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QUESTION WORKBOOK

Current–voltage characteristics

Electricity · Year 12

AQA 3.5.1.2 · CIE 9.3.2, 9.3.3, 9.3.4, 9.3.5 · OCR A 4.2.3(a), 4.2.3(b), 4.2.3(c)(i)

19 questions · 58 marks

NAVY SCREEN EDITION

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SECTION A · Warm-up

A1 State Ohm's law. [2]

A2 A point on a component's I–V graph reads V = 4.0 V and I = 0.20 A. Calculate the resistance at that point. [2]

A3 Sketch the current–voltage characteristic of an ohmic conductor at constant temperature. [2]

A4 When the I–V characteristic of a component is measured, the meters are assumed to be ideal. State the resistance of an ideal ammeter and of an ideal voltmeter. [2]

A5 State how the resistance of a component is found from a point on its I–V characteristic. [1]

A6 A student plots the characteristic of an ohmic conductor with V on the vertical axis and I on the horizontal axis. Describe the graph obtained and state what its gradient represents. [2]

SECTION B · Standard

B1 Describe the shape of the I–V characteristic of a filament lamp and explain its shape. [3]

B2 Describe the I–V characteristic of a semiconductor diode. [3]

B3 A filament lamp gives the readings V = 2.0 V, I = 0.40 A and V = 8.0 V, I = 0.80 A. Calculate the resistance at each point and comment on the change. [4]

B4 A component gives currents of 0.10 A, 0.20 A and 0.30 A at 2.0 V, 4.0 V and 6.0 V. Show that it is ohmic. [3]

B5 In forward bias a diode passes 35 mA when the pd across it is 0.62 V. In reverse bias a pd of 5.0 V drives a current of only 1.0 µA through it. Calculate the resistance of the diode at each point, and comment on the values. [4]

B6 A student measures the I–V characteristic of a metal wire at 20 °C, then repeats the measurement with the wire held at a steady 80 °C in an oven. Describe and explain how the two graphs differ. [3]

B7 The characteristic of a filament lamp is unchanged in shape when the pd is reversed, but the characteristic of a diode is not. Explain both observations. [3]

SECTION C · Stretch

C1 Describe how the resistance of a negative temperature coefficient (NTC) thermistor changes with temperature, and explain this in terms of charge carriers. [4]

C2 A filament lamp operates at 12 V with a current of 2.0 A. Calculate (a) its operating resistance and (b) its power. When barely lit it reads 1.0 V and 0.50 A; calculate its resistance then. [4]

C3 Explain why a filament lamp does not obey Ohm's law. [3]

C4 A control circuit needs a component whose resistance changes by less than 5% between pds of 2.0 V and 6.0 V. Component P passes 0.40 A at 2.0 V and 1.00 A at 6.0 V. Component Q passes 0.100 A at 2.0 V and 0.294 A at 6.0 V. Deduce which component is suitable. [4]

C5 Describe an experiment to obtain the full I–V characteristic of a filament lamp, including negative values of pd. Include the circuit used, the measurements taken and how the results are processed. [6]

C6 A student says: 'Below its threshold a diode has no resistance, because there is no current.' Explain the student's error and state what actually happens to the diode's resistance below the threshold. [3]