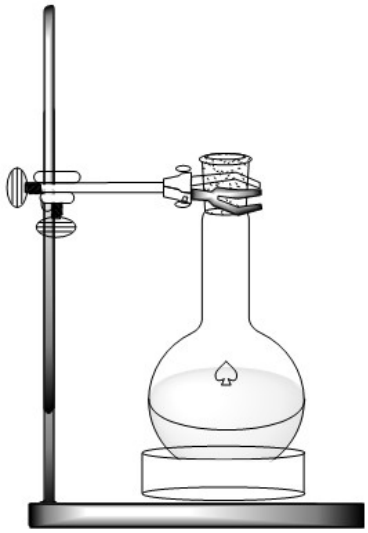
Combustion of Sulfur in Oxygen

Chemicals and Equipment Needed



- O_2 cylinder
- Yamada Indicator – **Z**
- Small vial of sulfur – **G3**
- Dropper bottle of 0.1 M NaOH – **S1**
- 5 L round bottom flask (and cork ring) – **Q5**
- Tall ring stand and large 3-finger clamp – **J**
- Propane torch – **A4**
- Small ring stand and iron ring – **J**
- #11 rubber stopper – **U3**
- #11 stopper with deflagrating spoon – **U3**
- Matches or striker – **U1**
- Scoopula – **U1**
- Paper towels

Hazards: Sulfur dioxide gas (SO_2) is an irritant to lungs, throat, and eyes. In order to minimize SO_2 (g) exposure, perform this demonstration in a hood, or near an in-bench hood. If a hood is not available, get the burning sulfur into the flask as quickly as possible.

Preparation

- Add 500 mL Yamada to the round bottom flask. If needed, add 0.1 M NaOH until neutral (green).
- Lay a piece of paper towel over the cork ring and set the flask on top (the white paper towel will show the colors better). Put the set up on the base of a tall ring stand and secure the neck of the flask with a large 3-finger clamp. See diagram above
- Put the propane torch on the small ring stand and use an iron ring to secure it.
- Right before delivery, charge the flask with oxygen by passing O_2 gas into the flask for ~30 s, then stopper. (Remove the hose from the in-house air in the hood and attach to the oxygen tank) Leave note (or label flask) to indicate that the flask is charged with O_2.
- Place demo next to the in-bench hood.

Presentation

- Show the students the green solution in the flask and explain that the indicator turns yellow or orange in acid, and blue or purple in base.
- Use the spatula to fill the bowl of the deflagrating spoon about half full. Heat the sulfur over the torch until it melts and then begins to burn.
- Remove the plain stopper from the flask, and insert the stopper + deflagrating spoon into the flask, **leaving the stopper somewhat loose**.
- Turn out the lights to better observe the blue glow emitted by the combustion of sulfur in oxygen:

$$S_8\,(g) + 8\,O_2\,(g) \rightarrow 8\,SO_2\,(g)$$

- The flask will rapidly fill with a white cloud. Turn the lights back on. **Tighten the stopper and shake the flask to quench the flame.**
- What happens to the color of the solution? It turns orange or red, indicating that the product is an acidic oxide, a compound that dissolves in water to yield an acidic solution:

$$SO_2\,(g) + H_2O\,(\ell) \rightarrow H_2SO_3\,(aq) \rightleftharpoons H^+\,(aq) + HSO_3^-\,(aq)$$

Clean-Up

- Place flask in the hood. Use the air hose to flush the SO_2 out of the flask before washing.
- Pour solution down the sink with plenty of water. Clean the deflagrating spoon thoroughly.

Presentation

- Show the students the green solution in the flask and explain that the indicator turns yellow or orange in acid, and blue or purple in base.
- Use the spatula to fill the bowl of the deflagrating spoon about half full. Heat the sulfur over the burner until it melts and then begins to burn.
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