

UNIT - 2

CURRENT ELECTRICITY

BOOK BACK ONE MARKS SOLVED

1. The following graph shows current versus voltage values of some unknown conductor. What is the resistance of this conductor?

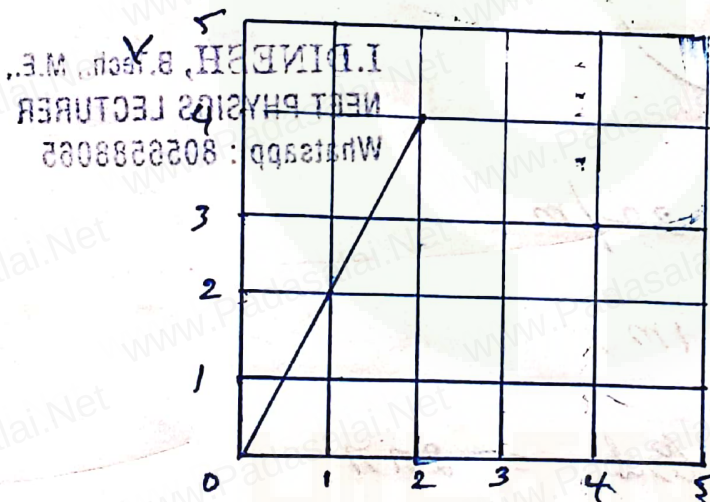
a) 2 ohm

b) 4 ohm

c) 8 ohm

d) 1 ohm.

Ans :



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In the graph (V vs I)

For 1 Ampere of current the corresponding voltage is 2V.

By ohm's law $V \propto I$

$$V = I \cdot R$$

$$R = \frac{V}{I}$$

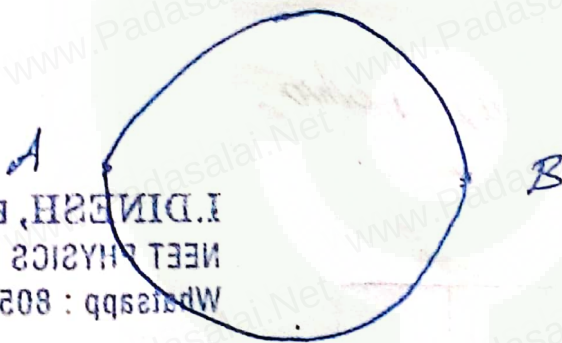
Q. A wire of resistance $2\ \Omega$ per meter is bent to form a circle of radius 1 m . The equivalent resistance between its two diametrically opposite points, A and B, shown in the figure is.

a) $\pi\ \Omega$

b) $\frac{\pi}{2}\ \Omega$

c) $2\pi\ \Omega$

d) $\frac{\pi}{4}\ \Omega$



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Ans :

Resistance $R = 2\ \Omega/\text{m}$

Radius $r = 1\text{ m}$.

Circumference of Circle $= 2\pi r$

$$= 2 \times \pi \times 1$$

$$= 2\pi$$

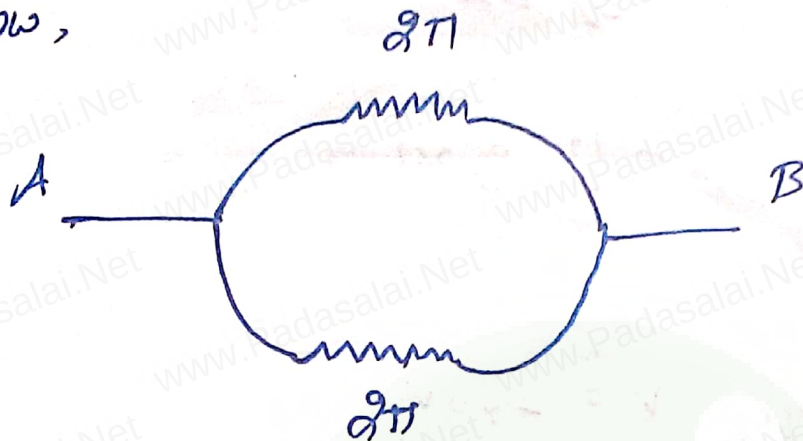
Resistance of full wire $= 2\pi \times 2\ \Omega/\text{m}$

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$$\text{Resistance of half section} = \frac{4\pi}{2}$$

$$= 2\pi \Omega$$

Now,



$$\text{The equivalent resistance } \frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_{eq}} = \frac{1}{2\pi} + \frac{1}{2\pi}$$

$$\frac{1}{R_{eq}} = \frac{2}{2\pi}$$

$$\frac{1}{R_{eq}} = \frac{1}{\pi}$$

$$R_{eq} = \pi \Omega$$

And. a).

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3. A toaster operating at 240V has a resistance of 120Ω . The power is

a) 400W

b) 2W

c) 480W

d) 240W

Ans :

operating Voltage $V = 240V$

Resistance $R = 120 \Omega$

The power consumed by toaster $P = V \cdot I$

$$P = 240 \times 2$$

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Ans : c)

4. A carbon resistor of $(47 \pm 4.7) k\Omega$ to be marked with rings of different colours for its identification. The colour code sequence will be.

a) Yellow - Green - violet - Gold

b) Yellow - Violet - orange - silver

c) Violet - Yellow - orange - silver

d) Green - orange - violet - Gold

Ans :

$$\text{Resistance } R = (47 \pm 4.7) \text{ k}\Omega$$

here

$$\text{Actual value of } R = 47 \text{ k}\Omega$$

$$R = 47 \times 1000 \Omega$$

$$R = 47000 \Omega$$

$$R = 47 \times 10^3 \Omega$$

From color coding table (Text book page. No. 96)

4 - Yellow

7 - Violet

10^3 - Orange

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Tolerance value $\pm 4.7 \text{ k}\Omega$ is 10% of $47 \text{ k}\Omega$

10% Tolerance - Silver

Ans. 4) Yellow - Violet - Orange - Silver.

5. What is the value of resistance of the following resistor?

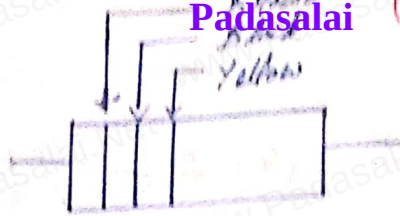
a) $100 \text{ k}\Omega$

b) $10 \text{ k}\Omega$

c) $1 \text{ k}\Omega$

d) $1000 \text{ k}\Omega$

Ans :



from the coding table (not last page no. 96)

$$\text{Resistance } R = 10 \times 10^4$$

$$R = 100,000 \Omega$$

$$R = 100 \text{ K}\Omega$$

Ans. a)

6. Two wires of A and B with identical cross section made up of the same material with equal lengths. Suppose $R_A = 3R_B$, then what is the ratio of radius of wire A to that of B?

a) 3

b) $\sqrt{3}$

c) $\frac{1}{\sqrt{3}}$

d) $\frac{1}{3}$

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Ans :

$$R_A = 3 R_B \quad \text{--- (1)}$$

W.K.T

$$R = \frac{\rho l}{A}$$

Since material (ρ) and length (l) are same

for wire A

$$R_A = \frac{\rho L}{A_A} \quad \text{--- (2)}$$

for wire B

$$R_B = \frac{\rho L}{A_B} \quad \text{--- (3)}$$

sub (2), (3) in (1)

$$\frac{\rho L}{A_A} = 3 \times \frac{\rho L}{A_B}$$

$$\frac{1}{A_A} = 3 \times \frac{1}{A_B}$$

$$A_B = 3A_A \quad \text{--- (4)}$$

u.k.+

Area of cross section $A = \pi r^2$

$$\text{for wire A } (A_A) = \pi r_A^2 \quad \text{--- (5)}$$

$$\text{for wire B } A_B = \pi r_B^2 \quad \text{--- (6)}$$

sub (5), (6) in (4)

$$\pi r_B^2 = 3 \times \pi r_A^2$$

$$r_B^2 = 3 \times r_A^2$$

$$\frac{1}{3} = \frac{r_A^2}{r_B^2}$$

$$\frac{r_A}{r_B} = \sqrt{\frac{1}{3}}$$

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$$\frac{r_A}{r_B} = \frac{1}{\sqrt{3}}$$

$$r_A : r_B :: 1 : \sqrt{3}$$

Ans. c)

7. A wire connected to a power supply of 230 V has power dissipation P_1 . Suppose the wire is cut into two equal pieces and connected parallel to the same power supply. In this case power dissipation is P_2 . The ratio $\frac{P_2}{P_1}$ is

a) 1
b) 2
c) 3
d) 4

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Ans:

W.K.T.

Power dissipation $P = \frac{V^2}{R}$

for case (i)

$$P_1 = \frac{(230)^2}{R} \quad \text{--- (1)}$$

for case (ii)

wire is cut into two pieces
hence resistance is halved ($R/2$) and connected parallel.

The equivalent resistance $\frac{1}{R_p} = \frac{1}{R/2} + \frac{1}{R/2}$

$$\frac{1}{R_p} = \frac{2}{R} + \frac{2}{R}$$

$$\frac{1}{R_p} = \frac{4}{R}$$

$$R_p = \frac{R}{4} \quad \text{--- (2)}$$

power dissipation $P_2 = \frac{(230)^2}{R_p}$

from (2)

$$P_2 = \frac{(230)^2}{\frac{R}{4}}$$

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$$P_2 = \frac{4 \times (230)^2}{R} \quad \text{--- (3)}$$

$$\frac{(3)}{(1)} \Rightarrow \frac{P_2}{P_1} = \frac{4 \times (230)^2}{R} \div \frac{(230)^2}{R}$$

$$\frac{P_2}{P_1} = \frac{4 \times (230)^2}{R} \times \frac{R}{(230)^2}$$

$$\boxed{\frac{P_2}{P_1} = 4}$$

Ans. d).

8. In India electricity is supplied for domestic use at 220V. It is supplied at 110V in USA. If the resistance of a bulb for use in India is R , the resistance of a bulb for use in USA will be

a) R

b) $2R$

c) $R/4$

d) $R/2$

Ans:

In India.

Power rating of bulb $P_1 = \frac{V_1^2}{R_1}$

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$$P_1 = \frac{(220)^2}{R_1} \quad \text{--- (1)}$$

In USA

Power rating of bulb $P_2 = \frac{V_2^2}{R_2}$

$$P_2 = \frac{(110)^2}{R_2} \quad \text{--- (2)}$$

Power rating is same for both places

$$\therefore P_1 = P_2$$

from ① & ②

$$\frac{(220)^2}{R_1} = \frac{(110)^2}{R_2}$$

$$\frac{(220)^2}{(110)^2} = \frac{R_1}{R_2}$$

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$$R_2 = R_1 \times \frac{(110)^2}{(220)^2}$$

$$R_2 = R_1 \times \frac{110 \times 110}{220 \times 220}$$

$$R_2 = \frac{R_1}{4}$$

Ans. c).

9. In a large building, there are 15 bulbs of 40W, 5 bulbs of 100W, 5 fans of 80W and 1 heater of 1KW are connected. The voltage of electric mains is 220V. The minimum capacity of the main fuse of the building will be.

a) 14A

b) 8A

c) 10A

d) 12A

Ans:

Total power

$$i) 15 \text{ bulbs} \times 40 \text{ W} = 600 \text{ W}$$

$$ii) 5 \text{ bulbs} \times 100 \text{ W} = 500 \text{ W}$$

$$iii) 5 \text{ fans} \times 80 \text{ W} = 400 \text{ W}$$

$$iv) 1 \text{ motor} \times 1 \text{ kW} = 1000 \text{ W}$$

Total power

2500 watts

W.K.T.

$$\text{Total Input power } P = V \cdot I$$

$$I = \frac{P}{V}$$

$$I = \frac{2500}{220}$$

$$\text{Rated Current } (I) = 11.36 \text{ A}$$

The fan should operate when current exceeds the rated current

hence Ans is) 12 A.

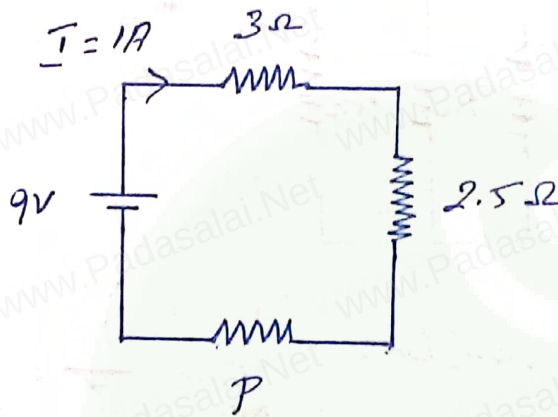
10. There is a current of $1A$ in the circuit shown below. What is the resistance of P ?

a) 1.5Ω

b) 2.5Ω

c) 3.5Ω

d) 4.5Ω



Ans:

The equivalent resistance $R_T = R_1 + R_2 + P$

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$$R_T = 3 + 2.5 + P$$

$$R_T = 5.5 + P$$

w.k.t

$$V = I \cdot R_T$$

$$9 = 1 \times (5.5 + P)$$

$$9 = 5.5 + P$$

$$P = 9 - 5.5$$

$$\boxed{P = 3.5\Omega}$$

Ans. c)

11. What is the current out of the battery?

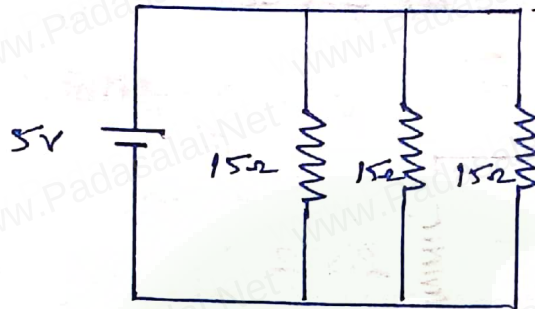
a) 1A

b) 2A

c) 3A

d) 4A

Ans:



The equivalent resistance $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$$\frac{1}{R_p} = \frac{1}{15} + \frac{1}{15} + \frac{1}{15}$$

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$$\frac{1}{R_p} = \frac{1}{5}$$

$$R_p = 5\Omega$$

W.K.T

$$V = I \cdot R_p$$

$$I = \frac{V}{R_p}$$

$$I = \frac{5}{5}$$

$$I = 1A$$

Ans. a)

18. The temperature coefficient of resistance of a wire is $0.00125 \text{ per } ^\circ\text{C}$. At 300 K , its resistance is 1Ω . The resistance of the wire will be 2Ω at

a) 1154 K

b) 1100 K

c) 1400 K

d) 1127 K

Ans:

Given:

$$\alpha = 0.00125 / ^\circ\text{C}$$

$$R_1 = 1 \Omega$$

$$T_1 = 300 \text{ K}$$

$$= 300 - 273$$

$$T_1 = 27^\circ\text{C}$$

$$R_2 = 2 \Omega$$

$$T_2 = ?$$

W.K.T.

$$\alpha = \frac{R_2 - R_1}{R_1 T_2 - R_2 T_1}$$

$$R_1 T_2 - R_2 T_1$$

$$0.00125 = \frac{2 - 1}{1 \times T_2 - (2 \times 27)}$$

$$125 \times 10^{-5} = \frac{1}{T_2 - 54}$$

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$$T_2 - 54 = \frac{1}{125 \times 10^5}$$

$$T_2 - 54 = \frac{10^5}{125}$$

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$$T_2 = \frac{10^5}{125} + 54$$

$$T_2 = \frac{10^5 + 54(125)}{125}$$

$$T_2 = \frac{10^5 + 6750}{125}$$

$$T_2 = \frac{100000 + 6750}{125}$$

$$T_2 = \frac{106750}{125}$$

$$T_2 = 854^\circ \text{C}$$

$$T_2 = (854^\circ \text{C} + 273) \text{ K}$$

$$\boxed{T_2 = 1127 \text{ K}}$$

Ans. d)

13. The internal resistance of a 2.1V cell which gives a current of 0.2A through a resistance of 10Ω is.

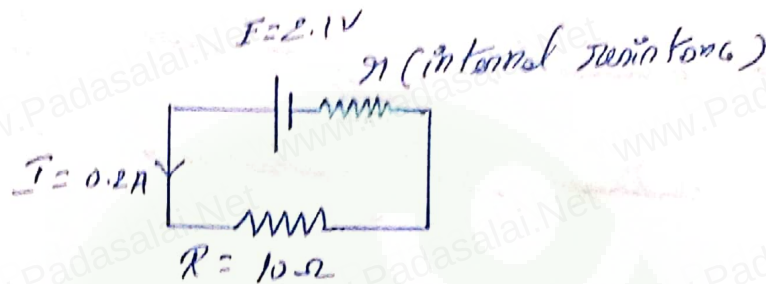
a) 0.2Ω

b) 0.5Ω

c) 0.8Ω

d) 1.0Ω

Ans:



W.K.T

$$\text{Internal Resistance } r = \frac{E}{I} - R$$

$$r = \frac{2.1}{0.2} - 10$$

$$r = \frac{2.1 - 10(0.2)}{0.2}$$

$$r = \frac{2.1 - 2}{0.2}$$

$$r = \frac{0.1}{0.2}$$

$$r = \frac{1 \times 10^{-1}}{2 \times 10^{-1}}$$

$$r = 0.5\Omega$$

Ans. b)

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14. A piece of Copper and another of germanium are cooled from room temperature to 80 K. The resistance of

- a) each of them increases
- b) each of them decreases
- c) copper increases and germanium decreases
- d) copper decreases and germanium increases

Ans :

Hint : i) Resistance of Conductor (Copper) decreases with temperature.

ii) Resistance of semi-conductor (germanium) increases with temperature.

Ans . d)

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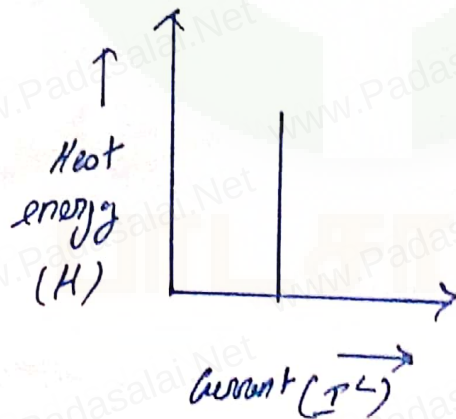
15. In Joule's heating law, when I and t are constant, if H is taken along the y-axis and I^2 along the x-axis, the graph is

- a) straight line b) parabola
c) circle d) ellipse

Ans:

Heat energy $H = I^2 R \times t$

Here current (I), time (t) and Resistance (R) are constant.



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Ans. a) straight line.