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Problem 32.41 (RHK)

For a hypothetical electronic device, the potential difference V in volts, measured across the device, is related to the current i in mA *by* $V = 3.55i^2$. (a) *We have to find the resistance when the current is* $2.40\ \text{mA}$. (b) *We have to find the value of the current when the resistance is equal to* $16.0\ \Omega$.

Solution:

Important point to note in answering this problem is to distinguish between the Ohm's law and the definition of the resistance. Resistance of a circuit element, *R*, is defined to be the ratio of the potential difference across the element, *V*, and the current, *i*, flowing through it. That is

$$R = \frac{V}{i}.$$

Relation between the potential difference *V* and the current *i* in a hypothetical electronic device is given to be

$V = 0.355i^2$,

where the current *i* is measured in mA. Therefore,

$$R = 0.355i \left(\frac{\text{volt}}{10^{-3}\text{A}} \right) = 0.355i\,(\text{mA})\,\text{k}\Omega.$$

Therefore, for $i = 2.40$ mA,

$$R = 3.55 \times 2.40\ \text{k}\Omega = 8.52\ \text{k}\Omega.$$

Resistance offered by the element will be 16Ω when the current is

$$i = \frac{16}{3.55 \times 10^{-3}}\ \text{mA} = 4.51\ \mu\text{A}.$$