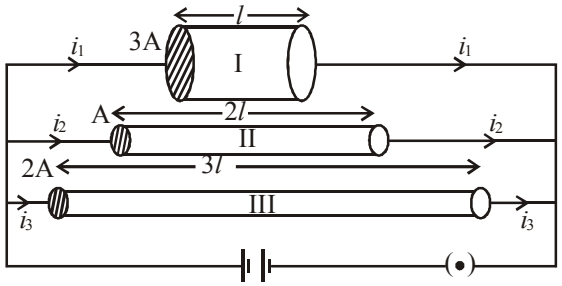
17 Current Electricity

Diagram Based Questions :

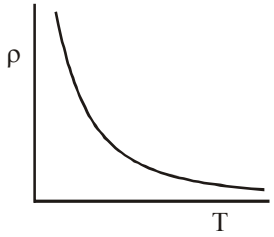
1. The figure shows three conductors I, II and III of same material, different lengths l, $2l$ and $3l$ and of different areas of cross-section 3A, A and 2A respectively. Arrange them in the increasing order of current drawn from battery.



(a) $i_1 < i_2 < i_3$ (b) $i_3 < i_2 < i_1$

(c) $i_2 < i_1 < i_3$ (d) $i_2 < i_3 < i_1$

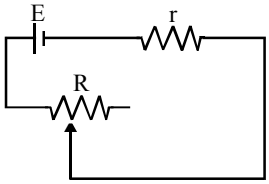
2. The graph shows the variation of resistivity with temperature T. The graph can be of



(a) copper (b) nichrome

(c) germanium (d) silver

3. A battery of e.m.f E and internal resistance r is connected to a variable resistor R as shown. Which one of the following is true ?



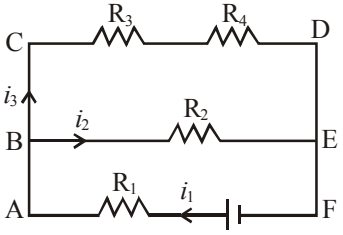
(a) Potential difference across the terminals of the battery is maximum when R = r

(b) Power delivered to resistor is maximum when R = 2r

(c) Current in the circuit is maximum when R = r

(d) Current in the circuit is maximum when R >> r

4. Which of the following is the correct equation when kirchhoff's loop rule is applied to the loop BCDEB in clockwise direction?



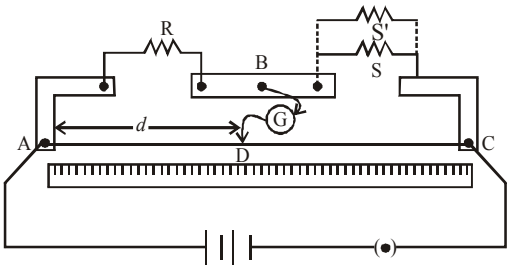
(a) $-i_3 R_3 - i_3 R_4 - i_2 R_2 = 0$

(b) $-i_3 R_3 - i_3 R_4 + i_2 R_2 = 0$

(c) $-i_3 R_3 + i_3 R_4 + i_2 R_2 = 0$

(d) $-i_3 R_3 + i_3 R_4 + i_2 R_2 = 0$

5. The figure shows a meter bridge in which null point is obtained at a length AD = l. When a resistance S' is connected in parallel with resistance S the new position of null point is obtained



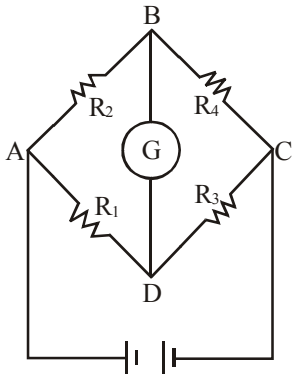
(a) to the left of D

(b) to the right of D

(c) at the same point D

(d) to the left of D if S' has lesser value than S and to the right of D if S' has more value than S.

6. In the figure in balanced condition of wheatstone bridge



(a) B is at higher potential
(b) D is at higher potential
(c) Any of the two B or D can be at higher potential than other arbitrarily.
(d) B and D are at same potential.

Solution

1. **(d)** As we know, resistance $R = \rho\frac{l}{A}$. The resistance of conductor l is given by

$$R_I = \rho\frac{l}{3A} = \frac{R}{3} \qquad \left(\text{where} \quad R = \rho\frac{l}{A}\right)$$

Similarly, $R_{II} = \rho\frac{2l}{A} = 2R$

and $R_{III} = \rho\frac{3l}{2A} = \frac{3}{2}R$

From this we conclude that $R_{II} > R_{III} > R_I$. Since in parallel combination of resistances current distributes in inverse ratio of resistances, therefore $i_2 < i_3 < i_1$

2. **(c)** The resistivity of semiconductor decreases with increase in temperature.

3. **(c)** $I = \frac{E}{R + r} = \frac{E}{(\sqrt{R} - \sqrt{r})^2 + 2\sqrt{R}\sqrt{r}}$

I is maximum when R = r

$P = I^2R$, when I is max, P is also max.

$P_{max} = I^2_{max}R$.

4. **(b)** If we apply Kirchhoff's loop rule to the loop BCDEB in clockwise direction the changes in potential across R_3 and R_4 are negative. Therefore i_3 R_3 and i_3 R_4 should have negative sign. But for this clockwise direction we are moving in a direction opposite to i_2 across R_2. Current flows from higher potential to lower potential but we are moving from lower potential to higher potential i.e., potential is increasing. So the change in potential is positive. Therefore i_2 R_2 has positive sign.

5. **(b)** The working principle of meter bridge is

$$\frac{R}{S} = \frac{l}{100 - l} \quad \ldots \text{(i)}$$

When S' is connected in parallel with S we obtain equivalent resistance S_{eq} of S and S' which is less than S. Thus if the value of denominator of L.H.S. of eq. (i) decreases then value of denominator of R.H.S. of eq. (i) also decreases. For this to happen the null point shifts to the right of D.

6. **(d)** In balance condition, since no current flows through the galvanometer therefore *B* and D are at the same potential.