DPP - 1

Q.1 A wire of resistance R_1 is drawn out so that its length is increased by twice of its original length. The ratio of new resistance to original resistance is

(A) 9: 1 (B) 1: 9 (C) 4: 1 (D) 3: 1

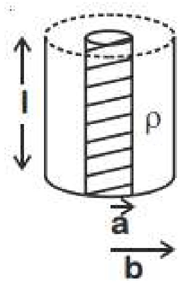
Q.2 A 1 m long wire is broken into two unequal parts X and Y. The X part of the wire is stretched into another wire W. Length of W is twice the length of X and the resistance of W is twice that of Y. Find the ratio of length of X and Y.

(A)1: 4 (B)1: 2 (C) 4: 1 (D) 2: 1

Q.3 An aluminum wire is stretched to make its length. 0.4% larger. The percentage change in resistance is

(A)0.4% (B)0.2% (C)0.8% (D) 0.6%

Q.4 Model a torch battery of length to be made up of a thin cylindrical bar of radius ' a ' and a concentric thin cylindrical shell of radius ' b ' filled in between with an electrolyte of resistivity ρ (see figure). If the battery is connected to a resistance of value R, the maximum Joule heating in R will take place for



(A) $R = \frac{\rho}{2\pi l}\left(\frac{b}{a}\right)$

(B) $R = \frac{\rho}{2\pi l}\ln\left(\frac{b}{a}\right)$

(C) $R = \frac{\rho}{\pi l}\ln\left(\frac{b}{a}\right)$

(D) $R = \frac{2\rho}{\pi l}\ln\left(\frac{b}{a}\right)$

Q.5 (a) The current density across a cylindrical conductor of radius R varies according to the equation $J = J_0\left(1 - \frac{r}{R}\right)$, where r is the distance from the axis. Thus the current density is a maximum J_0 at the axis $r = 0$ and decreases linearly to zero at the surface $r = R$. Calculate the current in terms of J_0 and the conductor's cross sectional area is $A = \pi R^2$.

(B) Suppose that instead the current density is a maximum J_0 at the surface and decreases linearly to zero at the axis so that $J = J_0\frac{r}{R}$. Calculate the current.

Q.6 A metal rod of length 10 cm and a rectangular cross-section of 1 cm $\times \frac{1}{2}$ cm is connected to a battery across opposite faces. The resistance will be

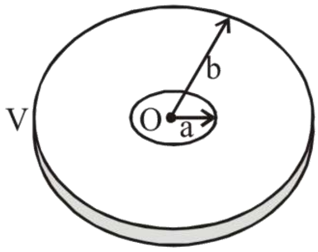
(A) maximum when the battery is connected across 1 cm $\times \frac{1}{2}$ cm faces.

(B) maximum when the battery is connected across 10 cm $\times$ 1 cm faces.

(C) maximum when the battery is connected across 10 cm $\times \frac{1}{2}$ cm faces.

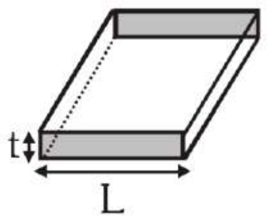
(D) same irrespective of the three faces.

Q.7 A circular portion is cut of a disc of thickness t, its resistivity is ρ and radii of disc are a and $b(b > a)$. A potential difference is maintained between outer and inner cylindrical surfaces of the disc. What is resistance of the disc?



(A) $\frac{\rho}{2\pi t}\ln\left(\frac{b}{a}\right)$
(B) $\rho\left(\frac{1}{a}-\frac{1}{b}\right)$
(C) $2\pi\rho t\left(\frac{1}{a^2}-\frac{1}{b^2}\right)$
(D) $\frac{\rho}{2\pi t}\left(\frac{b^2-a^2}{ab}\right)$

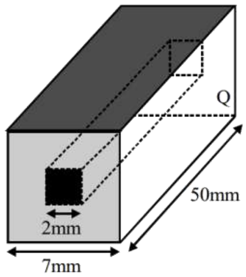
Q.8 Consider a thin square sheet of side L and thickness t, made of a material of resistivity ρ. The resistance between two opposite faces, shown by the shaded areas in the figure is



(A) directly proportional to L
(B) directly proportional to t
(C) independent of L
(D) independent of t

Q.9 In an aluminum (Al) bar of square cross section, a square hole is drilled and is filled with iron (Fe) as shown in the figure. The electrical resistivities of Al and Fe are $2.7 \times 10^{-8}\,\Omega$m and $1.0 \times 10^{-7}\,\Omega$m, respectively. The electrical resistance between the two faces P and Q of the composite bar is :

(A) $\frac{2475}{64}\,\mu\Omega$
(B) $\frac{1875}{64}\,\mu\Omega$
(C) $\frac{1875}{49}\,\mu\Omega$
(D) $\frac{2475}{132}\,\mu\Omega$



ANSWER KEY

1.	(A)	**2.**	(B)	**3.**	(C)	**4.**	(B)	**5.**	(a) J_0 A/3; (b) 2 J_0 A/3
6.	(A)	**7.**	(A)	**8.**	(B)	**9.**	(C)		