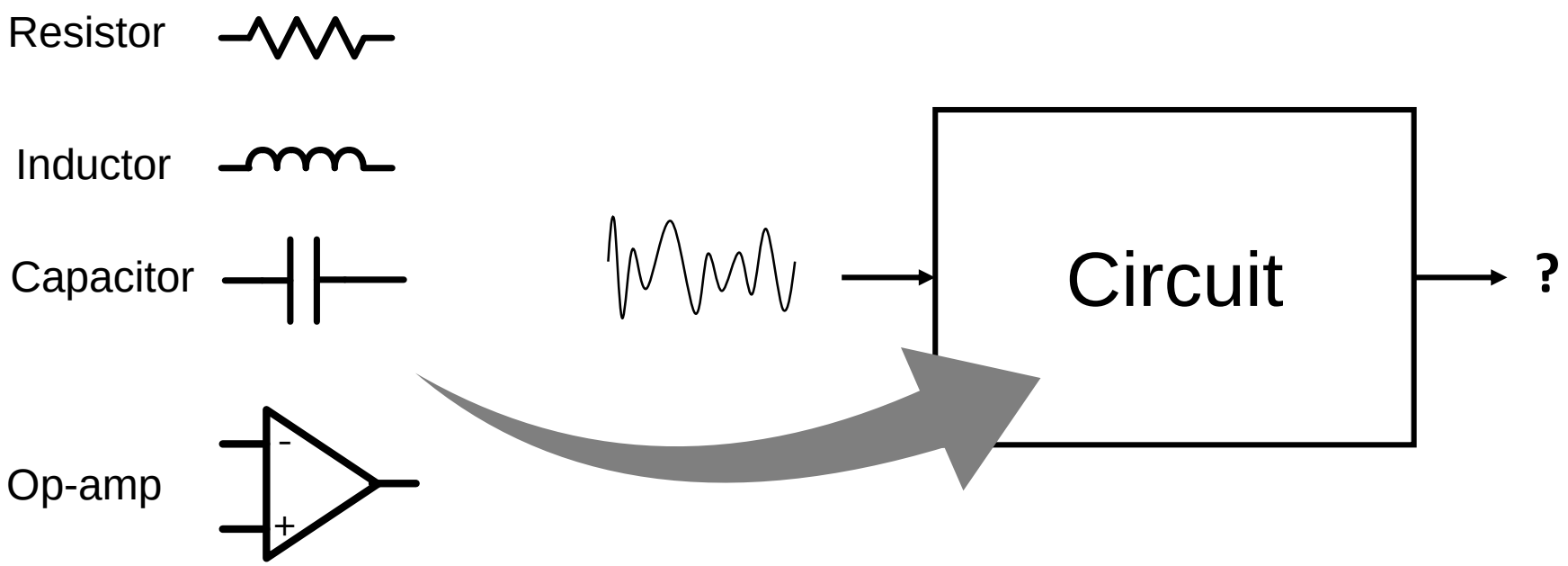
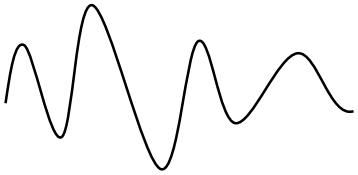
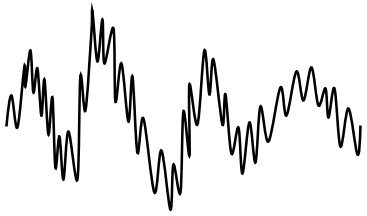
What We Will Learn in This Course

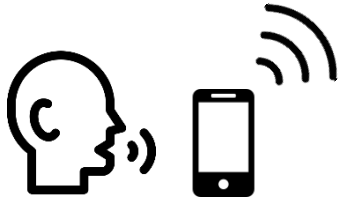


How to Deliver Information



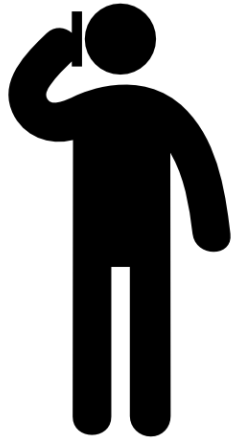


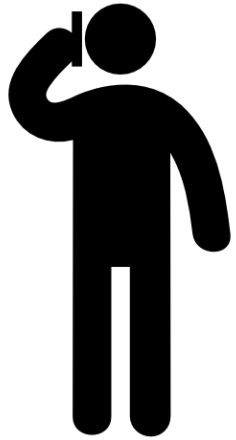




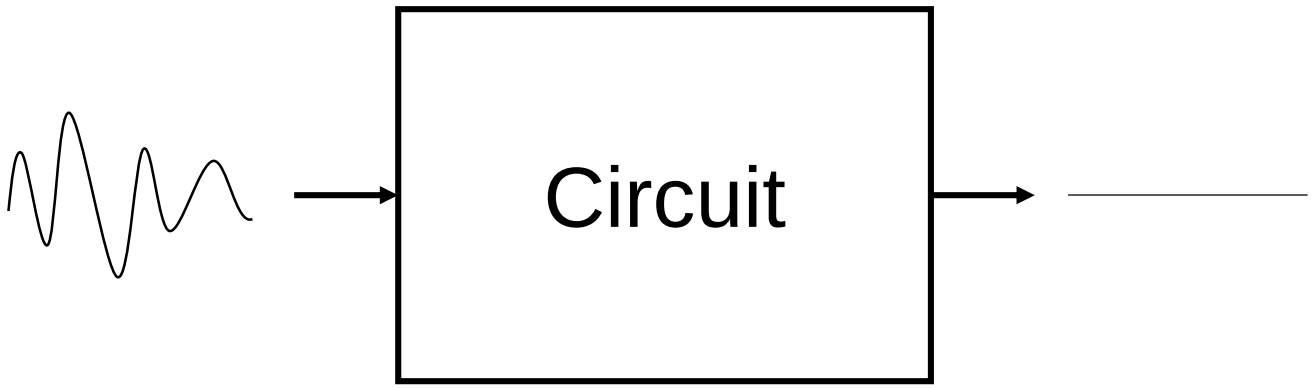


Frequency Filtering



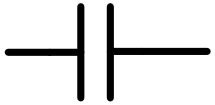


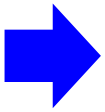
Frequency Response



Resistor 

Inductor 

Capacitor 



Energy Storage Elements

Only R? Impossible

Yes! Possible

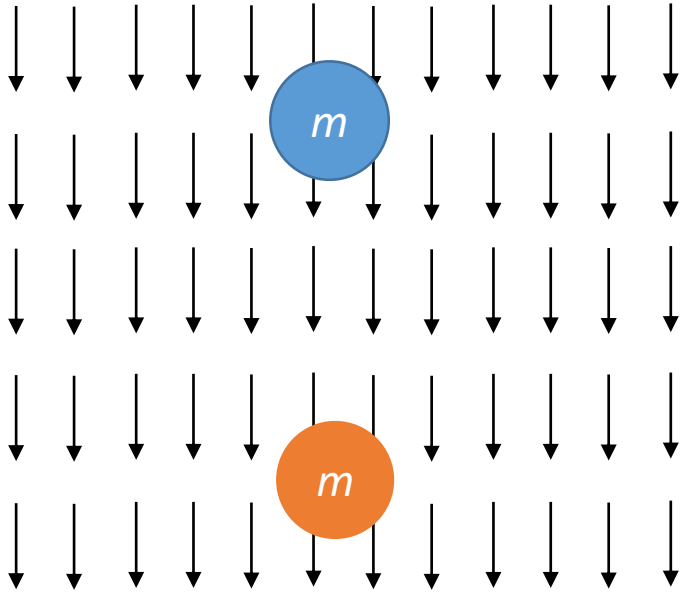
Review for Circuit Theory 1

Hanwool Jeong

hwjeong@kw.ac.kr

Force, Field and Potential Energy



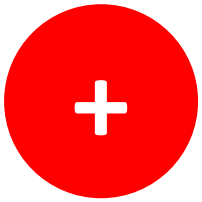


1) Which one has larger energy?
2) By how much? Force & Energy?
3) How would be they move? Why?

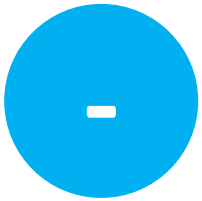
➔ Note that only difference matters for PE

Charge, Electric Force
Electric Potential

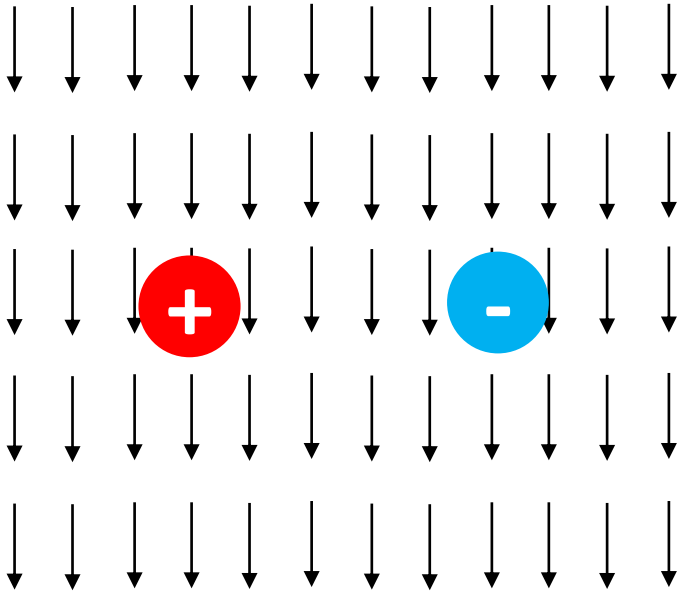
Positive Charge



Negative Charge



Electric force



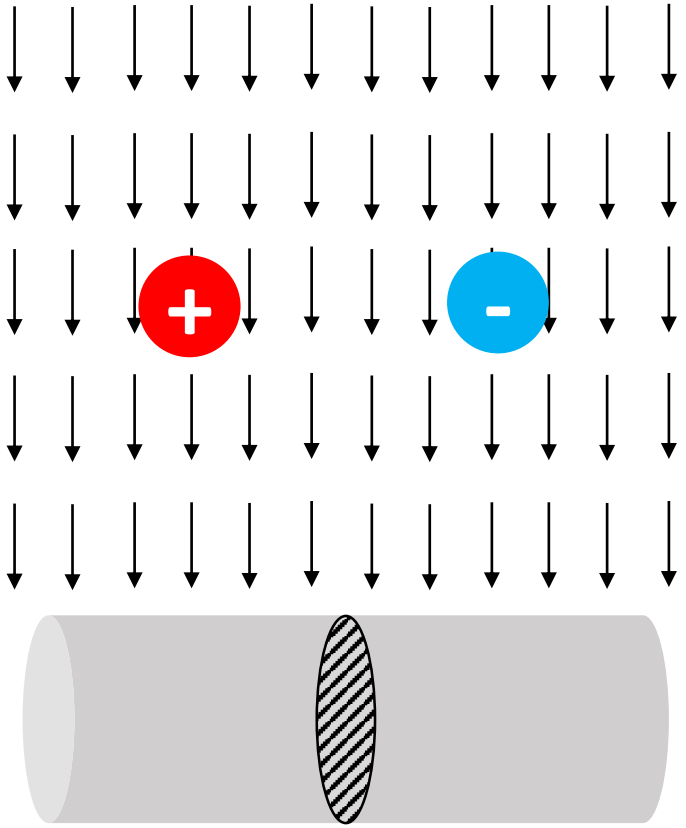
You aware of electric potential?

➔ We call this “Voltage”

➔ **Again, Note that only difference matters for voltage**

Charge Moves; Current Forms

$$i = Q/t$$



Ex) 12C is passed for 3sec ➔ 4A

Resistor

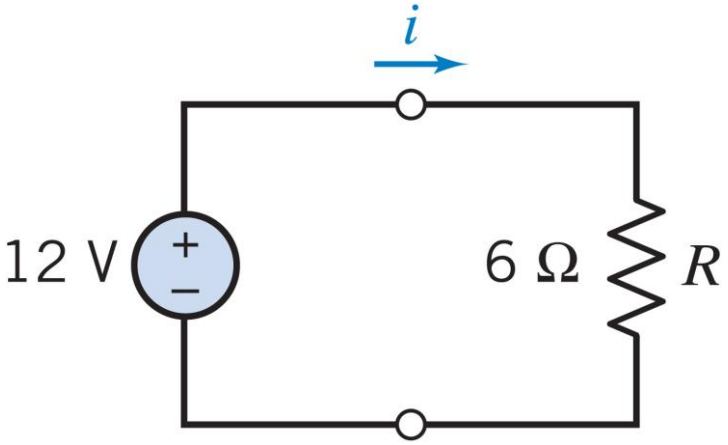
- Resistor follows Ohm's law.

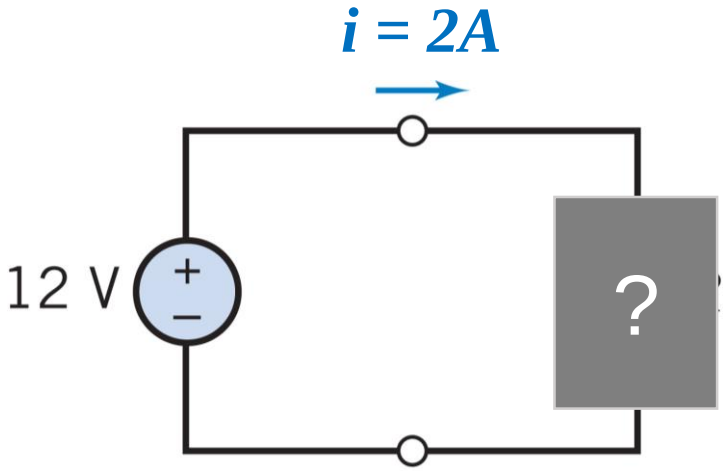
$$v = Ri$$

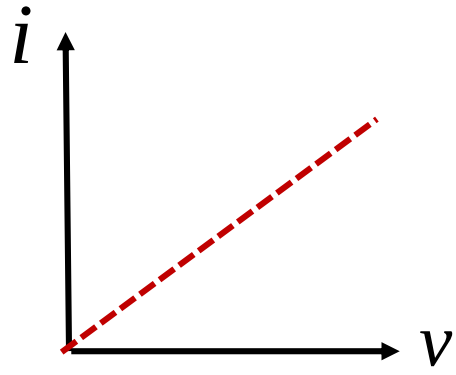


Symbol of resistor

- Example

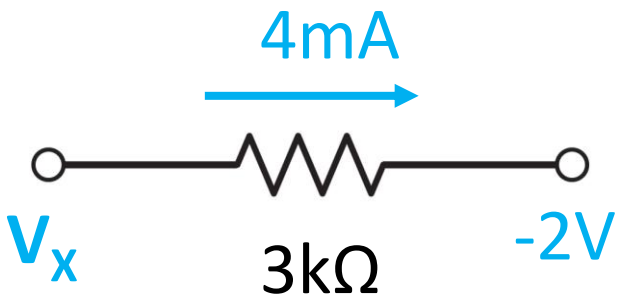




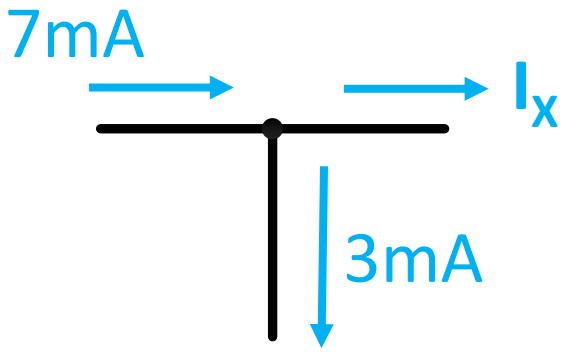


Ohm's law and KCL

- Ohm's law

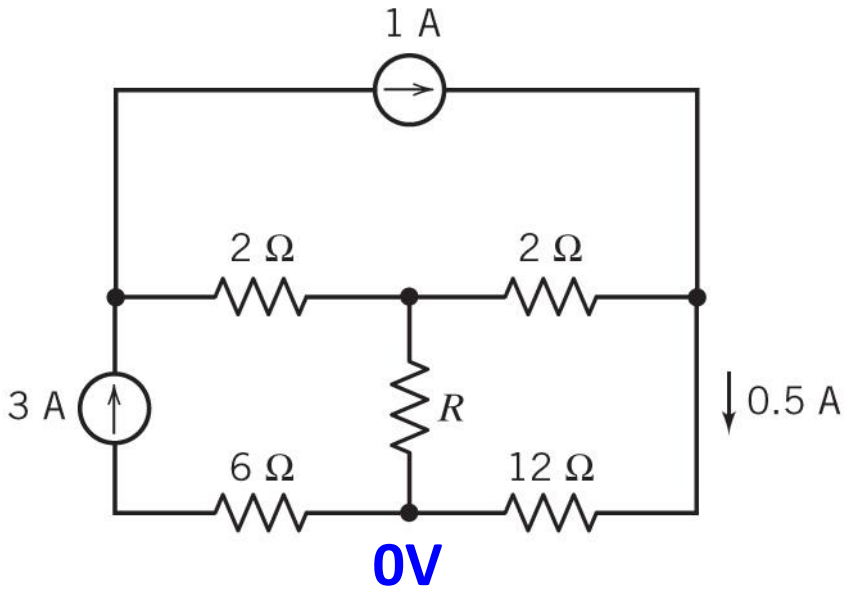


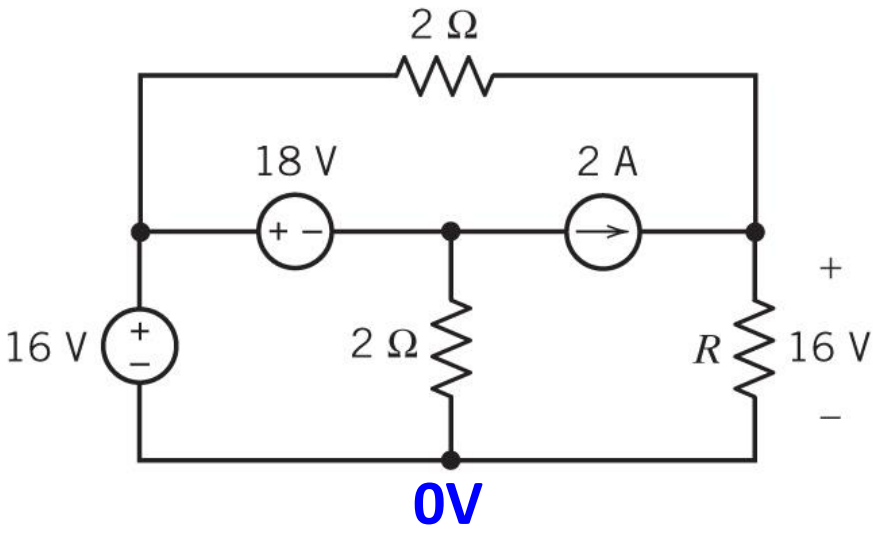
- Kirchhoff's current law



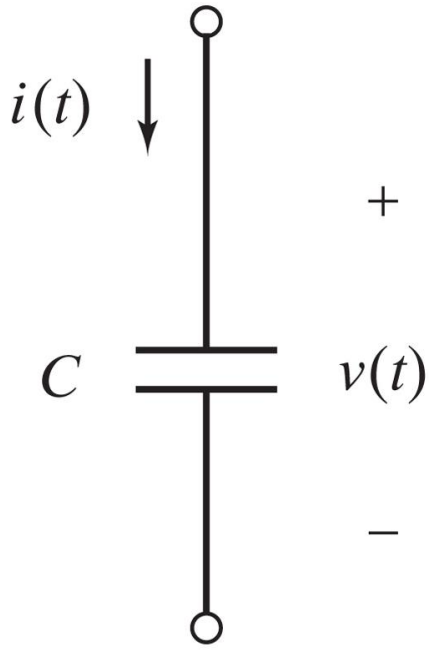
Resistive Circuit Analysis

- Applying Ohm's law and KCL appropriately, specify all current values **through all paths** and voltage values **at all nodes**.
- Provided that 0V point specified as follows





Capacitor

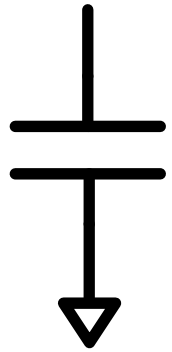


Symbol of capacitor

- Capacitance is a measure of the ability to store energy in forms of an electric field

$$q(t) = Cv(t) \quad \Rightarrow \quad i(t) = C\frac{d}{dt}v(t)$$

- Capacitor is named from “capacity”



v_C = 6V ➔ C = 2F ➔ **Q = 12C**

➔ C = 5F ➔ **Q = 30C**

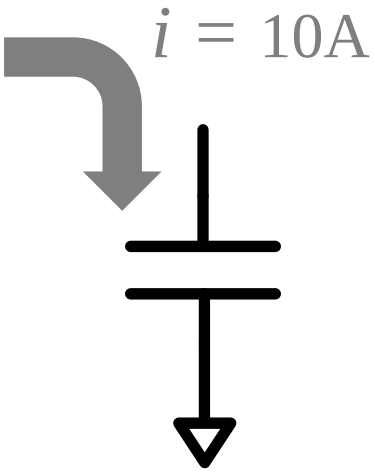
Q = 24C ➔ C = 2F ➔ **v_C = 12V**

➔ C = 5F ➔ **v_C = 4.8V**

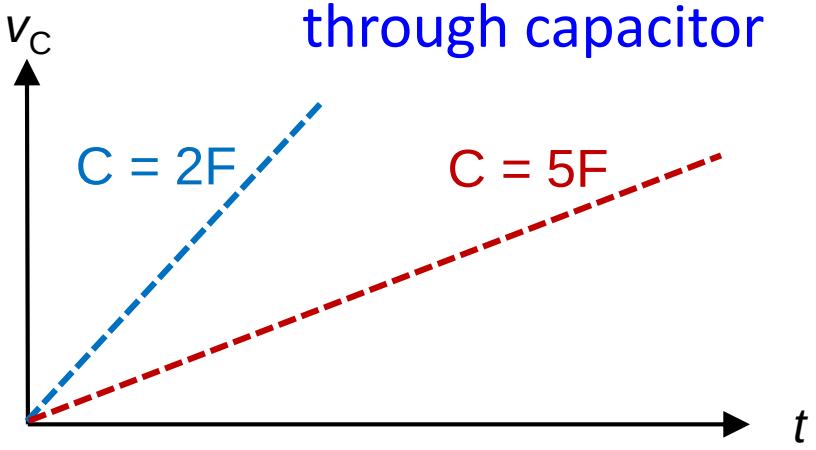
What is More important; Dynamic Characteristic of Capacitor

- Larger Cap ➔ **Harder to change voltage**
- Even w/ small cap ➔ **Impossible to change voltage abruptly**

$$i(t) = C\frac{d}{dt}v(t)$$



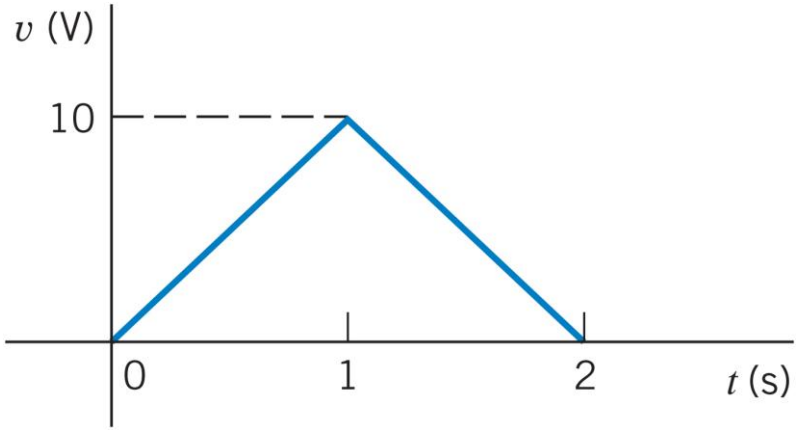
➔ Current accumulates Voltage through capacitor

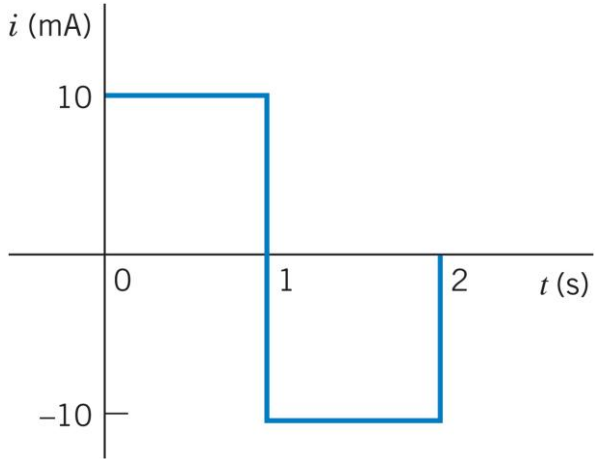


What if Voltage is Applied?

- Example : C = 1mF

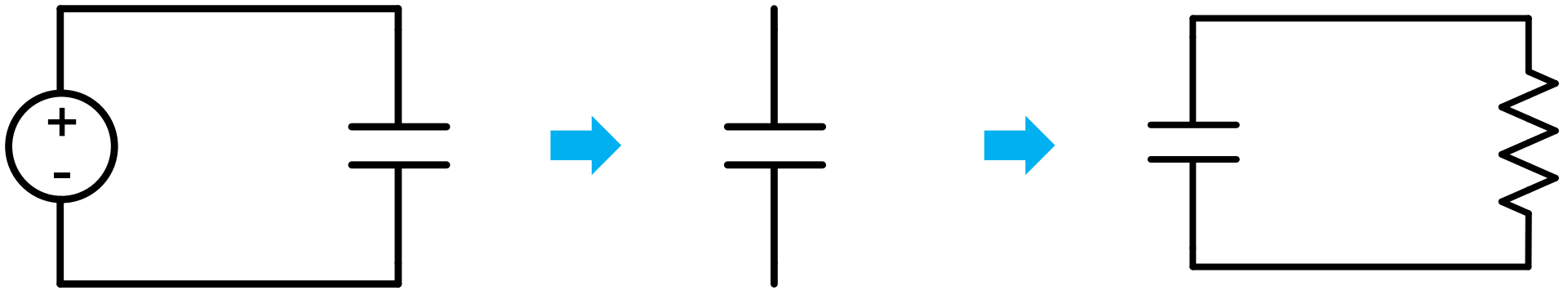
$$i(t) = C\frac{d}{dt}v(t)$$





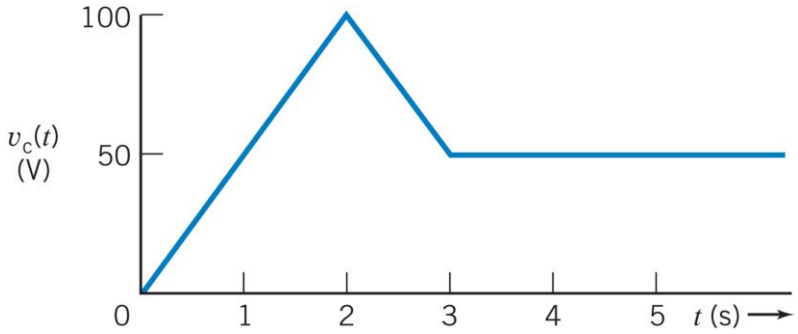
Energy Storage?

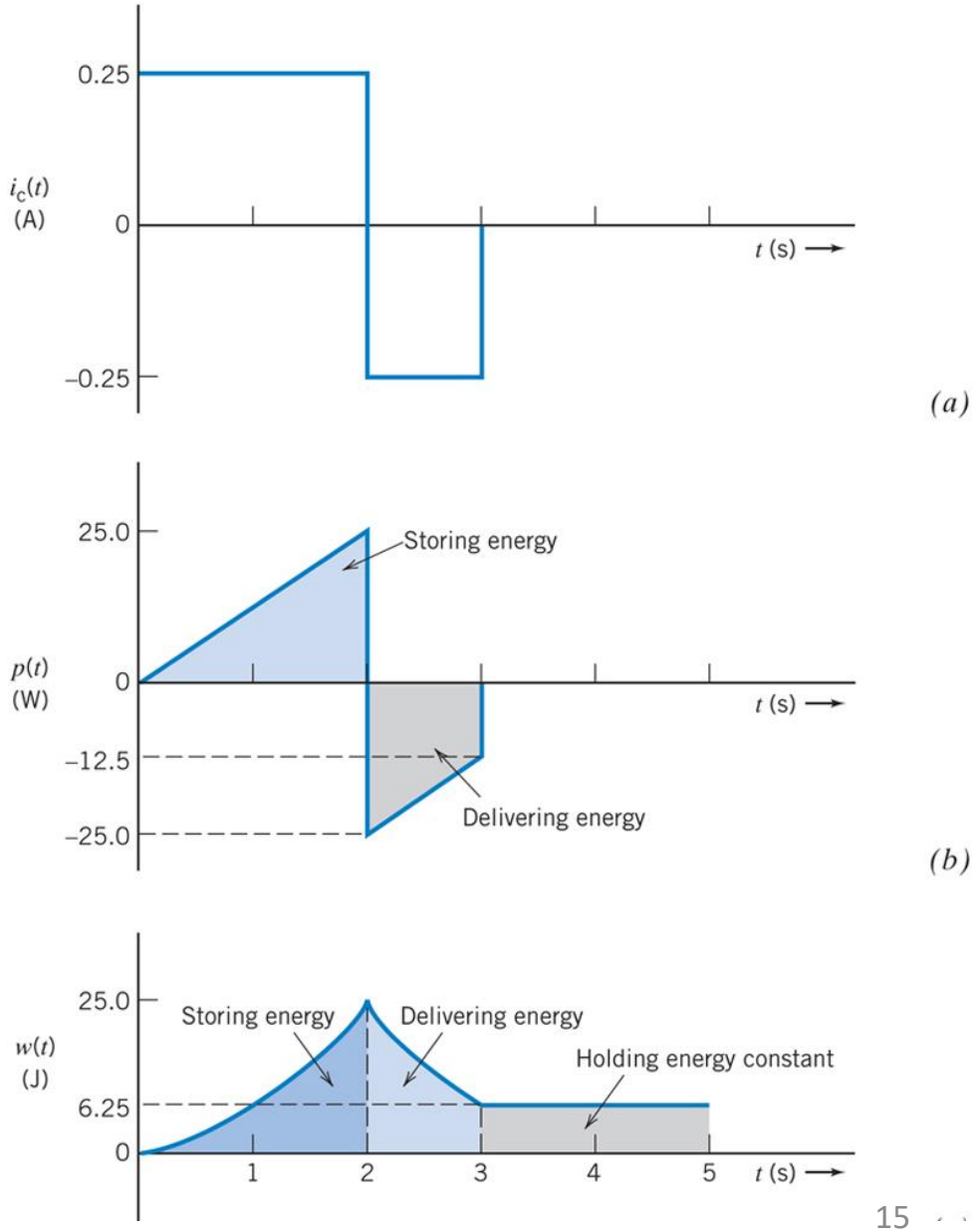
- Revisit: Capacitance is a measure of the ability to store energy in forms of an electric field



Power and Energy for a Capacitor

- C = 5mF

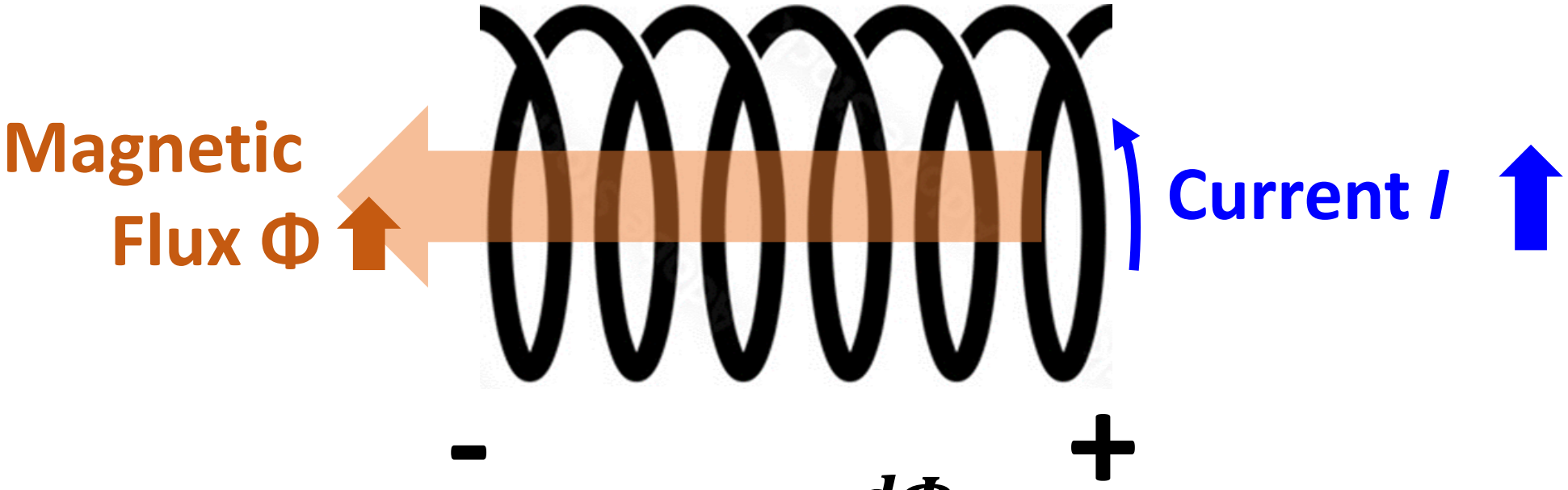




Ampere's law for Solenoid & Faraday's law

Current change
➔ Voltage Occurs

$$v(t) = k\frac{di(t)}{dt}$$



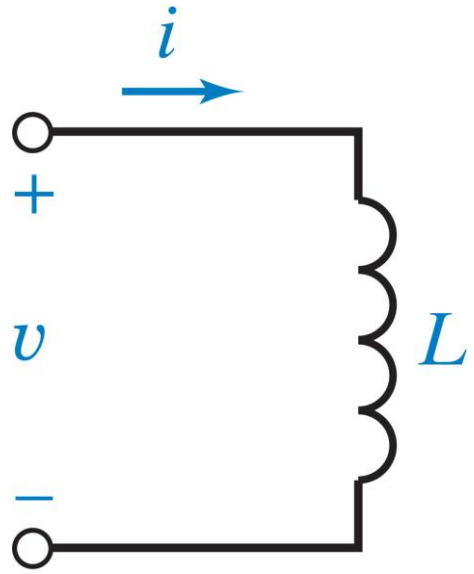
$$V \propto -\frac{d\Phi}{dt}$$

Faraday's law

Inductor

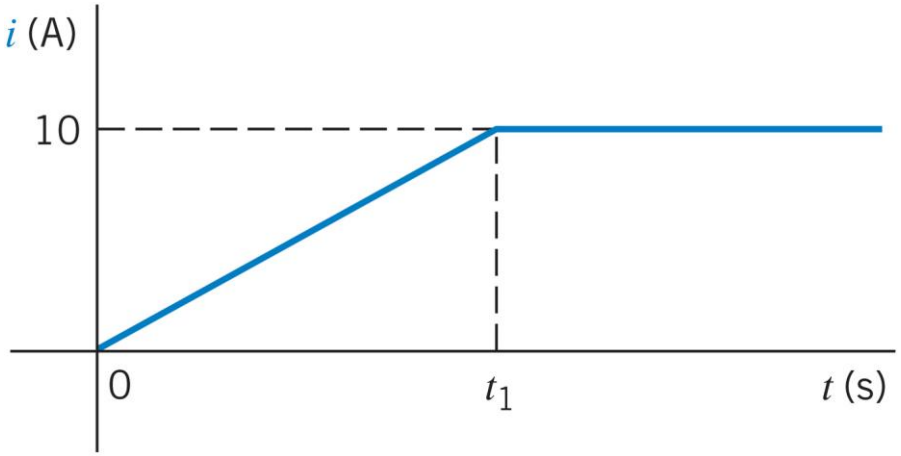
- Inductance is a measure of the ability to store energy in the form of a magnetic field

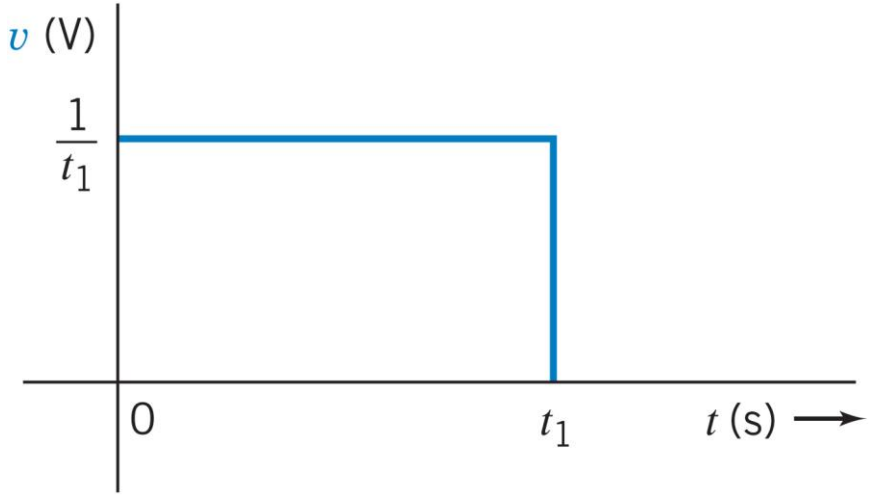
$$v(t) = L\frac{d}{dt}i(t)$$



Symbol of inductor

- Example L = 0.1-H



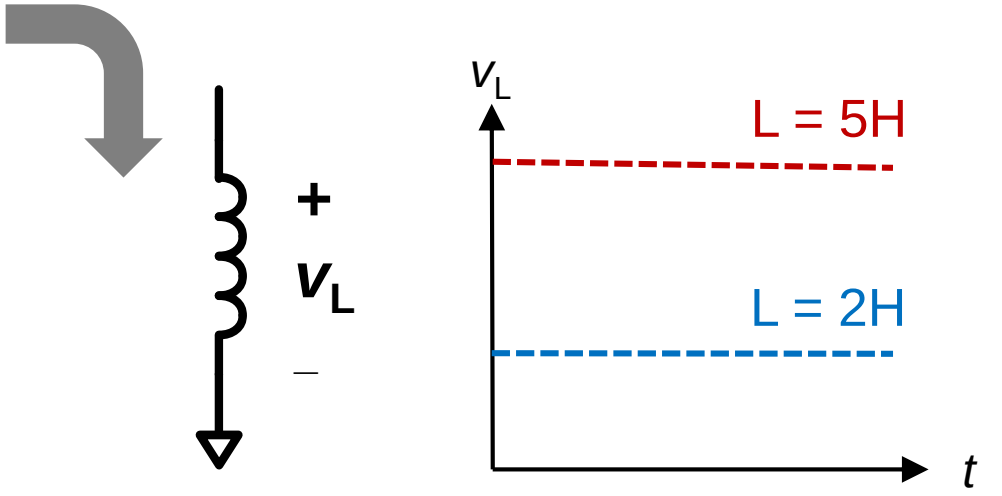


Characteristic of Inductor

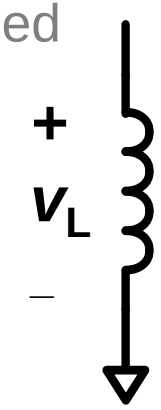
- Larger Inductance ➔ **Harder to change current**
- Even w/ small inductance ➔ **Impossible to change current abruptly**

$$v(t) = L\frac{d}{dt}i(t)$$

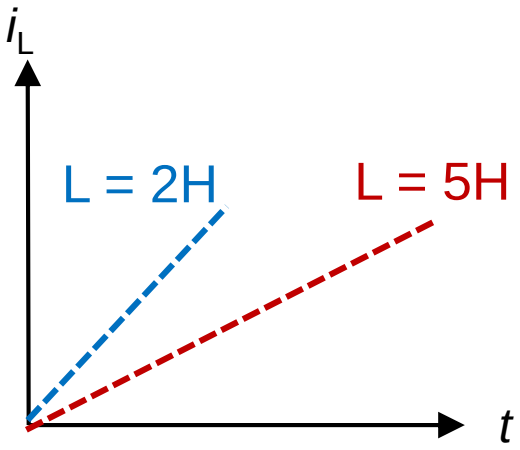
i increases linearly



Fixed Voltage is Applied

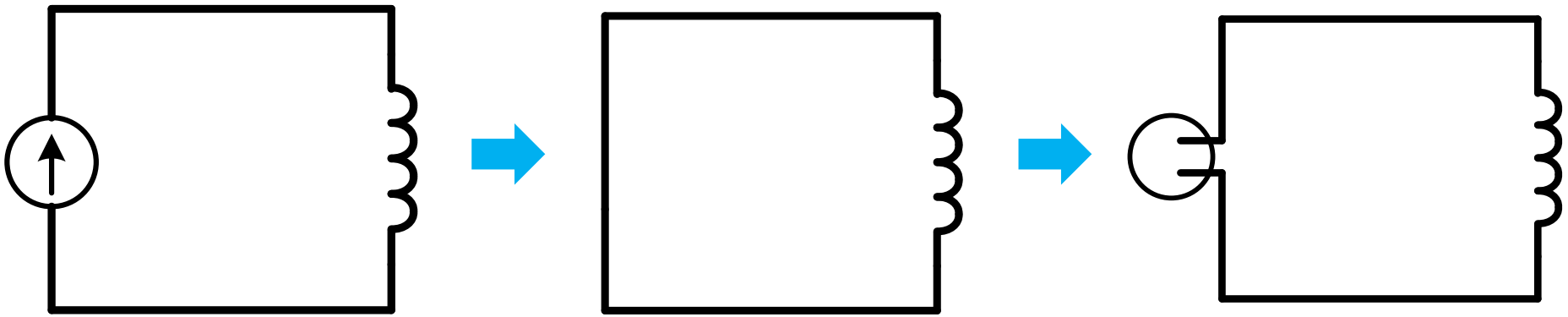


➔ Voltage accumulates Current through inductor



Energy Storage?

- Revisit: Inductance is a measure of the ability to store energy in the form of a magnetic field



$$v(t) = L\frac{d}{dt}i(t)$$

Checkpoints

- What is voltage? What is current?
- Capacitor
- Inductor