# THE AMAZING INDUCTOR
## – PART 1 –
## WHAT IS AN INDUCTOR?

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An inductor is a coil of wire that **stores energy** in a magnetic field when current flows.

### INDUCTANCE

**DEFINITION**

Inductance is the property of a coil that **opposes changes in current** by storing energy in a magnetic field.

| SI UNIT: | VARIABLE: |
|---|---|
| Henry (H) | $L$ |

### WHY IS THE SYMBOL "L"?

- Many people expect inductance to use the letter $I$, but $I$ is already used to represent electric current.
- The letter $L$ is used instead.
- It is commonly associated with Heinrich Lenz, whose work led to Lenz's Law, explaining that an induced voltage always opposes the change that created it.

$I$ = Current  $L$ = Inductance

### HEINRICH LENZ (1804–1865)

German-Russian Physicist

Famous for ***LENZ'S LAW:***

***The induced voltage always opposes the change in current or magnetic field that created it.***

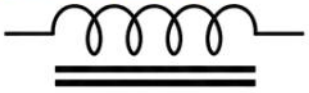
➡ This explains why inductors resist sudden changes in current.

### SCHEMATIC SYMBOLS

**1. AIR-CORE INDUCTOR**

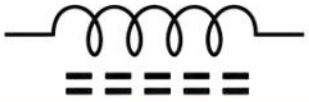
No magnetic core inside the coil.

**2. IRON-CORE INDUCTOR**



Soft iron core greatly increases the magnetic field and inductance.

**3. FERRITE-CORE INDUCTOR**



Ferrite core increases inductance and works very well at higher frequencies.

### THE HENRY (H)

The SI unit of inductance is the **henry** (H).

It is named after **Joseph Henry** (1797–1878), an American physicist who independently discovered electromagnetic induction and made major contributions to electromagnets and self-inductance.

1 Henry = 1 volt-second per ampere

$$1H = 1\,\frac{V \cdot s}{A}$$

### CORE MATERIALS

| CORE | | BEST USE |
|---|---|---|
| AIR |  | RF circuits, simple demonstrations |
| IRON |  | Transformers, electromagnets, power applications |
| FERRITE |  | Switching power supplies, high-frequency electronics |

### KEY TAKEAWAYS

- ✓ An inductor is a coil of wire.
- ✓ Current creates a magnetic field.
- ✓ Inductors store energy in that magnetic field.
- ✓ Inductors resist changes in current.
- ✓ Inductance is measured in **henrys** (H).
- ✓ $L$ represents inductance.
- ✓ Lenz's Law explains why inductors oppose changing current.

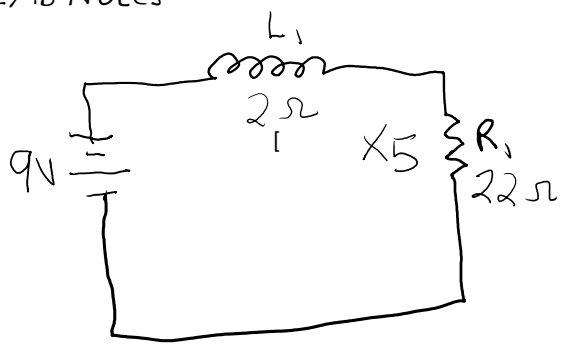
### QUICK REFERENCE

| | |
|---|---|
| $v_L = -L\,\frac{di}{dt}$ | Voltage across an inductor |
| $L = \frac{N\Phi}{I}$ | Inductance definition |
| $E = \frac{1}{2}\,L\,I^2$ | Energy stored in an inductor |

*-BUILD UNDERSTANDING.*
***BUILD CIRCUITS. BUILD THE FUTURE!***

BUILD CIRCUITS WITH RICH

LAB Notes




$R_L = 2\Omega$ $V_{DC} = 9V$

$R_1 = 110.5\Omega$ $I_T = 80mA$

$V = IR$

$R_T = \frac{V_{DC}}{I_T} = \frac{9}{80mA} = \underline{112.5\Omega}$

$R_1 = R_T - R_L$ $R_T = R_1 + R_L$

$R_1 = 112.5 - 2 = \underline{110.5\Omega}$

$V = IR$, $P = VI$

$P = IRI = I^2R$

Power

$P = I^2R$

$P = (0.080)^2 \times 110.5 = 0.707W$

$0.707 > 0.250$ $.25W = P_T$

$R = \frac{P}{I^2} = \frac{0.25}{0.080^2} = 39\Omega$ $.080 = I_T$

$P = (.080)^2 \times 22 = .141W < .250W$

kit: $22\Omega$

$R_T = 110 + 2 = 112\Omega$