

AS Physics 9702

Unit 9 · Electricity

Worked answers

Try the separate worksheet first. These worked answers explain methods as well as results. Equivalent valid reasoning and sensible rounding may also be correct. Suggested marks are RevisionTown practice guidance, not Cambridge marking instructions.

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) Electrons carry the current and drift from Q to P, opposite to conventional current [2]. (b) $Q = It = 0.32 \times 75 = 24 \text{ C}$ [1]. $N = Q/e = 24/(1.60 \times 10^{-19}) = 1.5 \times 10^{20}$ electrons [1]. (c) The proposed charge is $2.5e$ [1], which would require removing half an electron in addition to whole electrons. Net charge from adding or removing electrons is an integer multiple of e [1].

U9-Q2 · 7 marks

(a) In time t a drift distance vt corresponds to a volume Avt [1]. It contains $nAvt$ carriers, of charge $nAvtq$ [1]. $I = Q/t$ gives $I = Anvq$ [1]. (b) $A = 2.5 \times 10^{-7} \text{ m}^2$ [1]. $v = 0.60/[(2.5 \times 10^{-7})(7.5 \times 10^{28})(1.60 \times 10^{-19})] = 2.0 \times 10^{-4} \text{ m s}^{-1}$ [2]. (c) v is inversely proportional to A at fixed I , n and q , so it becomes $1.0 \times 10^{-4} \text{ m s}^{-1}$ [1].

U9-Q3 · 7 marks

(a) Potential difference is energy transferred per unit charge [1]; $V = W/Q = 216/36 = 6.0 \text{ V}$ [1]. (b) $I = 36/90 = 0.40 \text{ A}$ [1]; $P = 216/90 = 2.4 \text{ W}$ [1]; $R = 6.0/0.40 = 15 \Omega$ [1]. (c) $I^2R = 0.40^2 \times 15 = 2.4 \text{ W}$ [1], and $V^2/R = 6.0^2/15 = 2.4 \text{ W}$ [1].

U9-Q4 · 6 marks

(a) Resistance is the ratio of p.d. to current [1]; $R = 9.0/0.150 = 60 \Omega$ [1]. (b) $P = VI = 1.35 \text{ W}$ [1]; $W = Pt = 1.35 \times 240 = 324 \text{ J}$ [1]. (c) $P = V^2/R = 81/120 = 0.675 \text{ W}$ [1]. Voltage is fixed, so doubling resistance halves the current and the power [1].

U9-Q5 · 9 marks

(a) I is directly proportional to V when temperature and other physical conditions are constant [1]. The metal graph is a straight line through the origin in quadrants I and III [1]. The lamp curve passes through the origin, flattening as $|V|$ rises, with opposite-sign matching branches [2]. (b) The resistances are $0.80/0.10 = 8.0 \Omega$ and $6.0/0.30 = 20 \Omega$ [2]. The filament becomes hotter; stronger lattice vibrations produce greater electron scattering and hence greater resistance [2]. (c) $R = V/I = 20 \Omega$, the inverse gradient of the origin-to-point line; a tangent gives a local change ratio rather than the point's V/I [1].

U9-Q6 · 5 marks

(a) Label V horizontally and I vertically. In forward bias, show initially small current followed by a steep upward curve [1]. In reverse bias, show almost zero current, with no substantial reverse current in the specified range [1]. (b) Connect diode, ammeter and protective resistor in series with the variable low-voltage supply; connect a voltmeter across the diode [1]. Start at low voltage, record pairs, switch off before reversing connections, then repeat for reverse bias [1]. The steep forward characteristic means a small voltage increase can cause excessive current; the series resistor limits it and protects the diode [1].

U9-Q7 · 7 marks

(a) $A = \pi(4.00 \times 10^{-4})^2/4 = 1.2566 \times 10^{-7} \text{ m}^2$ [1]. $\rho = RA/L = 4.20 \times 1.2566 \times 10^{-7}/2.40 = 2.20 \times 10^{-7} \Omega \text{ m}$ [2]. (b) The length is halved and area quadrupled, so $R = 4.20/8 = 0.525 \Omega$ [2]. (c) Maximum percentage uncertainty = $2.0 + 0.5 + 2(1.0) = 4.5\%$ [1]. Absolute uncertainty = $0.045 \times 2.20 \times 10^{-7} = 0.10 \times 10^{-7} \Omega \text{ m}$; report approximately $(2.20 \pm 0.10) \times 10^{-7} \Omega \text{ m}$ [1].

U9-Q8 · 6 marks

(a) Gradient = $(0.95 - 0.35)/(0.80 - 0.20) = 1.00 \Omega \text{ m}^{-1}$ [1]. Since gradient = ρ/A , $\rho = 1.00 \times 1.80 \times 10^{-7} = 1.80 \times 10^{-7} \Omega \text{ m}$ [1]. Intercept = $0.35 - 1.00(0.20) = 0.15 \Omega$ [1]. (b) Approximately constant lead/contact resistance could add 0.15Ω [1]. It changes the intercept but not the gradient, so the gradient separates it from the wire's resistance per unit length [1]. (c) Use low current and brief measurements, switching off between readings to limit heating [1].

U9-Q9 · 6 marks

(a) An LDR's resistance falls as light intensity increases [1]; an NTC thermistor's resistance falls as temperature rises [1]. In the thermistor, increased mobile-carrier availability dominates; in a metal, greater lattice vibration increases electron scattering, so resistance rises [1]. (b) Keep other illumination and the LDR's temperature controlled; for the thermistor, allow thermal equilibrium in a stirred bath and use small current to avoid self-heating [2]. (c) $I = V/R = 0.50/2000 = 2.5 \times 10^{-4} \text{ A} = 0.25 \text{ mA}$ [1].

U9-Q10 · 5 marks

(a) $Q = (0.20)(30) + (0.050)(90) = 10.5 \text{ C}$ [1]. $I_{\text{average}} = 10.5/120 = 0.0875 \text{ A}$ [1]. (b) $W = VQ = 5.0 \times 10.5 = 52.5 \text{ J}$ [1]. The two powers are $VI = 1.0 \text{ W}$ and 0.25 W [2]. Equivalently, $1.0 \times 30 + 0.25 \times 90 = 52.5 \text{ J}$.

U9-Q11 · 3 marks

D is correct [1]. Doubling diameter quadruples area [1], and $I = Anvq$ makes v inversely proportional to A at fixed I , n and q [1]. A reverses the inverse relationship; B also treats area as proportional to diameter; C gets the inverse trend but misses the squared diameter.

U9-Q12 · 3 marks

B is correct [1]. Heating increases scattering and V/I , so the I - V curve flattens [1]. A violates charge conservation. C confuses the definition of resistance with constant resistance under Ohm's law. D has the wrong ratio and uses a tangent instead of the origin-to-point relation for a nonlinear graph [1 for identifying the three errors].

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