

Kirchhoff's Laws

Physics

The two conservation laws that solve any circuit.

Current into a junction equals current out. The sum of EMFs around a loop equals the sum of potential drops.

$$\Sigma I(\text{in}) = \Sigma I(\text{out}) \cdot \Sigma E = \Sigma IR$$

Junction with 3 A in

Charge is conserved.

3 A total out

Loop with 12 V EMF

Energy is conserved.

Drops sum to 12 V

Sign convention

Pick one and keep it.

Consistent direction around the loop

THE COMMON MISTAKE

✗ **Mixing sign conventions between loops**

✓ **Choosing one direction and applying it consistently**

The signs encode which way energy is gained or lost. Switching mid-problem produces contradictory equations.

For n unknowns you need n independent equations. Count loops and junctions before starting.