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Problem 32.31 (RHK)

An electrical cable consists of 125 *strands of fine wire, each having* $2.65-\mu\Omega$ *resistance. The same potential difference is applied between the ends of each strand and results in a total current of* 750 mA. (a) *We have to find the current in each strand;* (b) *the applied potential difference; and* (c) *the resistance of the cable.*

Solution:

(a)

The given electrical cable consists of 125 strands of wire.

Resistance, *r*, of each strand is

$r = 2.65\ \mu\Omega = 2.65\times10^{-6}\ \Omega.$

The total current flowing through the cable is

$I = 750\ \text{mA} = 750\times10^{-3}\ \text{A}.$

Therefore, current flowing in each strand of wire will be

$i = \frac{750}{125}\ \text{mA} = 6.0\ \text{mA}.$

(b)

As the resistance of each strand of wire is

$r = 2.65\ \mu\Omega = 2.65 \times 10^{-6}\ \Omega,$ the potential difference across each strand will be

$$V = ir = 6 \times 10^{-3} \times 2.65 \times 10^{-6}\ \text{V} = 15.9 \times 10^{-9}\ \text{V} = 15.9\ \text{nV}.$$

(c)

The resistance of the cable will be

$$R = \frac{V}{I} = \frac{15.9 \times 10^{-9}}{750 \times 10^{-3}} = 21.2 \times 10^{-9}\ \Omega = 21.2\ \text{n}\Omega.$$