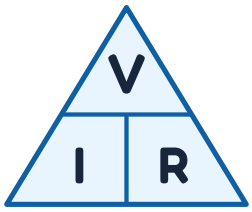
Ohm's law and power

Voltage, current, resistance and watts: the four sums behind almost every circuit.

LearnEE
CHEAT SHEET

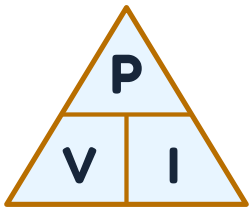
Ohm's law: V = I × R



Cover the one you want. What's left is the sum.

V = I × R	I = V ÷ R	R = V ÷ I
voltage	current	resistance

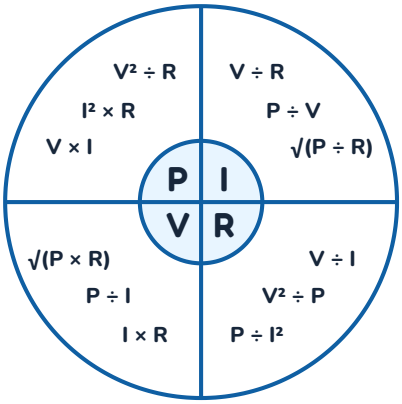
Power: P = V × I



Power is how fast a part turns energy into heat or light.

P = V × I	I = P ÷ V	V = P ÷ I
watts	current	voltage

The power wheel



Find the letter you want, then use the formula in its quarter that needs what you know.

Worked examples

1. What current flows? A 9 V battery across a 1 kΩ resistor.

I = V ÷ R = 9 V ÷ 1000 Ω = 0.009 A = **9 mA**

2. Which resistor for an LED? A red LED (2.0 V) at 20 mA from a 5 V supply.

$R = (V_{supply} - V_{LED}) \div I = (5 - 2.0)\ V \div 0.02\ A =$ **150 Ω**

150 Ω is a standard value. If your sum lands between values, round **up**.

3. Will it overheat? 5 V across a 100 Ω resistor rated 0.25 W.

I = 5 V ÷ 100 Ω = 0.05 A, so P = V × I = 5 V × 0.05 A = **0.25 W**

That's its full rating. Keep parts at **half their rating or less**: use a 0.5 W resistor.

Units and prefixes

QUANTITY	SYMBOL	UNIT
Voltage (the push)	V	volt, V
Current (the flow)	I	amp, A
Resistance (the squeeze)	R	ohm, Ω
Power (energy per second)	P	watt, W

PREFIX	MEANS	EXAMPLE
M mega	× 1,000,000	1 MΩ = 1,000,000 Ω
k kilo	× 1,000	4.7 kΩ = 4,700 Ω
m milli	÷ 1,000	20 mA = 0.02 A
µ micro	÷ 1,000,000	500 µA = 0.0005 A

Convert to volts, amps and ohms before you substitute. Or use the shortcut: volts ÷ kΩ gives mA directly, so 9 V ÷ 4.7 kΩ ≈ 1.9 mA. Case matters: m is milli, M is mega.

Check your answer

- **More resistance → less current:** double R, half the current.
- **More voltage → more current:** double V, double the current.
- **Double the current → four times the heat,** as P = I² × R.
- **Too big or too small by 1000?** Check you converted mA and kΩ.

Numbers worth knowing

- An AA cell is **1.5 V**, a USB port **5 V**, a PP3 battery **9 V**.
- A red LED drops about **2.0 V**, a blue or white one about **3.2 V**, at **20 mA**.
- Small resistors are rated **0.25 W**. Keep them under 0.125 W.
- An Arduino pin gives **5 V**: keep its current under **20 mA**.