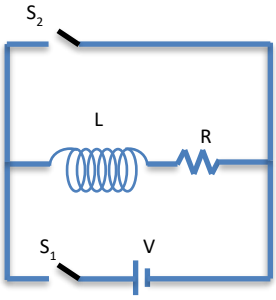
CONCEPT: LR CIRCUITS

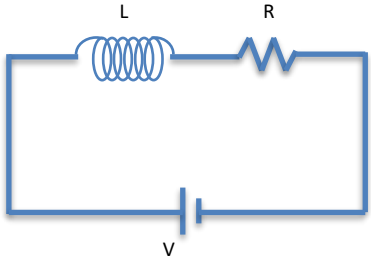
- *LR* (or *RL*) Circuits are circuits containing _____ and _____

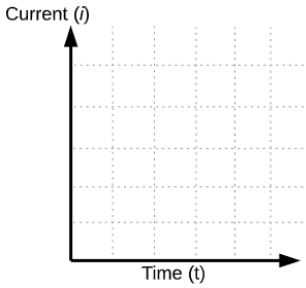
- Depending on the switch positions, there are two processes happening in this circuit:
  - CURRENT GROWTH: S_2 open and S_1 closed, current **[INCREASES | DECREASES]**
  - CURRENT DECAY: S_1 open and S_2 closed, current **[INCREASES | DECREASES]**



- CURRENT GROWTH: Current starts from **[ZERO | MAX]**; inductor resists growing current, eventually reaches _____

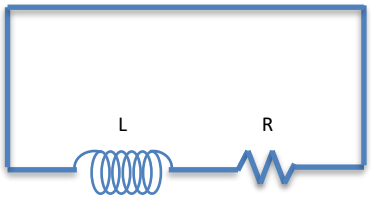
$$i(t) = \frac{V}{R}\left(1 - e^{-t/\tau}\right)$$

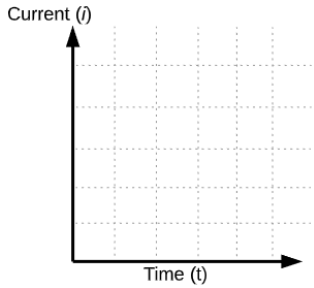




- CURRENT DECAY: Current starts from **[ZERO | MAX]**; inductor resists decreasing current, eventually reaches _____

$$i(t) = \frac{V}{R}e^{-t/\tau}$$





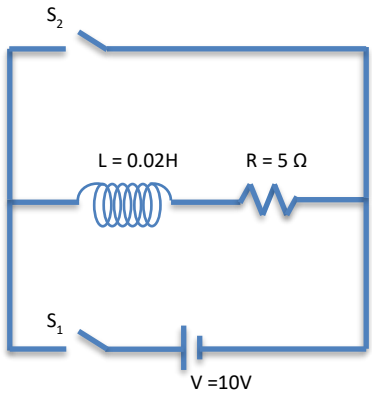
- The TIME CONSTANT, $\boldsymbol{\tau = \frac{L}{R}}$, determines the how quickly growth and decay occurs
  - Lower time constants → **[FASTER | SLOWER]** changes in current
  - Higher time constants → **[FASTER | SLOWER]** changes in current

EXAMPLE: UNKOWN RESISTANCE IN LR CIRCUIT

An LR circuit has a time constant of 0.025 s and is initially connected to a 10 V battery. If after 0.005 s of being disconnected from the battery, the current is 0.5 A, what is the resistance of the circuit?

PRACTICE: UNKNOWN CURRENT IN AN LR CIRCUIT

Consider the LR circuit shown below. Initially, both switches are open. Switch 1 is closed. **a)** What is the maximum current in the circuit after a long time? Then, S_1 is opened and S_2 is closed. **b)** What is the current in the circuit after 0.05s?



PRACTICE: TIME TO HALF MAXIMUM CURRENT

An LR circuit with L = 0.1 H and R = 10 Ω are connected to a battery with the circuit initially broken. When the circuit is closed, how much time passes until the current reaches half of its maximum value?