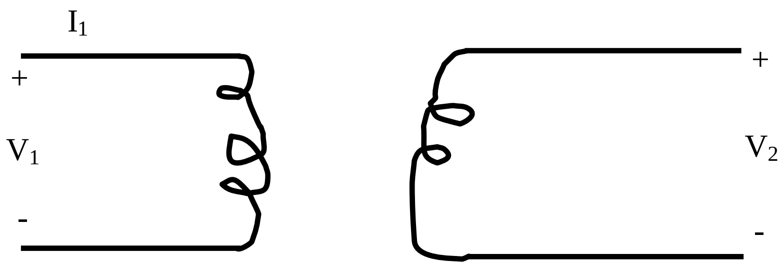
I. Mutual Inductance

In mutual inductance, a changing current flowing through a coil creates a varying magnetic flux in a second coil that induces an emf in a second coil.



We define mutual inductance in a manner similar to how we defined self-inductance:

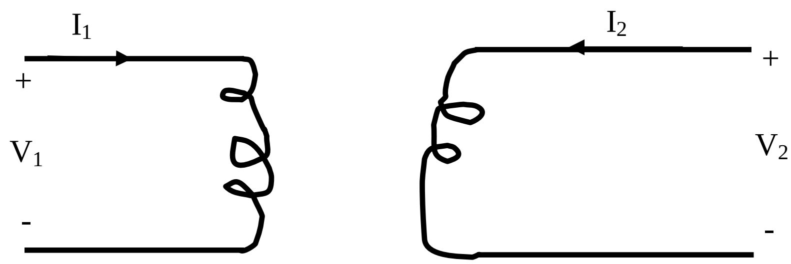
$$M = \frac{Magnetic\ Flux\ Linkage}{Current\ causing\ flux}$$

M =

Example: A long solenoid has a length L, area A, and N1 turns. A second solenoid is created by wrapping N2 turns around the first coil and making it have the same length. What is the coil's mutual inductance?

II. Transformers

Consider two coils as shown below where the magnetic flux produced in coil 1 is the magnetic flux seen by coil 2 and vice versa.



"N_1 turns" **"N_2 turns"**

From Faraday's Law of Magnetic Induction, we have

$$\varepsilon_1 =$$

$$\varepsilon_2 =$$

Since the flux seen by a single loop is the same for both coils, we have that

$$\frac{\varepsilon_2}{\varepsilon_1} =$$

Thus, the transformer provides a way to "step up" or "step down" a time varying voltage supply.

If $N_2 > N_1$ then the voltage is stepped up!!

If $N_2 < N_1$ then the voltage is stepped down!!

Question: What about the current?

Answer: The power provided to coil 2 is supplied by coil 1. Thus, we have that

$$P =$$

Thus, we have that

$$\frac{I_2}{I_1} =$$

Thus, if we increase the voltage we ______________________________ the current.

(conservation of energy)