Investigation of the Force Between Two Positively Charged Conducting Spheres

Tveite, Madeline (School: Gjovik Upper Secondary School)

This essay takes an in-depth look into the nature of positively charged conducting spheres, and the ability of Coulomb's law to predict the force between them. The force is expected to be repulsive at all times, which this essay seeks to disprove. The essay also seeks to create a model predicting the force. The research question is: "When considering the electrostatic force between two positively charged spheres, is there a separation and ratio of charge at which Coulomb's law for point charges no longer applies, and can the subsequent force between the spheres be predicted?" The scope of the essay concerns itself with theoretically predicting, for three different charge ratios, the force between two positively charged spheres using Coulomb's law, and then investigating the same force experimentally using a Coulomb balance. Finally, the essay proceeds to create a function which can be used to describe, and which to a large extent fits, the force observed experimentally, using Coulomb's law and inspiration from The Feynman Lectures on Physics. The function is: F=A[1/x^2 -(p+1/p) 2/x^5 -(p+1/p) 3/x^7 +6/x^8] where A is a constant, p is the ratio of charges and x is the spheres' separation in terms of their radii. The conclusion is that, in the case of positively charged spheres, Coulomb's law ceases to accurately predict the force between the spheres at small separations. The model created is in terms of the parameters A and p which, due to experimental errors, are not known theoretically and must be determined according to the data. Based on the method of image charges, the model is successful in providing an approximate prediction of the force between the spheres. The conclusion points out that, within certain conditions, spheres of equal charge attract.