

Resistance and how Ohm linked v, i and r

Grade 8 science (Year 9 · Class 8) · Worksheet answers

Each answer shows the formula, the substitution and the final result in bold with its unit. Check that you convert milliamperes and kilohms before substituting.

Level: Grade 8 science (Year 9 · Class 8) · **Curriculum:** MS-PS2-3

Problem 1 Quantities and units

1. The unit is the **ohm, symbol Ω** .
2. An **ammeter, connected in series**.
3. A **voltmeter, connected in parallel** across the component.

Problem 2 Prefix conversions

1. $4.7 \times 1000 = \mathbf{4700 \Omega}$.
2. $250 \div 1000 = \mathbf{0.250 A}$.
3. $0.033 \times 1000 = \mathbf{33 mA}$.
4. $2200 \div 1000 = \mathbf{2.2 k\Omega}$.

Problem 3 Find the current

1. $I = V \div R$.
2. $I = 12 \text{ V} \div 4.0 \Omega = \mathbf{3.0 A}$.

Problem 4 Find the voltage

1. $V = I \times R = 0.50 \text{ A} \times 24 \Omega = \mathbf{12 V}$.

Problem 5 Find the resistance

1. $R = V \div I = 9.0 \text{ V} \div 0.30 \text{ A} = \mathbf{30 \Omega}$.

Problem 6 Where do the meters go?

1. The ammeter A is **in series** and the voltmeter V is **in parallel** with the resistor.
2. V measures the **potential difference across the resistor**.

Problem 7 Two resistors on a graph

1. $R = 8.0 \div 0.40 = \mathbf{20 \Omega}$.
2. $R = 8.0 \div 0.16 = \mathbf{50 \Omega}$.

3. X has the smaller resistance, so more current flows for each volt, and the line is **steeper**.

Problem 8 A kettle element

1. $I = 230 \div 46 = \mathbf{5.0\ A}$.
2. The current would **double to 10 A**, because I is inversely proportional to R .

Problem 9 A longer wire

1. $R = 1.6 \div 0.80 = \mathbf{2.0\ \Omega}$.
2. Twice the length gives twice the resistance: **4.0 Ω** .
3. $I = 1.6 \div 4.0 = \mathbf{0.40\ A}$.

Problem 10 Data table

1. $2.0 \div 0.10 = 20$, $4.0 \div 0.20 = 20$, $6.0 \div 0.30 = 20$, $8.0 \div 0.40 = 20$: **20 Ω each time**.
2. R is constant, so the resistor is **ohmic**. Its I - V graph is a straight line through the origin.

Problem 11 A bulb's resistance

1. $R = 2.0 \div 0.30 = \mathbf{6.7\ \Omega}$.
2. $R = 6.0 \div 0.50 = \mathbf{12\ \Omega}$.
3. The filament gets hotter at the higher voltage, so its atoms vibrate more and the resistance **rises**.

Problem 12 A dimmer switch

1. $I = 6.0 \div 5.0 = \mathbf{1.2\ A}$.
2. $I = 6.0 \div 20 = \mathbf{0.30\ A}$.
3. The current falls, so the lamp gets **dimmer**.

Problem 13 Spot the errors

1. (a) Doubling V **doubles** I for an ohmic resistor. (b) **R stays the same**. (c) A voltmeter is connected **in parallel**.

Problem 14 Electrical safety

1. $I = 230 \div 100\ 000 = 0.0023\ \text{A} = \mathbf{2.3\ \text{mA}}$.
2. $I = 230 \div 1\ 000 = 0.23\ \text{A} = \mathbf{230\ \text{mA}}$.
3. The current is **100 times bigger** with wet skin, which can be fatal because the heart is affected by currents above about 30 mA.

Problem 15 Wire comparison

1. Q is twice as long, so R is **8.0 Ω** .
2. S has double the area, so R is halved: **2.0 Ω** .

Problem 16 An LED resistor

1. The voltages in series add up to 9.0 V, so $9.0 - 2.0 =$ **7.0 V**.
2. 20 mA = **0.020 A**.
3. $R = 7.0 \div 0.020 =$ **350 Ω** .

Problem 17 Two resistors in series

1. $R = 100 + 220 =$ **320 Ω** .
2. $I = 9.6 \div 320 =$ **0.030 A**.
3. $V = 0.030 \times 220 =$ **6.6 V**.
4. Across 100 Ω : $0.030 \times 100 = 3.0$ V, and $3.0 + 6.6 =$ **9.6 V**, which matches.

Problem 18 Gradient of a graph

1. Gradient = $0.20 \text{ A} \div 8.0 \text{ V} =$ **0.025 A/V**.
2. $R = 1 \div \text{gradient} = 1 \div 0.025 =$ **40 Ω** .
3. $I = 9.0 \div 40 =$ **0.225 A**, about 0.23 A.

Problem 19 Plan an investigation

1. Independent: **length**. Dependent: **resistance**. Controls: same wire, same thickness, same temperature (keep the current small).
2. Connect the wire in series with an ammeter and a cell, put a voltmeter across the length, read V and I, and calculate $R = V \div I$ for lengths from 10 cm to 100 cm.
3. A **straight line through the origin**: R is proportional to length, because doubling the length doubles the number of collisions.

Problem 20 A fire alarm sensor

1. At 20 °C: $R = 5.0 \div 0.0010 =$ **5000 Ω** . At 60 °C: $R = 5.0 \div 0.0040 =$ **1250 Ω** .
2. $5000 \div 1250 =$ **4.0**, so the resistance falls to a quarter.
3. When heat raises the temperature the current rises sharply, which a circuit can detect to trigger the alarm.