

## Problem 32.29

A 68 turn air-core solenoid is .08 meters long and has a diameter of .012 meters. How much energy is stored when it carries a .77 amp current?

The energy wrapped up in a current-carrying coil is  $U = \frac{1}{2}Li^2$ .

In Problem 32.10, we derived an expression for the inductance of an inductor in terms of its geometry. That relationship was

$$L = \mu_0 \frac{N^2 A}{l}$$

Putting in the numbers, we get:

$$\begin{aligned} L &= \mu_0 \frac{N^2 (\pi r^2)}{l} \\ &= (1.26 \times 10^{-6}) \frac{(68)^2 (\pi (.6 \times 10^{-2} \text{ m})^2)}{(.08 \text{ m})} \\ &= 8.21 \times 10^{-3} \text{ H} \end{aligned}$$

1.)

The energy in our current-carrying inductor is, then:

$$\begin{aligned} U &= \frac{1}{2}Li^2 \\ &= \frac{1}{2}(8.21 \times 10^{-3} \text{ H})(.77 \text{ A})^2 \\ &= 2.44 \times 10^{-6} \text{ J} \end{aligned}$$

2.)