

Conductivity Titration Demonstration

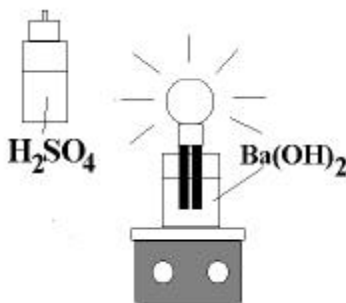
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Description: Electrodes from a conductivity tester are placed in a pink solution. The bulb becomes bright. $\text{H}_2\text{SO}_{4(\text{aq})}$ is added in small amounts. The bulb of the conductivity tester grows dimmer until it goes out, the solution becomes cloudy, and the pink color fades. As more acid is added, the bulb becomes brightly lit again.

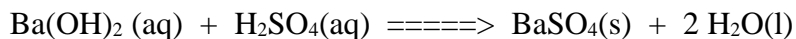
Materials: Conductivity tester, 2M H_2SO_4 in a dropping bottle, 400ml beaker, magnetic stirrer or stirring rod. Saturated solution of $\text{Ba}(\text{OH})_2$ (4g per 200 ml of solution), phenolphthalein.

Procedure:

- 1) Set up the conductivity tester and stir motor. A clamp and ring stand work well for this purpose.
- 2) Pour about 200 ml of the barium hydroxide solution into the 400 ml beaker. Add a few drops of phenolphthalein indicator. The solution should be pink, and the light bulb should be bright. You are ready to begin the demonstration.
- 3) Add several drops of sulfuric acid solution to the beaker. The solution will become cloudy, and the bulb will gradually dim.
- 4) Continue adding acid and stirring until the bulb goes out. Addition of a few more drops of acid will cause the pink color of the indicator to change to colorless leaving a white suspension.
- 5) Continue to slowly add acid, and the bulb will gradually become bright.



Discussion: The bulb is glowing at first primarily due to the presence of barium and hydroxide ions. The reaction occurring in the beaker is the neutralization of barium hydroxide by sulfuric acid to produce water and the slightly soluble barium sulfate. The precipitation of barium sulfate and the formation of the weak electrolyte, H_2O , remove ions from solution causing the conductivity to decrease. Upon complete neutralization of the base, the phenolphthalein becomes colorless leaving a white suspension of barium sulfate. Further addition of the strong electrolyte, sulfuric acid, increases the conductivity until the bulb once again shines brightly.



Hazards: Sulfuric acid and barium hydroxide solutions are corrosive and should be handled with care. Eye protection should be worn at all times. Soluble barium compounds are toxic if ingested. Contact with the skin may produce minor irritations or allergic reactions. Be sure the electrodes of the conductivity apparatus are well protected in order to avoid electrical shock.

Disposal: The contents of the beaker should be neutralized with base and flushed down the drain. Unplug the conductivity apparatus and rinse the electrodes.

Reference: Summerlin, Borgford, and Ealy, *Chemical Demonstrations: A Sourcebook for Teachers Vol. 2*, American Chemical Society, Washington, DC, 1987.