



ANSWER BOOK

Current-voltage characteristics

Electricity · Year 12

AQA 3.5.1.2 · CIE 9.3 · OCR A 4.2.3

10 questions · 30 marks

NAVY EDITION

SECTION A · Warm-up

- A1** For a metallic conductor at constant temperature, the current through it is directly proportional to the potential difference across it ($I \propto V$). [2]
- A2** $R = V/I = 4.0/0.20 = 20 \, \Omega$. [2]
- A3** A straight line passing through the origin, with the same gradient for positive and negative pd (current proportional to voltage). [2]

SECTION B · Standard

- B1** The curve is S-shaped (through the origin) and gets shallower as the voltage rises: for a given increase in V the current increases less. As current rises the filament heats up, so its resistance increases, curving the graph away from a straight line.
- B2** In forward bias almost no current flows until about 0.6 V, after which the current rises steeply. In reverse bias essentially no current flows, so the diode conducts in only one direction. [3]
- B3** At 2.0 V: $R = 2.0/0.40 = 5 \, \Omega$. At 8.0 V: $R = 8.0/0.80 = 10 \, \Omega$. The resistance has increased, because the filament is hotter at the higher voltage. [4]
- B4** $R = V/I = 2.0/0.10 = 4.0/0.20 = 6.0/0.30 = 20 \, \Omega$ in every case. The resistance is constant, so $I \propto V$ and the component is ohmic. [3]

SECTION C · Stretch

- C1** Its resistance decreases as temperature rises. Heating releases many more free charge carriers (electrons) in the semiconductor, so more current flows for a given voltage; this effect outweighs the increased vibration of the lattice, so the resistance falls. [4]
- C2** (a) $R = 12/2.0 = 6 \, \Omega$. (b) $P = VI = 12 \times 2.0 = 24 \, \text{W}$. When barely lit: $R = 1.0/0.50 = 2 \, \Omega$ (much lower, as the filament is cool). [4]
- C3** Ohm's law requires constant temperature. As the pd increases, the filament current heats it, raising its temperature and hence its resistance, so the current is not proportional to the voltage and the component is non-ohmic. [3]