

## SELF-INDUCTANCE

Link to: [physicspages home page](#).

To leave a comment or report an error, please use the auxiliary blog and include the title or URL of this post in your comment.

Post date: 27 Mar 2021.

In addition to mutual inductance between two different circuits, a single circuit also has *self-inductance*, or just *inductance*. The flux through a circuit is

$$\Phi = \int \mathbf{B} \cdot d\mathbf{a} \quad (1)$$

and for a steady current  $I$ , this is proportional to  $I$ :

$$\Phi = LI \quad (2)$$

where  $L$  is the inductance of the circuit. The emf induced in a circuit by changing the current in that circuit is then

$$\mathcal{E} = -\frac{d\Phi}{dt} = -L\dot{I} \quad (3)$$

The inductance (and mutual inductance) are measured in a unit called the *henry*, named after Joseph Henry, who is generally acknowledged to be a co-discoverer of inductance around the same time as Michael Faraday (Faraday, of course, has been immortalized in the farad, the unit of capacitance).

**Example 1.** We can work out the inductance of a long solenoid with  $n$  turns per unit length. The magnetic field of an infinite solenoid is

$$B = \mu_0 n I \quad (4)$$

so the flux through each turn of the solenoid is, if the solenoid's radius is  $R$

$$\Phi_1 = \pi R^2 \mu_0 n I \quad (5)$$

The inductance per turn is thus

$$L_1 = \pi R^2 \mu_0 n \quad (6)$$

and the inductance per unit length is

$$L = \pi R^2 \mu_0 n^2 \quad (7)$$

PINGBACKS

Pingback: [LC circuit - the oscillator](#)

Pingback: [Energy in a magnetic field](#)

Pingback: [Transformers](#)