

Freezer Flask

Purpose

To illustrate an endothermic reaction involving reactants in the solid state.

Materials

- Barium hydroxide 8-hydrate, $\text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$
- Ammonium thiocyanate, NH_4SCN
- 500-mL Erlenmeyer flask with rubber stopper
- Wood board
- Electronic balance
- Water

Safety

- Read the SDS sheets for all chemicals before using them.
- Ammonia gas is produced. Avoid inhalation. (You may wish to do this demonstration in a fume hood)
- Wear safety glasses, gloves, and lab coat.
- Firmly hold the rubber stopper to prevent it from popping off.

Procedure

1. Pour a small amount of water (enough to ensure good contact with the base of the Erlenmeyer flask) on a square wooden board.
2. Place 50 g of barium hydroxide octahydrate and 25 g ammonium thiocyanate into the Erlenmeyer flask. Place a rubber stopper in the flask. Swirl to mix.
3. Place the flask in the puddle of water on the board.
4. Lift the flask after a few minutes.

Results

- The reaction vessel gets cold enough to freeze the water between the board and the flask.

Follow-up Teaching Notes

- Energy absorbed by the reaction freezes the water so that the board will be attached to the flask.
- Reaction is:
$$\text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}_{(s)} + 2 \text{NH}_4\text{SCN}_{(s)} \rightarrow \text{Ba}(\text{SCN})_{2(aq)} + 2 \text{NH}_3_{(g)} + 10 \text{H}_2\text{O}_{(l)}$$
- Ammonium nitrate can be a substitute for ammonium thiocyanate.

Connections

- Enthalpy and heat of reaction, reaction between two solids.

Extensions

- Demonstration of an endothermic reaction: dissolve ammonium chloride in water.
- Demonstration of an exothermic reaction: dissolve calcium chloride in water.

Disposal/Clean-up

- Open the flask in a fume hood and allow the ammonia to evaporate overnight.
- Remaining contents can be placed in the science department's heavy metal waste container for proper disposal.