Georgia Institute of Technology

Linear Circuits

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An introduction to linear electric circuit elements and a study of circuits containing such devices.

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Capacitance

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- *Describe the behavior of capacitors by calculating:*
  - *the charge stored on the capacitor plates*
  - *the current flowing through the capacitor*
  - *the voltage across the capacitor*
  - *the capacitance of the capacitor*

Previous Class

- Finished resistive circuits
- Overview of module 3

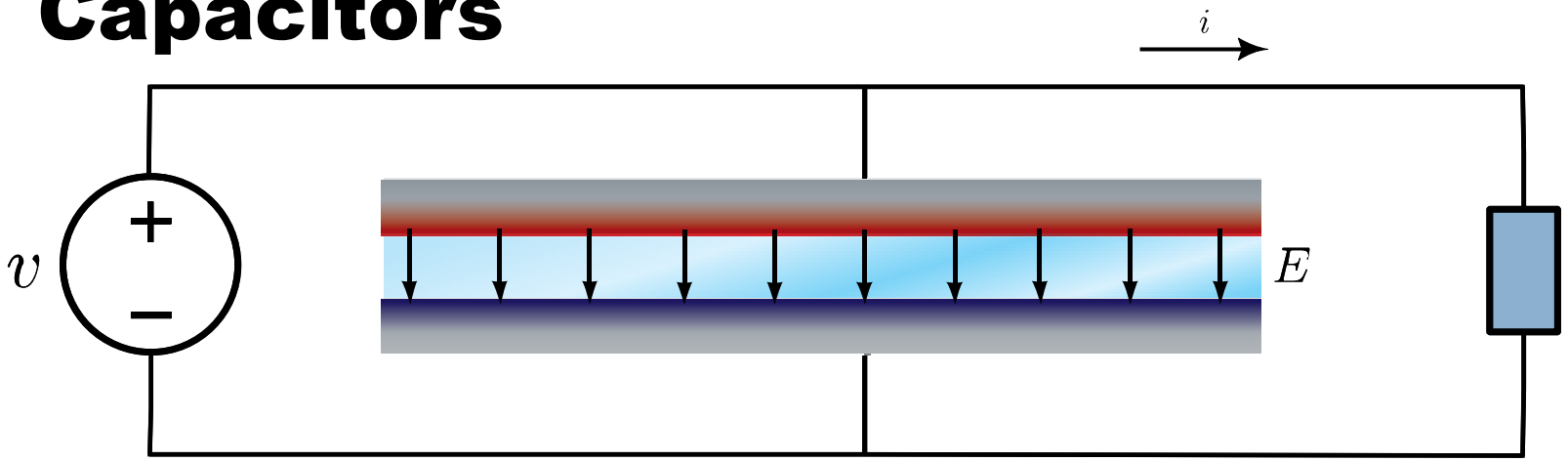
Module 3: Reactive Circuits

- Capacitors
- Inductors
- First-order differential equations
- RC Circuits
- RL Circuits
- Second-order differential equations
- RLC Circuits

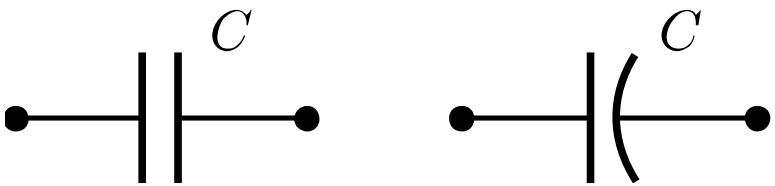
Lesson Objectives

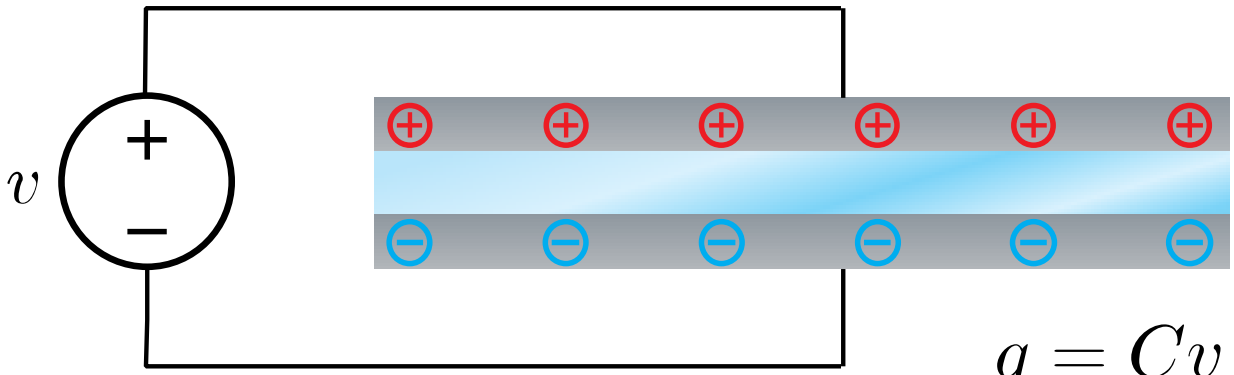
- Describe the construction of a capacitor
- Find charge stored on a capacitor
- Find the current through a capacitor
- Find the voltage across a capacitor
- Calculate the capacitance of a capacitor
- Explain how current flows “through” a capacitor

Capacitors



Capacitors and Charge

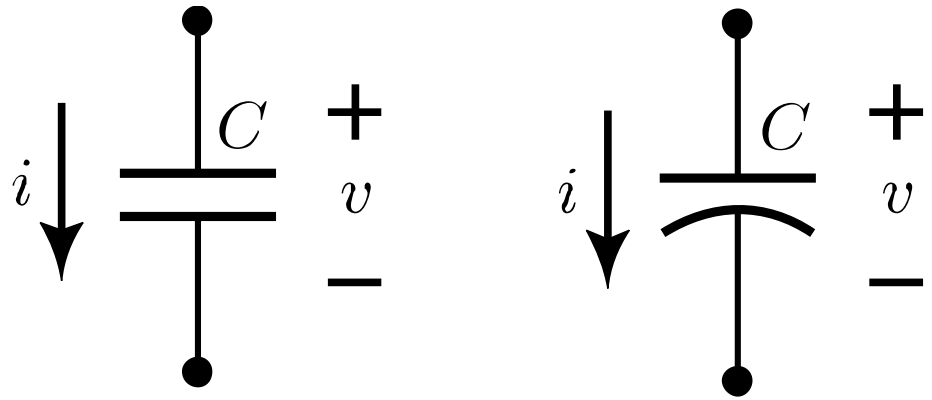




$$q = Cv$$

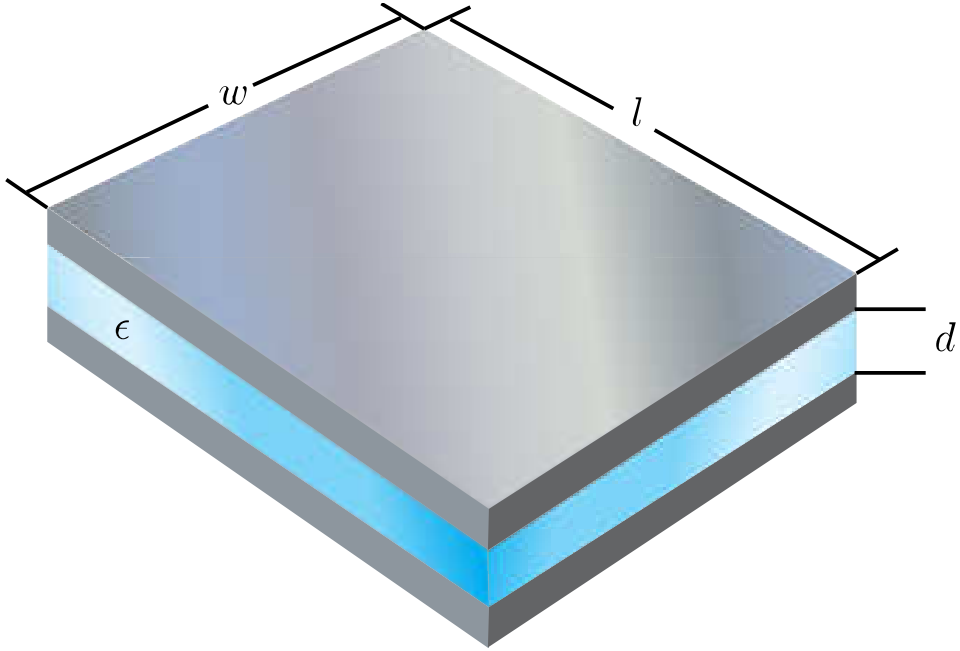
Current and Voltage

Capacitance	
Units	farad (F)
Variable	C



$$i = C\frac{dv}{dt} \qquad v = \frac{1}{C}\int_{t_0}^{t} i(\tau)d\tau + v(t_0)$$

Calculating Capacitance



$$C = \frac{\epsilon w l}{d}$$

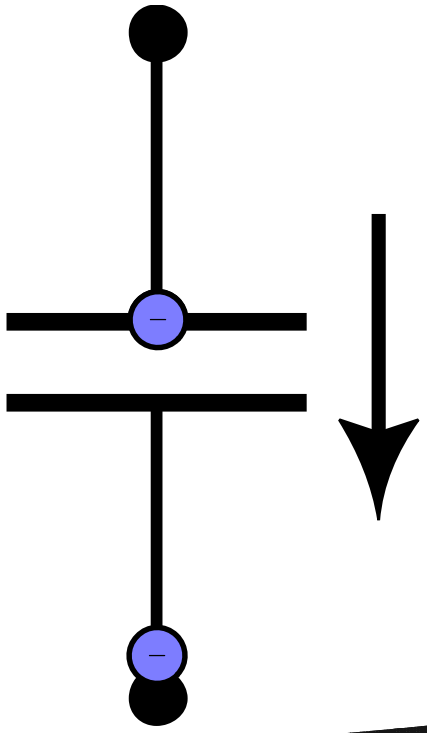
$$\epsilon = \epsilon_r \epsilon_0$$

$$\epsilon_0 \approx 8.85 \times 10^{-12} \ \ \mathrm{F/m}$$

Permittivity of Common Materials

Material	Approximate ε_r (or k)
Air	1
Teflon	2.1
Paper	3.9
Glass	4.7
Rubber	7.0
Silicon	11.7
Water	78.5 (varies by T)

Current "Through" A Capacitor



Summary

- Identified how capacitors work
- Calculated charge stored on a capacitor
- Identified the relationship between current and voltage on a capacitor
- Calculated capacitance
- Explained how current flows “through” a capacitor

Next Class

- Capacitors as circuit devices
- Behavior of capacitors in a system