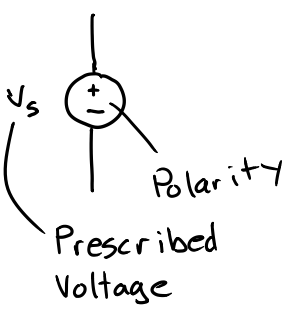
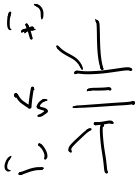
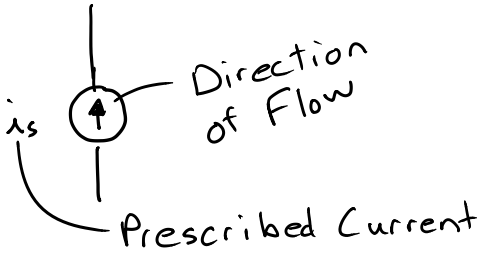
DC Voltage Source
- Prescribed voltage remains constant



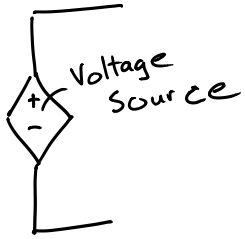


DC Current Source
- Prescribed current is constant

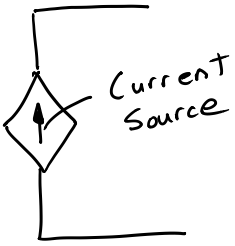


Dependent Source
The prescribed value depends on the value of voltage or current somewhere else in the circuit

$v_s = \alpha v_x$
or $v_s = \beta i_x$

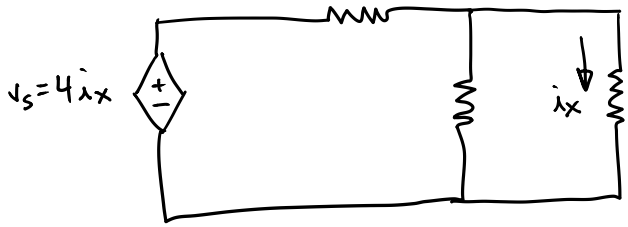


$i_s = \gamma v_x$
or $i_s = \mu i_x$



v_x, i_x => Values of voltage or current elsewhere in the circuit

$\alpha, \beta, \gamma, \mu$ => Multiplication Factors



If $i_x = 2A$, then $v_s = (4)(2) = 8V$

Ohm's Law

Resistor
- Impedes the flow of current

Symbol  Resistance (Ohms, Ω)

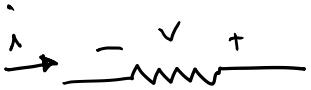
$v = iR$

Current flowing through the resistor

Voltage across the terminals of the resistor

Sign Convention

$v = iR$



$v = -iR$

Power in a Resistor

$p = vi$ $\quad v = iR$ or $i = \frac{v}{R}$

$p = i^2R$ or $p = \frac{v^2}{R}$

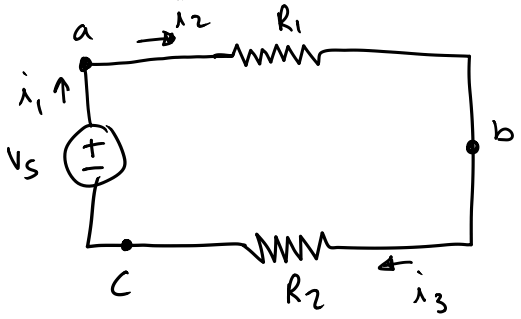
$p > 0$ for a resistor => Resistors always absorb power

Conductance

$G = \frac{1}{R}$ conductance

Kirchhoff's Laws

Node
- Point in a circuit that connects two or more circuit elements

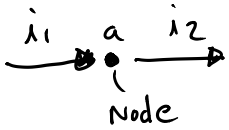


a, b, c are Nodes
a => Connects V_S & R_1
b => Connects R_1 & R_2
c => Connects R_2 & V_S

Kirchhoff's Current Law (KCL)
- The sum of all currents entering and exiting a node is zero

Sign Convention
- If the current is directed towards the node: Negative in the KCL equation
- If the current is directed away from the node: Positive in the KCL equation

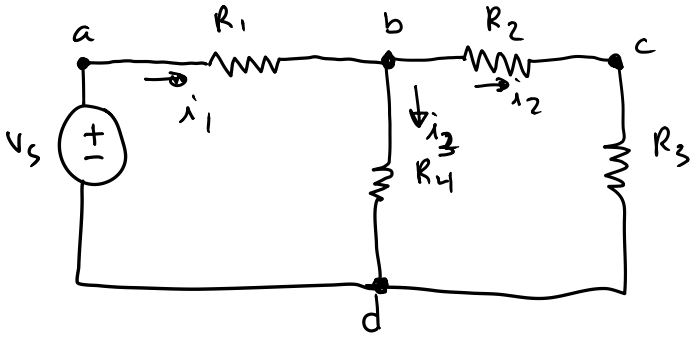
Nodes Connecting only Two Circuit Elements



KCL (a)

$-i_1 + i_2 = 0$

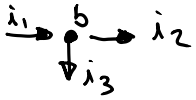
$i_1 = i_2$ (currents are equal)



a, b, c, and d are nodes

a, c => Connect only two elements (KCL equation not needed)

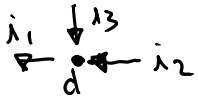
Node b



KCL (b)

$-i_1 + i_2 + i_3 = 0$

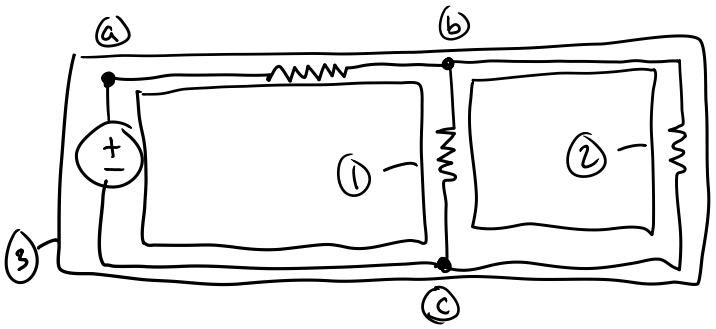
Node d



KCL (d)

$i_1 - i_2 - i_3 = 0$ (Same as KCL(b) Equation)

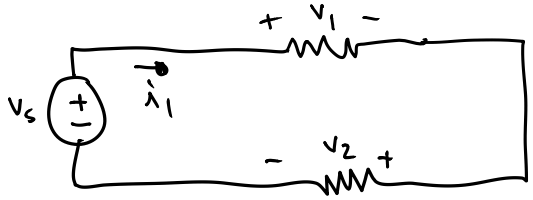
Closed Path (Loop)
- Start at one node in the circuit, and return to that same node
- Can't pass through any node more than once



a, b, c => Nodes
1, 2, 3 => Loops

Kirchhoff's Voltage Law
- Sum of all voltage drops ('+' to '-') or rises ('-' to '+') along a closed path (loop) is zero
- Go through the loop in a Clockwise (CW) or Counterclockwise (CCW) direction

Sign Convention
- For a voltage drop: Positive in the KVL equation
- For a voltage rise: Negative in the KVL equation



KVL (cw)

$$-v_s + v_1 + v_2 = 0$$