1 Electric Field of a Point Charge from the Potential

The electrostatic potential due to a point charge at the origin is given by:

$$V = \frac{1}{4\pi\epsilon_0}\frac{q}{r}$$

(a) Find the electric field due to a point charge at the origin as a gradient in rectangular coordinates.

(b) Find the electric field due to a point charge at the origin as a gradient in spherical coordinates.

(c) Find the electric field due to a point charge at the origin as a gradient in cylindrical coordinates.

2 Line Sources Using Coulomb's Law

(a) Find the electric field around a finite, uniformly charged, straight rod, at a point a distance s straight out from the midpoint, starting from Coulomb's Law.

(b) Find the electric field around an infinite, uniformly charged, straight rod, starting from the result for a finite rod.

3 Electric Field of a Line Source From Potential

Find the electric field around an infinite, uniformly charged, straight wire, starting from the following expression for the electrostatic potential:

$$V(\vec{r}) = \frac{2\lambda}{4\pi\epsilon_0}\ln\left(\frac{s_0}{s}\right)$$