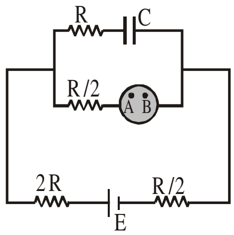
CAPACITANCE & CAPACITOR

1. Capacity of an isolated sphere is increased n times when it is enclosed by an earthed concentric sphere. The ratio of their radii would be:

(1) $\frac{n^2}{n-1}$ (2) $\frac{n}{n-1}$ (3) $\frac{2n}{n+1}$ (4) $\frac{2n+1}{n+1}$

2. A conducting solid sphere is joined in an electrical circuit as shown in figure-

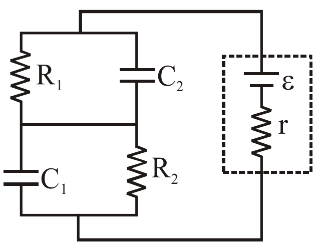


Two imaginary points A and B are taken inside the sphere. For given conditions-

(1) $V_A > V_B$ (2) $V_A < V_B$

(3) $V_A = V_B$ (4) Data insufficient

3. In the given circuit, $R_1 = 2\Omega$, $R_2 = 3\Omega$, $r = 1\Omega$, $\varepsilon = 6V$, $C_1 = 1\mu F$ and $C_2 = 2\ \mu F$. In steady state the ratio of energy stored in the capacitors C_2 and C_1 is

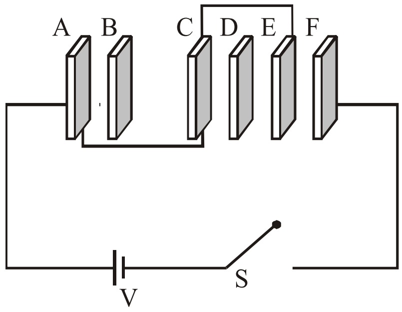


(1) 6/9 (2) 9/6 (3) 8/9 (4) 9/9

4. There are 8 drops of a conducting fluid. Each has radius r and they are charged to potential 1 volt. They are then combined to form a bigger drop. Find potential of big drop.

(1) 1 V (2) 4 V (3) 2 V (4) 8 V

5. A,B,C,D,E and F are conducting plates each of area A, and any two consecutive plates are separated by a distance d. The net energy stored in the system after the switch S is closed is :-



(1) $\frac{3\varepsilon_0 A}{2d}V^2$ (2) $\frac{5\varepsilon_0 A}{12d}V^2$

(3) $\frac{\varepsilon_0 A}{2d}V^2$ (4) $\frac{\varepsilon_0 A}{d}V^2$

6. When an additional charge of 2C is given to a capacitor, energy stored in it is increased by 21%. The original charge of the capacitor is :-

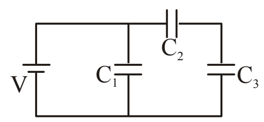
(1) 30 C (2) 40 C (3) 10 C (4) 20 C

7. Three capacitors C_1, C_2 and C_3 are connected to a battery as shown in figure. The three capacitors have equal capacitances. Which capacitor stores the most energy :-

(1) C_1

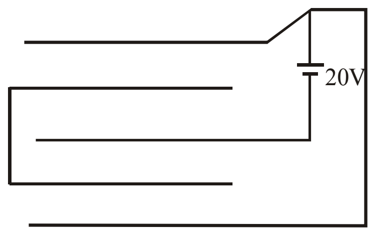
(2) C_2

(3) C_3



(4) All three capacitors store the same amount of energy

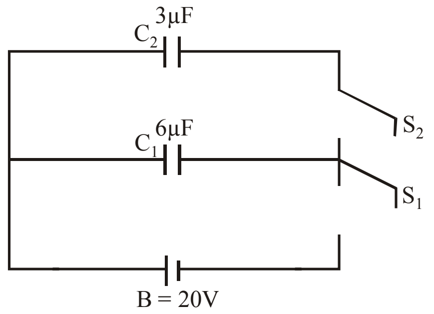
8. Five identical plates of dimension 5 cm × 8 m are placed at separation of 8.85 mm from each other. If they are connected through a battery which provides constant potential difference of 20V as shown, then find the total charge given by battery.



(1) 8×10^{-9} C (2) 16×10^{-9}C

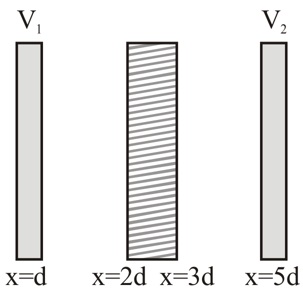
(3) 4×10^{-9} C (4) 12×10^{-9} C

9. In the circuit shown in fig. $C_1 = 6\mu F$, $C_2 = 3\mu F$ and battery B = 20V. The switch S_1 is first closed. It is opened after long time and S_2 is closed. What is the final charge on C_2?



(1) 120 μC (2) 80 μC (3) 40 μC (4) 20 μC

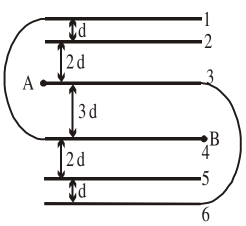
10. Two identical thin metal plates has potential V_1 and V_2 ($V_1 > V_2$). A neutral metal slab is placed between these two plates. Find potential of right surface of metal slab



(1) $\frac{V_1+V_2}{2}$ (2) $\frac{2V_1+V_2}{3}$

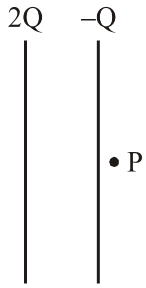
(3) $\frac{V_1-V_2}{3}$ (4) $\frac{V_1+2V_2}{3}$

11. There are six plates of equal area A and the plates are arranged as shown in figure. The equivalent capacitance between points A and B is $\frac{\alpha \in_0 A}{d}$. Find value of α.



(1) 1 (2) 2 (3) 3 (4) 4

12. In figure, the plates of a parallel plate capacitor have unequal charges. Its capacitance is C. P is a point outside the capacitor and close to the plate of charge –Q. The distance between the plates is d. Then which of following is incorrect:-



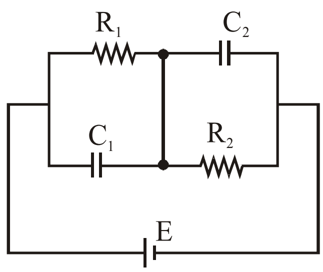
(1) a point charge at point P will experience electric force due to the capacitor

(2) the potential difference between the plates will be 3Q/2C

(3) the energy stored in the electric field in the region between the plates is $9Q^2/8C$

(4) the force on one plate due to the other plate is $Q^2/2\pi\varepsilon_0 d^2$

13. For the circuit shown in figure the ratio of energy stored in capacitor (1) to that of in capacitor (2) is



(1) $\frac{R_1C_1}{R_2C_2}$ (2) $\frac{R_1C_2}{R_2C_1}$ (3) $\frac{R_1^2C_1}{R_2^2C_2}$ (4) $\frac{R_1C_1^2}{R_2C_2^2}$

14. A proton, deutron and α-particle are accelerated by same potential difference. They enter between parallel plates of a capacitors in direction perpendicular to electric field, then deflection of:-

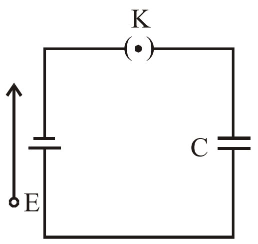
(1) Proton is maximum

(2) Deutron is maximum

(3) α-particle is maximum

(4) All particle will be same

15. A parallel plate capacitor is connected to a battery as shown in figure. Consider two situations:



A: Key K is kept closed and plates of capacitors are moved apart using insulating handle.

B: Key K is opened and plates of capacitors are moved apart using insulating handle.

Choose the **CORRECT** option :-

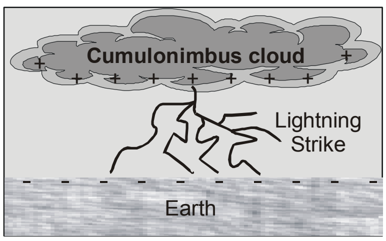
(1) In A : Q remains same but C changes.

(2) In B : V remains same but C changes.

(3) In A : V remains same and hence Q changes.

(4) In B : Q remains same and hence V remains constant.

16. A cumulonimbus cloud is 5 km long and 2 km wide and has its base 1 km above the surface of the earth as shown here. Consider the cloud and earth to be a parallel plate capacitor with air as the dielectric. Then the capacitance of the cloud-earth combination is-



(1) 8.8 μF (2) 8.08 μF

(3) 0.088 μF (4) 0.88 μF

17. A parallel plate capacitor is connected to a battery which builds up an electric field of 60 V/cm between the plates as shown in figure-I. Now two initially neutral plates that are connected are positioned as shown in figure-II. The plates are at equal distances from each other. Find the electric field strength between the plates B and D.

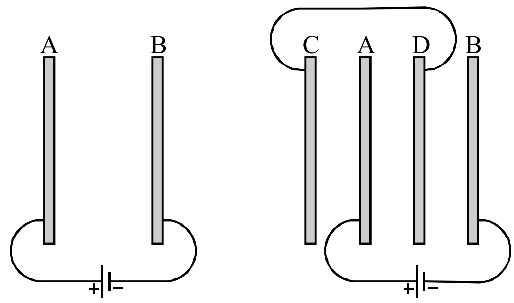


Figure-I **Figure-II**

(1) 8 kV/m (2) 6 kV/m (3) 4 kV/m (4) 3 kV/m

18. A parallel plate capacitor of plate area 0.2 m^2 and spacing 10^{-2} m is charged to 10^3 volt and then disconnected from the battery, and pull apart to double the plate spacing

(1) Final charge on the capacitor becomes two times of initial

(2) Final charge becomes half of initial value.

(3) Final voltage on the capacitor will remain 10^3 Volts.

(4) Final voltage on the capacitor is 2×10^3 Volts.

19. An electron is in equilibrium between two horizontal plates of a charged capacitor. If the plates are interchanged in position. It means electric field is reversed then the acceleration of the electron will be :-

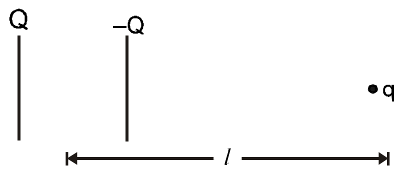
(1) Details are not complete

(2) g

(3) 2g

(4) 5 m/sec^2

20. The plates of small size of a parallel plate capacitor are charged as shown . The force on the charged particle of 'q' at a distance 'l' from the capacitor is : (Assume that the distance between the plates is d << l)



(1) zero (2) $\frac{Qqd}{2\pi \epsilon_0 \ell^3}$

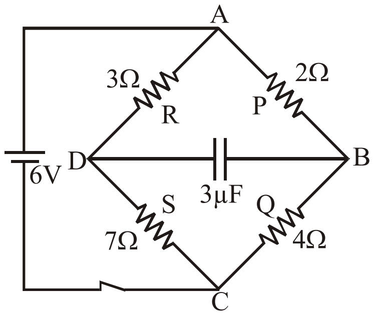
(3) $\frac{Qqd}{\pi \epsilon_0 \ell^3}$ (4) $\frac{Qqd}{4\pi \epsilon_0 \ell^3}$

21. A parallel plate capacitor is to be designed with a voltage rating 1 kV using a material of dielectric constant 3 and dielectric strength about 10^7 V/m. What minimum area of plates is required to have a capacitance 50 pF :-

(1) 1.9 cm^2 (2) 40 cm^2

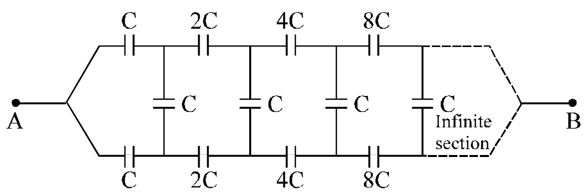
(3) 62 cm^2 (4) 35 cm^2

22. In steady state, the energy stored in the capacitor as shown in figure is :-



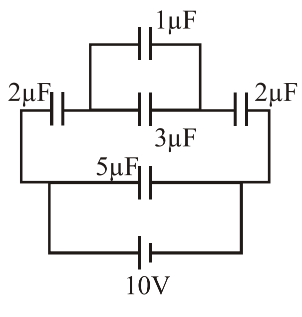
(1) 80 nJ (2) 20 nJ (3) 100 nJ (4) 60 nJ

23. Find the equivalent capacitance of the circuit between point A and B.



(1) $\frac{C}{3}$ (20) $\frac{C}{8}$ (3) C (4) $\frac{C}{32}$

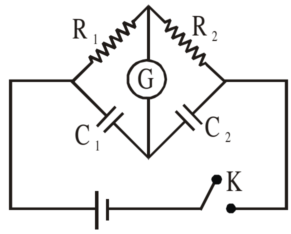
24. The ratio of potential difference between 1 μF and 5 μF capacitors -



(1) 1 : 2 (2) 4 : 5

(3) 1 : 5 (4) 1 : 4

25. In the circuit, if no current flows through the galvanometer when the key K is closed, the bridge is balanced. The balancing condition for bridge is



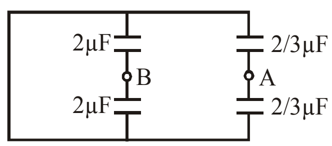
(1) $\frac{C_1}{C_2} = \frac{R_1}{R_2}$ (2) $\frac{C_1}{C_2} = \frac{R_2}{R_1}$

(3) $\frac{C_1^2}{C_2^2} = \frac{R_1^2}{R_2^2}$ (4) $\frac{C_1^2}{C_2^2} = \frac{R_2}{R_1}$

26. A parallel plate capacitor of capacitance C is connected to a battery and is charged to a potential difference V. Another capacitor of capacitance 2C is connected to another battery and is charged to potential difference 2V. The charging batteries are now disconnected and the capacitors are connected in parallel to each other in such a way that the positive terminal of one is connected to the negative terminal of the other. The final energy of the configuration is–

(1) Zero (2) $\frac{25CV^2}{6}$ (3) $\frac{3CV^2}{2}$ (4) $\frac{9CV^2}{2}$

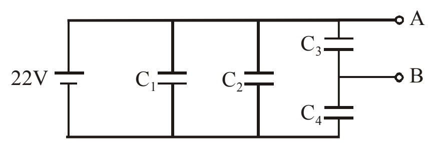
27. The equivalent capacitance of the circuit across the terminals A and B is equal to :-



(1) 0.5 μF (2) 2 μF

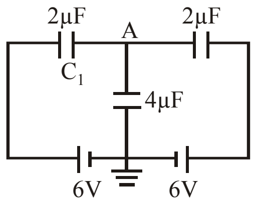
(3) 1 μF (4) none of these

28. In fig. given C_1= 3μF, C_2= 5μF, C_3= 9μF, and C_4= 13μF. What is the potential difference between points A and B?



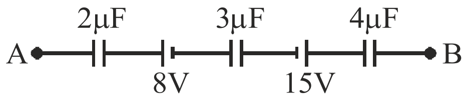
(1) 13 V (2) 9 V (3) 0 V (4) 11 V

29. Three capacitors are connected as shown in fig. Then the charge on capacitor C_1 is :-



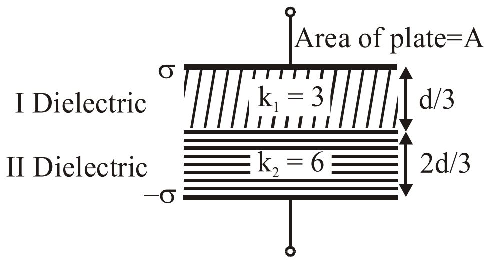
(1) 6μC (2) 12μC (3) 18μC (4) 24μC

30. The potential of the point A is greater than that of B by 19 volt. What is the potential difference in volts across the 3μF capacitor ?



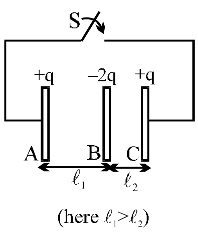
(1) 7 (2) 8 (3) 23 (4) 4

31. In the figure shown σ is the surface charge density on the upper metallic plate



(1) The ratio of energy density in I dielectric to II dielectric is 2
(2) The ratio of energy density in I dielectric to II dielectric is 4
(3) The ratio of energy density in I dielectric to II dielectric is 1
(4) None of these

32. Three long conducting plate A, B & C having charges +q, –2q & +q as shown in figure. Here plate A and C are fixed. If the switch S is closed the middle plate (B) will start moving in

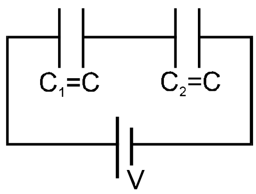


(1) Left direction
(2) Right direction
(3) will not move
(4) First move leftward & then rightward

33. Two parallel plate capacitors of capacitance C_0 and $2C_0$ are connected in parallel and charged to a potential difference V_0. Now the battery is disconnected and the region between the capacitor plates of capacitance C_0 is completely filled with a dielectric of dielectric constant K. The potential difference across the capacitors, now becomes :

(1) $\frac{V_0}{(3K+1)}$ (2) $\frac{3V_0}{(K+2)}$ (3) $\frac{2V_0}{K}$ (4) $\frac{V_0}{(2K+1)}$

34. Two identical capacitor C_1 and C_2 are connected in series with a battery. They are fully charged. Now a dielectric slab is inserted between the plates of C_2. The potential difference across C_1 will :



(1) increase
(2) decrease
(3) remain same
(4) depend on internal resistance of the cell

35. Two identical plates of a parallel plate capacitor are given charges +q and –3q. If σ_1 and σ_2 are the charge densities on outer and inner faces of the first plate then,

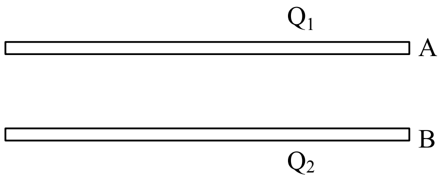
(1) $\sigma_1 = \sigma_2$ (2) $\sigma_1 = \frac{-\sigma_2}{2}$

(3) $\sigma_1 = \frac{\sigma_2}{2}$ (4) $\sigma_2 = \frac{\sigma_1}{2}$

36. If dielectric constant and dielectric strength be denoted by K and X respectively, then a material suitable for use as a dielectric in a capacitor must have

(1) high K and high X (2) high K and low X
(3) low K and high X (4) low K and low X

37. Two conducting plates A and B are parallel. A is given a charge Q_1 and B is given a charge Q_2. The charge on inner side of B is -



(1) $\frac{Q_1 - Q_2}{2}$

(2) $\frac{Q_2 - Q_1}{2}$

(3) $\frac{(Q_1 + Q_2)}{2}$

(4) $\frac{-(Q_1 + Q_2)}{2}$

38. A capacitor has some dielectric between its plates, and the capacitor is connected to a dc source. The battery is now disconnected and then the dielectric is removed, then :-

(1) capacitance will increase

(2) energy stored will decrease

(3) electric field will increase

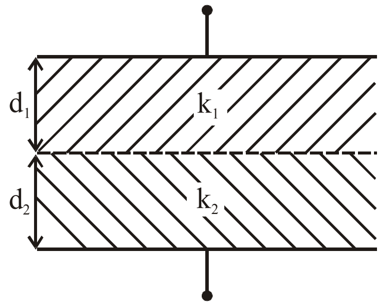
(4) voltage will decrease

39. In a parallel plate capacitor with air between the plates each plate has an area of 6×10^{-3} m^2 and the distance between the plates is 3 mm. Now this capacitor is connected to a 100 V supply. Now supply is disconnected and a mica sheet (of dielectric constant = 6) is inserted between the plates. Find the voltage across capacitor :-

(1) 100 V (2) 600 V

(3) $\frac{50}{3}$V (4) $\frac{100}{3}$V

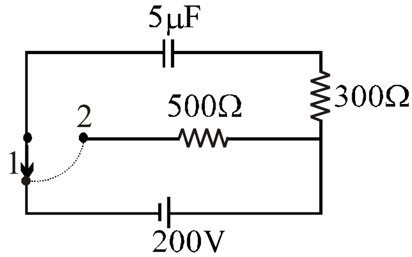
40. A parallel plate capacitor is made of two dielectric blocks in series. One of the block has thickness d_1 and dielectric constant k_1 and the other has thickness d_2 and dielectric constant k_2 as shown in figure. This arrangement can be thought as a dielectric slab of thickness $d = (d_1 + d_2)$ and effective dielectric constant k. The value of k is :-



(1) $\frac{k_1d_1 + k_2d_2}{d_1 + d_2}$ (2) $\frac{k_1d_1 + k_2d_2}{k_1 + k_2}$

(3) $\frac{k_1k_2(d_1 + d_2)}{k_1d_2 + k_2d_1}$ (4) $\frac{2k_1k_2}{k_1 + k_2}$

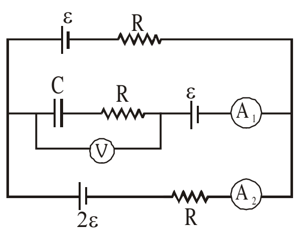
41. A capacitor of capacitance 5μF is connected to a source of constant emf of 200V for a long time, then the switch was shifted to contact 2 from contact 1. The total amount of heat generated in the 500Ω resistance, thereafter is:-



(1) 1/32 J (2) 3/32 J

(3) 2/32 J (4) 5/32 J

42. In the given circuit, ammeters A_1 and A_2 are ideal and the voltmeter (V) is having very large resistance. In the steady state reading of ammeters A_1, A_2 and voltmeter (V) will be respectively



(1) 0, $\frac{\varepsilon}{2R}$ and $\frac{\varepsilon}{2}$ (2) 0, $\frac{\varepsilon}{R}$ and $\frac{\varepsilon}{2}$

(3) 0, $\frac{\varepsilon}{2R}$ and $\frac{5\varepsilon}{2}$ (4) 0, $\frac{\varepsilon}{2R}$ and $\frac{3\varepsilon}{2}$

43. The capacitor shown in figure 1 is charged by connecting switch S to contact 'a' for a long time. If switch S is thrown to contact 'b' at time t = 0, which of the curves in figure 2 represents the magnitude of the current through the resistor R as a function of time?

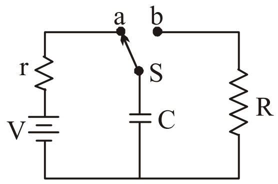


Figure 1

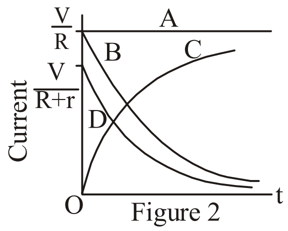
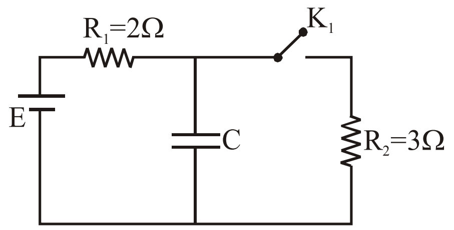


Figure 2

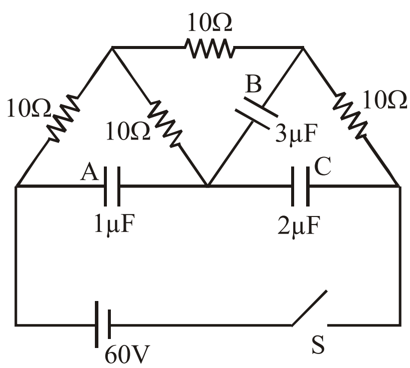
(1) A (2) B (3) C (4) D

44. In the circuit shown in the figure K_1 is open. The charge on capacitor C in steady state is q_1. Now key is closed and at steady state charge on C is q_2. The ratio of charges q_1/q_2 is



(1) 5/3 (2) 3/5 (3) 1 (4) 2/3

45. In the given figure, the switch S is closed at time t = 0. Q_A, Q_B and Q_C are charges on the capacitor A, capacitor B and capacitor C in the steady state respectively. Choose the correct statement :-



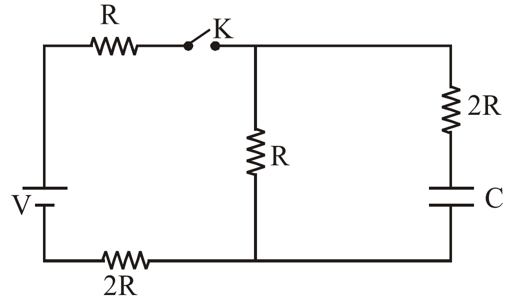
(1) $Q_A < Q_B < Q_C$

(2) $Q_A < Q_C < Q_B$

(3) $Q_C < Q_A < Q_B$

(4) $Q_C < Q_B < Q_A$

46.



Find time constant for given circuit :-

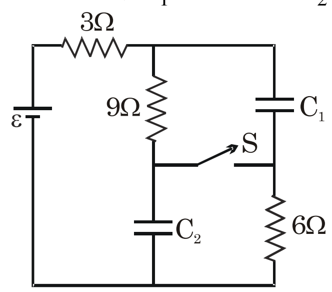
(1) $\frac{11RC}{4}$ (2) $\frac{8RC}{3}$ (3) $\frac{7RC}{3}$ (4) $\frac{9RC}{4}$

47. In above question, find time constant when key is open :

(1) $\frac{8RC}{3}$ (2) $\frac{7RC}{3}$ (3) 3 RC (4) $\frac{3RC}{2}$

48. In the circuit shown there is steady state with the switch closed. The switch is opened at t = 0. Choose the incorrect option.

(Given : ε = 24V, C_1 = 3F and C_2 = 2F)



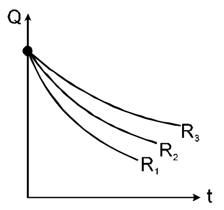
(1) The voltage across C_1 before the switch is open is 12V.

(2) The voltage across C_1 after a long time after the switch is open is 12V.

(3) The voltage across C_2 after a long time after the switch is open is 24V.

(4) The voltage across C_2 before the switch is open is 8V.

49. Three identical capacitors are given a charge Q each and they are then allowed to discharge through resistance R_1, R_2 and R_3 separately. Their charges, as a function of time are shown in the graph below. The smallest of the three resistances is



(1) R_3 (2) R_2

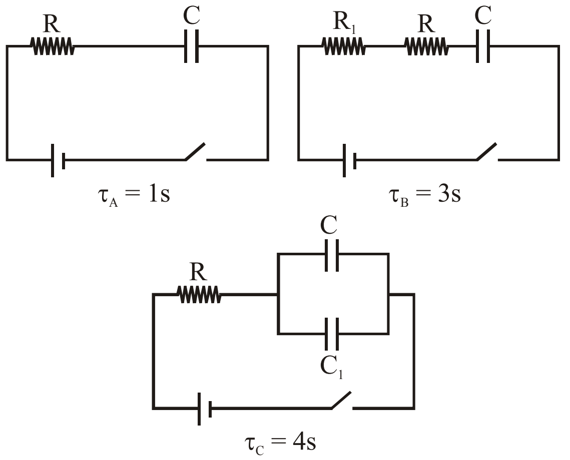
(3) R_1 (4) cannot be predicted

50. A parallel combination of 0.1 M Ω resistor and a 10 μF capacitor is connected across a 1.5 volt source of negligible resistance. The time required for the capacitor to set charged upto 0.75 volt is approximately (in seconds) :

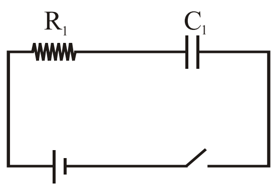
(1) ∞ (2) $\log_e 2$

(3) $\log_{10} 2$ (4) Zero

51. Given below are three circuits with their time constants,



then find time constant (in second) of circuit shown below.



(1) 2 sec (2) 4 sec

(3) 6 sec (4) 1 sec

52. A 600 pF capacitor is connected to a battery of 200 V, Now we remove battery and connect a similar capacitor to that charged capacitor. How much energy is lost in this whole process :-

(1) 3×10^{-6} J (2) 6×10^{-6} J

(3) 4×10^{-6} J (4) 18×10^{-6} J

53. In a Van-de-Graaff generator a spherical metal shell is to be a 15×10^6 V electrode. The dielectric strength of the gas surrounding the electrode is 5×10^7 V/m. The minimum radius of shell must be:-

(1) 30 cm (2) 20 cm

(3) 10 cm (4) 15 cm

ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	2
Ans.	**2**	**1**	**3**	**2**	**3**	**4**	**1**	**1**	**3**	**2**	**1**	**4**	**3**	**4**	**3**	**3**	**1**	**4**	**3**	**2**
Que.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	4
Ans.	**1**	**4**	**3**	**3**	**2**	**3**	**3**	**1**	**1**	**2**	**1**	**2**	**2**	**1**	**2**	**1**	**2**	**3**	**3**	**3**
Que.	41	42	43	44	45	46	47	48	49	50	51	52	53							
Ans.	**3**	**1**	**2**	**1**	**1**	**1**	**3**	**2**	**3**	**4**	**3**	**4**	**1**							