



Electromagnetics:  
Electromagnetic Field Theory

## Example 1 – Force on a Wire

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### Example #1 – Force on a Wire

What is the maximum force that a kitchen magnet can put a 1.0 inch long wire carrying 1 A?

#### Solution

The average kitchen magnet has a strength on the order of 5 mT.

$$\vec{B} = 5 \text{ mT} = 0.005 \text{ Wb/m}^2$$

The maximum force occurs when the magnetic field is perpendicular to the current. When this is the case,

$$\begin{aligned} \vec{F} &= \int_L (I d\vec{\ell}) \times \vec{B} = \int_0^L IB dz = IBL \\ &= (1 \text{ A}) \left( 0.005 \frac{\text{Wb}}{\text{m}^2} \right) (1 \text{ in}) \left( \frac{2.54 \text{ cm}}{1 \text{ in}} \right) \left( \frac{1 \text{ m}}{100 \text{ cm}} \right) = \boxed{127 \mu\text{N}} \end{aligned}$$

This is roughly 1/100 of the weight of a penny.



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