InkPhysics

QUESTION WORKBOOK

Circuits and Kirchhoff's laws

Electricity · Year 12

AQA 3.5.1.4 · CIE 9.2.3, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.2.3, 10.2.4, 10.2.5, 10.2.6, 10.2.7
OCR A 4.1.1(g), 4.2.1(a), 4.2.1(b), 4.2.5(a), 4.2.5(b), 4.3.1(a), 4.3.1(b), 4.3.1(c), 4.3.1(d), 4.3.1(e), 4.3.1(f)

20 questions · 60 marks

NAVY SCREEN EDITION

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SECTION A · Warm-up

A1 State Kirchhoff's first law and the conservation principle it expresses. [2]

A2 Two resistors of 20 Ω and 30 Ω are connected in series. Calculate the total resistance. [2]

A3 Two 20 Ω resistors are connected in parallel. Calculate the total resistance. [2]

A4 Two 1.5 V cells are connected in series to form a battery. State the emf of the battery. State the emf if the two identical cells are instead connected in parallel, and give one advantage of the parallel arrangement. [2]

A5 Explain why the combined resistance of two resistors in parallel is always less than the smaller of the two resistances. [2]

A6 State which form of the power equation is most direct for comparing the powers dissipated in two resistors in series, and give the reason. [2]

SECTION B · Standard

B1 A 6.0 Ω resistor and a 3.0 Ω resistor are connected in parallel across a 12 V supply. Calculate (a) the total resistance and (b) the total current from the supply. [3]

B2 A 4.0 Ω and an 8.0 Ω resistor are connected in series across a 12 V supply. Calculate (a) the current in the circuit and (b) the potential difference across each resistor. [4]

B3 At a junction in a circuit, currents of 3.0 A and 2.0 A flow in, and a single wire carries the current out. Determine the current in the output wire, stating the law you use. [2]

B4 A resistor of 5.0 Ω carries a current of 2.0 A. Calculate the power dissipated in it. [2]

B5 An electric shower is rated 10.5 kW at 230 V. Calculate the current it draws and the resistance of its heating element. [3]

B6 A phone charger's packaging claims it delivers 38 kJ of energy in a 45 minute charge. In a test it supplies a steady 2.1 A at 5.0 V for the full 45 minutes. Deduce whether the claim is accurate. [3]

B7 A battery of emf 24 V drives a current round a series loop containing three components. The pds across two of them are 9.0 V and 7.5 V. Determine the pd across the third component, stating the law you use. [2]

B8 A camping heater runs from a 12 V supply of negligible internal resistance and has two identical 4.6 Ω elements. Calculate the total power when the elements are connected (a) in series and (b) in parallel. [4]

SECTION C · Stretch

C1 A 4.0 Ω resistor is connected in series with a parallel combination of a 6.0 Ω and a 3.0 Ω resistor, across a 12 V supply. Calculate (a) the total resistance, (b) the total current and (c) the current in each of the parallel resistors. [4]

C2 A 60 W lamp is switched on for 5.0 minutes while connected to a 230 V supply. Calculate (a) the energy it transfers and (b) the charge that flows through it. [4]

C3 State Kirchhoff's second law and the conservation principle it expresses. [3]

C4 A car's two headlamps, each of resistance 6.0 Ω, are connected in parallel. The pair is in series with wiring of total resistance 0.40 Ω across the car's 12 V supply. The circuit is protected by a 5.0 A fuse. Deduce whether the fuse melts when both headlamps are on. [4]

C5 A 3.0 Ω resistor and a 9.0 Ω resistor are connected in series across a 6.0 V supply of negligible internal resistance. Calculate the power dissipated in each resistor, and state which runs hotter. [4]

C6 Two identical filament lamps are connected to a battery of negligible internal resistance, first in series and then in parallel. Explain fully why the lamps are brighter in parallel, and why the battery discharges sooner. A student claims that each lamp in series dissipates exactly one quarter of its parallel power. Comment on that claim. [6]