

Wednesday Reading Assessment: Unit 0, Electric Fields

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1 Memory Bank

- $\vec{E} = \frac{kQ}{r^2} \hat{r}$... Coulomb field of a charge Q .
- $k = 8.99 \times 10^9 \text{ N C}^{-2} \text{ m}^2$... Constant of proportionality for Coulomb field.

2 Electric Fields

1. Consider Fig. 1 below. A ring of charge with radius R is situated in the xy -plane. The charge is positive, and it is distributed evenly across the ring. We write $\Delta q = \lambda R \Delta \theta$, to mean that there are λ Coulombs per meter along an angle $\Delta \theta$. If $\Delta \theta$ were to extend to 2π (all the way around the circle), then the total charge is $Q = \lambda(2\pi R)$. (a) By *symmetry*, where should the electric field be zero? (b) Where would the electric field be infinite?

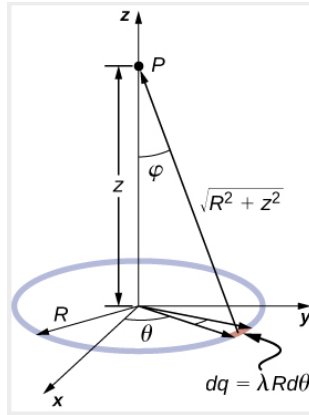


Figure 1: A ring of charge situated in the xy -plane.

2. Consider again Fig. 1. As $z \rightarrow \infty$, what happens to the field?

- A: The field-strength increases.
- B: The field-strength remains constant.
- C: The field-strength decreases.
- D: The field-strength is exactly zero.

3. Suppose the actual function for the E-field $\vec{E}(z)$ is

$$\vec{E}(z) = \frac{1}{4\pi\epsilon_0} \frac{qz}{(z^2 + R^2)^{3/2}} \hat{z} \quad (1)$$

To see what happens when z is much larger than R , try setting $R = 0$. What is the result in Eq. 1 if $R = 0$?

4. Do you recognize the expression? What does the ring resemble if $R \approx 0$?