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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Kirchhoff's Laws

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- *Introduce Kirchhoff's Voltage Law (KVL) and apply to parallel circuits*
- *Introduce Kirchhoff's Current Law (KCL) and apply to series circuits*
- *Use Kirchhoff's Laws to solve a simple circuit*

Previous Class

- Introduced Ohm's Law
- Introduced Resistance
- Calculated Resistance
- Equations for behavior *within* a device

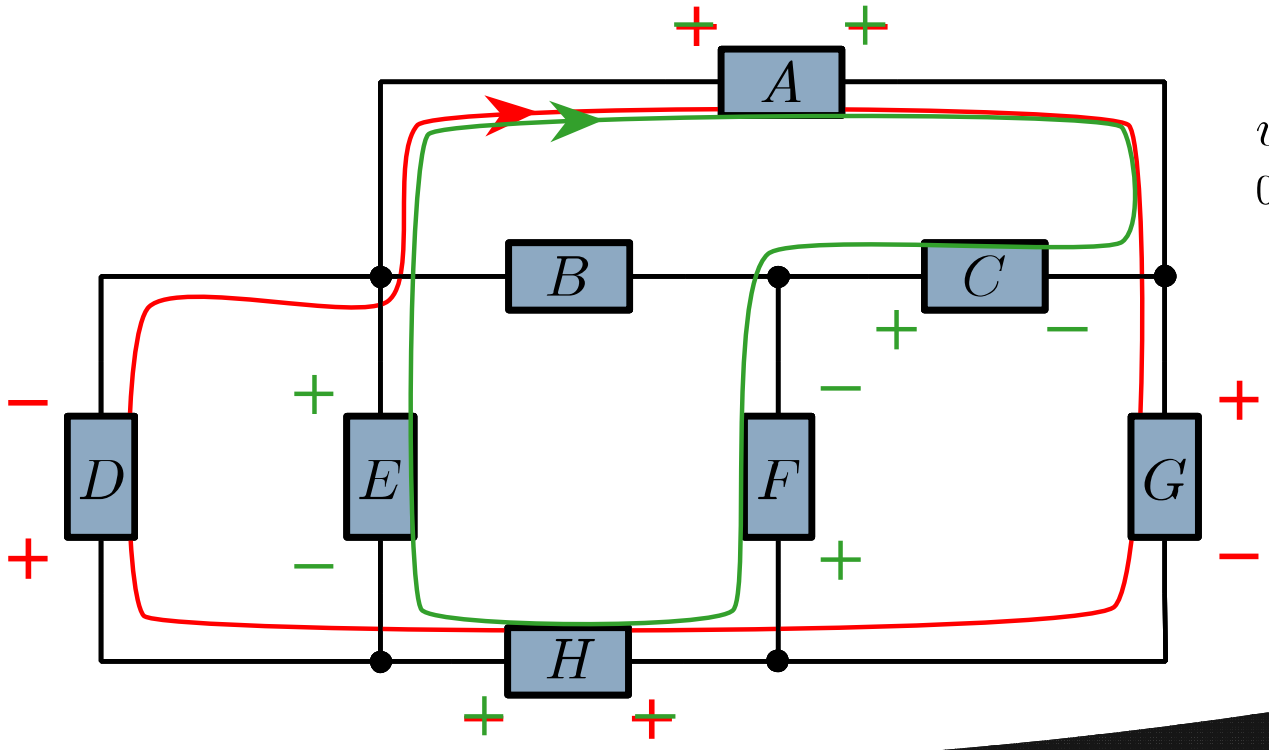
Module 2: Resistive Circuits

- Resistance and Ohm's Law
- Kirchhoff's Laws
- Resistors
- Superposition
- Obtaining Circuit Equations
- Maximum Power Transfer
- Wye-Delta and Wheatstone Bridge

Lesson Objectives

- Describe KVL and KCL
- Describe the voltage relationship of parallel elements
- Describe the current relationship of series elements
- Use Kirchhoff's Laws to find unknown values in a simple circuit

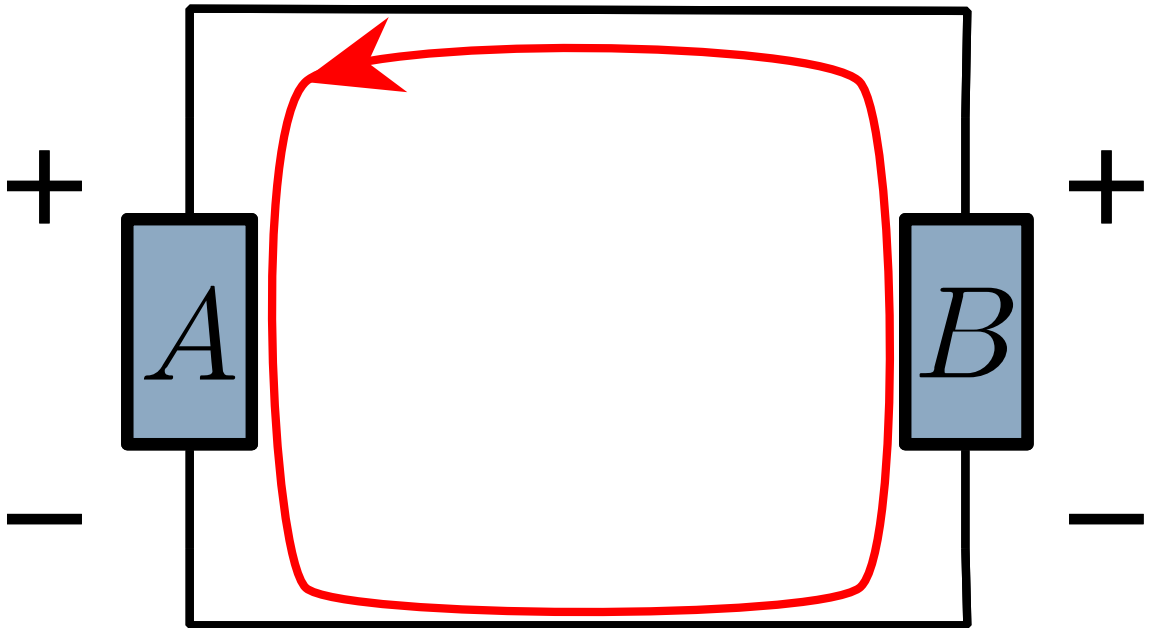
Kirchhoff's Voltage Law (KVL)



$$v_A + v_G + v_H + v_D = 0$$

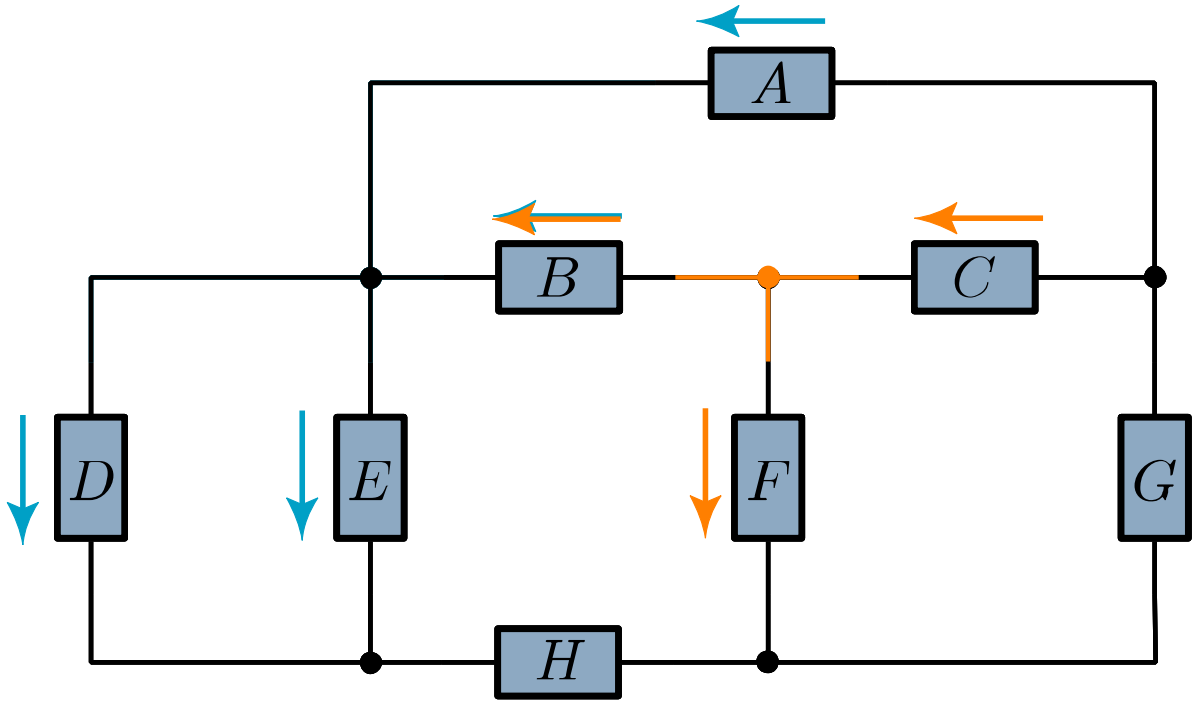
$$0 = v_A + v_C + v_F + v_H + v_E$$

KVL and Parallel Circuits



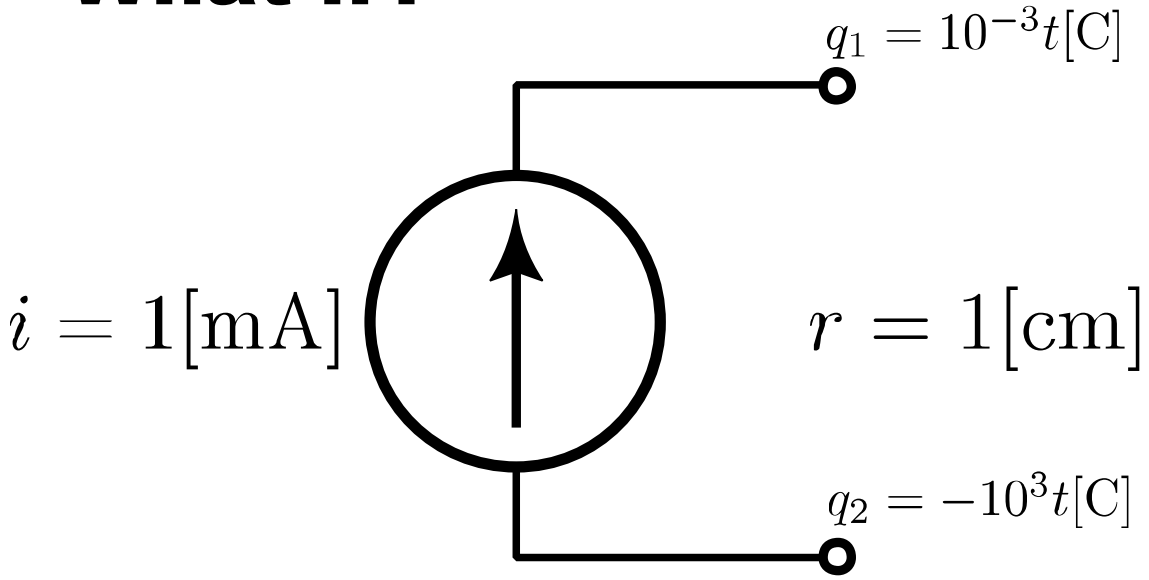
$$v_A - v_B = 0$$
$$v_A = v_B$$

Kirchhoff's Current Law (KCL)



$$i_A + i_B = i_D + i_E$$
$$i_B + i_F = i_C$$

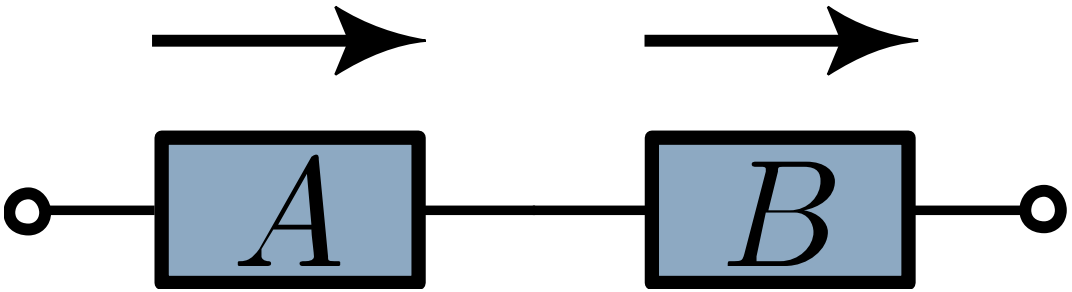
What if?



Time	$\lvert F\rvert$[lbs]	$\lvert F\rvert$[kg]
1ms	20.2	9.16
1s	20.2 M	9.16 M
2s	80.8 M	36.6 M

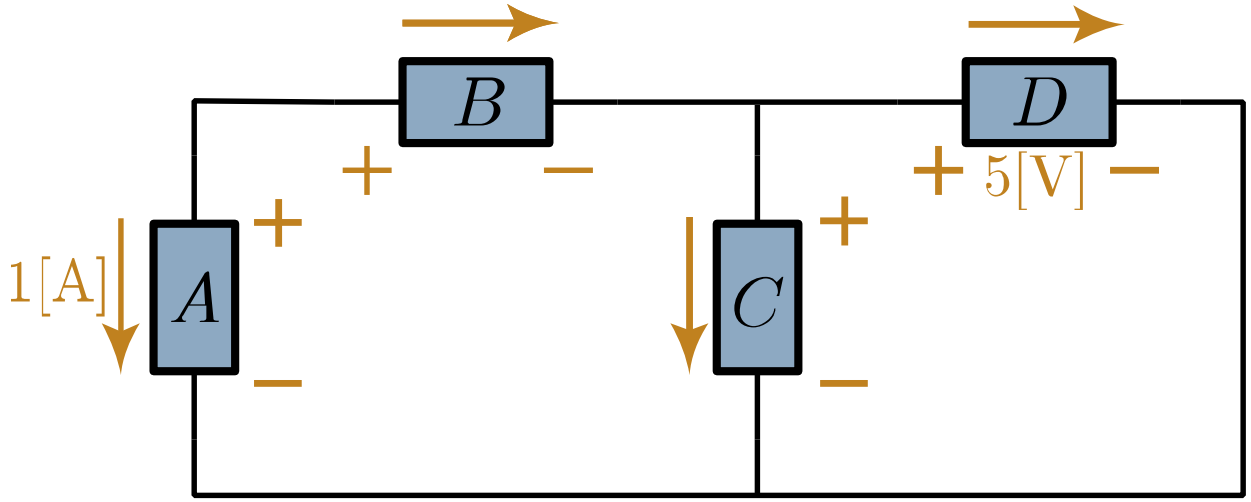
$$|F| = k_e \frac{|q_1 q_2|}{r^2} = 8.987 \times 10^9 \left[\frac{\mathrm{Nm}^2}{\mathrm{C}^2}\right] \frac{10^{-6} t^2[\mathrm{C}^2]}{10^{-4}[\mathrm{m}^2]} = 8.987 \times 10^9 \left[\frac{\mathrm{Nm}^2}{\mathrm{C}^2}\right] [\mathrm{MN}]$$

KCL and Series Circuits



$$i_A = i_B$$

Solving Values in Circuits



$P_A = 3[\mathrm{W}]$

Summary

- Introduced KVL and KCL
- Applied KVL to parallel elements
- Applied KCL to series elements
- Gave a justification for KCL
- Solved a simple circuit using Kirchhoff's Laws

Next Class

- Introduce resistors – devices specifically designed to inhibit current flow
- Apply Ohm's Law and Kirchhoff's Law to resistor circuits