Electric Field & Electric Potential

Electric field & potential · 8 questions · step-by-step answers at the end

Name: Date: Score: / 8

USEFUL EQUATIONS

$E = F/q_0 \quad E = kq/r^2 \quad V = kq/r \quad \Delta U = q\Delta V \quad E = \Delta V/d \quad E_x = -\mathrm{d}V/\mathrm{d}x$

Questions

Show your working in the space under each question.

1. Parallel plates 4.0 cm apart have a uniform field of 500 V/m between them. What is the potential difference?

2. A +5.0 nC point charge is fixed in place. At 0.10 m away, find E and V. How much work is needed to bring a +2.0 nC charge in from infinity to that point?

3. How much work does the field do on a charge that moves along an equipotential?

4. In a region, V(x) = 4x² − 2x (volts, metres). Find E at x = 1 m.

5. At the midpoint between +q and −q, are E and V zero?

6. How much work does it take to bring a 2.0 μC charge from infinity to a point where V = 500 V?

7. Find V 2.0 cm from a 2.0 nC charge.

8. Far from a ring ($x \gg R$), what does $E = kQx/(x^2 + R^2)^{3/2}$ reduce to?

Step-by-step answers

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1. $\Delta V = Ed = (500)(0.040) =$ **20 V**.

2. 1. $E = kq/r^2 = (8.99 \times 10^9)(5.0 \times 10^{-9})/(0.10)^2 =$ **4.5×10^3 N/C**, pointing away from the charge.
2. $V = kq/r = (8.99 \times 10^9)(5.0 \times 10^{-9})/0.10 =$ **450 V**.
3. Work needed $= \Delta U = q\Delta V = (2.0 \times 10^{-9})(450 - 0) =$ **9.0×10^{-7} J**.
4. This is positive work, because you push against the repulsion.

Answer: $E = 4.5 \times 10^3$ N/C, V = 450 V, $W = 9.0 \times 10^{-7}$ J

3. **Zero**: $\Delta V = 0$, so $W = -q\Delta V = 0$.

4. $E_x = -dV/dx = -(8x - 2) =$ **−6 V/m**, pointing in the −x direction.

5. $V = kq/r - kq/r =$ **0**, but E is **not** zero: both fields point toward −q and add.

6. $W = qV =$ **1.0 mJ**.

7. $V = kQ/r =$ **900 V**.

8. $E \to$ **kQ/x^2**, a point charge, as it should.