First Order Time-Dependent Circuits

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- Natural Response
  - An inductor or a capacitor can store energy when charge by current or a voltage source
  - If they are abruptly disconnected, they will lose energy through a resistor
  - The timing response of the circuit is called the natural response
- Time Constant
  - Notice the equation

$$\boxed{i(t) = I_0 e^{\frac{-Rt}{L}}}$$

  - The term $\frac{L}{R}$ is called the time constant of the circuit
  - The equation can be changed to:

$$\boxed{i(t) = I_0 e^{-\frac{t}{\tau}}}$$

  - Time constant is represented as τ and is the time it takes for the current to reduce to 37% of original value
  - When we say long time, we typically mean 5 or more time constants
  - Momentary events such as opening of the switch and circuit response that follows is called transient response
  - The response of the circuit after a long time (several time constants) is called the steady-state response