EvaluAIde Beta Bonus Assignment – College Physics II: Electrostatics

Instructions:

- Answer all questions in detail. Show your work and reasoning for each part.
- Your submission must be a single PDF file. You may type your solutions or handwrite and scan them.
- This assignment is for bonus credit and will help improve our grading tools—thank you for participating!
- Submit your PDF via the usual course submission portal by the posted deadline.

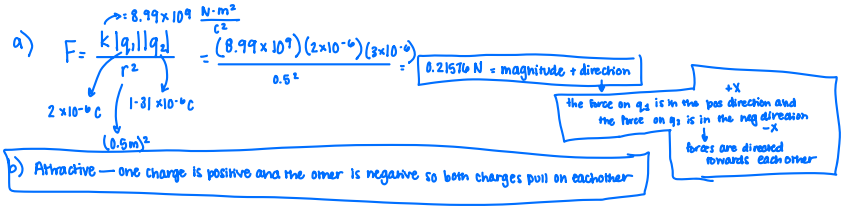
Questions

1. **Coulomb's Law:**

   Two point charges, $q_1 = +2.0\ \mu\text{C}$ and $q_2 = -3.0\ \mu\text{C}$, are placed 0.50 m apart in vacuum.

   a) Calculate the magnitude and direction of the electrostatic force on each charge.

   b) Is the force attractive or repulsive?



2. **Electric Field of a Point Charge:**

What is the magnitude and direction of the electric field at a point 0.30 m away from a +5.0 μC point charge?

$+5\ \mu C \longrightarrow 5\times10^{-6}\ C$

$E = \frac{k|q|}{r^2}$ ($k = 8.99\times10^9\ N\cdot\frac{m^2}{C^2}$, $q = +5\times10^{-6}\ C$, $r^2 \rightarrow 0.3^2\ m^2$)

$= 499{,}444.44\ N/C$ = magnitude

direction = away from the charge = in +x direction

3. **Electric Field from Multiple Charges:**

Two charges, +1.0 μC and −2.0 μC, are fixed 0.40 m apart.

a) Find the electric field at the midpoint between them (magnitude and direction).

b) If a +1.0 nC test charge is placed at the midpoint, what force does it experience (magnitude and direction)?

a)

$q_1 = +1\ \mu C \longrightarrow +1\times10^{-6}\ C$

$q_2 = -2\ \mu C \longrightarrow -2\times10^{-6}\ C$

$r = 0.4/2 = 0.2$

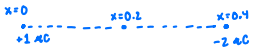
$E = \frac{k|q|}{r^2}$

$E_1 = \frac{(8.99\times10^9)(1\times10^{-6}\ C)}{(0.2)^2\ m^2} = 224{,}750\ N/C$

$E_2 = \frac{(8.99\times10^9)(2\times10^{-6}\ C)}{(0.2)^2\ m^2} = 449{,}500\ N/C$

$E_{net} = 224750\ N/C + 449500\ N/C$ = 674250 N/C = magnitude

direction = +x = toward −2 μC



b)

$q = +1\ nC = 1\times10^{-9}\ C$

$F = qE = (1\times10^{-9}\ C)(674250) = 6.7425\times10^{-4}\ N$ = in −2 direction = +x direction

4. **Electric Potential (Point Charges):**

What is the electric potential at a point 0.25 m from a −4.0 μC point charge? (Assume zero potential at infinity.)

$q = -4\ \mu C = -4\times10^{-6}\ C$

$r = 0.25\ m$

$V = \frac{kq}{r} = \frac{(8.99\times10^9\ N\cdot\frac{m^2}{C^2})(-4\times10^{-6}\ C)}{0.25\ m} = -143840\ V$

5. **Potential Difference and Work:**

An electron moves from point A (potential = +100 V) to point B (potential = −50 V).

a) What is the potential difference $V_B - V_A$?

b) How much work is done by the electric field on the electron during this move?

a) $V_B = -50$ V

$V_A = +100$ V

$V_B - V_A = -50 - 100 = -150$ V

b) $W = -q\Delta V = -(-1.6 \times 10^{-19}\ C)(-150\ V) = -2.4 \times 10^{17}$ J

$= -1.6 \times 10^{-19}$ C