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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Charge and Current

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- *Calculate the force charges exert on one another*
- *Calculate functions of charge and current*

Course Outline

- Background
- Resistive Circuits
- Reactive Circuits
- Frequency Analysis
- Power

Previous Class

- Outline of the course
- Outline of module 1

Module 1: Background

- Charge
- Current
- Voltage
- Power
- Energy
- Circuit Introduction

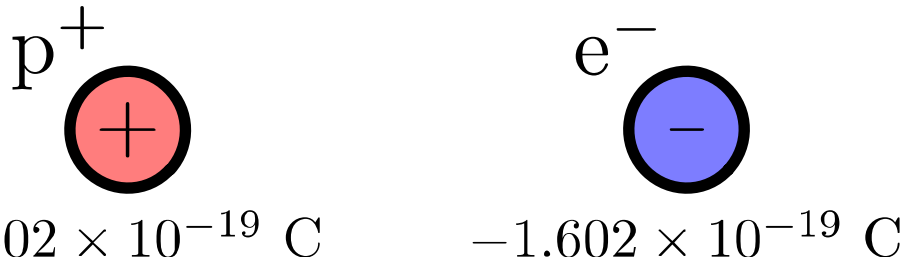
Lesson Objectives

- Calculate the forces two point charges exert on each other
- Calculate current based on a charge function
- Calculate charge based on a current function

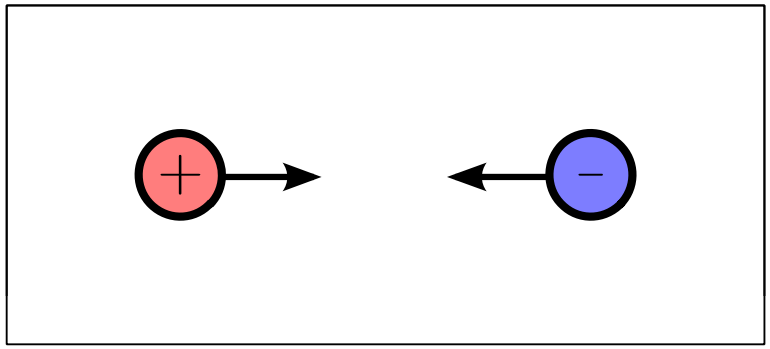
Electric Charge

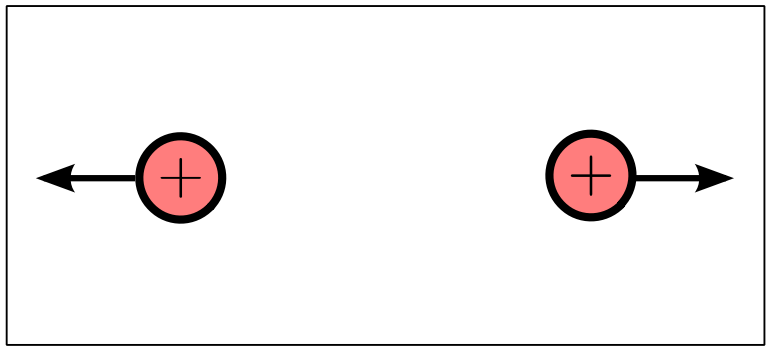
Charge	
Units	coulomb (C)
Variable	q, Q

- Property of matter
- Quantized
- Measured in Coulombs (C)



Electromagnetic Force





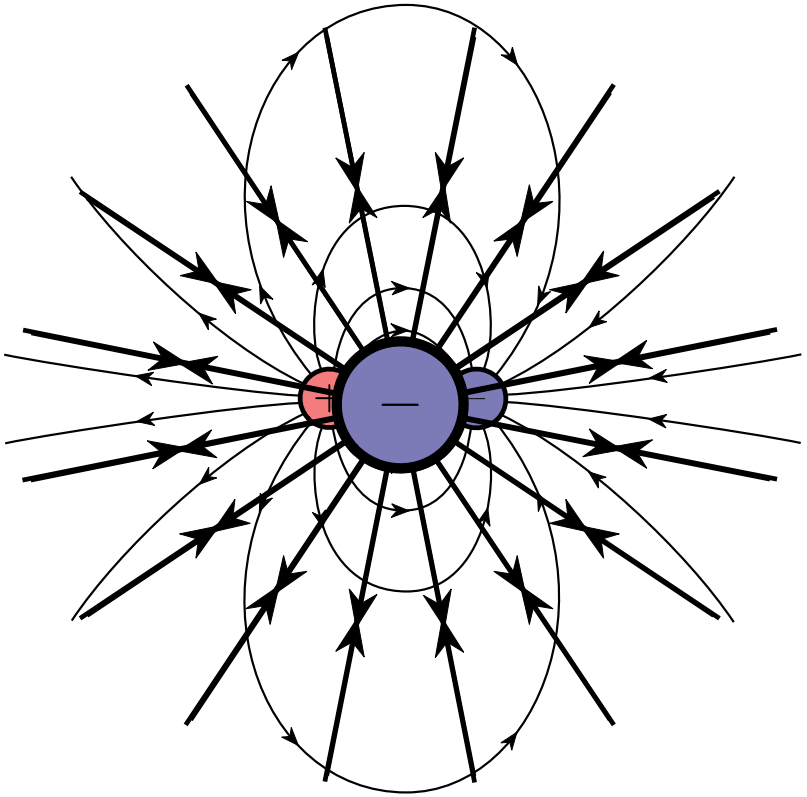
Coulomb's Law:

$$|\mathbf{F}| = k_e \frac{|q_1 q_2|}{r^2}$$

$$k_e = \frac{1}{4\pi\epsilon_0} \frac{\mathrm{Nm}^2}{\mathrm{C}^2}$$

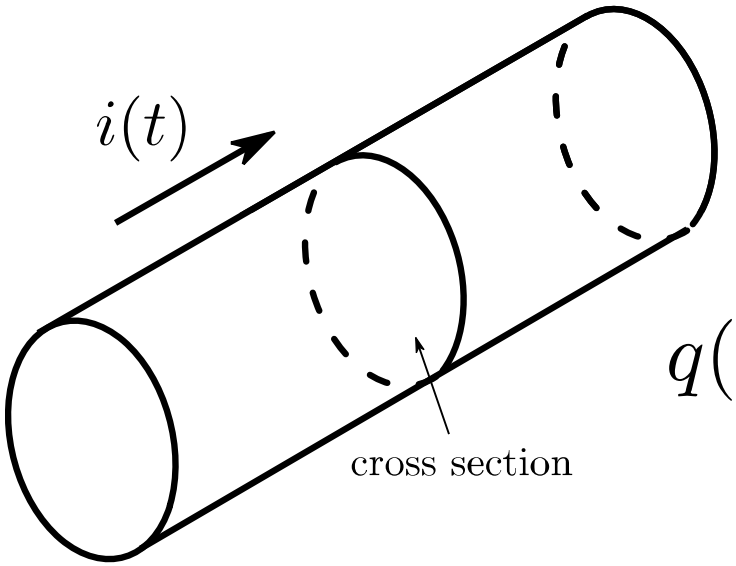
$$k_e = 8.988 \times 10^9 \frac{\mathrm{Nm}^2}{\mathrm{C}^2}$$

Electric Fields



Electrical Current

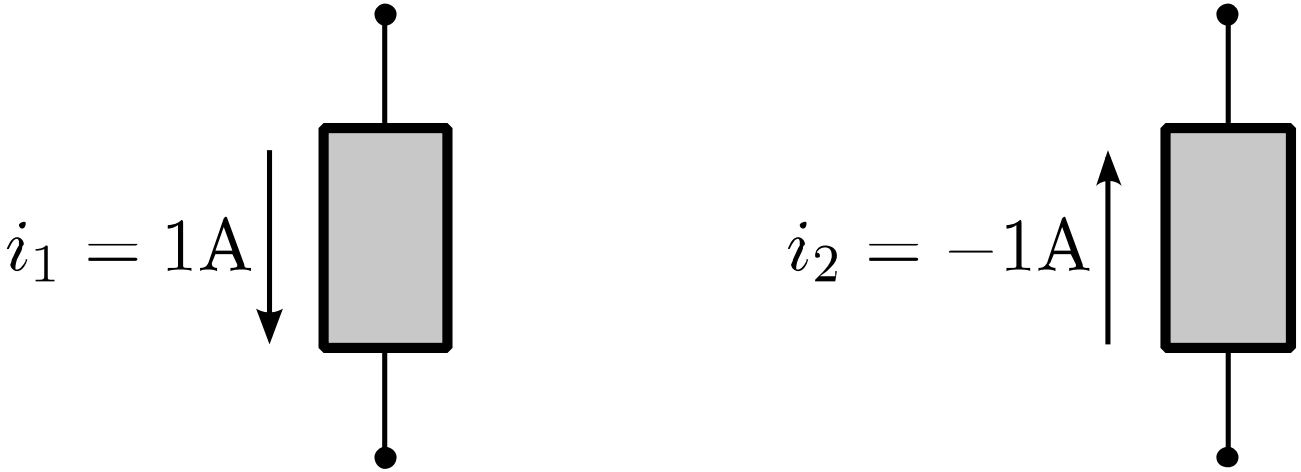
Current	
Units	ampere ($\mathrm{A}=\frac{\mathrm{C}}{\mathrm{s}}$)
Variable	i



$$i(t) = \frac{dq(t)}{dt}$$

$$q(t) = \int_{t_0}^{t} i(\tau)d\tau + q(t_0)$$

Reference Directions



Learning Objectives

- Charge and how to calculate its effect on other charges
- Current and how to calculate it from charge flow in time

Pause

Summary

- Discussed charge as a property of matter
- Calculated forces of charge using Coulomb's Law
- Explored electric fields – the means of this interaction
- Described current as the time derivative of charge
- Emphasized the importance of current reference directions

Next Class

- Take a closer look at electric fields
- Present the idea of voltage
- See a practical example: how a car battery works