JEE Main Level Practice Test-14

Topic : ELECTRIC CURRENT & CIRCUIT, CAPACITANCE **Time: 75Min Marking +4 –1**

Section - A : MCQs with Single Option Correct

1. Three capacitors each of 4 μF are to be connected in such a way that the effective capacitance is 6 μF. This can be done by connecting them :

(A) All in series (B) All in parallel

(C) Two in parallel and one in series (D) Two in series and one in parallel

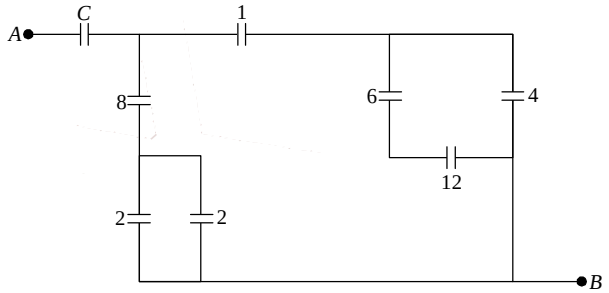
2. Figure shows a network of capacitors where the numbers indicates capacitances in micro Farad. The value of capacitance C if the equivalent capacitance between point A and B is to be 1 μF is :

(A) $\frac{32}{23}\mu F$

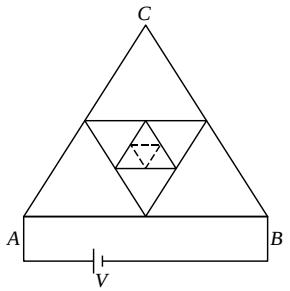
(B) $\frac{31}{23}\mu F$

(C) $\frac{33}{23}\mu F$

(D) $\frac{34}{23}\mu F$



3. From a wire of resistance per unit length 'λ' an infinite grid is created as shown in the figure. The largest triangle has a length of $2L$. If a battery of voltage V is connected to the points A and B, find the total current supplied by the battery. [Each equilateral triangle has a edge half of its previous]



(A) $\frac{3V}{4\lambda L(\sqrt{7}-1)}$ (B) $\frac{3V}{2\lambda L(\sqrt{7}-1)}$

(C) $\frac{3V}{\lambda L(\sqrt{7}-1)}$ (D) $\frac{V}{\lambda L(3\sqrt{2}-1)}$

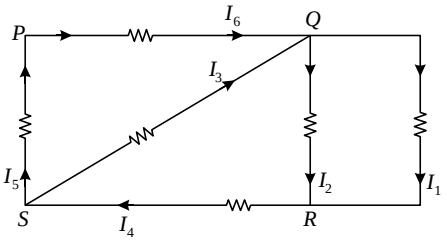
4. The resistance of a wire is R. It is bent at the middle by 180° and both the ends are twisted together to make a shorter wire. The resistance of the new wire is :

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

5. When 5 V potential difference is applied across a wire of length 0.1 m, the drift speed of electrons is 2.5×10^{-4} ms^{1}. If the electron density in the wire is 8×10^{28} m^{-3}, the resistivity of the material is close to :

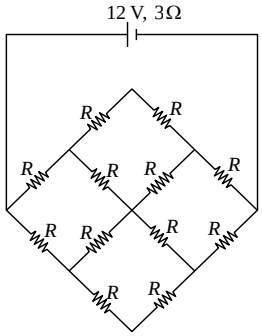
(A) $1.6 \times 10^{-8}\,\Omega$m (B) $1.6 \times 10^{-7}\,\Omega$m (C) $1.6 \times 10^{-6}\,\Omega$m (D) $1.6 \times 10^{-5}\,\Omega$m

6. In the given circuit diagram, the currents, $I_1 = -0.3$ A, $I_4 = 0.8$ A and $I_5 = 0.4$ A, are flowing as shown. The currents I_2, I_3 and I_6, respectively, are :



(A) 1.1 A, 0.4 A, 0.4 A (B) –0.4 A, 0.4 A, 1.1 A (C) 0.4 A, 1.1 A, 0.4 A (D) 1.1 A, –0.4 A, 0.4 A

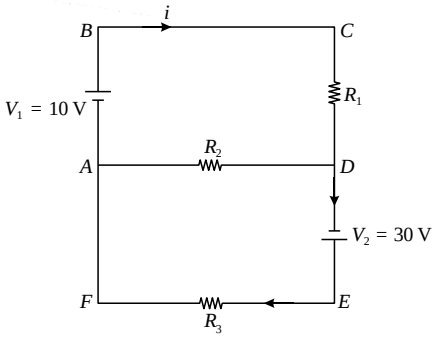
7. In the circuit shown in the figure cell will deliver maximum power to the network if R is equal to



(A) 3 Ω (B) 1 Ω (C) 4 Ω (D) 2 Ω

8. Two ideal batteries of emf V_1 and V_2 and three resistances R_1, R_2 and R_3 are connected as shown in the below figure. The current in resistance R_2 is zero. If colour code of R_1 is red, green, yellow then colour code of R_3 will be.

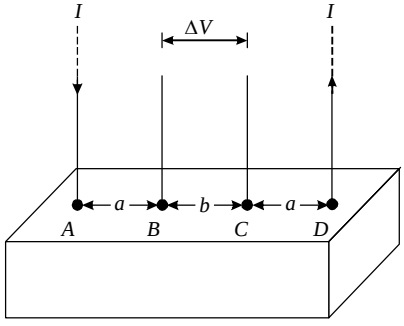
(A) Gray, Red, Violet
(B) Red, Green, Yellow
(C) Violet, Green, Yellow
(D) Green, Violet, Yellow



3. Consider a block of conducting material of resistivity ρ shown in the figure. 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 $E = \rho j$, 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

For current entering at A, the electric field at a distance r from A is :

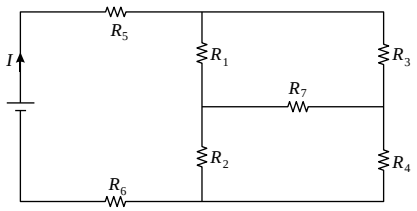


(A) $\frac{\rho I}{8\pi r^2}$ (B) $\frac{\rho I}{r^2}$ (C) $\frac{\rho I}{2\pi r^2}$ (D) $\frac{\rho I}{4\pi r^2}$

10. 8 identical cells, each of emf E and internal resistance r, are connected in series. If polarity of two cells are reversed, then the total internal resistance in the circuit will be :

(A) $8r$ (B) $6r$ (C) $4r$ (D) $2r$

11. In the given circuit, it is observed that the current I is independent of the value of the resistance R_7. Then, the resistance values must satisfy :



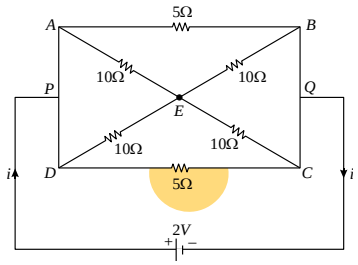
(A) $R_1R_2R_5R_6 = R_3R_4R_7$

(B) $\frac{1}{R_5}+\frac{1}{R_6}+\frac{1}{R_7} = \frac{1}{R_1+R_2}+\frac{1}{R_3+R_4}$

(C) $R_1R_4 = R_2R_3$

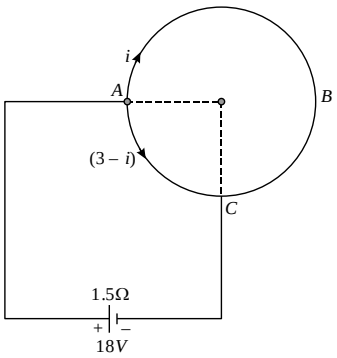
(D) $R_1R_3 = R_2R_4$

12. Calculate the current i in the circuit shown in figure.



(A) $2A$ (B) $1A$ (C) $3A$ (D) $4A$

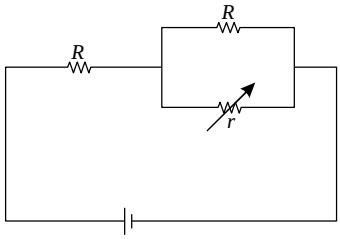
13. The terminals of an 18 V battery with internal resistance 1.5 Ω are connected to a circular coil of resistance 24 Ω at two points, distant one quarter of the circumference of the coil as shown in the figure



The current flowing through the bigger part will be :

(A) 0.5 A (B) 0.75 A (C) 1.0 A (D) 1.5 A

14. In the circuit shown, the resistance r is a variable resistance. If for $r = fR$, the heat generation in r is maximum then the value of f is :

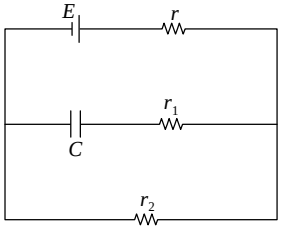


(A) $\frac{1}{2}$ (B) 1 (C) $\frac{1}{4}$ (D) $\frac{3}{4}$

15. The resistance of an electrical toaster has a temperature dependence given by $R(T) = R_0[1 + \alpha(T - T_0)]$ in its range of operation. At $T_0 = 300$ K, $R = 100\,\Omega$ and at $T = 500$ K, $R = 120\,\Omega$. The toaster is connected to a voltage source at 200 V and its temperature is raised at a constant rate from 300 to 500 K in 30 s. The total work done in raising the temperature is :

(A) $400 \ln \frac{5}{6}$ J (B) $200 \ln \frac{2}{3}$ J (C) 300 J (D) $60000 \ln (1.2)$

16. In the given circuit diagram when the current reaches steady state in the circuit, the charge on the capacitor of capacitance C will be :



(A) $CE\frac{r_2}{(r+r_2)}$ (B) $CE\frac{r_1}{(r_1+r)}$

(C) CE (D) $CE\frac{r_1}{(r_2+r)}$

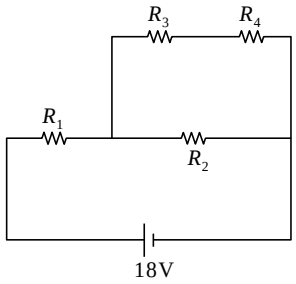
17. In a circuit for finding the resistance of a galvanometer by half deflection method, a 6 V battery and a high resistance of 11 kΩ are used. The figure of merit of the galvanometer 60 μA/division. In the absence of shunt resistance, the galvanometer produces a deflection of θ = 9 divisions when current flows in the circuit. The value of the shunt resistance that can cause the deflection of θ/2, is closest to :

(A) 55 Ω (B) 110 Ω (C) 220 Ω (D) 550 Ω

18. A galvanometer with its coil resistance 25 Ω requires a current of 1 mA for its full deflection. In order to construct an ammeter to read up to a current of 2 A, the approximate value of the shunt resistance should be :

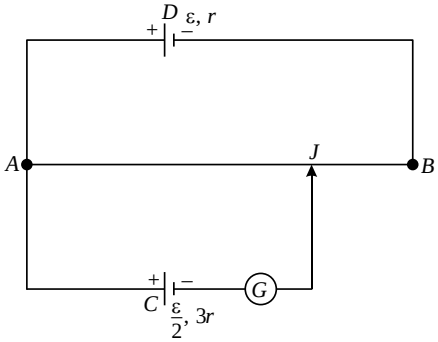
(A) $2.5 \times 10^{-2}\,\Omega$ (B) $1.25 \times 10^{-3}\,\Omega$ (C) $2.5 \times 10^{-3}\,\Omega$ (D) $1.25 \times 10^{-2}\,\Omega$

19. In the given circuit the internal resistance of the 18 V cell is negligible. If $R_1 = 400\,\Omega$, $R_3 = 100\,\Omega$ and $R_4 = 500\,\Omega$ and the reading of an ideal voltmeter across R_4 is 5 V, then the value R_2 will be :



(A) 300 Ω (B) 230 Ω (C) 450 Ω (D) 550 Ω

20. A potentiometer wire AB having length L and resistance $12r$ is joined to a cell D of emf ε and internal resistance r. A cell C having emf ε/2 and internal resistance $3r$ is connected. The length AJ at which the galvanometer as shown in figure shows no deflection is :



(A) $\frac{5}{12}L$ (B) $\frac{11}{24}L$

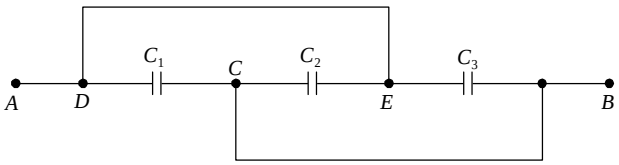
(C) $\frac{11}{12}L$ (D) $\frac{13}{24}L$

Section- B: INTEGER Answer Type Questions

21. A capacitance of 2 μF is required in an electrical circuit across a potential difference of 1.0 kV. A large number of 1 μF capacitors are available which can withstand a potential difference of not more than 300 V. Calculate the minimum number of capacitors required to achieve this.

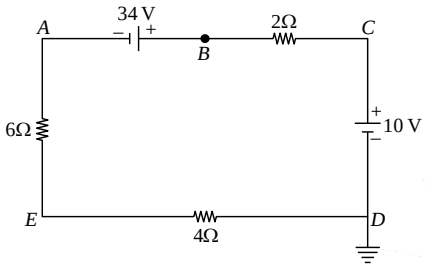
22. The energy stored in the electric field produced by a metal sphere is 4.5 J. If the sphere contains 4 μC charge, calcuate its radius in mm. [Take : $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9\ \text{N} - \text{m}^2/\text{C}^2$]

23. A combination of parallel plate capacitors is maintained at a certain potential difference. When a 3 mm thick slab is introduced between all the plates, in order to maintain the same potential difference, the distance between the plates is increased by 2.4 mm. Calculate the dielectric constant of the slab.

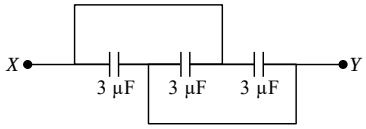


24. The resistance of a wire is 5 ohm at 50°C and 6 ohm at 100°C. Calculate the resistance of the wire at 0°C in ohm.

25. Find the potential (in V) at point D if E is grounded, as shown in figure.

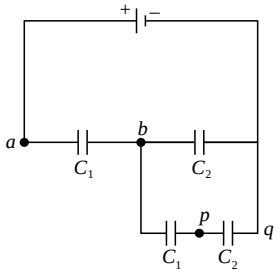


26. Calculate the equivalent capacitance (in μF) in the below figure between the point *X* and *Y*.

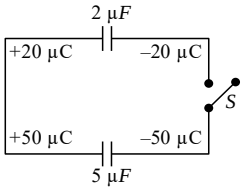


27. Two condensers of same capacity are first connected in parallel and then in series. Calculate the ratio of resultant capacities in the two cases.

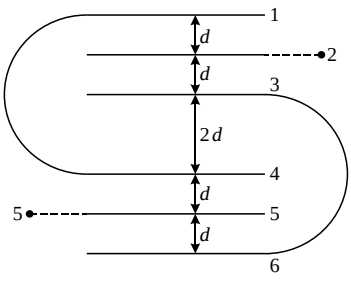
28. In the given network if potential difference between *p* and *q* is 2 V and $C_2 = 3\ C_1$, find the potential difference (in V) between *a* & *b*.



29. Find heat produced in the circuit shown in figure on closing the switch *S*.



30. There are six plates of equal area *A* and separation between the plates is *d* (*d* << *A*) are arranged as shown in figure. The equivalent capacitance between points 2 and 5, is $\eta\frac{\in_0 A}{d}$. Then find the value of η.



Answer Key

Topic : ELECTRIC CURRENT & CIRCUIT, CAPACITANCE — ANSWER KEY

Section - A : MCQs with Single Option Correct

1. (D)	**2.** (A)	**3.** (B)	**4.** (C)
5. (D)	**6.** (A)	**7.** (D)	**8.** (C)
9. (C)	**10.** (A)	**11.** (C)	**12.** (B)
13. (B)	**14.** (A)	**15.** (D)	**16.** (A)
17. (B)	**18.** (D)	**19.** (A)	**20.** (D)

Section- B: INTEGER Answer Type Questions

21. [32]	**22.** [16]	**23.** [5]	**24.** [4]
25. [8]	**26.** [9]	**27.** [4]	**28**. [30]
29. [0]	**30.** [1]		