Seeing the Light – Titration Reactions

Purpose

To demonstrate conductivity and the titration of a strong acid with a strong base yielding a precipitate

Materials

conductivity apparatus
- buret / clamp
- 250 mL beaker
- magnetic stirrer / bar

0.01 *M* H_2SO_4

0.02 *M* $Ba(OH)_2 \cdot 8H_2O$

ringstand / clamp

phenolphthalein

Procedure

1. Prepare 0.01 *M* H_2SO_4. Mix 56 mL of concentrated sulfuric acid with distilled water and bring the volume to one liter. This solution is 1.0 *M*. Use 10.0 mL of the 1.0 *M* solution and mix with distilled water to bring to the volume to one liter. This solution is 0.01 *M* H_2SO_4.

2. Prepare 0.02 *M* $Ba(OH)_2$ $8H_2O$. Dissolve 1.6 gram of hydrated barium hydroxide in distilled water and bring the volume to one liter. Filter the solution if it appears cloudy.

3. Check the conductivity of both solutions by using about 50 mL in a beaker with the conductivity apparatus.

4. Fill a clean, dry 50 mL buret with the base solution.

5. Pour out 25 mL of the acid into the 250 mL beaker and add 8-10 drops of phenolphthalein.

6. Place the beaker on a magnetic stirrer. Place the electrodes of the apparatus in the beaker. Be sure that the electrodes do not hit the stirring bar.

7. Fix the buret so that a slow constant flow of the base enters the beaker.

8. Stress to students the change of light intensity and the color of the solution.

9. Continue titration until the bulb goes out. Further titrate. The solution turns pink, the bulb goes back on with increased intensity.

Additional Information

1. Sulfuric acid is a strong acid and barium hydroxide solution is a strong base. They are both excellent conductors of electricity, due to the presence of their respective ions. Thus the bulb glows brightly in the presence of both. When the two solutions are mixed together, however, the brightness of the light steadily decreases. This decrease is caused by the formation of the white barium sulfate precipitate. Remember, all ionic salts do not readily dissociate.

2. At the end point of this reaction, the solution turns pink due to the presence of the indicator.

3. As more $Ba(OH)_2$ solution is added, an excess of ions is again produced, allowing the bulb to glow once more.

4. Back titrate with the acid to find the endpoint again.

Additional Information

Waste should be collected in a labelled container with UI# 203462.

Questions for the Students

1. What are the major species in the beaker before the titration?

2. Should the solution in the beaker conduct electricity? Explain.

3. What are the major species in the buret?

4. Should this solution conduct electricity? Explain?
5. What reaction is taking place during the titration?

6. Why did the light go out?

7. What are the major species in the solution now?

8. Why did the phenolphthalein turn pink after the light was out?

9. Why did the light go back on?

10. What are the major species in the solution now?

Reference

ICE, Chemical Demonstrations Workshop, University of Arizona, 1985