

TEACHER'S GUIDE TO BOYLE'S LAW, A SMALL-SCALE EXPERIMENT

1. Preparation of the colored liquid.

To a mixture of 25 mL of water and 25 mL of rubbing alcohol in a container, add 10 drops of blue food coloring and stir.

2. Filling the Beral pipet with the colored liquid.

By alternately drawing liquid up into the bulb of the pipet, then inverting the pipet so the air bubble is at the top, expelling droplets of water in the stem and the air in the bulb, inverting again and drawing up more liquid, etc., the pipet can be completely filled with the liquid. Then very carefully expel liquid from the stem, drop-by-drop, until the liquid level is about 10-15 mm above the juncture of the stem and the bulb. (Note: More accurate readings are obtained using a thin stem Beral pipet; however, a conventional microtip Beral pipet can be used if a thin stem one is not readily available.

3. How to heat-seal the liquid-filled Beral pipet.

Place a candle in a small container of sand. Light the candle and hold the tip of the Beral pipet containing the liquid above the flame. When the tip changes from translucent to clear, compress the end of the pipet with tongs or pliers. Place the tip of the pipet in some water in a beaker. Squeeze the bulb of the pipet. If no bubbles are observed, you have sealed the pipet. If bubbles are observed, repeat the procedure above until pressure produces no bubbling when the tip is submerged in water.

4. Preparation of the transparent plastic metric ruler.

Using a copier and a blank overhead transparency sheet for copiers, make a copy of the page of metric rulers (found at the end of this material) onto the transparency sheet. From this sheet you can make 24 plastic rulers. Cut each ruler on one end so that the 0 line is intact; cut the other end of the ruler at the junction of the stem and the bulb of the sealed pipet (about 110 mm).

5. Attachment of the ruler to the Beral pipet stem.

Using a metal file, roughen the surface of the Beral pipet on the side on which the ruler is to be attached. Attach a clear plastic ruler to the stem of the sealed Beral pipet with super glue (using a thin line of glue across the length of the ruler) so that the zero mm mark is at the sealed tip of the pipet. (Be sure to wipe all glue off the tip of the glue container before replacing the cap.)

WARNING: Do not use super glue unless you have close at hand either super glue remover or an organic solvent such as acetone or ethyl acetate. (Nail polish remover will work also.) Appropriate super glue is Zap-a-Gap (from a hobby store) or Lok-Knot (from a sporting goods store in the fishing section). Other brands may not be satisfactory.

6. Alternative weights that may be used instead of books.

If the use of identical books as weights is not feasible, we suggest using 2" x 6" x 8" wooden boards. (Actually "dressed" lumber in this size is really 1½ inches thick and

5½ inches wide.) Such short lengths are often discarded at construction sites and probably can be obtained at no cost. Make sure the lumber from which these boards come was not treated with wood preservatives. It is best to have each set of 5 or 6 blocks cut from a single board.

7. Additional Information

More accurate readings can be obtained when taking measurements by viewing the ruler from the side; i.e., the ruler is almost perpendicular to the eye.

Questions

1. What unit of pressure is used in this experiment?

[ans: a book]

2. What is the dependent variable in this experiment?

[ans: volume or $\frac{1}{V}$]

3. What is the independent variable in this experiment?

[ans: pressure measured in number of books]