Kirchhoff’s Current Law (KCL)

Sum of currents entering a node = 0

OR

\[ i_1 - i_2 - i_3 + i_4 = 0 \]

OR

\[ -i_1 + i_2 + i_3 - i_4 = 0 \]

Sum of currents leaving a node = sum of currents entering a node

\[ i_1 + i_4 = i_2 + i_3 \]
Kirchhoff’s Voltage Law (KVL)

Sum of voltages around a closed path = 0

OR

\[-V_{DC} + V_1 + V_2 = 0\]

Sum of voltage drops = sum of voltage rises

\[V_{DC} = V_1 + V_2\]

Sign Convention

- Add up the voltages in a systematic clockwise movement around the loop.
- Assign a positive sign to the voltage across an element if the (+) side of that voltage is encountered first, and assign a negative sign if the (−) side is encountered first.

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Super Important: Node Voltage Direction and Polarity (+ / -)

\[ \text{Va} - \text{Vb} = (I)R1 \]
KCL and KVL Cookbook

1. Write all KNOWN values
2. Keep track of all **unknown** values (Need as many independent equations as unknowns)
3. Write all **KVL (Loop)** equations. Each loop must pick up at least one new element. Current sources can’t be in loops.
4. Apply Ohm’s Law (I prefer to do this ‘as I go’, for convenience)
5. Apply as many **KCL (node)** equations as needed to fill in unknowns. Each KCL equation must pick up at least one new current. Shorts combine nodes. Nodes connected by only voltage sources can’t be used.
6. Solve for the unknowns.

Another Way …