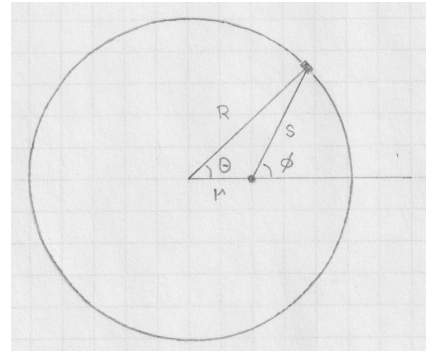


[gex35] Magnetic field of circular current and elliptic integrals

Calculate the magnetic field of a conducting ring of radius R with a current I flowing at points along a radial line (in the plane of the ring). Show that the result can be expressed in terms of complete elliptic integrals [gmd4C] as follows:

$$B(r) = \frac{\mu_0 I}{2\pi R} \left[\frac{1}{1+x} K\left(\frac{4x}{(1+x)^2}\right) + \frac{1}{1-x} E\left(\frac{4x}{(1+x)^2}\right) \right], \quad x \doteq \frac{r}{R}.$$

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: