

CONCEPT: MUTUAL INDUCTANCE

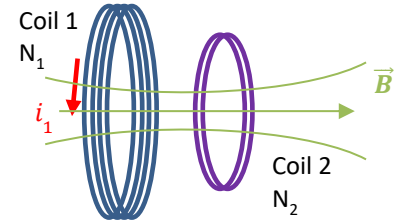
- **Mutual Inductance:** For two nearby conducting coils, a current changing through one coil induces an EMF on the other.

- The coil with the changing current is known as the _____, the other is the _____.

- Total Flux Φ_2 depends on N_2 & Magnetic Field $\vec{B}$, which depends on _____

- Φ_2 is _____ to i_1

→ _____

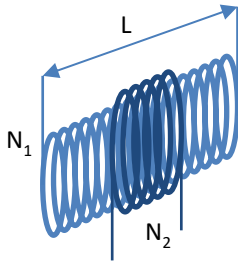


- M is a proportionality constant called the MUTUAL INDUCTANCE

$$M = \text{_____} \rightarrow \text{UNITS: Henry [H]} \rightarrow 1 \text{ H} = 1 \text{ _____} / \text{_____}$$

- depends only on the # of turns and the shape of the coils! (i_1 will cancel out)

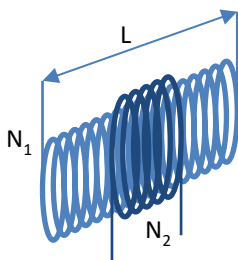
EXAMPLE: What is the mutual inductance of two solenoids of length L and area A , one with N_1 turns and the other with N_2 ?



- The EMF on the secondary coil is

$$\mathcal{E} = \text{_____} = \text{_____}$$

EXAMPLE: A solenoid of 25 turns, with an area of 0.005 m^2 is wound around a 10 cm solenoid with 50 turns, as shown in the figure below. If, at some instant in time, the current through the 10 cm solenoid is 0.5 A and changing at 50 mA/s , what's the induced EMF on the 25 turn solenoid?



PRACTICE: MUTUAL INDUCTANCE OF TWO SOLENOIDS

An outer solenoid with 30 turns is wound tightly around an inner coil 25cm long with a diameter of 4cm and 300 turns. The current in the inner solenoid is 0.12 A and is increasing at a rate of $1.75 \times 10^3 \text{ A/s}$. **a)** What is the average magnetic flux through each turn of the outer coil? **b)** If the resistance of the outer coil is $20 \text{ m}\Omega$, what is the magnitude of the induced current through the outer coil?