CONCEPT: MUTUAL INDUCTANCE

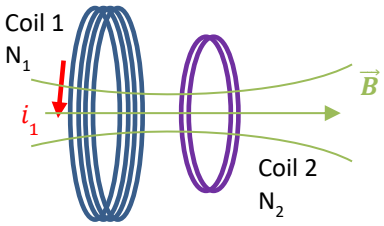
● **Mutual Inductance:** For two nearby conducting coils, a current changing through one coil induces an EMF on the other.

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

● Total Flux $\boldsymbol{\Phi_2}$ depends on $\mathbf{N_2}$ & Magnetic Field $\vec{\boldsymbol{B}}$, which depends on _____

- $\boldsymbol{\Phi_2}$ is _____ to i_1

→ _____

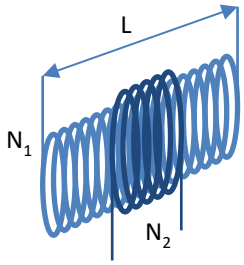


● **M** is a proportionality constant called the MUTUAL INDUCTANCE

$\boldsymbol{M}$ = _____ → UNITS: Henry [**H**] → 1 H = 1 ____ / ____

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

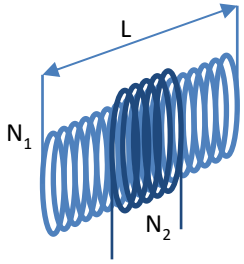
EXAMPLE: What is the mutual inductance of two solenoids of length L and area A, one with N_1 turns and the other with N_2?



● The EMF on the secondary coil is

$\mathcal{E}$ = _____ = _____

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 1.75×10^{3}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 20mΩ, what is the magnitude of the induced current through the outer coil?