Activity: Electric Fields

SPECIFIC EXPECTATIONS

A1. demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analysing and interpreting, and communicating);

A2. identify and describe careers related to the fields of science under study, and describe the contributions of scientists, including Canadians, to those fields.

D1.2 assess the impact on society and the environment of technologies that use gravitational, electric, or magnetic fields (e.g., satellites used in surveillance or storm tracking, particle accelerators that provide high-energy particles for medical imaging) [AI, C]

D2.1 use appropriate terminology related to fields, including, but not limited to: forces, potential energies, potential, and exchange particles [C]

D2.3 analyse, and solve problems involving, electric force, field strength, potential energy, and potential as they apply to uniform and non-uniform electric fields (e.g., the fields produced by a parallel plate and by point charges) [AI]

D2.5 conduct a laboratory inquiry or computer simulation to examine the behaviour of a particle in a field (e.g., test Coulomb's law; replicate Millikan's experiment or Rutherford's scattering experiment; use a bubble or cloud chamber) [PR]

D3.3 use field diagrams to explain differences in the sources and directions of fields, including, but not limited to, differences between near Earth and distant fields, parallel plates and point charges, straight line conductors and solenoids

Purpose

- Explore the Millikan Oil Drop experiment.

Observations (A1, D2.3)

- Access the Millikan Oil drop Lab simulation (D2.5) from the physics aviary using the link provided and follow the instructions for ten trials: https://www.thephysicsaviary.com/Physics/Programs/Labs/MillikanOilDropLab/index.html
- Construct a data table to summarize your observed and calculated values for ten trials
- Recall, you may use software to help with repetitive calculations, but ensure you have programmed it correctly!

Useful Constants

$\rho_{oil} = 900\, {}^{kg}/_{m^3}$ $\qquad$ $g = 9.8049\, {}^{N}/_{kg}$ $\qquad$ $\Delta d = 3.0mm$ $\qquad$ $q = 1.602x10^{-19}C$

Useful Equations

$V_{sphere} = \frac{4}{3}\pi r^3$ $\qquad$ $m = V\rho$ $\qquad$ $q = \frac{mg\Delta d}{\Delta V}$ $\qquad$ $\%_{error} = \frac{|q_{th} - q_{ex}|}{q_{th}} x100\%$

Discussion questions

1. It was not guaranteed that there would be an oil drop left suspended between the plates for each trial. Using an FBD, explain why this is the case. (D2.1)
2. For the case of the suspended oil drop, draw a labelled field diagram. For assistance, see: https://www.falstad.com/emstatic/. (Please note the orientation of positive and negative charged plates as compared to the laboratory simulator). (D3.3)
3. Comment on the percent error you calculated for each trial. In what ways did the design of the simulation contribute to this error? Explain. (A1)
4. The determination of the elementary charge was a significant accomplishment back in 1909. Reflect on modern technologies – how has knowing the fundamental charge been part of their design? Explain. (A2)

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