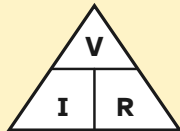


Electricity at Home and in the Car

Ohm's law and power · real-world practice · ages 14–16 (grades 9–10) · 50 min

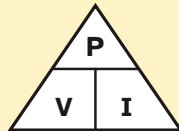
Name: _____ Class: _____ Date: _____

7 cm given ? unknown formula



$$V = I \cdot R$$

$$I = \frac{V}{R} \quad R = \frac{V}{I}$$



$$P = V \cdot I$$

$$I = \frac{P}{V} \quad V = \frac{P}{I}$$

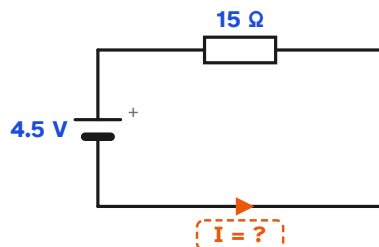
Also:

$$P = I^2 \cdot R \quad P = \frac{V^2}{R}$$

Cover the letter you are looking for in the triangle: what is left is the formula. Units: V (volt), A (ampere), Ω (ohm), W (watt).

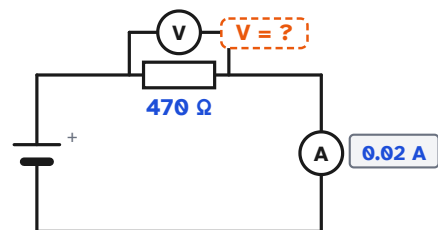
●○○ Level 1 · Circuits

1 What current flows?



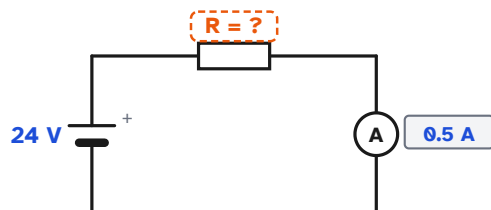
Answer: _____

2 What does the voltmeter read?



Answer: _____

3 What is the resistance?



Answer: _____

4 A 2.2 k Ω resistor is connected to 11 V. What current flows, in mA?

Answer: _____

●●○ Level 2 · Labels

Read the label and choose the values you need.

5 How many amps does it draw?

CAR HEADLIGHT BULB
12 V · 55 W

Answer: _____

6 What current does it draw?

COFFEE MAKER
120 V ~ 60 Hz · 900 W

Answer: _____

7 How much power does it deliver at the output?

PHONE CHARGER

Input: 100–240 V ~ 0.5 A

Output: 5 V = 3 A

Answer: _____

8 What current does it draw?

MICROWAVE OVEN

120 V ~ 60 Hz · 1200 W

Answer: _____

●●● **Level 3 • Problems**

9 A 1,500 W space heater runs on 120 V. What current does it draw? What is its resistance?

Answer: _____

10 A power strip is rated for 15 A at 120 V. What is the most power it can handle? Can you plug in a 1,500 W kettle and a 1,000 W toaster at the same time?

Answer: _____

11 A 100 Ω resistor is rated for 0.25 W at most. Can you connect it to 9 V?

Answer: _____

12 A 100 W TV is on 5 hours a day. How many kWh does it use in 30 days? If electricity costs \$0.16 per kWh, how much does that cost?

Answer: _____

Answers (scrambled): 15 W · 48 Ω · 7.5 A · 0.81 W (no) · 5 mA · 10 A · 4.58 A · 15 kWh (\$2.40) · 0.3 A · 1,800 W (no) · 9.4 V · 12.5 A and 9.6 Ω

Can't find your answer? In #4, if you got 0.005: that is in amps; multiply by 1,000 for mA. In #5, if you got 660: you multiplied instead of dividing. In #11, if you got 0.09: you found the current, not the power.

Safety: never experiment with wall outlets (120 V or 230 V). The circuits on this sheet use batteries or low-voltage power supplies.



Check your answers with the step-by-step solution: zapcalculator.com/calculate-watts-amps-and-voltage
Free to use in the classroom · CC BY 4.0

For the teacher (do not photocopy)

Goal: find voltage, current or resistance with $V = I \cdot R$, find power with $P = V \cdot I$ and read real appliance labels.

When: practice or homework, after the measurements (or data) that lead to $V = I \cdot R$. **Time:** 50 min. **Materials:** calculator; if possible, real labels from appliances at home.

Household voltage: 120 V in the US and Canada (127 V in Mexico); 230 V in the UK, Europe, Australia and India.

Answer key

1. $I = 4.5 \div 15 = 0.3 \text{ A}$
2. $V = 0.02 \times 470 = 9.4 \text{ V}$
3. $R = 24 \div 0.5 = 48 \Omega$
4. $I = 11 \div 2,200 = 0.005 \text{ A} = 5 \text{ mA}$
5. $I = 55 \div 12 \approx 4.58 \text{ A}$
6. $I = 900 \div 120 = 7.5 \text{ A}$
7. $P = 5 \times 3 = 15 \text{ W}$
8. $I = 1,200 \div 120 = 10 \text{ A}$
9. $I = 1,500 \div 120 = 12.5 \text{ A}$; $R = 120 \div 12.5 = 9.6 \Omega$ (or $V^2 \div P = 14,400 \div 1,500$)
10. $P = 15 \times 120 = 1,800 \text{ W}$; $1,500 + 1,000 = 2,500 \text{ W} > 1,800 \text{ W}$: no
11. $P = V^2 \div R = 81 \div 100 = 0.81 \text{ W} > 0.25 \text{ W}$: no (5 V at most)
12. $100 \text{ W} \times 5 \text{ h} \times 30 = 15,000 \text{ Wh} = 15 \text{ kWh}$; $15 \times \$0.16 = \$2.40$

Mistakes to watch for

- Using the triangle from memory and solving the wrong way (multiplying instead of dividing).
- Mixing up mA and A, k Ω and Ω , kW and kWh.
- Thinking that a more powerful appliance has more resistance (at the same voltage, it's the other way around).

Exit ticket

How many appliances can you plug into a 15 A power strip? Pick three at home, find their power on the label and check whether they fit.