I'm not gonna lie, you really do need to have learned from these three previous lessons of mine in order to understand this:

- LR Circuit Basics
- LR Circuit Equation Derivations
- Time Constant - LR Circuit

We can consider derivative of current with respect to time to be like acceleration of moving objects.

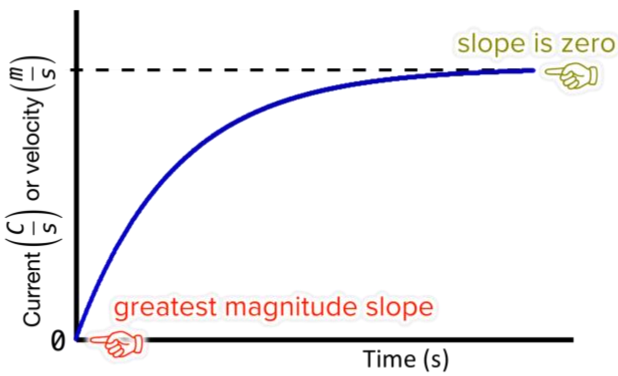
- I is in Amps or $\frac{C}{s}$ & v is in $\frac{m}{s}$
  - Current is like velocity.
- $\frac{dI}{dt}$ is in $\frac{C}{s^2}$ & $a = \frac{dv}{dt}$ in $\frac{m}{s^2}$
  - Derivative of current with respect to time is like acceleration.

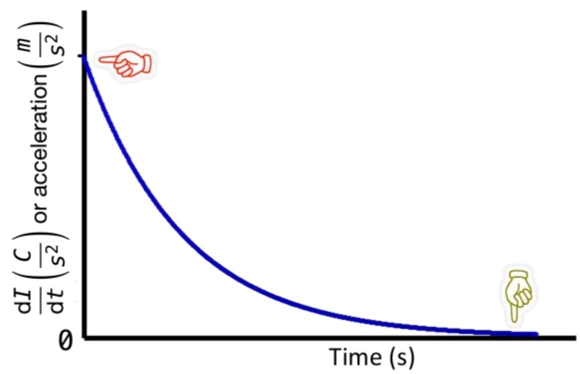
LR Circuit:

$$I(t) = \frac{\varepsilon}{R}\left(1 - e^{\left(-\frac{t}{\tau}\right)}\right) \;\&\; \frac{dI}{dt}(t) = \frac{\varepsilon}{L} e^{\left(-\frac{t}{\tau}\right)}$$

Dropped Object with Drag Force:

$$v(t) = v_{\text{terminal}}\left(1 - e^{-\frac{t}{\tau}}\right) \;\&\; a(t) = g e^{-\frac{t}{\tau}}$$

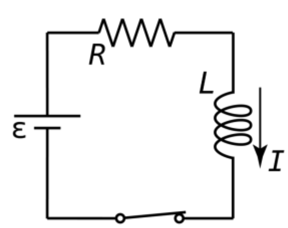


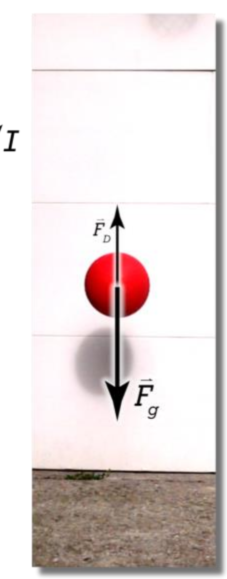


$$\Delta V_{Loop} = 0 = \varepsilon - \Delta V_R - \Delta V_L = \varepsilon - IR - L\frac{dI}{dt}$$

$$\sum F_y = F_g - F_D = ma_y \Rightarrow 0 = F_g - F_D - ma_y = F_g - F_D - m\frac{dv}{dt}$$

(down is positive)





We can consider derivative of current with respect to time to be like acceleration of moving objects.

- ε is like F_g; constant values attempting to cause changes in their systems.
- ΔV_R is like F_D; dissipating energy from their systems.
- ΔV_L is like ma;
  - L is like m; L opposes changes in I and m opposes changes in v.
  - $\frac{dI}{dt}$ is like $\frac{dv}{dt}$

Units for ΔV and force don't match:

$$\Delta V = \frac{\Delta U_e}{q} \Rightarrow \Delta V \text{ in volts} = \frac{J}{C} = \frac{N \cdot m}{C} \;\&\; \text{Force in newtons}$$