

**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;