

measurement exercise vii

In this group exercise, we will work through Millikan's thought process as he took his raw data and used it to determine the charge on an electron. We will use the first set of data published by Millikan in his 1911 paper "The Isolation of an Ion, a Precision Measurement of its Charge, and the Correction of Stokes's Law," which was published in the journal *Physical Review*. The data consists of 37 measurements made on a single drop suspended in his instrument as it moved down in response to the pull of gravity and up in response to its attraction to a plate held at a fixed positive potential. During the time he observed the drop, it both gains electrons from other drops and loses electrons to other drops. The data in the spreadsheet `millikan_data.xlsx` gives the calculated charges on the drop expressed in electrostatic units (esu); this is an older unit of charge, which today is expressed in Coulombs.

Task 1: Why do the charges increase and decrease over time? How can we explain observations 29-31?

Task 2: What do we see when we examine the change in charge,  $\Delta Q$ , between successive observations?

Task 3: Can we provide an estimate of the charge on a single electron?

Task 4: Can we determine how many electrons are captured or lost during each observation?

Task 5: How many total electrons are on the drop during each observation?