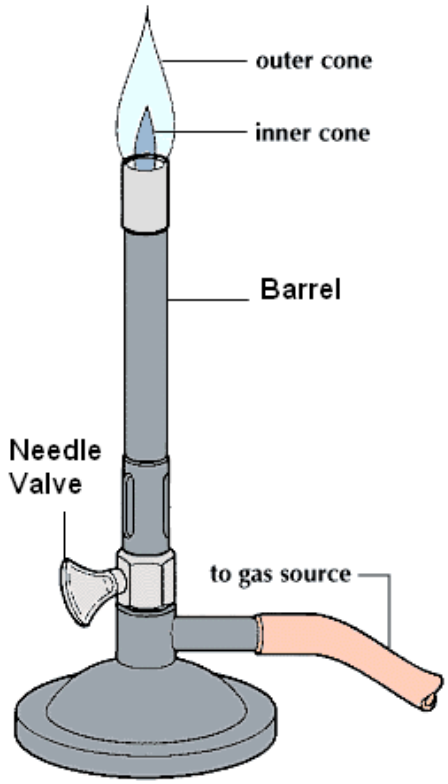
Lab #1 – Heating Sources and Techniques

Heat is frequently used to increase reaction rates, enhance evaporation, or speed dissolution. Gas burners, usually Bunsen Burners, and hot plates are the two most common heat sources.

Bunsen Burner

The Bunsen burner was invented in 1855 by Robert Bunsen, a German chemist. A typical Bunsen burner is shown in the figure below. Combustible gas (in our case, propane) flows through rubber or plastic tubing from a gas valve on the laboratory bench to the gas inlet on the burner. A typical Bunsen burner has a metal mixing tube, or barrel, attached to its base. Gas passing up the burner barrel mixes with air drawn into the barrel through the air inlets. The gas-air mixture is ignited by holding a burning match just above the top of the barrel. Alternatively, an inverted striker is held just above the barrel top, and the striker handle is squeezed to create a spark.

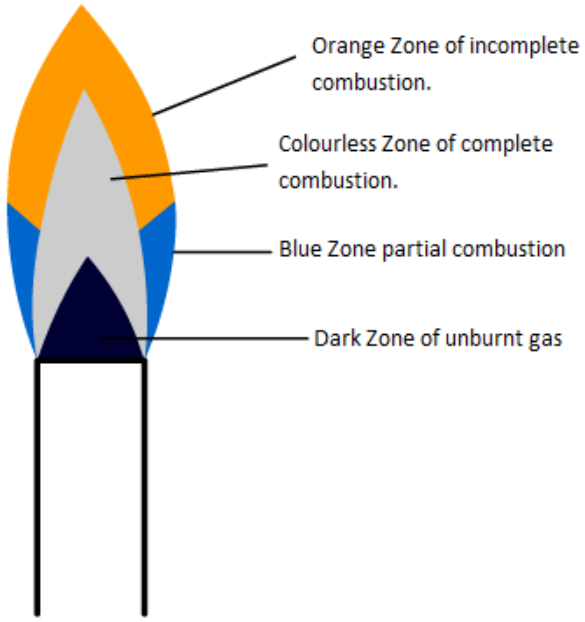


The type of flame is controlled by varying the relative amounts of gas and air entering the barrel. Major adjustments in gas flow are made by turning the handle on the bench gas valve. More precise control is achieved by careful adjustment of the needle-valve screw at the base of the burner. The amount of air entering the barrel is controlled by rotating the barrel to reposition the collar. The rotation causes the collar to cover the air inlet holes to a greater or lesser extent.

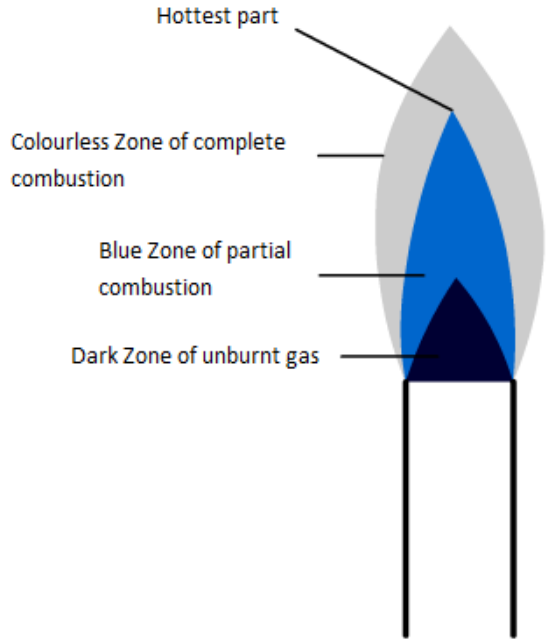
If the flame goes out, ***turn off the gas, and wait at least 30 seconds*** before attempting to relight the burner to allow the uncombusted gas to disperse.

Different flame temperatures result from different gas-air mixtures. A mixture that is mostly gas with only a little air produces a relatively cool yellow flame, referred to as a reducing, or luminous, flame. This flame is typically unsuitable for heating because it produces soot (carbon). As more air is mixed with the gas, the temperature of the flame increases. Efficiently burned gas produces a hot flame, called an oxidizing, or nonluminous, flame. An oxidizing flame has an inner flame that is bright blue and an outer flame that is sometimes almost colorless. The hottest portion of an oxidizing flame is just above the peak of the blue inner flame.

If the gas begins to burn inside of the barrel, immediately turn off the gas valve. Allow the barrel to cool. Then adjust the collar to decrease the amount of air entering the barrel. Relight the burner, and make further adjustments to obtain the proper mixture of gas and air.



Luminous flame



Non-luminous flame

Hot plate

A hot plate is an electrical heating device that is particularly useful for experiments where an open flame is prohibited. A dial or knob controls the hot plate temperature.

Objective

How can we operate and control the Bunsen burner?

Materials

- Bunsen burner (with gas hose)
- Nichrome wire
- Crucible tongs
- 2 - 250 mL beakers
- Ring stand / ring
- Wire gauze
- Thermometer
- Graduated cylinder
- Beaker tongs
- Matches / striker

Pre-lab Questions

1. What is the purpose of the needle valve and the barrel?
2. Where is the flame the hottest?
3. If you needed to heat a flammable liquid, which would be the best to use, a Bunsen burner or a hot plate? Why?

Procedure

1. Examine the burner and learn the names of the parts.
2. Make sure that both the barrel and needle valve are completely closed.
3. Connect the burner to the gas valve on the lab bench with rubber tubing.
4. Turn the needle valve about a ¼ to ½ turn. This will allow gas to enter into the barrel.
5. Light the burner using a match or a striker. Qualitatively describe the flame.
6. Open the air holes by turning the barrel and reduce the size of the flame using the needle valve. Qualitatively describe the new flame.
7. Test the inner cone of the flame by holding a Nichrome wire on the top of the barrel for a few seconds.
8. Raise the wire slowly into the outer cone. Qualitatively describe what you see taking place with the wire as you move it.
9. Turn off your Bunsen burner at the bench gas valve.
10. Pour 150 mL of cold tap water into a 250 mL beaker. Measure and record the temperature of the water. Place the beaker on wire gauze on a ring.
11. Heat the water over a blue flame for 2 minutes. Turn off Bunsen burner. Measure and record the new temperature.
12. Repeat steps 10 – 11 using a new beaker and a yellow flame.

Post-lab Questions

1. Based on your results, which cone gives off more heat?
2. Based on your results, which flame generated more heat? Why?
3. How would you adjust the Bunsen burner to obtain a luminous flame?
4. How would you adjust the Bunsen burner to obtain a nonluminous flame?
5. What did you notice happening to the outside of the beaker when heating with a luminous flame? Why?
6. Compare the two flames for heating purposes.
7. Which part of the Bunsen burner regulates the temperature of the flame?
8. What happens inside of the barrel of the Bunsen burner?