Names (partners only): _____

Millikan's Oil Drop Simulation Lab

SPH4U

Purpose: To determine the charge on small electrically charged oil drops, using a computer simulation of Millikan's famous apparatus (millikan.exe).

Procedure:

1. Start the millikan.exe simulation and read the introductory two screens. We will be modifying this procedure slightly. Rather than timing the rise and fall of the drops, we will be adjusting the potential difference so that the drops are held suspended, the electrostatic force balancing the force of gravity.

2. Start the simulation. Use the "p" key to release several drops. Note that you will only need to catch one of these drops. Once the drops are in the centre of the screen, hit "l" to close the circuit so that there is a potential difference across the parallel plates. Use the "q," "w", "e", and "r" keys to increase and the "a," "s", "d", and "f" keys to decrease the potential difference. When you have a drop suspended (you may need to watch it for a while), record the potential difference across the plates and the radius of the drop in Table 1 below. Hit "l" again to open the circuit and release the drop(s).

3. Repeat Step 2 until Table 1 is complete.

Data:

Table 1: Potential difference to hold a drop suspended and radius of the drop

Drop	Potential difference (V)	Radius (μm)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Show Table 1 to your teacher and ask your teacher to initial here: _____

Analysis:

1. Assuming that the drops are spherical, calculate the volume of Drop 1. Show your work.

2. The density of the oil drops is $\rho = 919.9 \frac{kg}{m^3}$. Calculate the mass of Drop 1. Show your work.

3. Calculate the force of gravity on Drop 1. Show your work.

4. What is the electrostatic force on Drop 1? _____

5. The separation between the plates is $0.025\,m$. Calculate the strength of the electric field. Show your work.

6. Calculate the charge on Drop 1. Show your work.

Show your calculations to your teacher and ask your teacher to initial here: _____

7. Record your calculations for Drop 1 in Table 2 below and repeat your calculations for each of the other drops.

Table 2: Volume, Mass, Forces, and Charge on a Drop Suspended in a Field

Drop	Volume (m^3)	Mass (kg)	$F_g = F_e$ (N)	Field (N/C)	Charge (C)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Show Table 2 to your teacher and ask your teacher to initial here: _____

8. The charges in the table above are all multiples of what elementary charge?

_____

How many elementary charges are there on Drop 1? Show your work.

Show your calculation to your teacher and ask your teacher to initial here: _____

9. How would the drop have acquired this charge? (Refer to p. 360.) _____

10. Is this charge positive or negative? Explain how you know. (Look at the charges on the plates.)

_____

_____

_____

Show your answers to your teacher and ask your teacher to initial here: _____