



ELECTRO-TECHNIC PRODUCTS, INC.

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Instructions for the Use of Model 6005 Bromine Tubes

Description. This set of tubes is designed to meet the requirements of the IPS and other instructional programs. Consists of a set of two glass tubes about 12 in. long, each sealed on both ends. One tube contains bromine vapor and approximately one-half atmosphere of air, and the other tube contains bromine gas and a small amount of liquid bromine. These tubes are used to demonstrate the principle of gas diffusion. Bromine is used because its reddish color is easily visible, and its change of state from gas to liquid is achieved at temperatures easily attainable in science labs.

Theory. Gas molecules intermingle or diffuse because of their random thermal motion, and collisions with each other. The rate of diffusion increases with temperature, and decreases as the pressure of the gases increases. Standard physical science texts should be consulted for a more thorough explanation of the gas kinetic theory.

Suggested Experiment. Prepare a dry ice and alcohol bath to cool each tube. Use denatured ethyl alcohol or isopropyl alcohol, neither of which are included with this set. Purchase "dry ice" (frozen carbon dioxide) locally. Crush the dry ice and make a slurry of dry ice and alcohol.

1. Cool the tube containing bromine gas and air in the mixture of dry ice and alcohol. As the gas cools, the reddish-brown bromine will begin to solidify at the bottom of the tube.
2. After the bromine solidifies, remove the tube from the dry ice and alcohol mixture. Place the tube upright and let stand at room temperature.
3. As the bromine warms, the gas moves slowly up the tube until it is evenly dispersed.
4. Repeat Steps 1 and 2, using the other tube which contains bromine gas and a small amount of liquid bromine.
5. As this tube warms to room temperature, the bromine melts and the color is the same throughout the tube. The color will continue to darken as more of the bromine melts.

6. Place a card to cover both ends of the tube. Note that it is difficult to determine in which direction the gas is moving.

Conclusions. The rate of diffusion is very temperature dependent. The bromine diffuses more rapidly as the tube warms. The rate of diffusion is slower when the density of the gas is higher. When there is no air in the tube, the bromine gas diffuses quickly throughout the tube, but for the tube with air inside, the rate of diffusion is slower.

Safety Precautions. This product has been designed for safe use. A minimal amount of bromine is contained in each tube to adequately demonstrate the phenomena of diffusion. Exercise the standard laboratory precautions when handling this or any other type of glassware. If a tube should break, avoid inhaling the bromine vapors or contacting any liquid bromine.

Other Suggested Experiments. Other products which demonstrate other related properties illustrating the kinetic theory of gases include the following:

Model 6003 Molecular Motion Demonstrator
Model 6006 Iodine Diffusion Tube
Model 6007 Nitrogen Dioxide Tubes

These products are available from your favorite science-education supplier.