InkPhysics

QUESTION WORKBOOK

EMF and internal resistance

Electricity · Year 12

AQA 3.5.1.6 · CIE 10.1.3, 10.1.4, 10.1.5
OCR A 4.2.2(b), 4.2.2(c), 4.2.2(d), 4.3.2(a), 4.3.2(b), 4.3.2(c)(i), 4.3.2(c)(ii)

19 questions · 58 marks

PRINT EDITION

inkphysics.co.uk/physics/ · youtube.com/@InkPhysics

SECTION A · Warm-up

A1 Define the electromotive force (emf) of a source. [2]

A2 A battery of emf 6.0 V and internal resistance 1.0 Ω supplies a current of 0.50 A. Calculate its terminal potential difference. [2]

A3 State the equation linking emf, current, external resistance and internal resistance. [2]

A4 State the condition under which the terminal pd of a cell equals its emf. [1]

A5 A battery of emf 9.0 V has a terminal pd of 8.4 V while supplying a current. Calculate the lost volts, and state where the corresponding energy is transferred. [2]

A6 Explain why a digital voltmeter of very high resistance connected directly across an isolated cell reads almost exactly the cell's emf. [2]

SECTION B · Standard

B1 A cell of emf 12 V and internal resistance 1.0 Ω is connected to an external resistor of 5.0 Ω. Calculate the current in the circuit. [3]

B2 A battery of emf 9.0 V and internal resistance 0.50 Ω is connected to a 4.0 Ω resistor. Calculate (a) the current, (b) the terminal potential difference and (c) the power dissipated inside the battery. [4]

B3 A cell of emf 1.5 V delivers a current of 0.30 A, and its terminal potential difference falls to 1.35 V. Calculate the internal resistance of the cell. [3]

B4 A cell of emf 6.0 V has an internal resistance of 0.20 Ω. Calculate the current if its terminals are short-circuited (R = 0). [2]

B5 A battery has a terminal pd of 5.7 V when supplying a current of 0.60 A, and 5.1 V when supplying 1.8 A. Determine the internal resistance and the emf of the battery. [4]

B6 A car battery of emf 12.6 V and internal resistance 25 mΩ supplies 160 A to the starter motor. Calculate the terminal pd of the battery, and determine the fraction of the battery's power that is delivered to the external circuit. [4]

B7 A cell of emf 6.0 V and internal resistance 0.50 Ω is connected to two 5.0 Ω resistors in parallel. Calculate the current supplied by the cell and the cell's terminal pd. [3]

SECTION C · Stretch

C1 A graph of terminal potential difference V against current I for a cell is a straight line with a V-axis intercept of 1.5 V and a gradient of −0.5 V A^{-1}. State the emf and internal resistance, and calculate the terminal pd when the current is 1.0 A. [4]

C2 A battery of emf 12 V and internal resistance 2.0 Ω is connected to a variable resistor. Calculate the resistance value that makes the terminal potential difference equal to 10 V. [4]

C3 Explain why the terminal potential difference of a battery falls as it supplies a larger current. [3]

C4 Describe an experiment to determine the emf and internal resistance of a cell using a variable resistor, an ammeter and a voltmeter. Explain how the results are processed, and why this method gives a better value for the emf than a single voltmeter reading across the cell. [6]

C5 A model boat's motor needs a pd of at least 4.4 V across it while drawing 2.0 A. Two batteries are available: battery P (emf 6.0 V, internal resistance 0.90 Ω) and battery Q (emf 5.0 V, internal resistance 0.20 Ω). Deduce which battery should be used. [4]

C6 Two identical cells, each of emf 1.5 V and internal resistance 0.30 Ω, are connected in series to a 2.4 Ω resistor. Calculate the current in the circuit and the pd across the resistor. [3]