Chapter

2

Capacitance

1. Two conducting spheres of radii 6 cm and 12 cm, each having same charge of 3×10^{-8}C are kept very far apart. If the spheres are connected to each other by a conducting wire, then charge flowing is-
(A) 10^{-8} C from larger sphere to smaller sphere
(B) 4×10^{-8} C from smaller sphere to larger sphere
(C) 10^{-8} C from smaller sphere to larger sphere
(D) 2×10^{-8} C from smaller sphere to larger sphere

2. In the above question, the potential of smaller sphere and bigger sphere after they are connected are respectively-
(A) 6 kV, 3 kV (B) 3 k V, 3 kV (C) 6 kV, 6 kV (D) 9 kV, 9 kV

3. The capacity of an earthed spherical conductor is-
(A) 0 (B) 1 (C) 100 (D) ∞

4. The capacitance of a spherical conductor depends on-
(A) Electric charge stored on the conductor only
(B) Electric charge stored and potential through which it is raised
(C) Shape, size of conductor and medium in which it is placed
(D) None of these

5. Two Leyden jars are exactly similar in size and shape but one has glass dielectric and other ebonite. The Leyden jar with glass dielectric is charged, but when the charge is shared between the two Leyden jars, the potential drops to 0.6 of its original value. If Specific Inductive Capacity (SIC) of ebonite is 2, that of glass is:
(A) 1 (B) 2 (C) 3 (D) 4

6. A spherical drop of capacitance 1 μF is broken into eight drops of equal radius. The capacitance of each small drop is:
(A) $\frac{1}{2}\mu F$ (B) $\frac{1}{4}\mu F$ (C) $\frac{1}{8}\mu F$ (D) $\frac{1}{16}\mu F$

7. A 40 μF capacitor is a defibrillator is charged to 3000 V. The energy stored in the capacitor is sent through the patient during a pulse of duration 2 ms. The power delivered to the patient is:
(A) 45 kW (B) 90 kW (C) 180 kW (D) 360 kW

8. A fully charged capacitor has a capacitance C. It is discharged through a small coil of resistance wire embedded in a thermally insulated block of specific heat capacity s and mass m. If the temperature of the block is raised by ΔT, the potential difference V across the capacitance is:
(A) $\frac{ms\Delta T}{C}$ (B) $\sqrt{\frac{2ms\Delta T}{C}}$ (C) $\sqrt{\frac{2mc\Delta T}{s}}$ (D) $\frac{mc\Delta T}{s}$

9. The capacitance of two oppositely charged metal spheres each of capacitance C and of same radius when placed far apart will have be equal to:
(A) 2C (B) C/2 (C) C/4 (D) 4C

10. A capacitor of capacitance 160 μF is charged to a potential difference of 200 volt and then connected across a discharge tube which conducts until the potential difference across it has fallen to 100 V. The energy dissipated in the tube is:

(A) 6.4 J (B) 4.8 J (C) 3.2 J (D) 2.4 J

11. If K is the dielectric constant of a medium, and ε_0 permittivity of free space, then the energy stored per unit volume of the medium is given by:

(A) $\frac{1}{2}K^2\varepsilon_0^2/E$ (B) $\frac{1}{2}K\varepsilon_0^2E$ (C) $\frac{1}{2}K\varepsilon_0E^2$ (D) $\frac{1}{2}K\varepsilon_0E$

12. A capacitor of capacitance C is fully charged by a 200 V supply. It is then discharged through a small coil of resistance wire embedded in a thermally insulated block of specific heat 2.5×10^2 J kg^{-1} K^{-1} and of mass 0.1 kg. If the temperature of the block rises by 0.40 K, what is the value of C ?

(A) 500 μF (B) 400 μF (C) 300 μF (D) 200 μF

13. If the charge on a capacitor is increased by 2 coulomb, the energy stored in it increases by 21%. The original charge on the capacitor (in coulomb) is

(A) 10 (B) 20 (C) 30 (D) 40

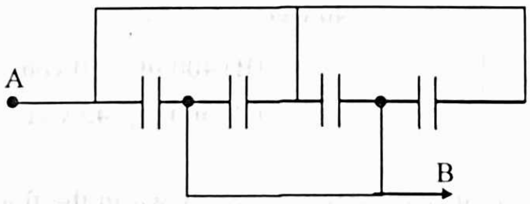
14. If n drops, each of capacitance C, coalesce to form a single big drop, the capacitance of the big drop will be

(A) n^3C (B) nC (C) $n^{1/2}C$ (D) $n^{1/3}C$

15. A condenser having a capacity of 6 μF is charged to 100 volt and is then joined to an uncharged condenser of 14 μF and then removed. The ratio of the charges on 6 μF and 14 μF condenser and the potential of 6 μF condenser will be

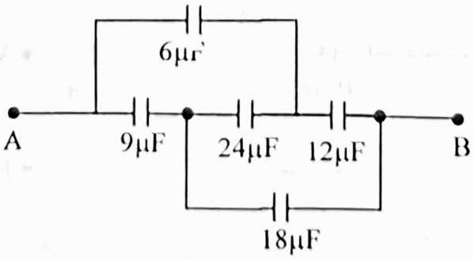
(A) $\frac{1}{2}$ and 50 volt (B) $\frac{7}{3}$ and 30 volt (C) $\frac{3}{7}$ and 30 volt (D) $\frac{7}{3}$ and 10 volt.

16. Four condenser are joined as shown in figure. The capacity of each is 8μF. The equivalent capacity between the points A and B will be-



(A) 32 μF (B) 2μF (C) 8μF (D) 16μF

17. In the connections shown in figure, the equivalent capacity between A and B will be-



(A) 10.8 μF (B) 69 μF (C) 15μF (D) 10μF

18. Figure shows two capacitors connected in series and joined to a battery. The graph in figure (b) shows the variation in potential as one moves from left to right on the branch containing the capacitors, if C_1 and C_2 are capacities of capacitor then

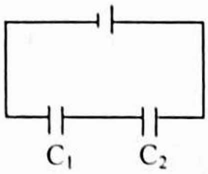


Figure (a)

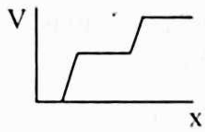


Figure (b)

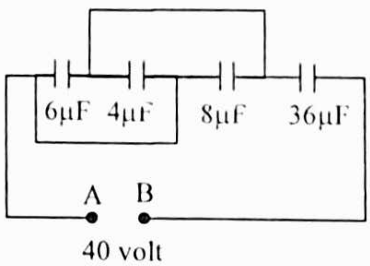
(A) $C_1 > C_2$ (B) $C_1 = C_2$
(C) $C_1 < C_2$ (D) The information is not sufficient to decide

19. A dielectric slab of length ℓ, width b, thickness d and dielectric constant K fills all the space inside a parallel plate capacitor. At t = 0, the slab begins to be pulled out slowly with speed v. At time t, the capacity of the capacitor is-

(A) $\frac{\varepsilon_0 b}{d}[K\ell - (K-1)vt]$ (B) $\frac{\varepsilon_0 \ell}{b}[K\ell + Kvt]$

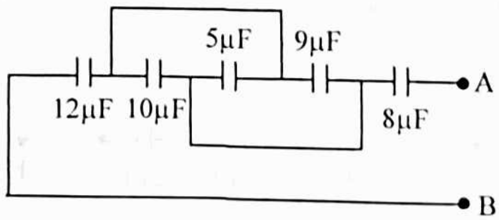
(C) $\frac{\varepsilon_0 d}{b}[(K+1)vt]$ (D) $\frac{\varepsilon_0 b}{d}[\ell - (K+1)vt]$

20. Four capacitors are connected as shown in figure. The approximate charge and potential across 8 μF capacitance will be respectively-



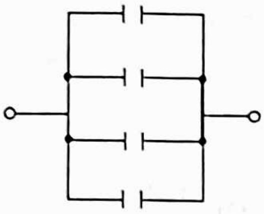
(A) 320 μC ; 40 volt (B) 400 μC ; 50 volt
(B) 213 μC ; 27 volt (D) 360 μC; 45 volt

21. The capacitance and connection of five capacitors are shown in the figure. The potential difference between the points A and B is 60 volt. Then the equivalent capacity between A and B and the charge on 5μF capacitance will be respectively

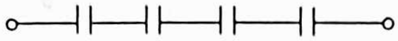


(A) 44μF, 300 μC (B) 16μF, 150 μC
(C) 15 μF, 200 μC (D) 4μF, 50 μC

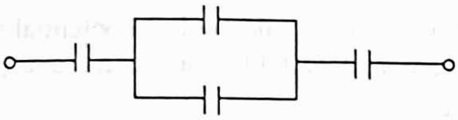
22. Four identical capacitors are connected as shown



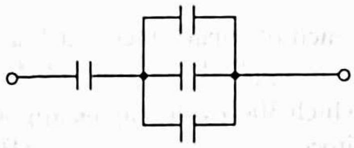
(a)



(b)



(c)

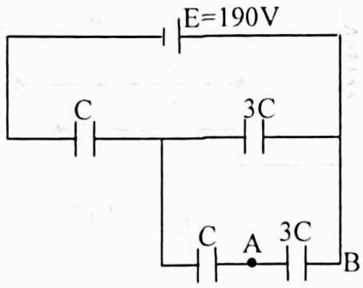


(d)

which of the following list the arrangement in order of decreasing capacitance ?

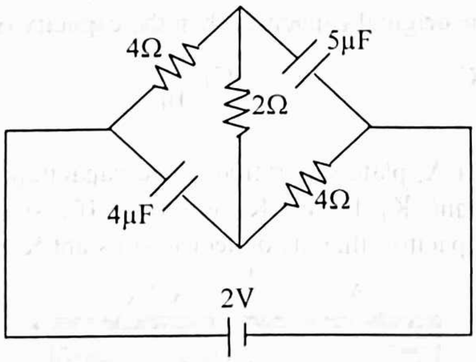
(A) acdb (B) adcb (C) bcda (D) bdca

23. In the circuit shown in figure potential difference between A and B is-



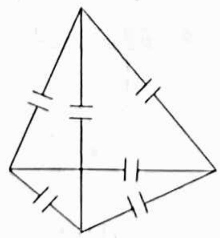
(A) 30 V (B) 60 V (C) 10 V (D) 90 V

24. The ratio between the energy stored in $5\mu F$ capacitor to the $4\mu F$ capacitor in the given circuit is-



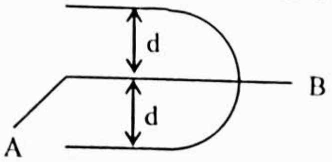
(A) 1.2 (B) 1 (C) 1.25 (D) 3.6

25. If the capacitance of each capacitor is C, then effective capacitance of the shown network across any two junctions is-



(A) 2C (B) C (C) C/2 (D) 5C

26. Three plates of common surface area A are connected as shown. The effective capacitance will be

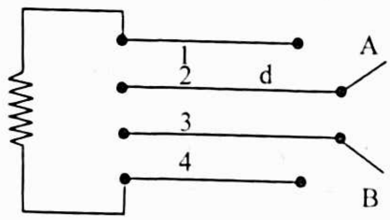


(A) $\frac{\varepsilon_0 A}{d}$ (B) $\frac{3\varepsilon_0 A}{d}$ (C) $\frac{3}{2}\frac{\varepsilon_0 A}{d}$ (D) $\frac{2\varepsilon_0 A}{d}$

27. A number of capacitors, each of capacitance 1 μ F and each one of which gets punctured if a potential difference just exceeding 500 volt is applied, are provided. Then an arrangement suitable for giving a capacitor of capacitance 2μF across which 3000 volt may be applied requires at least-

(A) 18 component capacitors
(B) 36 component capacitors
(C) 72 component capacitors
(D) 144 component capacitor

28. Four metallic plates, each with a surface area of one side A, are placed at a distance d from each other. The plates reconnected as shown in the figure. Then the capacitance of the system between A and B is-

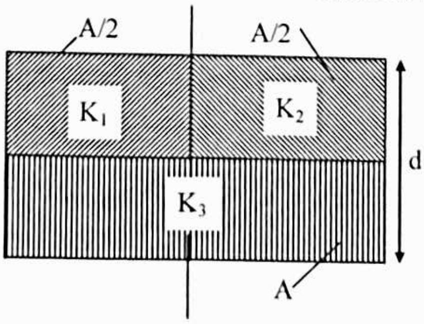


(A) $\frac{3\varepsilon_0 A}{d}$ (B) $\frac{2\varepsilon_0 A}{d}$ (C) $\frac{2}{3}\frac{\varepsilon_0 A}{d}$ (D) $\frac{3}{2}\frac{\varepsilon_0 A}{d}$

29. Between the plates of a parallel plate capacitor of capacity C, two parallel plates, of the same material and area same as the plate of the original capacitor, are placed. It the thickness of these plates is equal to $\frac{1}{5}$th of the distance between the plates of the original capacitor, then the capacity of the new capacitor is-

(A) $\frac{5}{3}C$ (B) $\frac{3}{5}C$ (C) $\frac{3C}{10}$ (D) $\frac{10C}{3}$

30. A parallel plate capacitor of area A, plate separation d and capacitance C is filled with three different dielectric materials having dielectric constants K_1, K_2 and K_3 as shown. If a single dielectric material is to be used to have the same capacitance C in this capacitor, then its dielectric constant K is given by : (A = Area of plates)

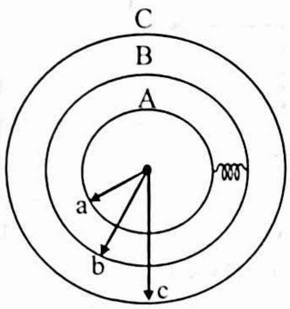


(A) $\frac{1}{K}=\frac{1}{K_1}+\frac{1}{K_2}+\frac{1}{2K_3}$
(B) $\frac{1}{K}=\frac{1}{K_1+K_2}+\frac{1}{2K_3}$
(C) $K=\frac{K_1K_2}{K_1+K_2}+2K_3$
(D) $K=K_1+K_2+2K_3$

31. The capacity of a spherical capacitor is C_1 when the inner sphere is charged and outer sphere is earthed and C_2 when the inner sphere is earthed and outer sphere is charged. Then C_1/C_2 is (a = radius of inner sphere, b = radius of outer sphere)

(A) 1 (B) $\frac{a}{b}$ (C) $\frac{b}{a}$ (D) $\frac{a+b}{a-b}$

32. Three conducting spheres A, B and C are as shown in the figure. The radii of the spheres are **a**, **b** and **c** respectively. A and B are connected by a conducting wire. The capacity of the system is-



(A) $4\pi\varepsilon_0(a + b + c)$ (B) $4\pi\varepsilon_0\left(\frac{bc}{c-b}\right)$ (C) $4\pi\varepsilon_0\left[\frac{1}{a}+\frac{1}{b}+\frac{1}{c}\right]$ (D) $4\pi\varepsilon_0\left[\frac{abc}{ab+bc+ca}\right]$

33. A capacitor of capacitance C is charged to a potential difference V from a cell and then disconnected from it. A charge +Q is now given to its positive plate. The potential difference across the capacitor is now

(A) V (B) $V + \frac{Q}{C}$ (C) $V + \frac{Q}{2C}$ (D) None of these

34. A capacitor is filled with an insulator and certain potential difference is applied to its plates. The energy stored in the capacitor is U. Now the capacitor is disconnected from the source and the insulator is pulled out of the capacitor. The work performed against the forces of electric field in pulling out the insulator is 4U. Then dielectric constant of the insulator is-

(A) 4 (B) 8 (C) 5 (D) 3

35. A charged soap bubble of radius R and surface tension of σ is in equilibrium with outside and inside pressure equal. The charge on the soap bubble is-

(A) $\sqrt{32\varepsilon_0\pi R^3\sigma}$ (B) $\sqrt{128\varepsilon_0\pi^2R^3\sigma}$ (C) $128\,\varepsilon_0R^3\sigma$ (D) $32\varepsilon_0\pi^2R^3\sigma$

36. The respective radii of the two spheres of a spherical condenser are 12 cm and 9 cm. The dielectric constant of the medium between them is 6. The capacity of the condenser will be-

(A) 240 pF (B) 240 μF (C) 240 F (D) None of these

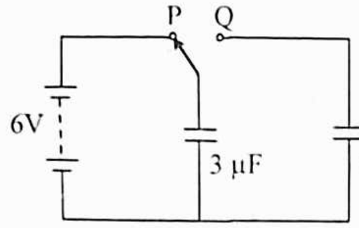
37. Condenser A has a capacity of 15 μ F when it is filled with a medium of dielectric constant 15. Another condenser B has a capacity 1μF with air between the plates. Both are charged separately by a battery of 100 V. After charging, the battery is disconnected and then the dielectric removed. Now, the two capacitors are connected in parallel. The common potential will now be-

(A) 400 V (B) 800 V (C) 1200 V (D) 1600 V

38. Two identical capacitor have the same capacitance C. One of them is charged to potential V_1 and the other to V_2. The negative ends of the capacitors are connected together. When the positive ends are also connected, the decrease in energy of the combined system is-

(A) $\frac{1}{4}C(V_1^2 - V_2^2)$ (B) $\frac{1}{4}C(V_1^2 + V_2^2)$ (C) $\frac{1}{4}C(V_1 - V_2)^2$ (D) $\frac{1}{4}C(V_1 + V_2)^2$

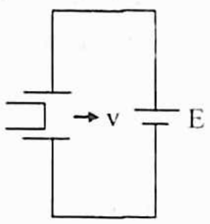
39. In the circuit shown, a capacitor of capacitance 3μF is charged from a battery of emf 6 V with the switch connected to terminal P.

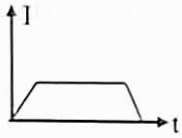


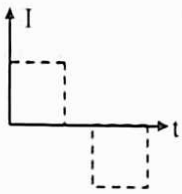
The switch is now connected to Q. This charges the 6μF capacitor from the 3 μF one.
What is the new potential difference across the combination?

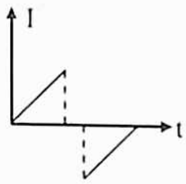
(A) 1 V (B) 2V (C) 4 V (D) 6V

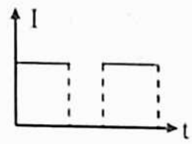
40. A dielectric slab of area A and thickness d is inserted between the plates of a capacitor of area 2A and distance between plates d with a constant speed v shown in the figure. The capacitor is connected to a battery of e.m.f. E. The current in the circuit varies with time as



(A) 

(B) 

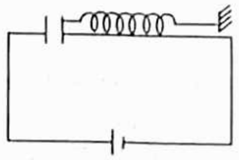
(C) 

(D) 

41. A parallel plate capacitor has an electric field of 10^5 V/m between the plates. If the charge on the capacitor plate is 1 μC, the force on each capacitor plate is:

(A) 0.5 N (B) 0.05 N (C) 0.005 N (D) None of these

42. One plate of a capacitor is connected to a spring as shown in the figure. Area of both the plates is A. In steady state separation between the plates is 0.8d (spring was unstreched and the distance between the plates was d when the capacitor was uncharged). The force constant of the spring is approximately –



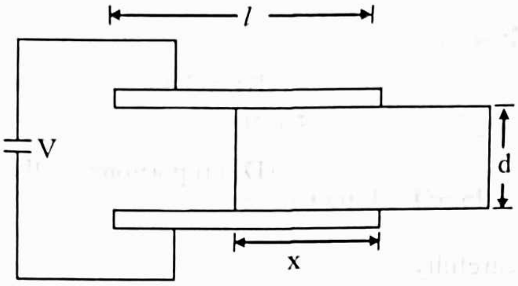
E

(A) $\frac{4\varepsilon_0 AV^2}{d^3}$ (B) $\frac{2\varepsilon_0 AE}{d^2}$ (C) $\frac{6\varepsilon_0 E^2}{Ad^3}$ (D) $\frac{\varepsilon_0 AE^3}{2d^3}$

43. Capacity of an isolated sphere is increased n times when it is enclosed by an earthed concentric sphere. The ratio of their radii is-

(A) $\frac{n^2}{n-1}$ (B) $\frac{n}{n-1}$ (C) $\frac{2n}{n+1}$ (D) $\frac{2n+1}{n+1}$

44. Figure shows a parallel plate capacitor with plates of width b and length l. The separation between the plates is d. The plates are rigidly clamped and connected to a battery of emf V.

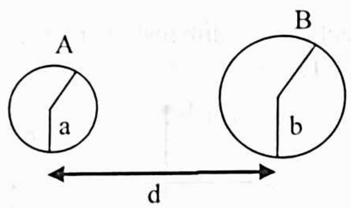


A dielectric slab of thickness d and dielectric constant K is slowly inserted between the plates. What force should be applied on the slab to ensure that it goes slowly into the capacitor :

(A) $\frac{\varepsilon_0 bV^2}{2d}[l + x(K-1)]$ (B) $\frac{\varepsilon_0 bV^2}{2d}[l + (K-1)]$

(C) $\frac{\varepsilon_0 bV^2}{2d}[K-1]$ (D) $\frac{\varepsilon_0 bV^2}{d}[l + (K-1)]$

45. Two conducting spherical shells having radii a and b (>a) carry equal and opposite charges and are separated by a distance d(>> a or b). The capacity of the system –



(A) $C = \frac{4\pi\varepsilon_0}{a-b-d}$ (B) $C = \frac{4\pi\varepsilon_0}{\frac{1}{a}-\frac{1}{b}-\frac{1}{d}}$ (C) $\frac{4\pi\varepsilon_0}{\frac{1}{a}+\frac{1}{b}-\frac{1}{d}}$ (D) $C = \frac{4\pi\varepsilon_0}{\frac{1}{a}+\frac{1}{b}-\frac{2}{d}}$