

AS Physics 9702

Unit 10 · D.C. circuits

Original worksheet

Name: _____ Date: _____

Suggested marks: 115. 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.

U10-Q1 · 27 marks

Symbol fluency. Without looking at the chart, draw and label one standard symbol for each item: cell; battery of cells; power supply; a.c. power supply; junction of conductors; lamp; fixed resistor; variable resistor; thermistor; LDR; heater; switch; earth; electric bell; buzzer; microphone; loudspeaker; motor; generator; ammeter; voltmeter; galvanometer; potentiometer; oscilloscope; diode; LED; capacitor. Include leads and preserve the features distinguishing similar symbols.

U10-Q1: symbol drawing space		
Cell	Battery of cells	Power supply
A.C. power supply	Junction of conductors	Lamp
Fixed resistor	Variable resistor	Thermistor
LDR	Heater	Switch
Earth	Electric bell	Buzzer

U10-Q1: symbol drawing space		
Microphone	Loudspeaker	Motor
Generator	Ammeter	Voltmeter
Galvanometer	Potentiometer	Oscilloscope
Diode	LED	Capacitor

U10-Q2 · 6 marks

Draw this circuit using standard symbols. The positive terminal of a cell connects through an open switch, an ammeter and a variable resistor, in that order, to a lamp; the lamp returns to the cell's negative terminal. A voltmeter connects directly across the lamp. (a) Show all connections and mark conventional current when the switch closes. (b) Consider two separate wiring mistakes, one at a time: (i) the ammeter is connected directly across the cell instead of in series, with a wire restoring the original series path; (ii) the ammeter remains correctly in series, but the voltmeter is moved from across the lamp into the series path between the variable resistor and lamp. Explain the danger or measurement failure in each case.

U10-Q3 · 7 marks

A source converts 420 J of chemical energy into electrical energy while 35 C travels through it. During the same interval its internal resistance dissipates 70 J. (a) Define e.m.f. and calculate it. (b) Calculate the external terminal p.d. and distinguish it from e.m.f. using energy transfers. (c) If the current is 2.0 A, calculate the internal resistance.

U10-Q4 · 7 marks

A source with e.m.f. 8.4 V and internal resistance $0.60\ \Omega$ is connected only to an external $3.6\ \Omega$ resistor. (a) Find current, terminal p.d., external power and internal heating power. (b) The load is replaced by $7.8\ \Omega$. Find the new terminal p.d. and explain its change. (c) State a safety reason not to replace the load with a wire.

U10-Q5 · 6 marks

For a source, terminal readings are ($I = 0.20\text{ A}$, $V = 5.76\text{ V}$) and ($I = 0.80\text{ A}$, $V = 5.04\text{ V}$). They lie on a straight V - I best-fit line. (a) Find its gradient, internal resistance and e.m.f. (b) Predict the terminal voltage at 0.50 A . (c) Describe a safe way to obtain additional points and one cause of a systematic deviation from the straight line.

U10-Q6 · 10 marks

(a) State both Kirchhoff laws and the conservation principle behind each. (b) Derive the combined resistance of two resistors in series and two in parallel from these laws. (c) Calculate the combined resistance of $4.0\ \Omega$ and $12\ \Omega$ when connected first in series, then in parallel. Check each result against the component values.

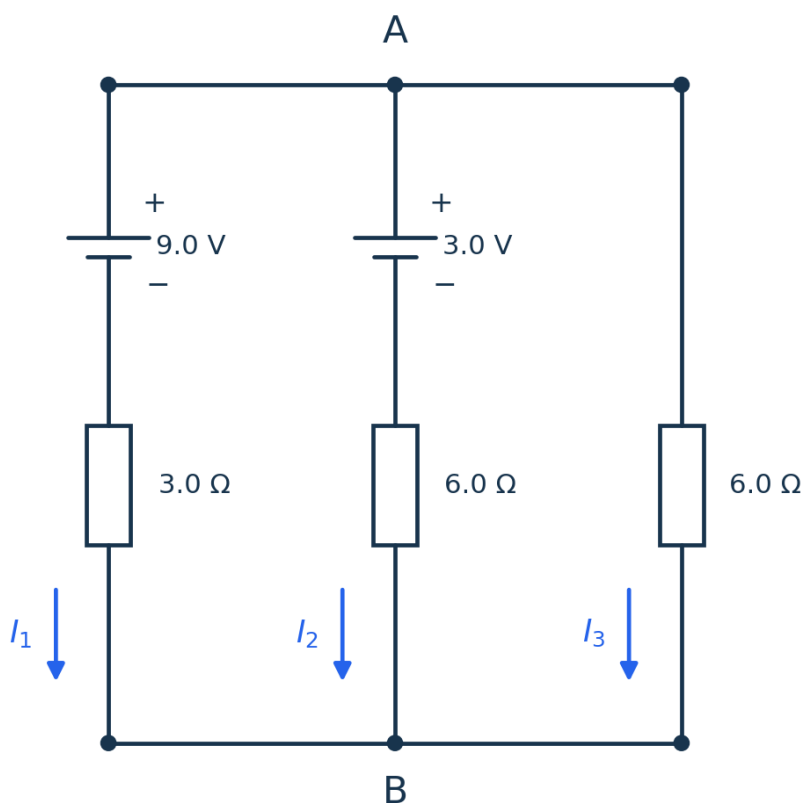
U10-Q7 · 7 marks

An ideal 15 V source is connected to a $2.0\ \Omega$ resistor from its positive terminal to node J. From J there are two branches to the negative terminal: one contains a $6.0\ \Omega$ resistor and the other a $3.0\ \Omega$ resistor. (a) Find total resistance and source current. (b) Find the potential of J relative to the negative terminal and the current in each branch. (c) Check both Kirchhoff laws numerically.

U10-Q8 · 8 marks

Nodes A and B are joined by three separate branches. Branch 1 contains an ideal 9.0 V cell, with its positive terminal at A, followed by a $3.0\ \Omega$ resistor leading to B. Branch 2 contains an ideal 3.0 V cell, also with its positive terminal at A, followed by a $6.0\ \Omega$ resistor leading to B. Branch 3 is a single $6.0\ \Omega$ resistor directly from A to B. Let $V = V_A - V_B$, and initially define all three currents from A to B. Find V and the three signed currents, stating each actual direction.

Figure for U10-Q8

U10-Q8 • Three parallel branches

All arrows are assumed directions, from A to B.

U10-Q9 · 7 marks

An ideal 9.0 V source feeds an upper 3.0 k Ω resistor from positive to J and a lower 6.0 k Ω resistor from J to the 0 V terminal. (a) Derive the unloaded divider expression and find the output $V_J - 0$ V. (b) A 6.0 k Ω load is connected between J and 0 V. Find the new output and source current. (c) Explain why the original expression cannot be used with the original lower resistance after adding the load.

U10-Q10 · 8 marks

A 6.0 V source has a fixed 3.0 k Ω resistor from its positive terminal to J, and an LDR from J to 0 V. The output is J relative to 0 V. The LDR is 12 k Ω in dim light and 3.0 k Ω in bright light. (a) Find both output voltages and describe their trend. (b) The LDR and fixed resistor exchange positions. Find the new dim and bright outputs. (c) With an NTC thermistor replacing the LDR, state the output trend on warming in each arrangement and explain why the arrangements respond oppositely.

U10-Q11 · 8 marks

A uniform potentiometer wire has its high-potential end at A. A reference cell of 1.50 V balances at $AJ = 0.600$ m. With unchanged wire current, an unknown cell balances at 0.484 m. For each test, the cell's positive terminal connects to A and its negative terminal connects through a galvanometer to J. (a) Explain what balance means and find the unknown e.m.f. (b) Explain why internal resistance in the test cell does not lower the measured e.m.f. at balance. (c) Each balance length has maximum uncertainty ± 0.002 m; the reference e.m.f. uncertainty is negligible. Estimate the percentage and absolute uncertainty in the unknown e.m.f.

U10-Q12 · 8 marks

A 1.00 m uniform potentiometer wire has a constant total p.d. of 2.00 V. A correctly connected 1.20 V test cell is balanced. (a) Find its balance length. (b) Explain why a 2.40 V cell cannot be balanced with this setting. (c) State two other reasons for failing to find a valid null and describe one check that distinguishes a real balance from a broken galvanometer connection. (d) Two operating sensor-circuit outputs are compared at the same wire current, balancing at 0.350 m and 0.525 m. Find the ratio of the second p.d. to the first and state one condition needed for that comparison.

U10-Q13 · 3 marks

Diagnostic multiple choice. A battery with nonzero internal resistance supplies one external resistor. The external resistance is increased. Which pair of changes occurs? A: Current rises, terminal p.d. falls. B: Current falls, terminal p.d. rises. C: Current falls, terminal p.d. falls. D: Current is unchanged, terminal p.d. rises. Choose one and justify it.

U10-Q14 · 3 marks

Diagnostic multiple choice. An NTC thermistor connects from the positive rail to J; a fixed resistor connects from J to 0 V. Output is J relative to 0 V. Which statement is correct? A: Warming lowers the output because all warm components have greater resistance. B: Warming raises the output because the upper resistance falls. C: At a potentiometer null, all current in the driver wire stops. D: A galvanometer is connected across a source as an ordinary low-resistance voltmeter. Choose one and explain the errors in the alternatives.

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