

Dr. Gregory J. Mazzaro Spring 2015

ELEC 318 – Electromagnetic Fields

Lecture 8(a)

Review for Final Exam Part 1

Example: Potential, Point Charge



A point charge of 5 nC is located at the origin.

If the potential at (0, 6 m, -8 m) is 2 V, determine the potential at P(-3 m, 2 m, 6 m).

Assume $\varepsilon = \varepsilon_0$.

$$V_{\text{charge}}^{\text{point}} = \frac{q}{4\pi\varepsilon_0 \left| \mathbf{R} - \mathbf{R}' \right|}$$

Triboelectric Series



TABLE 4.1 The Triboelectric Series

Material	Polarity of Charge
Air	+
Human hands	A
Rabbit fur	
Glass	
Mica	
Human hair	
Fur	
Lead	
Silk	
Aluminum	
Paper	
Cotton	
Steel	
Wood	
Amber	
Wax	
Hard rubber	
Nickel, copper	
Gold	
Polyester	
Polyethylene	
PVC (vinyl)	
Silicon	
Teflon	

Example: E Field, Potential, Work



Given the electric field intensity (at right),

- (a) determine if this field is irrotational, and
- (b) determine the work done in moving a $-2 \mu C$ charge from (0, 5 m, 0) to (2 m, -1 m, 0) along the straight-line path between these points.

$$\mathbf{E} = (3x^2 + y)\hat{\mathbf{x}} + x\hat{\mathbf{y}} \frac{kV}{m}$$

$$\nabla \times \mathbf{E} = \begin{vmatrix} \hat{\mathbf{x}} & \hat{\mathbf{y}} & \hat{\mathbf{z}} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ E_x & E_y & E_z \end{vmatrix}$$

$$V_{AB} = \frac{W}{q} = -\int_{A}^{B} \mathbf{E} \cdot d\mathbf{l}$$

Lightning



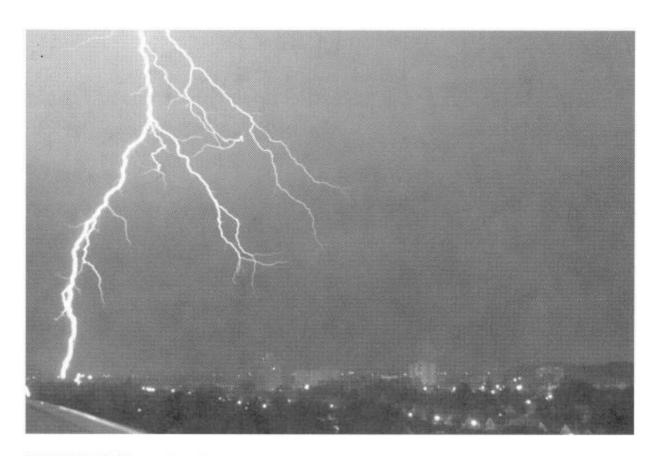


FIGURE 7.22 A cloud-to-ground lightning.

Example: Point Charges, Energy Stored



Three point charges and their locations are given:

$$-1$$
 nC at $(0, 0, 0)$

Determine the electrostatic energy stored in this system.

$$V_{AB} = \frac{W}{q}$$
 $V_{\text{charge}}^{\text{point}} = \frac{q}{4\pi\varepsilon_0 |\mathbf{R} - \mathbf{R}'|}$

Magneto-Resonance Imaging





Example: Current & Current Density



Determine the total current passing through the hemispherical shell given below, for the current density also defined below.

$$R = 20 \text{ cm}, \ 0 < \theta < \pi/2, \ 0 < \phi < 2\pi$$

$$\mathbf{J} = \frac{1}{R^3} \left(2 \cos \theta \ \hat{\mathbf{R}} + \sin \theta \ \hat{\mathbf{\theta}} \right) \quad \left(\frac{\mathbf{m} \, \mathbf{A}}{\mathbf{m}^2} \right)$$