

Circuit rules, power and mains safety

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

Model answers use the sample table. Your own results will differ slightly, but the straight-line graph through the origin and a gradient close to the resistor value should appear in every good data set.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** GCSE P2, HS-PS3-3

Question 1 Planning the readings

Independent variable: **the supply voltage** (which sets the current). Dependent variable: **the power** (calculated from V and I). Controls: the same 10 Ω resistor and the same temperature or room conditions, with the switch closed only briefly.

Question 2 Check one row

$P = VI = 4.0 \times 0.39 = 1.56 \text{ W}$. $I^2R = 0.39^2 \times 10 = 0.1521 \times 10 = 1.52 \text{ W}$. Difference = $(1.56 - 1.52) \div 1.52 \times 100 = \text{about } 2.6 \%$, within the measurement uncertainty.

Question 3 Plot and gradient

The points lie on a straight line through the origin, so P is proportional to I^2 . Gradient = $(3.54 - 0.10) \div (0.348 - 0.010) = 3.44 \div 0.338 = \mathbf{10.2 \Omega}$. The unit is $\text{W} \div \text{A}^2 = \Omega$.

Question 4 Resistance from $V \div I$

$V \div I = 10.0, 10.0, 10.3, 10.3, 10.2$ and 10.2Ω . The mean is **10.2 Ω** , the same as the gradient and close to the labelled 10 Ω .

Question 5 Heating effect

The resistor transfers electrical energy as heat. Leaving the current on lets it warm up, and in a metal the resistance rises with temperature, so later readings would not match earlier ones. At 6.0 V it dissipates about 3.5 W, so **the resistance may rise slightly**, which fits the slight upward drift in $V \div I$.

Question 6 Uncertainty

At 0.10 A: $0.01 \div 0.10 \times 100 = \mathbf{10 \%}$. At 0.59 A: $0.01 \div 0.59 \times 100 = \mathbf{1.7 \%}$. The large-

current readings are more reliable. The uncertainty in I^2 is double that in I .

Question 7 Improve the lab

Use an ammeter with a finer resolution (0.001 A) and take more readings, especially at higher currents. Repeat each measurement and average. **These reduce random and resolution uncertainty.**