Shown below are the calculations that were used to find a value for q for each drop and the accompanying error estimate calculations

**First, declare measurements that are constant for this lab**

Distance between electric plates of capacitor, measured with micrometer



Density of oil, taken from the Pasco manual



Gravity



Constant:

 

Atomospheric pressure in pascals for day 1 and day 2





**Now Enter data data for drop 2**





Viscosity of air based on temperature



Data for drop fall time









Data for drop rise time under influence of electric field E/d







**Perform the Calculations**

For source of calculations, see the Pasco 8210 Millikan Oil Drop Apparatus manual. Pages 2 and 9

First calculate the radius of the drop (Not sure why I labeled it a instead of r)



Now calculate the mass of the oil drop



Then calculate charge





Correction as I can't figure out how to make Mathcad print out q correctly when it is this small



**Errror Analysis Drop 2**

First find the standard deviation for the data and assign it to a variable

, 

, 

Find the derivative with respect the rising and falling velocities

















Apply equation for error in a function of multiple variables with independent uncertainty (Taylor, 3.47)



Again, a correction for simpler printing





These measurements were then repeated for all other drop data and the following values were found

==

drop values



Best estimate by Weighted averages





As the best estimate is a function of two values, and as partial deriviatives of Q with respect to any element in D is 1, Taylor 3.47 reduces to the root mean square

==

Q values by drop



Best estimate for multiple values with independent error is by weighted averages

The weights are 







Because the calculation for the best estimate is the function Q of multiple values D, and as partial derivatives of Q with respect to any element in D is 1, Taylor 3.47 reduces to the root mean square







So, final answer is the charge of an electron 

Which is right on the accepted value of within the known error for this experiment. This technique with this apparatus appears likely to produce reasonably accurate results, but would require a great many more acquisitions to deal with the high uncertainty inherent in this experiment

If, instead of using the above methods, a least squares fit is done using the Matlab fit routine, the values are somewhat different. The integer number of charges is guessed at and data points plotted as a scatter plot. A curve fit is then performed on this data and the resulting line plotted. The slope of the curve fit is the electron charge and the RMS error reported by the curve fit is the standard error. Thus, as calculated by Matlab

Slope = 1.58E+000

RMS error = 7.900E-001

This method has the disadvantage of not weighting the values with known uncertainty, and is therefore somewhat less accurate.

