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;