

Ohm's law and component characteristics

Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Worksheet answers

Full answers follow each problem in the same order. Check each substitution, confirm the units cancel, and compare any graph readings with the values given in the figures.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** GCSE P2, IGCSE 4.3

Problem 1 Quantities and units

1. **Ampere (A).**
2. **Volt (V).**
3. **Ohm (Ω).**
4. **Coulomb (C).**

Problem 2 Finding voltage

1. $V = I \times R$.
2. $V = 0.50 \times 12 = \mathbf{6.0\ V}$.

Problem 3 Finding resistance

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

Problem 4 Finding current

1. $I = V \div R$.
2. $I = 12 \div 48 = \mathbf{0.25\ A}$.

Problem 5 Unit conversions

1. 350 mA = **0.35 A**.
2. 4.7 k Ω = **4700 Ω** .
3. 2.2 M Ω = **2 200 000 Ω** ($2.2 \times 10^6\ \Omega$).

Problem 6 Reading a resistor graph

1. Halfway between 0.20 A and 0.40 A: **0.30 A**.
2. $R = 3.0 \div 0.30 = \mathbf{10\ \Omega}$ (the same at any point).
3. The resistance is **constant** and I is proportional to V, so the resistor is ohmic.

Problem 7 Thermistor resistance

1. $3.0 \text{ mA} = 0.0030 \text{ A}$.
2. $R = 6.0 \div 0.0030 = \mathbf{2000 \Omega = 2.0 \text{ k}\Omega}$.

Problem 8 Energy from the battery

1. $W = Q \times V$.
2. $W = 45 \times 12 = \mathbf{540 \text{ J}}$.

Problem 9 Charge and energy in a lamp

1. $Q = I t = 0.50 \times 120 = \mathbf{60 \text{ C}}$.
2. $W = Q V = 60 \times 6.0 = \mathbf{360 \text{ J}}$.

Problem 10 Filament lamp data

1. $R = V \div I$: 10.0Ω , 11.1Ω , 12.5Ω , 13.8Ω , 15.2Ω .
2. The resistance **increases** as the current and voltage rise.
3. The filament gets hotter, so its ions vibrate more and collide with electrons more often.

Problem 11 A diode in a phone charger

1. About **0.4 V** (the current rises steeply above about 0.6 V).
2. $R = 0.75 \div 0.050 = \mathbf{15 \Omega}$.
3. Almost **zero**: the resistance is very large in reverse.

Problem 12 LDR street lamp

1. $I = 4.0 \div 200 = \mathbf{0.020 \text{ A (20 mA)}}$.
2. $I = 4.0 \div 50\,000 = \mathbf{8.0 \times 10^{-5} \text{ A (80 }\mu\text{A)}}$.
3. $0.020 \div 0.000080 = \mathbf{250}$ times.

Problem 13 Thermistor graph

1. $5.3 \text{ k}\Omega$ at 40°C and $1.3 \text{ k}\Omega$ at 80°C .
2. At 40°C : $I = 6.0 \div 5300 = \mathbf{1.1 \text{ mA}}$. At 80°C : $I = 6.0 \div 1300 = \mathbf{4.6 \text{ mA}}$.
3. The resistance **falls** as temperature rises, so the current increases.

Problem 14 Resistance of wires

1. Three times as long gives three times the resistance: **12Ω** .
2. Double the area halves it: $12 \div 2 = \mathbf{6.0 \Omega}$.

Problem 15 Spot the errors

1. An ammeter is connected in **series**.
2. $R = V \div I$.
3. An NTC thermistor's resistance **decreases** when it is heated.
4. A diode conducts in **one direction only**.

Problem 16 Gradient of an unknown resistor

1. Gradient = $(101 - 21) \div (5.0 - 1.0) = 80 \div 4.0 = \mathbf{20 \text{ mA/V}} = 0.020 \text{ A/V}$.
2. $R = 1 \div \text{gradient} = 1 \div 0.020 = \mathbf{50 \Omega}$.
3. **Yes**: the points lie on a straight line through the origin (current $\propto$ voltage), within experimental error.

Problem 17 Thermistor and fixed resistor

1. $R = 5.3 + 1.0 = 6.3 \text{ k}\Omega$; $I = 6.0 \div 6300 = \mathbf{0.95 \text{ mA}}$.
2. $R = 1.3 + 1.0 = 2.3 \text{ k}\Omega$; $I = 6.0 \div 2300 = \mathbf{2.6 \text{ mA}}$.
3. $V = I R$: at 40°C $0.95 \text{ mA} \times 1000 = \mathbf{0.95 \text{ V}}$; at 80°C $2.6 \text{ mA} \times 1000 = \mathbf{2.6 \text{ V}}$. The voltage across the resistor rises with temperature, so an alarm can trigger when it passes a set value.

Problem 18 Hot and cold lamp

1. $R = 12 \div 0.50 = \mathbf{24 \Omega}$.
2. $I = 12 \div 3.0 = \mathbf{4.0 \text{ A}}$, eight times the running current.
3. The large surge heats and stresses the thin filament, so a weak spot can melt at switch-on.

Problem 19 Plan a light investigation

1. Independent: **distance from the lamp**. Dependent: **resistance**. Control: lamp brightness and room light.
2. Connect the LDR in series with an ammeter and a cell, with a voltmeter across the LDR. At each distance, calculate $R = V \div I$.
3. Draw a graph of R against distance. Keep hands away from the hot lamp.

Problem 20 Mystery components

1. P: 20Ω , 20Ω , 20Ω . Q: 10Ω , 13Ω , 17Ω . R: 40Ω , 27Ω , 15Ω .
2. **P is the ohmic resistor** (constant R), **Q is the filament lamp** (R rises as it heats) and **R is the thermistor** (R falls as it warms).