suppose that you do not add the water to rinse the inside wall of the flask during the titration, and several drops of base solution remain there unreacted. Explain what happens to the volume of base solution that you need to reach the endpoint. What is the overall effect on the calculated acetic acid % of your sample?

3. Deionized water absorbs CO_2 when it is exposed to the air, and is boiled prior to this experiment to remove the CO_2. CO_2 is an acid, and is equivalent to H_2CO_3, so it creates H^{+1}. Suppose your deionized water is not boiled. Explain what happens to the moles of OH^{-1} needed from the buret to neutralize the acid as a result. What is the overall effect on the calculated acetic acid % of your sample?

4. Suppose your solution has a very faint pink color. The intensity of the pink color at the endpoint is a function of the amount of what substance that you added to your solution? Explain whether or not you need to add more NaOH solution to make the color darker. What is the overall effect on the calculated acetic acid % of your sample if you do add more NaOH?

5. Suppose that you do not add the NaOH slowly and dropwise near the endpoint. Explain why this causes you overshoot the endpoint. Explain whether or not you can tell if you have passed the endpoint from the color of the indicator. What is the overall effect on the calculated acetic acid % of your sample?