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Millikan Oil Drop Experiment

**Procedure**

1. Record the resistance of the thermistor and use the table on the apparatus to convert that resistance to temperature in degrees celsius. Record the value for temperature followed by the voltage across the plates.
2. While looking through the viewing scope with the lights off, spray Droplets using the atomizer into the system. First squeeze the bulb quickly and release followed by a slower squeeze that will only release air into the system.
3. Using the plate voltage switch, you are able to change the polarity to either, zero, positive, or negative. You should be able to see that the droplets begin to rise when the electric field is on and fall when the field is off.
4. Find a droplet that is falling slow enough to get an accurate reading of the fall time between two of the major grid lines (5 smaller grid lines). However not too slow so that you can get multiple readings in a reasonable time.
5. While one partner follows a droplet the other should record the start and stop time for the drop to fall and rise between two major grid lines.
6. Switch droplets once enough data (~10 data points) has been gathered. Feel free to switch roles in the group as the task of staring at a dot can get exhausting.
7. Finally record the temperature and voltage at the end of the experiment.
8. For any droplet that has three or less data points, do not include in your calculations but leave the data present. In addition any data points that were recorded with procedural errors do not include in the calculations and take note of the source of error but leave the data present.
9. If data is taken on multiple days, take the resistance of the thermistor and record the temperature for the new day. Make note in your data that numbers were recorded on separate days.

**Analysis**

1. The resistance of the thermistor for the first collecting run was measured to be very close to the value of 2.233 megaohms (an exact resistance was never recorded in our data spreadsheet), correlating to 21 °C inside the thermistor. Using this temperature and appendix A, the viscosity of air in the chamber can be interpreted as 1.8280⁢⨉10-5 Nsm-2. After it was determined that more data needed to be collected, the resistance was 2.29 megaohms. This closely corresponds to the value of 2.3 megaohms, which is 20 °C as taken from in appendix B. This corresponds to an air viscosity of 1.8240⁢⨉10-5 Nsm-2 (from appendix A).
2. The mean fall time for each drop was 44.57, 54.65, and 17.22 seconds from day one. The mean fall time for each drop from day two was 19.88, 21.52, 32.60, and 33.04 seconds. The times from day one convert to fall speeds of 1.12⁢⨉10-5, 9.15⁢⨉10-6, and 2.9⁢⨉10-5 m/s. From day two, the fall speeds convert to 2.52⁢⨉10-5, 2.32⁢⨉10-5, 1.53⁢⨉10-5, and 1.51⁢⨉10-5 m/s. The droplets from day one had radii of 2.87⨉10-7, 2.56⨉10-7, and 4.85⁢⨉10-7m. The droplets from day two had radii of 4.87⁢⨉10-7, 4.68⁢⨉10-7, 3.81⁢⨉10-7, and 3.78⁢⨉10-7 m. The droplets from day one had masses of 8.81⨉10-17, 6.23⨉10-17, and 4.23⨉10-16 kg. The droplets from day two had masses of 3.34⁢⨉10-17, 2.93⁢⨉10-17, 1.48⁢⨉10-17, and 1.45⁢⨉10-17 kg.
3. The mean rise speed of droplets from day one was 1.14⁢⨉10-7, 9.72⁢⨉10-7, and 4.26⁢⨉10-7 m/s. The mean rise speed of droplets from day two was 1.66⁢⨉10-7, 1.9⁢⨉10-7, 2.72⁢⨉10-7, and 1.12⁢⨉10-7 m/s. From this data, it can be interpreted that individual droplets from day one had charges of 1.80⨉10-19, 1.33⨉10-19, and 1.67⨉10-19 C. Droplets from day two had charges of 1.55⨉10-19, 1.64⨉10-19, 1.69⨉10-19, and 2.23⨉10-19 C. The average value for the elementary charge over seven different droplets was (1.70±0.21)⨉10-19 C.

**Discussion**

1. The accepted value of the elementary charge on an electron is 1.602⨉10-19 C. The average value for the elementary charge over seven different droplets was (1.70±0.21)⨉10-19 C. The actual value is within the confidence value of the observed value, making our results consistent with the accepted value.
2. Sources of error while executing the experiment include things such as table bumps, reaction time when timing, and confusion between droplets. Table bumps were of serious significance, as they resulted in lost samples in individual droplet collection when the observer lost track of the droplet. Due to the timing being based on the call and response of the observer and the timer, this creates a delay between when the observer says “start” or “stop” and when the button on the timer is struck. Finally, if the observer lost track of their droplet this rendered the data recorded useless. Not only did it waste time but it led to less data points making our averages less accurate.
3. “It does not matter how slowly you go, as long as you do not stop” - Confucius.