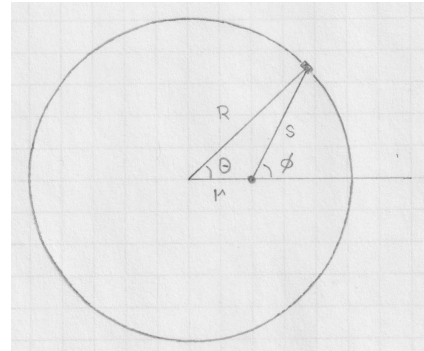


[lex4] Electric field of charged ring II

Calculate the electric field of a uniformly charged ring of radius R at points along a radial line (in the plane of the ring). The line charge density (charge per unit length) is λ . Show that the result can be expressed in terms of complete elliptic integrals as follows:

$$E(r) = \frac{kQ}{\pi r(r^2 - R^2)} \left[(r - R) K \left(\frac{4rR}{(r + R)^2} \right) + (r + R) E \left(\frac{4rR}{(r + R)^2} \right) \right], \quad k \doteq \frac{1}{4\pi\epsilon_0}.$$

Plot the expression on a scale that shows all its features. Infer from the general result asymptotic expressions for field points (i) near $r = 0$, (ii) near $r = R$, and (iii) at $r \gg R$.



Solution: