

63. (a) At any point the magnetic energy density is given by $u_B = B^2/2\mu_0$, where B is the magnitude of the magnetic field at that point. Inside a solenoid $B = \mu_0 ni$, where n , for the solenoid of this problem, is $(950 \text{ turns})/(0.850 \text{ m}) = 1.118 \times 10^3 \text{ m}^{-1}$. The magnetic energy density is

$$u_B = \frac{1}{2}\mu_0 n^2 i^2 = \frac{1}{2} (4\pi \times 10^{-7} \text{ T}\cdot\text{m/A}) (1.118 \times 10^3 \text{ m}^{-1})^2 (6.60 \text{ A})^2 = 34.2 \text{ J/m}^3 .$$

- (b) Since the magnetic field is uniform inside an ideal solenoid, the total energy stored in the field is $U_B = u_B \mathcal{V}$, where \mathcal{V} is the volume of the solenoid. \mathcal{V} is calculated as the product of the cross-sectional area and the length. Thus

$$U_B = (34.2 \text{ J/m}^3)(17.0 \times 10^{-4} \text{ m}^2)(0.850 \text{ m}) = 4.94 \times 10^{-2} \text{ J} .$$