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, $q_1 = +2.0\ \mu$C and $q_2 = -3.0\ \mu$C, are placed 0.50 m apart in vacuum.
   a) Calculate the magnitude and direction of the electrostatic force on each charge.

   $F = k_e \frac{|q1q2|}{r^2}$

   $F = (8.99*10^9) * \frac{|(2.0*10^{-6})(-3.0*10^{-6})|}{(0.50)^2}$

   $F = 0.216$ N

   b) Is the force attractive or repulsive?

   The force is attractive because the charges have opposite signs.

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 $+5.0\ \mu$C point charge?

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

   $E = (8.99*10^9)* \frac{|(5.0*10^{-6})|}{(0.30)^2}$

   Magnitude: E = 499444 N/C or $5.0*10^5$ N/C

   Direction: Away from the charge because it is positive.

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

   Two charges, $+1.0\ \mu$C (left)(away) and $-2.0\ \mu$C, (right)(toward) are fixed 0.40 m apart.

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

   $E_1 = k_e \frac{|q1|}{r^2} = \frac{(8.99*10^9)(1.0*10^{-6})}{(0.20)^2} = 2.25 * 10^5$ N/C

   $E_2 = k_e \frac{|q2|}{r^2} = \frac{(8.99*10^9)(2.0*10^{-6})}{(0.20)^2} = 4.50 * 10^5$ N/C

   $E_{net} = E_1 + E_2 = 2.25 * 10^5$ N/C + $4.50 * 10^5$ N/C

   Magnitude: $E_{net} = 6.75 * 10^5$ N/C

   Direction: To the right

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

   $F = E*q = (6.75 * 10^5) * (1.0 * 10^{-9}) = 6.75 * 10^{-4}$ N

   Magnitude: $F = 6.75 * 10^{-4}$ N

   Direction: To the right

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

   What is the electric potential at a point 0.25 m from a $-4.0\ \mu$C point charge? (Assume zero potential at infinity.)

   $V = k_e \frac{q}{r}$

   $V = \frac{(8.99*10^9)(-4.0*10^{-6})}{0.25} = -1.44 * 10^5$ V

   $V = -1.44 * 10^5$ 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 $V_B - V_A$?

$V_B - V_A$

$V_B - V_A$ = -50 – 100 = -150V

Potential difference: -150V

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

W = qΔV

W = $(-1.6*10^{-19})(-150) = 2.4 * 10^{-17}$ J

W = $2.4 * 10^{-17}$ J