Name: ____ **Date:** ____________________

Measuring Surface Tension

Introduction

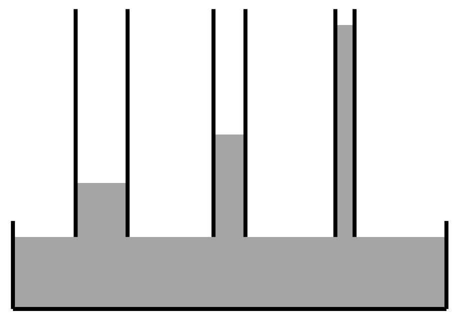
Many industrial processes depend on the accurate measurement of surface tension. When an object must be painted or finely coated with some material, the surface tension of the coating must be carefully maintained to produce the desired coating thickness without any uneven patches. The strength and effectiveness of detergents are also partially determined by surface tension. One accurate method to measure surface tension is through capillary action. In this lab, we will use the capillary action of water in thin glass tubes to measure water's surface tension.

Equipment

- 1 ring stand with support ring attached
- capillary tubes of various diameters
- Petri dish
- Twist-ties
- water with food coloring

Procedure

1. **Place** an empty Petri dish directly below support ring.
2. On a lab bench, **arrange** the glass capillary tubes in order of increasing inner diameter (ID) as noted on their tags.
3. **Attach** each capillary tube to the support ring using a twist-tie. *Caution: Capillary tubes are delicate—handle with care.*
4. **Arrange** the capillary tubes so that each *almost* touches the bottom of the Petri dish.
5. **Fill** the Petri dish with water dyed with food coloring.



6. Water will begin to quickly rise in each of the capillary tubes. **Wait** two minutes, or until the water stops rising. **Record** the water height in each capillary tube, below:

Inner Diameter (mm)	Maximum Height of Water (cm)
3.00	
1.20	
0.60	
0.31	
0.20	

Analysis

1. Calculate Surface Tension

Use the following equation to calculate the surface tension found experimentally in each capillary tube. ρ is the density of water ($\rho = 1000\ kg/m^3$), g is the acceleration due to gravity ($g = 9.8\ m/s^2$), a is the *radius* of capillary tube, and θ is the contact angle between water and glass (assume $\theta = 0^o$). Use SI units, scientific notation, and **show all work**.

$$\gamma = \frac{\rho g a}{2}\frac{h}{\cos\theta}$$

Inner Diameter (m)	Height h of Water in Capillary Tube (m)	Surface Tension of Water (J/m^2)
3.00×10^{-3}		
1.20×10^{-3}		
6.0×10^{-4}		
3.1×10^{-4}		
2.0×10^{-4}		

2. Statistics

Follow your teacher's instructions to find the average surface tension and the experimental standard deviation. Include units and report average surface tension in scientific notation.

3. Conclusion

Does your average surface tension agree with the accepted value (at 20^o C) $\gamma = 0.073\ J/m^2$ within your experimental error? If not, what are some possible reasons for the difference?