Magnetic Field on the Axis of a Solenoid

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

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