

The Electrostatic Field Due to a Ring of Charge

1. Use Coulomb's law

$$\vec{E}(\vec{r}) = \frac{1}{4\pi\epsilon_0} \int \frac{\rho(\vec{r}') (\vec{r} - \vec{r}')}{|\vec{r} - \vec{r}'|^3} d\tau'$$

to find the electric field everywhere in space due to a charged ring with radius R and total charge Q .

2. Evaluate your expression for the special case that $\vec{r}$ is on the z -axis.
3. Evaluate your expression for the special case that $\vec{r}$ is on the x -axis.
4. Find a series expansion for the electric field at these special locations:
 - a) Near the center of the ring, in the plane of the ring;
 - b) Near the center of the ring, on the axis perpendicular to the plane of the ring;
 - c) Far from the ring on the axis perpendicular to the plane of the ring;
 - d) Far from the ring, in the plane of the ring;