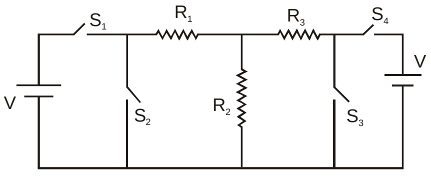
PHYSICS TARGET : JEE- Advanced 2023	**CAPS-12** **CURRENT ELECTRICITY**

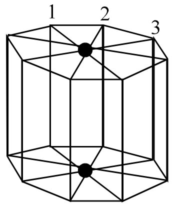
SCQ (Single Correct Type) :

1. Consider a circuit shown in the figure. If only S_1 is closed (ON) power liberated is 1 watt, if S_1 and S_3 are closed together power liberated is 2 watt and if only S_4 closed power liberated is 3 watt. Determine the power liberated (in watt) when S_2 and S_4 are closed together, (Batteries are ideal).



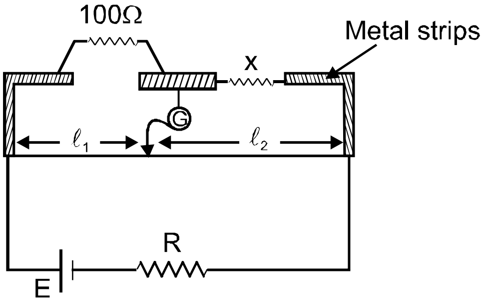
(A) 3 (B) 6 (C) 8 (D) 10

2. In the diagram shown, all the wires have resistance R. The equivalent resistance between the upper and lower dots shown in the diagram is



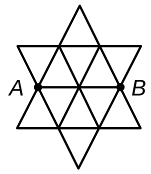
(A) R/8 (B) R (C) 2R/5 (D) 3R/8

3. In a practical Meter bridge circuit as shown, when another resistance of 50Ω is connected parallel with unknown resistance 'x' then ratio $\frac{\ell'_1}{\ell'_2}$ become 3, where ℓ'_1 is new balance length. AB is a uniform wire. Then value of 'x' must be :



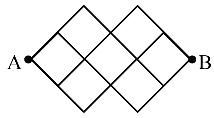
(A) 100 Ω (B) 200 Ω (C) 50 Ω (D) 400 Ω

4. The equivalent resistance of the circuit between point A and B in the figure is : (each branch is of resistance = 1 Ω).



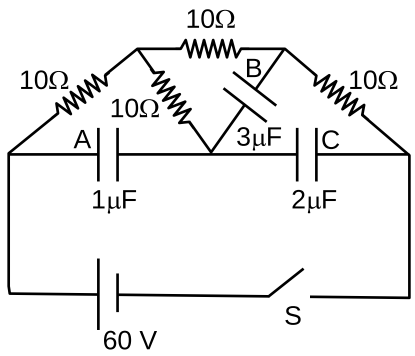
(A) $\frac{22}{35}\Omega$ (B) $\frac{35}{22}\Omega$ (C) $\frac{59}{24}\Omega$ (D) $\frac{22}{59}\Omega$

5. Each branch in the following circuit has a resistance R. The equivalent resistance of the circuit between two points A and B



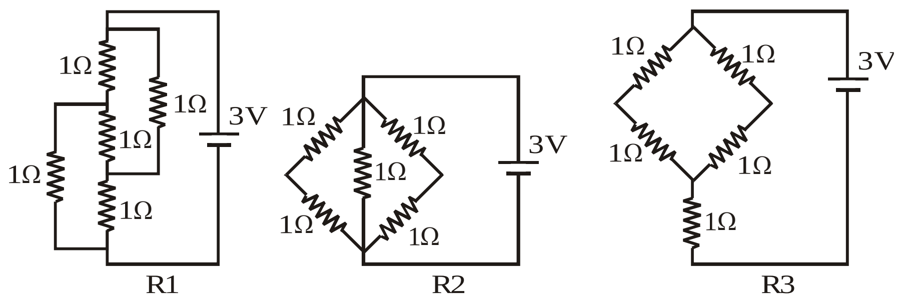
(A) R (B) 2R (C) 4R (D) 8R

6. In the adjacent figure the switch S is closed at t = 0. Q_A, Q_B and Q_C are charge on the capacitor A, Capacitor B and capacitor C in the steady state respectively. Choose the correct statement.



(A) $Q_A < Q_B < Q_C$ (B) $Q_A < Q_C < Q_B$ (C) $Q_C < Q_A < Q_B$ (D) $Q_C < Q_B < Q_A$

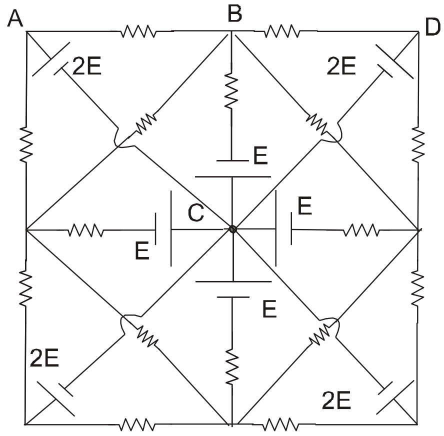
7. Figure shows three resistor configurations R_1, R_2 and R_3 connected to 3V battery. If the power dissipated by the configuration R_1, R_2 and R_3 is P_1, P_2 and P_3, respectively, then :-



(A) $P_1 > P_2 > P_3$ (B) $P_1 > P_3 > P_2$ (C) $P_2 > P_1 > P_3$ (D) $P_3 > P_2 > P_1$

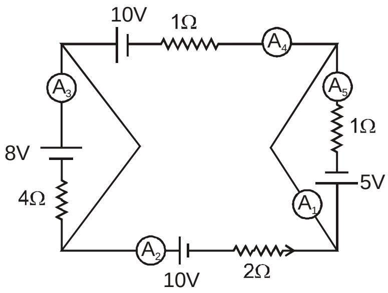
MCQ (One or more than one correct) :

8. Consider the circuit shown in the figure. If E = 4 Volts and each resistance is 1 Ω. Take $V_c = 0$ Volt then choose correct options for the given situation (All batteries are ideal)



(A) Magnitude of current in AB is 4 amp.
(B) Magnitude of current in BC is 8 amp.
(C) Potential at A in 8 volt
(D) Potential at B in 4 volt

9. In the given circuit all ammeters are ideal. Then choose correct statement.



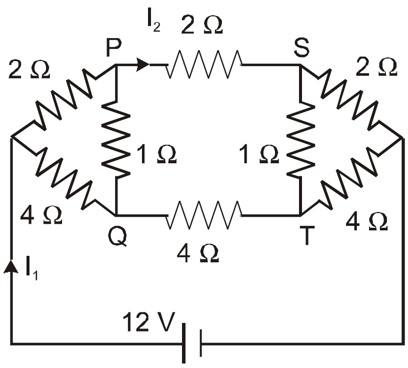
(A) Reading of A_2 = Reading of A_5.

(B) Reading of A_2 and Reading of A_4 both are zero.

(C) Reading of A_1 is 5 amp

(D) Reading of A_1 = 2.5 times reading of A_3.

10. For the resistance network shown in the figure, choose the correct option(s).



(A) The current through PQ is zero.

(B) I_1 = 3 A.

(C) The potential at S is less than that at Q.

(D) $I_2 = 2$ A.

11. Consider two identical galvanometers and two identical resistors with resistance R. If the internal resistance of the galvanometers $R_C < R/2$, which of the following statement(s) about any one of the galvanometers is(are) true ?

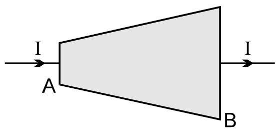
(A) The maximum voltage range is obtained when all the components are connected in series

(B) The maximum voltage range is obtained when the two resistors and one galvanometer are connected in series, and the second galvanometer is connected in parallel to the first galvanometer

(C) The maximum current range is obtained when all the components are connected in parallel

(D) The maximum current range is obtained when the two galvanometers are connected in series, and the combination is connected in parallel with both the resistors.

12. In the figure a conductor of non–uniform cross-section is shown. A steady current I flows in it.



(A) The electric field at A is more than at B.

(B) The electric field at B is more than at A.

(C) The thermal power generated at A is more than at B in an element of small same width.

(D) The thermal power generated at B is more than at A in an element of small same width.

13. N cells each of e.m.f. E & identical resistance r are grouped into sets of K cells connected in series. The (N/K) sets are connected in parallel to a load of resistance R, then;

(A) Maximum power is delivered to the load if $K = \sqrt{\frac{NR}{r}}$.

(B) Maximum power is delivered to the load if $K = \sqrt{\frac{r}{NR}}$

(C) Maximum power delivered to the load is $\frac{E^2}{4Nr}$

(D) Maximum power delivered to the load is $\frac{NE^2}{4r}$

Comprehension Type Question:

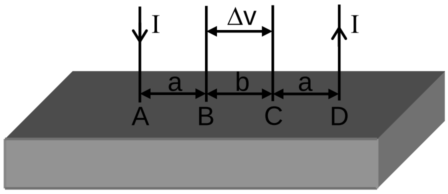
Consider a very large block of conducting material of resistivity 'ρ'. Figure shows a small part of it current 'I' enters at 'A' and leaves from 'D'. We apply superposition principle to find voltage 'ΔV' developed between 'B' and 'C'. The calculation is done in the following steps:

(i) Take current 'I' entering from 'A' and assume it to spread over a hemispherical surface in the block.

(ii) Calculate field E(r) at distance 'r' from A by using Ohm's law E = ρJ, where J is the current per unit area at 'r'.

(iii) From the 'r' dependence of E(r), obtain the potential V(r) at r.

(iv) Repeat (i), (ii) and (iii) for current 'I' leaving 'D' and superpose results for 'A' and 'D.



14. ΔV measured between B and C is –

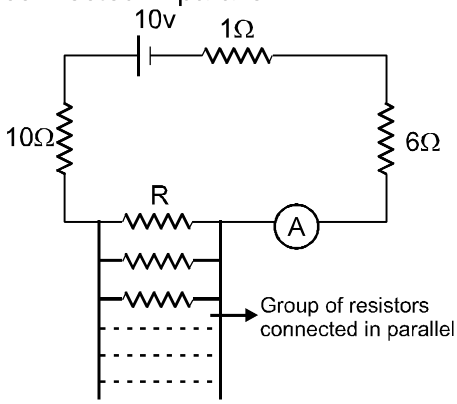
(A) $\frac{\rho I}{\pi a} - \frac{\rho I}{\pi(a+b)}$ (B) $\frac{\rho I}{a} - \frac{\rho I}{\pi(a+b)}$ (C) $\frac{\rho I}{2\pi a} - \frac{\rho I}{2\pi(a+b)}$ (D) $\frac{\rho I}{2\pi(a-b)}$

15. For current entering at A, the electric field at a distance 'r' from A is –

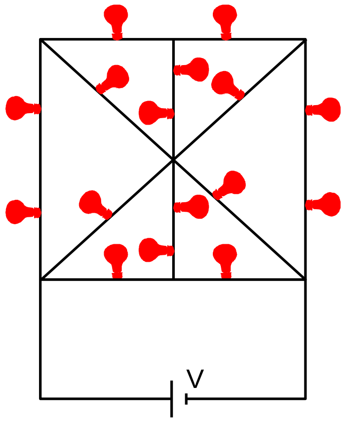
(A) $\frac{\rho I}{8\pi r^2}$ (B) $\frac{\rho I}{r^2}$ (C) $\frac{\rho I}{2\pi r^2}$ (D) $\frac{\rho I}{4\pi r^2}$

Numerical based Questions :

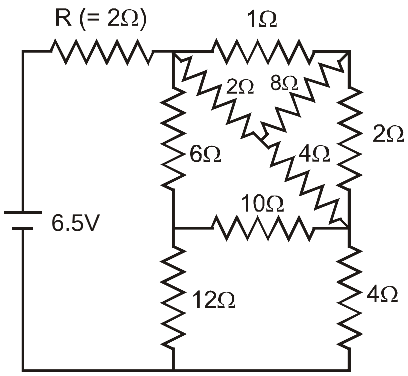
16. In the circuit shown, the ammeter reading is 0.5 amp but when two resistors from the group of identical resistors connected in parallel are removed, the ammeter reading changes by $\frac{100}{21}$%. How many resistors were connected in parallel.



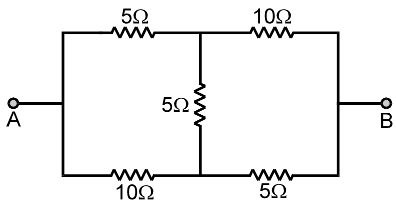
17. Standard rating of each bulb is P, V. If total power consumption by combination is $\frac{3XP}{5}$ then calculate 'X'.



18. In the following circuit, the current through the resistor R (= 2Ω) is I Amperes. The valeu of I is :

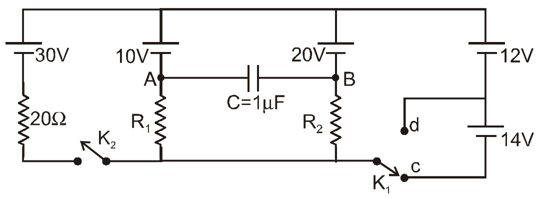


19. Find the equivalent resistance of the circuit between the terminals A and B.



Matrix Match Type :

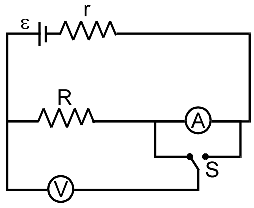
20. A circuit involving five ideal cells, three resistors (R_1, R_2 and 20Ω) and a capacitor of capacitance C = 1 μF is shown. Match the conditions in column-I with results given in column-II.



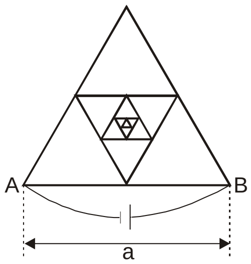
column-I	column-II
(A) K_2 is open and K_1 is in position C	(p)Potential at point A is greater than potential at B
(B) K_2 is open and K_1 is in position D	(q) Current through R_1 is downward
(C) K_2 is closed and K_1 is in position C	(r) Current through R_2 is upward
(D) K_2 is closed and K_1 is in position D	(s) Charge on capacitor is 10μC.

Subjective Type Questions :

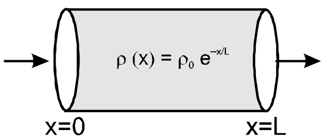
21. The emf ε and the internal resistance r of the battery shown in figure are 4.3 V and 1.0 Ω respectively. The external resistance R is 50 Ω. The resistances of the ammeter and voltmeter are 2.0 Ω and 200 Ω respectively. (a) Find the readings of the two meters. (b) The switch is thrown to the other side. What will be the readings of the two meters now ?



22. Determine the resistance R_{AB} between points A and B of the frame made of thin homogeneous wire (as shown in figure), assuming that the number of successively embedded equilateral triangles (with sides decreasing by half) tends to infinity. Side AB is equal to a, and the resistance of unit length of the wire is ρ.



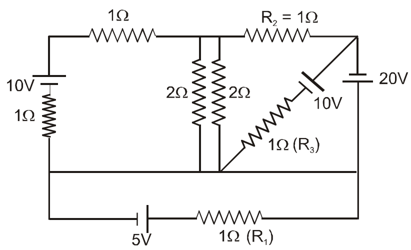
23. A rod of length L and cross-section area A lies along the x-axis between x = 0 and x = L. The material obeys Ohm's law and its resistivity varies along the rod according to, $\rho(x) = \rho_0 e^{-x/L}$
The end of the rod at x = 0 is at a potential V_0 and it is zero at x = L



(a) Find the total resistance of the rod and the current in the wire.

(b) Find the electric potential V(x) in the rod as a function of x.

24. Find currents through R_1, R_2 and R_3. All cells are ideal



25. A hemisphere network of radius 'a' is made by using a conducting wire of resistance per unit length r. Find the equivalent resistance across OP.