

AS Physics 9702

Unit 9 · Electricity

Original worksheet

Name: _____ Date: _____

Suggested marks: 70. Work through the questions over more than one study session if needed. Use additional paper for extended working and graph paper where requested.

Show equations, substitutions, units and reasoning. Use the constants specified in each question. The questions are original practice, not an official Cambridge examination or mark scheme.

Scope: Cambridge International AS Physics 9702, 2025–2027 learning outcomes. The published 2028–2030 AS scope has been checked separately and is substantively unchanged. Version: 11 October 2026.

U9-Q1 · 6 marks

A metal lead carries a steady conventional current of 0.32 A from P to Q for 75 s. (a) Identify the mobile charge carriers and their drift direction. (b) Find the charge crossing a section and the number of electrons involved, using $e = 1.60 \times 10^{-19}$ C. (c) Explain why removing electrons cannot leave an otherwise neutral object with charge $+4.0 \times 10^{-19}$ C.

U9-Q2 · 7 marks

A wire of cross-sectional area 0.25 mm^2 carries 0.60 A. Its mobile-electron number density is $7.5 \times 10^{28} \text{ m}^{-3}$. Use $e = 1.60 \times 10^{-19}$ C. (a) Derive $I = Anvq$ by counting the carriers crossing a section in time t . (b) Calculate their drift speed. (c) A second wire of the same material and temperature has twice the cross-sectional area and carries the same current. Find its drift speed.

U9-Q3 · 7 marks

A component transfers 216 J from electrical energy while 36 C passes through it in 90 s. (a) Define potential difference and calculate it. (b) Calculate the current, power and operating resistance. (c) Verify the power using both I^2R and V^2/R .

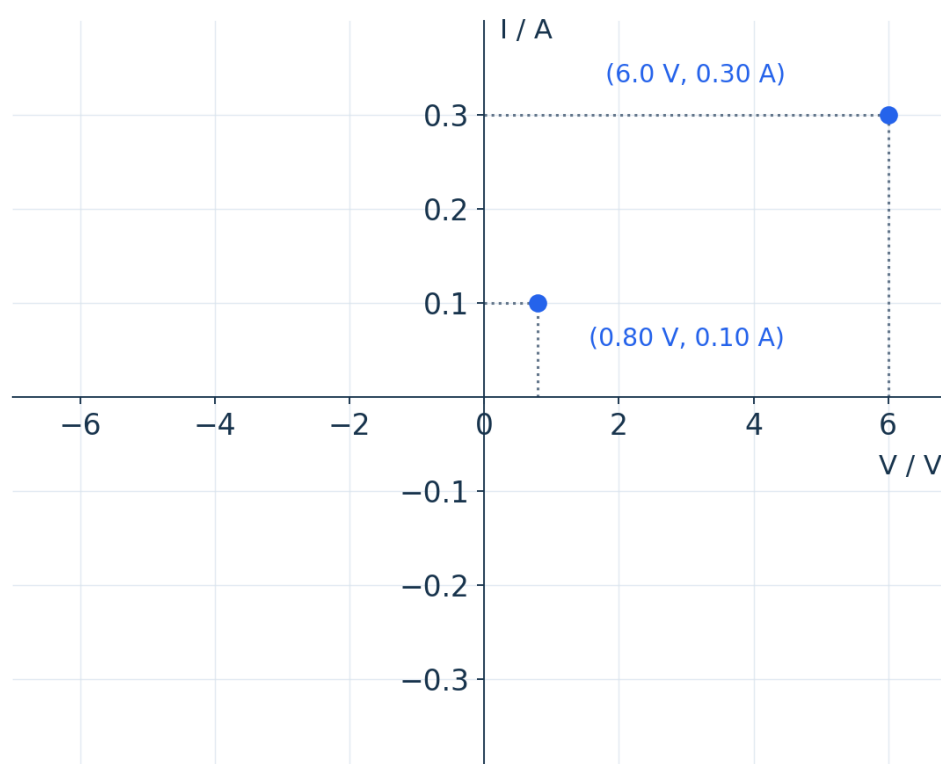
U9-Q4 • 6 marks

A fixed resistor takes 0.150 A at 9.0 V and remains at the same temperature throughout. (a) Define resistance and find its value. (b) Find its power and the energy dissipated in 4.0 minutes. (c) A 120 Ω resistor replaces it across the same 9.0 V source. Find the new power and explain why it is smaller despite the larger resistance.

U9-Q5 • 9 marks

(a) State Ohm's law. On axes with I vertical and V horizontal, sketch the positive- and negative-voltage characteristics of a constant-temperature metal resistor and a filament lamp. (b) A lamp draws 0.10 A at 0.80 V and 0.30 A at 6.0 V. Calculate its resistance at each point and explain the change microscopically. (c) State how the resistance at the 6.0 V point is obtained from the I-V graph, and why the local tangent is not used.

Figure for U9-Q5

U9-Q5 • Supplied lamp measurements

The two measured points are shown. Add the requested sketches separately.

U9-Q6 · 5 marks

(a) Sketch the I-V characteristic of a semiconductor diode over its normal forward- and reverse-bias operating ranges. (b) Describe a circuit and procedure for measuring it safely. Explain why a current-limiting component is needed even when the supply voltage is adjustable.

U9-Q7 · 7 marks

A uniform wire is 2.40 m long and 0.400 mm in diameter. Its measured resistance is 4.20 Ω . (a) Find its resistivity. (b) Find the resistance of a 1.20 m length of the same material at the same temperature with diameter 0.800 mm. (c) For the original wire, the percentage uncertainties in R, L and d are 2.0%, 0.5% and 1.0%. Estimate the maximum percentage uncertainty in ρ and give an absolute uncertainty.

U9-Q8 · 6 marks

Measurements on different lengths of one wire give $R = 0.35 \Omega$ at $L = 0.20$ m and $R = 0.95 \Omega$ at $L = 0.80$ m. A straight best-fit R-L graph passes through these two values. Its cross-sectional area is 0.180 mm^2 . (a) Calculate the gradient, resistivity and intercept. (b) Suggest a reason for the intercept and explain why the gradient method is useful. (c) Give one precaution that limits a temperature-related bias.

U9-Q9 · 6 marks

An LDR changes from 28 k Ω in a shaded box to 3.5 k Ω under a bright lamp. An NTC thermistor changes from 9.0 k Ω at 18 $^{\circ}\text{C}$ to 2.0 k Ω at 55 $^{\circ}\text{C}$. (a) State the resistance trend for each sensor and explain why heating a metal does not give the same trend as this thermistor. (b) Describe one control needed for each sensor's calibration. (c) At 0.50 V across the hot thermistor, calculate its current.

U9-Q10 · 5 marks

A 5.0 V device takes 0.20 A for its first 30 s, then 0.050 A for another 90 s. The supply voltage remains constant. (a) Find the total charge delivered and average current over 120 s. (b) Find the total energy delivered and the power during each interval.

U9-Q11 · 3 marks

Diagnostic multiple choice. Two wires have the same carrier number density, carrier charge and current. Wire X has twice the diameter of wire Y. Which statement is correct? A: $v_X = 4v_Y$. B: $v_X = 2v_Y$. C: $v_X = v_Y/2$. D: $v_X = v_Y/4$. Choose one option and justify it.

U9-Q12 · 3 marks

Diagnostic multiple choice. A filament lamp's I-V graph, with I vertical, becomes less steep at higher positive voltages. Which explanation is best? A: Electrons are used up in the filament. B: The hotter lattice causes greater electron scattering, raising resistance. C: The lamp must obey Ohm's law because $R = V/I$ can be calculated. D: The filament's resistance equals the local I-V tangent gradient. Choose one option and reject the others.

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