# KCL & KVL

Electrical Engineering

Kirchhoff's two laws written in the sign convention circuit analysis actually uses.

**Currents leaving a node sum to zero; voltages around any closed loop sum to zero.**

$$\Sigma\, i(\text{leaving node}) = 0 \cdot \Sigma\, v(\text{around loop}) = 0$$

| | |
|---|---|
| **3 A in, 1 A out**<br>Charge conserved. | **2 A in the third branch** |
| **Loop with a 10 V source**<br>Energy conserved. | **Drops sum to 10 V** |
| **n nodes**<br>One node is datum. | **n – 1 equations** |

**THE COMMON MISTAKE**

× **Flipping the loop direction part-way through**

✓ **One direction and one sign rule for every loop**

The signs encode energy gained against energy lost. Changing convention mid-problem produces equations that contradict each other.

**Both laws hold instantaneously, for any waveform, linear or not. They are conservation of charge and of energy.**