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:** $k \cdot \frac{q_1 q_2}{r^2}$

   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.

   K=8.99 * 10^9 N*m^2/C^2

   q
   =+2.0μ C = 2.0 * 10^-6C

   Q2= -3μ C = -3.0*10^-6C

   R=0.5m

   $F = \frac{(8.99 \cdot 10^9) \cdot \left((2 \cdot 10^{-6})(-3 \cdot 10^{-6})\right)}{0.5^2} = F = \frac{(53.94 \cdot 10^{-3})}{0.25} = 0.216N$

   b) Is the force attractive or repulsive?

   Attractive because on the line that connects the charges, the charges are pulled towards each other.

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?

   K= 8.99 * 10^9 N*m^2/C^2

   Q= 5 μ C= 5*10^-6C

   R=0.3m

$$E = \frac{\left((8.99 \cdot 10^9)(5 \cdot 10^{-6})\right)}{0.3^2} = 5 \cdot 10^5 \ \frac{N}{C}$$

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).

   Q1=1μ C = 1*10^-6C

   Q2-=-2μ C=-2*1-^-6C

   Between charges =d= 0.4m

   Midpoint = r = 0.2m

   E1=$\frac{\left((8.99 \cdot 10^9)(1 \cdot 10^{-6})\right)}{0.2^2} = 224{,}750 \ \frac{N}{C}$

   E2=$\frac{\left((8.99 \cdot 10^9)(2 \cdot 10^{-6})\right)}{0.2^2} = 449{,}500 \ \frac{N}{C}$

   Magnitude = 449,500 + 224,750 = 674,250 N/C

   Direction = toward the -2μ C charge

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

   Magnitude = $F = q \cdot E = (1 \cdot 10^{-9})(674{,}250) = 6.74 \cdot 10^{-4} N$

   Direction = toward the -2C charge

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.)

Q=-4μ C = -4*10^-6C

R=0.25m

$$V = \frac{\left((8.99 \cdot 10^{9})(-4 \cdot 10^{-6})\right)}{0.25} = -143{,}840V$$

Since the answer is negative, the potential at the point we are talking about is more negative because of the negative charge and it doesn't have a direction either

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 $V_B - V_A$?

   Va=100V

   Vb=-50V

   -50 – (+100) = -150V
   b) How much work is done by the electric field on the electron during this move?

   W = -q (Vb – Va)

   Q= 1.6 * 10^-19C

   Va – Vb = -150V

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