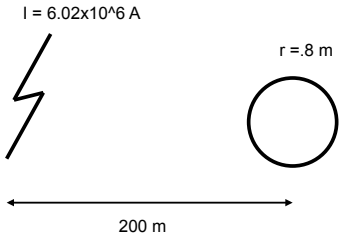
Problem 20.61

The charge flow in a bolt of lightning drops from 6.02x10^6 amps to zero in 10.5 microseconds. A 100 turn coil of radius .8 meters is 200 meters away. What is the induced EMF in the coil?



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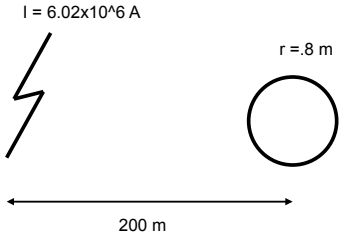


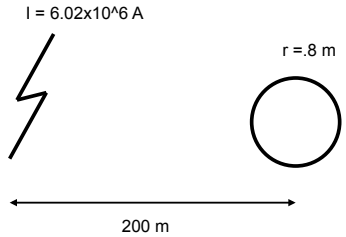
The initial magnetic field at 200 meters is:

$$B = \frac{\mu_o i}{2\pi d}$$

$$= \frac{\left(4\pi x10^{-7}\right)\left(6.02x10^{6}\right)}{2\pi(200)}$$

$$= .006 \text{ T}$$

The induced EMF will be:



$$\varepsilon_{ind} = -N\frac{\Delta\phi_B}{\Delta t}$$

$$\varepsilon_{ind} = -N\frac{A\Delta B}{\Delta t}$$

$$= -(100)\frac{\left(\pi(.8)^2\right)(0-.006)}{\left(10.5x10^{-6}\right)}$$

$$= 1.15x10^5 \text{ volts (this is 115 kV)}$$