



# Magnetic Field on the Axis of a Solenoid

- Number of turns per unit length:  $n = N/L$
- Current circulating in ring of width  $dx'$ :  $nI dx'$
- Magnetic field on axis of ring:  $dB_x = \frac{\mu_0(nI dx')}{2} \frac{R^2}{[(x - x')^2 + R^2]^{3/2}}$
- Magnetic field on axis of solenoid:

$$B_x = \frac{\mu_0 n I}{2} R^2 \int_{x_1}^{x_2} \frac{dx'}{[(x - x')^2 + R^2]^{3/2}} = \frac{\mu_0 n I}{2} \left( \frac{x - x_1}{\sqrt{(x - x_1)^2 + R^2}} - \frac{x - x_2}{\sqrt{(x - x_2)^2 + R^2}} \right)$$

