

# OPERATING INSTRUCTIONS

## Molecular Size and Mass Kit No. 72701-81

### 1. Introduction

The Molecular Size and Mass Kit contains all the materials for a class study of the size of a molecule. Basing their results on the displacement of a film of lycopodium powder, students can make a simple but accurate determination.

### 2. Description

The kit contains the basic supplies for this experiment. Included are nine dropper bottles, 15cc of lycopodium powder, and a 1-oz. bottle of oleic acid.

Not included, but required for use, are a shallow tray, a 25ml graduated cylinder, a supply of methyl alcohol, and a 30cm ruler for each group.

### 3. Operation

Before beginning, make certain that the trays, droppers, dropper bottles, and graduated cylinders used in the experiment are free from all contamination. This is essential for the experiment. Wash all supplies with fresh tap water or, if possible, with distilled water. Cover the tray once it has been cleaned.

Carefully measure 1ml of oleic acid in the graduated cylinder. Pour the acid into a clean dropper bottle. Add 24ml of methyl alcohol, measured in the same cylinder. Pour the alcohol into the bottle with the acid, cap the bottle tightly, and shake well. Uncap the bottle and measure 1ml of the oleic acid-methanol solution into a fresh bottle. Add an additional 24ml of alcohol to this bottle, cap the bottle, and shake well. The volume of acid in one ml of this solution is equal to

$$\frac{1}{24 + 1} \times \frac{1}{24 + 1} = .0016\text{ml}$$

Fill a clean dropper with this solution, and measure 1ml of the solution into the graduated cylinder, counting the number N of drops contained in 1ml. The volume of acid in each drop is equal to  $.0016\text{ml}/N$ .

Without touching the inside of the clean tray, set it on a level surface. Cover the bottom with water; distilled water is again preferable, but fresh tap water may be used. Hold the bottle of lycopodium powder 18 inches above the surface of the water and drop a small amount onto the water. Allow it to settle on the surface. The film of powder should be barely visible.

Drop one drop of the final oleic acid solution onto the center of the film of powder. The powder will disperse into a circle; a thin film of oleic acid, actually a monolayer, will be visible in the circle. Measure the average diameter D of this circle. The oleic acid forms a monolayer, that is, a film which is only one molecule thick. A necessary assumption is that the methanol used to dilute the

oleic acid goes into solution in the water; the monolayer is thus made up of only oleic acid molecules. The thickness of the monolayer should therefore equal the size of one molecule of oleic acid.

The volume of acid applied to the system is known. Its value can be used to find the thickness  $t$  of the acid monolayer by the equation

$$V = (D/2)2t$$

The thickness is then equal to

$$t = \frac{4V}{D^2}$$

A thorough description of the oleic acid-lycopodium experiment is given in experiment I-6 of the second edition of the PSSC Laboratory Guide, as well as in many other texts. Suggestions for further analysis are available in these sources.

#### 4. Maintenance

The Molecular Size and Mass Kit needs no special maintenance. If any difficulty develops, contact Central Scientific Company, giving all details of the problem. Do not return this apparatus without written authorization from Central Scientific Company.

#### 5. Replacement Parts and Accessories

<u>Description</u>	<u>Cat. No.</u>
Lycopodium Powder, 25g .....	84855-01
Oleic Acid, 500ml .....	37114-1
Methyl Alcohol, 500ml .....	37231
Amber Glass Dropping Bottle, 30ml Capacity .....	10542-03
Single-Graduated 25ml Pyrex Cylinder with Plastic Hex Base .....	16102-02

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