Exercise-1

PART-I : ONLY ONE OPTION CORRECT TYPE

SECTION (A) : DEFINITION OF CAPACITANCE

1. The radii of two metallic spheres are 5 cm and 10 cm and both carry equal charge of 75μC. If the two spheres are shorted then charge will be transferred–

(1) 25 μC from smaller to bigger (2) 25 μC from bigger to smaller
(3) 50 μC from smaller to bigger (4) 50 μC from bigger to smaller

2. Two isolated charged metallic spheres of radii R_1 and R_2 having charges Q_1 and Q_2 respectively are connected to each other, then there is:

(1) No change in the electrical energy of the system
(2) An increase in the electrical energy of the system
(3) Always a decrease in the electrical energy of the system
(4) A decrease in electrical energy of the system until $Q_1 R_2 = Q_2 R_1$

3. A parallel plate capacitor is charged and the charging battery is then disconnected. The plates of the capacitor are now moved, farther apart. The following things happen :

(1) The charge on the capacitor increases
(2) The electrostatics energy stored in the capacitor increases
(3) The voltage between the plates decreases
(4) The capacitance increases.

4. A parallel plate capacitor is charged and then isolated. On increasing the plate separation–

	Charge	**Potential**	**Capacitance**
(1)	remains constant	remains constant	decreases
(2)	remains constant	increases	decreases
(3)	remains constant	decreases	increases
(4)	increases	increases	decreases

5. The value of one farad in e.s.u. is-

(1) 3×10^{10} (2) 9×10^{11} (3) $\frac{1}{9} \times 10^{-11}$ (4) $\frac{1}{3} \times 10^{-10}$

6. A parallel plate air capacitor is charged to a potential difference V. After disconnecting the battery the distance between the plates of the capacitor is increased using an insulating handle. As a result the potential difference between the plates-

(1) Increases (2) Decreases (3) Does not change (4) Becomes zero

7. The capacitance of a parallel plate capacitor is 10 μF when distance between its plates is 8 cm. If distance between the plates is reduced to 4 cm, its capacitance will be-

(1) 5 μF (2) 10 μF (3) 20 μF (4) 40 μF

8. Capacitance in farad of a spherical conductor with radius 1 metre is-

(1) 1.1×10^{-10} (2) 10^{-6} (3) 9×10^{-9} (4) 10^{-3}

9. The capacitance of spherical conductor is given by-

(1) $C = \frac{1}{4\pi\varepsilon_0 R}$ (2) $C = 4\pi\varepsilon_0 R$ (3) $C = 4\pi\varepsilon_0 R^2$ (4) $C = r\pi\varepsilon_0 R^3$

10. Eight drops of mercury of equal radii and each possessing the same charge combine to form a big drop. The capacitance of this big drop as compared to that of each smaller drop is-

(1) 2 times (2) 4 times (3) 8 times (4) 16 times

11. Capacity of a conductor depends upon-
(1) Size of conductor
(2) Thickness of conductor
(3) Material of conductor
(4) All of these

12. Metallic sphere of radius R is charged to potential V. Then charge q is proportional to-
(1) V
(2) R
(3) Both
(4) None

13. A conducting sphere of radius 10 cm is charged with 10 μC. Another uncharged sphere of radius 20 cm is allowed to touch it for some time. After that if the sphere are separated, then surface density of charged on the spheres will be in the ratio of :
(1) 1 : 4
(2) 1 : 3
(3) 2 : 1
(4) 1 : 1

14. Capacitance (in F) of a spherical conductor having radius 1m, is :
(1) 1.1×10^{-10}
(2) 10^{-6}
(3) 9×10^{-9}
(4) 10^{-3}

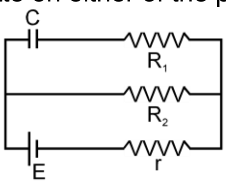
15. The capacitance of a parallel plate capacitor is 12μF. If the distance between its plates is reduced to half and the area of plates is doubled, then the capacitance of the capacitor will become
(1) 24μF
(2) 12μF
(3) 16μF
(4) 48μF

16. The radius of the circular plates of a parallel plate capacitor is R. Air is dielectric medium between the plates. If the capacitance of the capacitor is equal to the capacitance of a sphere of radius R, then the distance between the plates is
(1) R/4
(2) R/2
(3) R
(4) 2R

SECTION (B) : CIRCUITS WITH CAPACITOR AND USE OF KCL AND KVL

1. The work done against electric forces in increasing the potential difference of a condenser from 20V to 40V is W. The work done in increasing its potential difference from 40V to 50V will be
(1) 4W
(2) $\frac{3W}{4}$
(3) 2W
(4) $\frac{W}{2}$

2. The magnitude of charge in steady state on either of the plates of condenser C in the adjoining circuit is-



(1) CE
(2) $\frac{CER_2}{(R_1+r)}$
(3) $\frac{CER_2}{(R_2+r)}$
(4) $\frac{CER_1}{(R_2+r)}$

3. The plate separation in a parallel plate condenser is d and plate area is A. If it is charged to V volt & battery is disconnected then the work done in increasing the plate separation to 2d will be–
(1) $\frac{3}{2}\frac{\varepsilon_0 AV^2}{d}$
(2) $\frac{\varepsilon_0 AV^2}{d}$
(3) $\frac{2\varepsilon_0 AV^2}{d}$
(4) $\frac{\varepsilon_0 AV^2}{2d}$

4. A capacitor of capacitance C_1 is charged to potential V and battery is disconnected. Now the capacitor is connected to a uncharged capacitor of capacitance C_2 then what will be common potential of the combination
(1) $\frac{C_1 V}{C_1+C_2}$
(2) $\frac{C_2 V}{C_1+C_2}$
(3) $\frac{(C_1+C_2)V}{C_1+C_2}$
(4) $\frac{C_2}{C_1+C_2}$

5. If the charge on a body is increased by 2μC, the energy stored in it increases by 21%. The original charge on the body in micro-coulombs is

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

6. What fraction of the energy drawn from the charging battery is stored in a capacitor

(1) 100% (2) 75% (3) 50% (4) 25%

7. The plates of a parallel plate condenser are pulled apart with a velocity v. If at any instant mutual distance of separation is d, then the magnitude of the time of rate of change of electrostatic energy of the capacity depends on d as follows(potential difference between plates is kept constant)-

(1) $\frac{1}{d}$ (2) $\frac{1}{d^2}$ (3) d_2 (4) d

8. 125 water drops of equal radius and equal capacitance C, coalesce to form a single drop of capacitance C´. The relation between C and C´ is-

(1) C´ = 125 C (2) C´ = C (3) $C' = \frac{C}{125}$ (4) C´ = 5C

9. Energy per unit volume for a capacitor having area A and separation d kept at potential difference V is given by-

(1) $\frac{1}{2}\varepsilon_0\frac{V^2}{d^2}$ (2) $\frac{1}{2\varepsilon_0}\frac{V^2}{d^2}$ (3) $\frac{1}{2}CV^2$ (4) $\frac{Q^2}{2C}$

10. The mean electric energy density between plates of a charged capacitor is- (here q = charge on the capacitor and A = area of the capacitor plate)

(1) $\frac{q^2}{2\varepsilon_0 A^2}$ (2) $\frac{q}{2\varepsilon_0 A^2}$ (3) $\frac{q^2}{2\varepsilon_0 A}$ (4) None of above

11. A capacitor when charged by a potential difference of 200 volt, stores a charge of 0.1 C. By discharging, energy liberated by the capacitor is-

(1) –30 J (2) –15 J (3) 10 J (4) 20 J

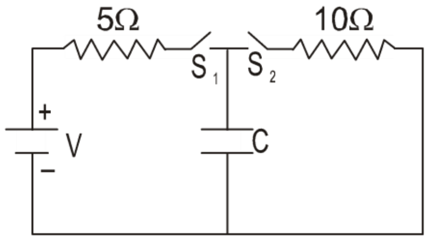
12. Work done in placing a charge of $8 \times 10_{-18}$ C on a condenser of capacity 100 microfarad is-

(1) $16 \times 10_{-32}$ J (2) $3.1 \times 10_{-26}$ J (3) $4 \times 10_{-10}$ J (4) $32 \times 10_{-32}$ J

13. The work done in doubling the separation between plates of a parallel plate capacitor of capacity C and having charge Q is-

(1) $\frac{Q^2}{C}$ (2) $\frac{Q^2}{2C}$ (3) $\frac{Q^2}{4C}$ (4) $\frac{2Q^2}{C}$

14. In the adjoining diagram, (assuming the battery to be ideal) the condenser C will be charged to potential V if-



(1) S_1 and S_2 both are open (2) S_1 and S_2 both are closed

(3) S_1 is closed and S_2 is open (4) S_1 is open and S_2 is closed.

15. A capacitor 4mF charged to 50 V is connected to another capacitor of 2mF charged to 100V with plates of like charges connected together. The total energy before and after connection in multiples [10 J] is-(1) 1.5 and 1.33 (2) 1.33 and 1.5 (3) 3.0 and 2.67 (4) 2.67 and 3.0

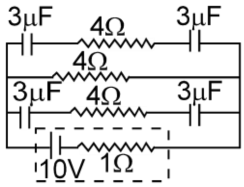
16. A condenser of capacitance 10mF has been charged to 100 volts. It is now connected to another uncharged condenser in parallel. The common potential becomes 40 volts. The capacitance of another condenser is-

(1) 15 mF (2) 5 mF (3) 10 mF (4) 16.6 mF

17. Two capacitors of capacitances 3μF and 6μF are charged to a potential of 12V each. They are now connected to each other, with the positive plate of each joined to the negative plate of the other. The potential difference across each will be

(1) 6V (2) 4V (3) 3V (4) Zero

18. In the following figure, the charge on each condenser in the steady state will be–



(1) 3μC (2) 6μC (3) 9μC (4) 12μC

19. Two parallel plate condensers of capacity of 20μF and 30μF are charged to the potentials of 30V and 20V respectively. If likely charged plates are connected together then the common potential difference will be-

(1) 100 V (2) 50 V (3) 24 V (4) 10 V

20. The work done in placing a charge of 8×10^{-18} coulomb on a condenser of capacity 100 micro-farad is :

(1) 16×10^{-32} joule (2) 3.1×10^{-26} joule (3) 4×10^{-10} joule (4) 32×10^{-32} joule

21. A capacitor is charged by connecting a battery across its plates. It stores energy U. Now the battery is disconnected and another identical capacitor is connected across it, then the energy stored by both capacitors of the system will be :

(1) U (2) $\frac{U}{2}$ (3) 2U (4) $\frac{3}{2}$ U

22. In a parallel plate capacitor, the distance between the plates is d and potential difference across plates is V. Energy stored per unit volume between the plates of capacitor is :

(1) $\frac{Q^2}{2V^2}$ (2) $\frac{1}{2}\varepsilon_0\frac{V^2}{d^2}$ (3) $\frac{\varepsilon_0^2V^2}{d^2}$ (4) $\frac{1}{2}\frac{\varepsilon_0^2V^2}{d^2}$

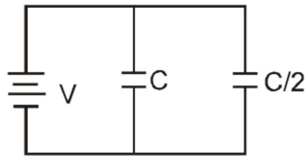
23. A capacitor of capacity C_1 is charged upto potential V volt and then connected in parallel to an uncharged capacitor of capacity C_2. The final potential difference across each capacitor will be :

(1) $\frac{C_2V}{C_1+C_2}$ (2) $\frac{C_1V}{C_1+C_2}$ (3) $\left(1+\frac{C_2}{C_1}\right)V$ (4) $\left(1-\frac{C_2}{C_2}\right)V$

24. A parallel plate air capacitor is charged to a potential difference of *V* volts. After disconnecting the charging battery the distance between the plates of the capacitor is increased using an insulating handle. As a result the potential difference between the plates :

(1) decreases (2) does not change (3) becomes zero (4) increases

25. Two condensers, one of capacity C and the other of capacity $\frac{C}{2}$, are connected to a V volt battery, as shown.



The work doen in charging fully both the condensers is

(1) $2CV^2$ (2) $\frac{1}{4}CV^2$ (3) $\frac{3}{2}CV^2$ (4) $\frac{1}{2}CV^2$

26. The energy required to charge a parallel plate condenser of plate separation d and plate area of cross-section A such that the uniform electric field between the plates is E, is

(1) $\frac{1}{2}\varepsilon_0E^2/Ad$ (2) ε_0E^2/Ad (3) ε_0E^2Ad (4) $\frac{1}{2}\varepsilon_0E^2Ad$

27. A 40 μF capacitor in 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

(1) 45 kW (2) 90 kW (3) 180 kW (4) 360 kW

28. If there are n capacitors of capacitance C in parallel connected to V volt source, then the energy stored is equal to :

(1) CV (2) $\frac{1}{2}nCV^2$ (3) CV^2 (4) $\frac{1}{2n}CV^2$

29. A battery is used to charge a parallel plate capacitor till the potential difference between the plates becomes equal to the electromotive force of the battery. The ratio of the energy stored in the capacitor and the work done by the battery will be

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

30. A parallel plate capacitor with air between the plates has a capacitance of 9 pF. The separation between its plates is 'd'. The space between the plates is now filled with two dielectrics. One of the dielectrics has dielectric constant $k_1 = 3$ and thickness d/3 while the other one has dielectric constant $k_2 = 6$ and thickness 2d/3. Capacitance of the capacitor is now :

(1) 45 pF (2) 40.5 pF (3) 20.25 pF (4) 1.8 pF

31. If the energy of a capacitor of capacitance 2μF is 0.16 joule, then its potential difference will be

(1) 800 V (2) 400 V (3) 16×10^4 V (4) 16×10^{-4} V

32. A capacitor of 6μF is charged to such an extent that the potential difference between the plates becomes 50 V. The work done in this process will be

(1) 7.5×10^{-2} J (2) 7.5×10^{-3} J (3) 3×10^{-6} J (4) 3×10^{-3} J

33. Two identical capacitors 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:

(1) $\frac{1}{4}C(V_1^2 - V_2^2)$ (2) $\frac{1}{4}C(V_1^2 + V_2^2)$ (3) $\frac{1}{4}C(V_1 - V_2)^2$ (4) $\frac{1}{4}C(V_1 + V_2)^2$

34. A capacitor is connected to a cell of emf E having some internal resistance r. The potential difference across the :

(1) cell is < E (2) cell is E (3) capacitor is > E (4) capacitor is < E

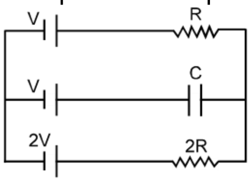
35. A 10 μF capacitor is charged to a 1000 volt potential, then it is removed from power supplied and connected to a 6 μF uncharged capacitor. Find potential difference across each capacitor.

(1) 167 V (2) 100 V (3) 625 V (4) 250 V

36. The uniform electric field in the space between the plates of a parallel plate condenser of plate separation d and plate areas A is E. The energy of this charged condencer is :

(1) $\frac{1}{2}.\frac{\epsilon_0 E^2}{A.d}$ (2) $\epsilon_0 E^2 Ad$ (3) $\frac{1}{2}\epsilon_0 E^2 Ad$ (4) $\frac{1}{2}.\frac{\epsilon_0 E^2}{Ad}$

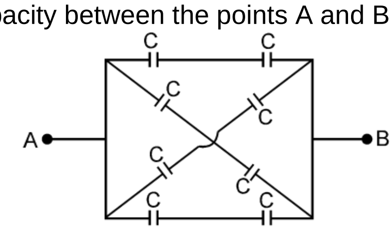
37. In the given circuit with steady current the potential drop across the capacitor must be :



(1) V (2) V/2 (3) V/3 (4) 2V/3

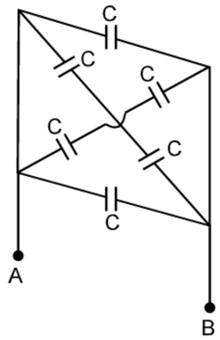
SECTION (C) : COMBINATION OF CAPACITORS

1. In the adjoining circuit, the capacity between the points A and B will be -



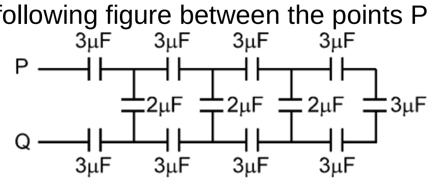
(1) C (2) 2C (3) 3C (4) 4C

2. The resultant capacity between the points A and B in the adjoining circuit will be -



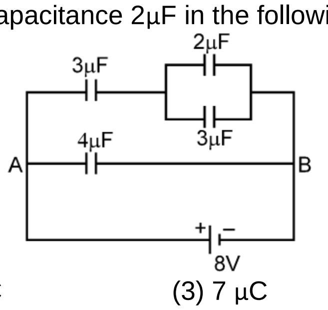
(1) C (2) 2C (3) 3C (4) 4C

3. The effective capacity in the following figure between the points P and Q will be –



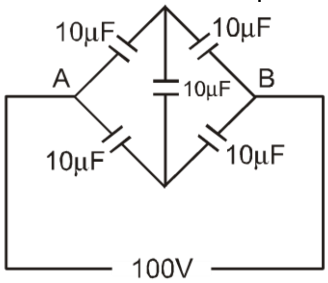
(1) 3μF (2) 5μF (3) 2μF (4) 1μF

4. The charge on the condenser of capacitance 2μF in the following circuit will be –



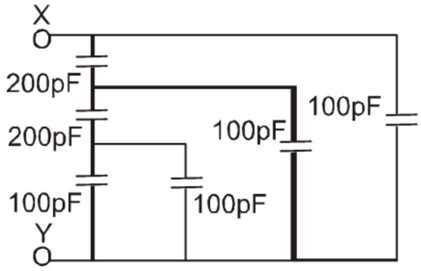
(1) 4.5 μC (2) 6.0 μC (3) 7 μC (4) 30 μC

5. Five capacitors of 10μF capacity each are connected to a d.c. potential difference of 100 volts as shown in the figure. The equivalent capacitance between the points A and B will be equal to-



(1) 40μF (2) 20μF (3) 30μF (4) 10μF

6. The equivalent capacitance between the terminals X and Y in the figure shown will be–



(1) 100 pF (2) 200 pF (3) 300 pF (4) 400 pF

7. Three capacitors of capacity 1 μF each, are connected in such a way, that resultant capacity is 1.5 μF, then:
(1) all the capacitors are joned in series
(2) all the capacitors are joined in parallel
(3) two capacitors are in parallel, while third is in series
(4) two capacitors are in series, while third is in parallel

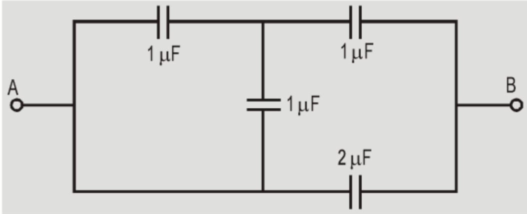
8. n identical condenser are joined in parallel and are charged to potential V. Now they are separated and joined in series. Then the total energy and potential difference of the combination will be-
(1) Energy and potential difference remain same
(2) Energy remains same and potential difference is nV
(3) Energy increases n times and potentials differences is nV
(4) Energy increases n times and potential difference remains same

9. 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 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) $\frac{9CV^2}{2}$

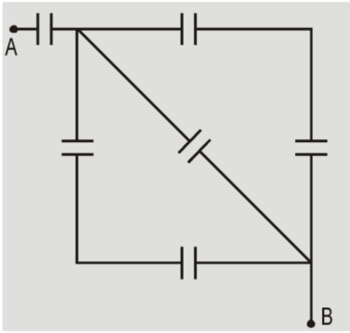
10. A 3 μF capacitor is charged to a potential of 300 V and a 2μF capacitor is charged to 200 V. The capacitors are then connected in parallel with plates of opposite polarity joined together. What amount of charge will flow when the plates are so connected-
(1) 250μC (2) 600μC (3) 700μC (4) 1300μC

11. The equivalent capacitance of the circuit shown, between points A and B will be-



(1) $\frac{2}{3}\mu F$ (2) $\frac{5}{3}\mu F$ (3) $\frac{8}{3}\mu F$ (4) $\frac{7}{3}\mu F$

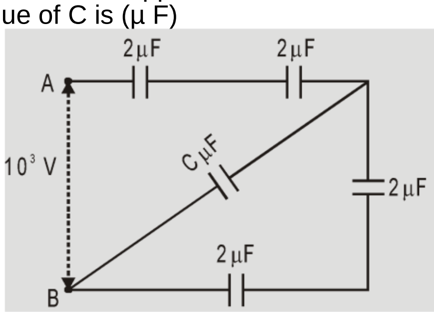
12. In the electric circuit given below, capacitance of each capacitor is 1 μF. The effective capacitance between the points A and B is- (in μF)



(1) $\frac{2}{3}$ (2) $\frac{3}{2}$ (3) $\frac{1}{6}$ (4) 6

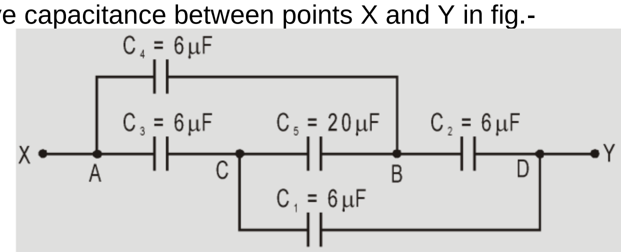
13. The equivalent capacitance of three capacitors of capacitance C_1, C_2 and C_3 connected in parallel is 12 units and the product $C_1 . C_2 . C_3 = 48$. When the capacitors C_1 and C_2 are connected in parallel the equivalent capacitance is 6 units. Then the capacitance are-
(1) 2, 4, 6 (2) 1, 5, 6 (3) 1.5, 2.5, 8 (4) 2, 3, 7

14. When a potential difference of 10^3 V is applied between A and B, a charge of 0.75 mC is stored in the system of capacitors. The value of C is (μ F)



(1) (2) 3 (3) 2.5 (4) 2

15. What is effective capacitance between points X and Y in fig.-



(1) 6 μF (2) 12 μF (3) 18 μF (4) 24 μF

16. Ten capacitors are joined in parallel and charged with a battery up to a potential V. They are then disconnected from battery and joined again in series then the potential of this combination will be-

(1) V (2) 10 V (3) 5 V (4) 2 V

17. The energy stored in the capacitor is U, when it is charged with a battery. After disconnecting battery another capacitor of same capacity is connected in parallel with it, then energy stored in each capacitor is-

(1) $\frac{U}{6}$ (2) $\frac{U}{4}$ (3) 9U (4) 8U

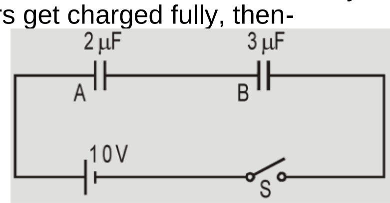
18. Minimum numbers of 8μF and 250V capacitors are used to make a combination of 16μF and 1000V are-

(1) 4 (2) 32 (3) 8 (4) 3

19. A condenser of capacity 50 μF is charged to 10V. The energy stored is-

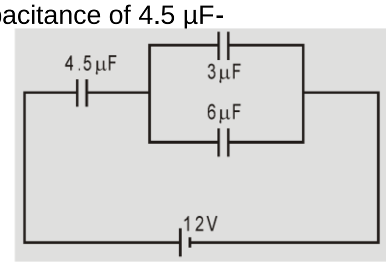
(1) 1.25×10^{-3} J (2) 2.5×10^{-3} J (3) 3.75×10^{-3} J (4) 5×10^{-3} J

20. The capacitors A and B are connected in series with a battery as shown in the figure. When the switch S is closed and the two capacitors get charged fully, then-



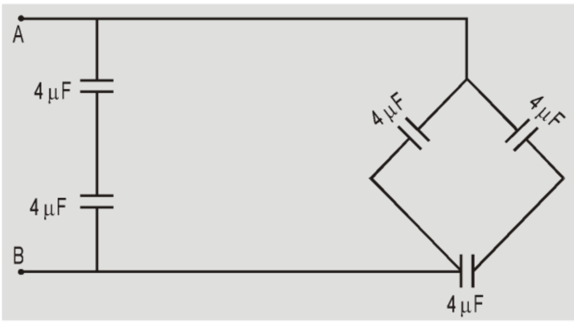
(1) The potential difference across the plates of A is 4V and across the plates of B is 6V
(2) The potential difference across the plates of A is 6V and across the plates of B is 4V
(3) The ratio of electric energies stored in A and B is 2 : 3
(4) The ratio of charges on A and B is 3 : 2

21. Potential difference across capacitance of 4.5 μF-



(1) 8 V (2) 4 V (3) 2 V (4) 6 V

22. The equivalent capacitance in the circuit shown in fig. will be-



(1) $\frac{10}{3}$ μF (2) 4 μF (3) 6 μF (4) 8 μF

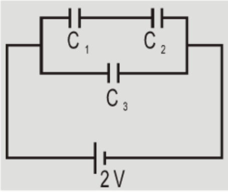
23. Three condenser of capacity C each are joined first in series and then in parallel. The capacity becomes n times, where n is-

(1) 3 (2) 6 (3) 9 (4) 12

24. Two spherical conductors A and B of radius a and b (b > a) are placed in air concentrically. B is given charge +Q coulomb and A is grounded. The equivalent capacitance of these will be-

(1) $4\pi\varepsilon_0 \frac{ab}{b-a}$ (2) $4\pi\varepsilon_0 (a + b)$ (3) $4\pi\varepsilon_0 b$ (4) $4\pi\varepsilon_0 \frac{b^2}{b-a}$

25. Two capacitor $C_1 = 2\mu F$, $C_2 = 6\mu F$ are in series order, connected in parallel to a third capacitor of $4\mu F$. This combination is connected to 2 volt battery, in charging these capacitors energy consumed by the battery is-



(1) 22×10^{-6} joule (2) 11×10^{-6} joule (3) $\frac{32}{3} \times 10^{-6}$ joule (4) $\frac{16}{3} \times 10^{-6}$ joule

26. A capacitor of capacity $C_1 = 1\ \mu F$ can withstand maximum voltage $V_1 = 6$ kV and other capacitor $C_2 = 3\mu F$ can withstand maximum voltage $V_2 = 4$ kV. If these are connected in series, then the combined system can withstand a maximum voltage at-

(1) 4 kV (2) 6 kV (3) 8 kV (4) 10 kV

27. Conducting sphere of radius R_1 is covered by concentric sphere of radius R_2. Capacity of this combination is proportional to-

(1) $\frac{R_2 - R_1}{R_1 R_2}$ (2) $\frac{R_2 + R_1}{R_1 R_2}$ (3) $\frac{R_1 R_2}{R_1 + R_2}$ (4) $\frac{R_1 R_2}{R_2 - R_1}$

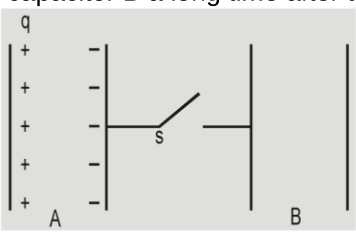
28. Two capacitors when connected in series have a capacitance of 3 μF, and when connected in parallel have a capacitance of 16 μF. Their individual capacities are-

(1) 1 μF, 2 μF (2) 6 μF, 2 μF (3) 12 μF, 4 μF (4) 3 μF, 16 μF

29. A parallel plate capacitor is formed by placing n plates in alternate series one over another. If the capacity between any two consecutive plates is C, then total capacity of the capacitor is-

(1) C (2) nC (3) (n – 1) C (4) (n + 1) C

30. Consider the situation shown in fig. The capacitor A has a charge q on it whereas B is uncharged. The charge appearing on the capacitor B a long time after the switch is closed is-

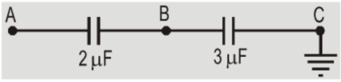


(1) Zero (2) $\frac{q}{2}$ (3) q (4) 2q

31. Two capacitors are joined as shown in figure. Potentials at points A and B are V_1 and V_2 respectively. The potential of point D is-

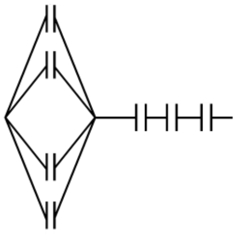
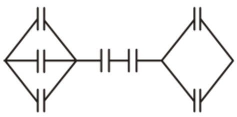
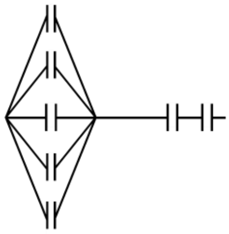
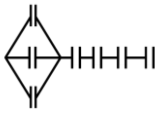
(1) $\frac{1}{2}(V_1 + V_2)$ (2) $\frac{C_1V_2 + C_2V_1}{C_1 + C_2}$ (3) $\frac{C_1V_1 + C_2V_2}{C_1 + C_2}$ (4) $\frac{C_2V_1 - C_1V_2}{C_1 + C_2}$

32. Two capacitors of 2μF and 3μF are connected in series. The potential at point A is 1000 volt and the outer plate of 3μF capacitor is earthed. The potential at point B is-

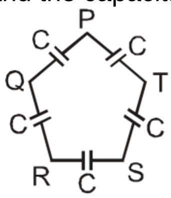


(1) 300 volt (2) 500 volt (3) 600 volt (4) 400 volt

33. How the seven condensers, each of capacity 2μF, should be connected in order to obtain a resultant capacitance of $\frac{10}{11}$ μF?

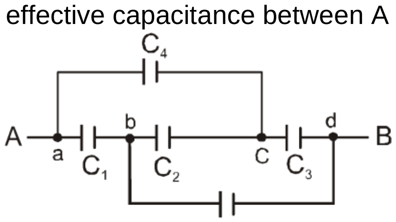
(1)  (2)  (3)  (4) 

34. Five capacitors, each of capacitance value C are connected as shown in the figure. The ratio of capacitance between P and R, and the capacitance between P and Q is –



(1) 3 : 1 (2) 5 : 2 (3) 2 : 3 (4) 1 : 1

35. In the given figure, the capacitors C_1, C_3, C_4 C_5 have a capacitance 4μF each. If the capacitor C_2 has a capacitance 10 μF, then effective capacitance between A and B will be :

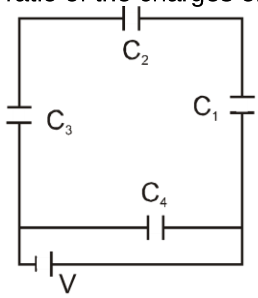


(1) 2μF (2) 4μF (3) 6μF (4) 8μF

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

(1) connecting two in series and one in parallel (2) connecting two in parallel and one in series
(3) connecting all of them in series (4) connecting all of them in parallel

37. A network of four capacitors of capacity equal to $C_1 = C$, $C_2 = 2C$, $C_3 = 3C$ and $C_4 = 4C$ are connected to a battery as shown in the figure. The ratio of the charges on C_2 an C_4 is :

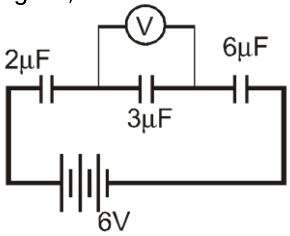


(1) $\frac{22}{3}$ (2) $\frac{3}{22}$ (3) $\frac{7}{4}$ (4) $\frac{4}{7}$

38. A parallel plate capacitor is made by stacking n equally spaced plates connected alternatively. If the capacitance between any two adjacent plates is 'C', then the resultant capacitance is :
(1) (n – 1)C (2) (n + 1) C0 (3) C (4) nC

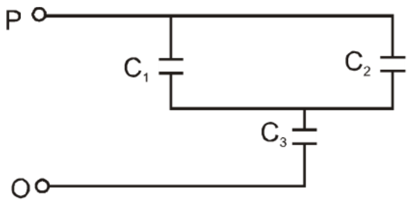
39. Two spheres of capacitances 3μF and 5μF are charged to 300 V and 500 V respectively and are connected together. The common potential in steady state will be
(1) 400 V (2) 425 V (3) 350 V (4) 375 V

40. In the combination shown in the figure, the ideal voltmeter reading will be



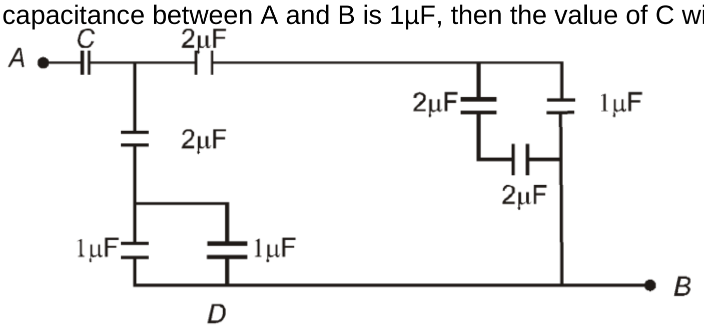
(1) 4.5 V (2) $\left(\frac{18}{11}\right)$V (3) 3 V (4) 2 V

41. In the given network capacitance $C_2 = 10$ μF, $C_1 = 5$ μF and $C_3 = 4$ μF. The resultant capacitance between P and Q will be :



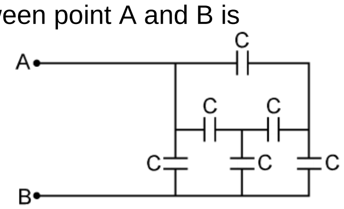
(1) 4.7 μF (2) 1.2 μF (3) 3.2 μF (4) 2.2 μF

42. If the equivalent capacitance between A and B is 1μF, then the value of C will be



(1) 2μF (2) 4μF (3) 3μF (4) 6μF

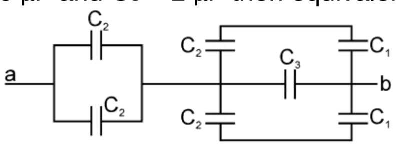
43. The equivalent capacitance between point A and B is



(1) C/4 (2) C/2 (3) C (4) 2C

44. A combination arrangement of the capacitors is shown in the figure

(i) $C_1 = 3$ μF, $C_2 = 6$ μF and $C_3 = 2$ μF then equivalent capacitance between 'a' and 'b' is :

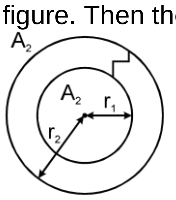


(1) 4 μF (2) 6 μF (3) 1 μF (4) 2 μF

(ii) If a potential difference of 48 V is applied across points a and b, then charge on the capacitor C_3 at steady state condition will be :

(1) 8 μC (2) 16 μC (3) 32 μC (4) 64 μC

45. Two spherical conductors A_1 and A_2 of radii r_1 and r_2 are placed concentrically in air. The two are connected by a copper wire as shown in figure. Then the equivalent capacitance of the system is

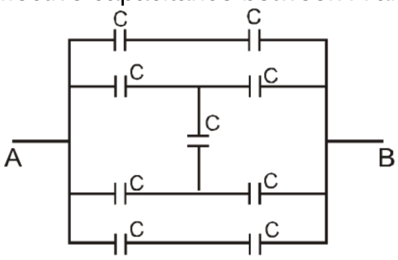


(1) $\frac{4\pi\varepsilon_0 k\, r_1.r_2}{r_2 - r_1}$ (2) $4\pi\in_0 (r_1 + r_2)$ (3) $4\pi\in_0 r_2$ (4) $4\pi\in_0 r_1$

46. Eight drops of mercury of same radius and having same charge coalesce to form a big drop. Capacitance of big drop relative to that of small drop will be

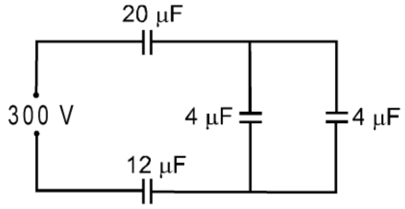
(1) 16 times (2) 8 times (3) 4 times (4) 2 times

47. In the figure given, the effective capacitance between A and B will be



(1) C (2) C/2 (3) 2C (4) 3C

48. If the shown figure combination of four capacitors and their values are given. Charge and potential difference acorss 4 μF capacitor will be -



(1) 600 μC ; 150 Volt (2) 300 μC ; 75 Volt (3) 800 μC ; 200 Volt (4) 580 μC ; 145 Volt

SECTION (D) : EQUATION OF CHARGING AND DISCHARGING

1. The plates of a capacitor of capacitance 10 μF, charged to 60 μC, are joined together by a wire of resistance 10 Ω at t = 0, then

(i) the charge on the capacitor in the circuit at t = 0 is :
(1) 120 μC (2) 60 μC (3) 30 μC (4) 44 μC

(ii) the charge on the capacitor in the circuit at t = 100 μs is :
(1) 120 μC (2) 60 μC (3) 22 μC (4) 18 μC

(iii) the charge on the capacitor in the circuit at t = 1.0 ms is :
(1) 0.003 μC (2) 60 μC (3) 44 μC (4) 18 μC

2. An uncharged capacitor of capacitance 8.0 μF is connected to a battery of emf 6.0 V through a resistance of 24 Ω, then

(i) the current in the circuit just after the connections are made is :
(1) 0.25 A (2) 0.5 A (3) 0.4 A (4) 0 A

(ii) the current in the circuit at one time constant after the connections are made is :
(1) 0.25 A (2) 0.09 A (3) 0.4 A (4) 0 A

3. An uncharged capacitor of capacitances 12.0 μF is connected to a battery of emf 6.00 V and internal resistance 1.00 Ω through resistanceless leads. At 12.0 μs after the connections are made :

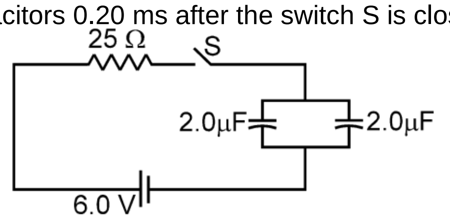
(i) the current in the circuit is :
(1) 4.42 A (2) 6 A (3) 2.21 A (4) 0 A

(ii) the power spent by the battery is :
(1) 26.4 W (2) 13.2 W (3) 4.87 W (4) 0

(iii) the power dissipated in heat is :
(1) 26.4 W (2) 13.2 W (3) 4.87 W (4) 0

(iv) the rate at which energy stored in the capacitor is increasing is :
(1) 26.4 W (2) 13.2 W (3) 4.87 W (4) 8.37 W

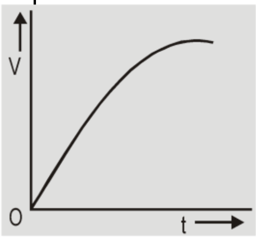
4. The charge on each of the capacitors 0.20 ms after the switch S is closed in figure is :

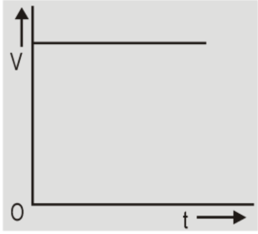


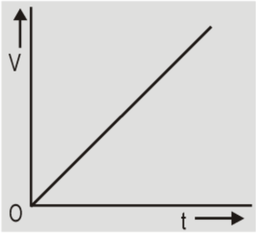
(1) 24 μC (2) 16.8 μC (3) 10.37 μC (4) 4.5 μC

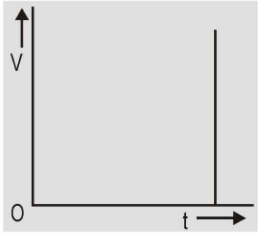
5. Time constant of a series R-C circuit is
(1) +RC (2) –RC (3) R/C (4) C/R

6. If a current, that charges a capacitor, is constant, then graph representing the change in voltage across the capacitor with time t is-

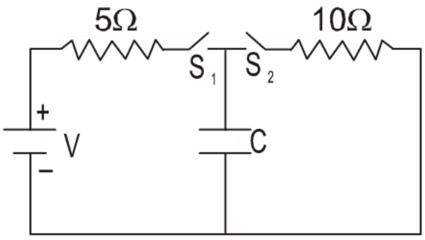
(1) 

(2) 

(3) 

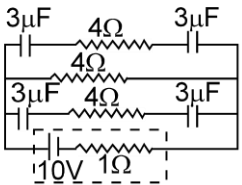
(4) 

7. In the adjoining diagram, (assuming the battery to be ideal) the condenser C will be fully charged to potential V if -



(1) S_1 and S_2 both are open
(2) S_1 and S_2 both are closed
(3) S_1 is closed and S_2 is open
(4) S_1 is open and S_2 is closed.

8. In the following figure, the charge on each condenser in the steady state will be–



(1) 3μC (2) 6μC (3) 9μC (4) 12μC

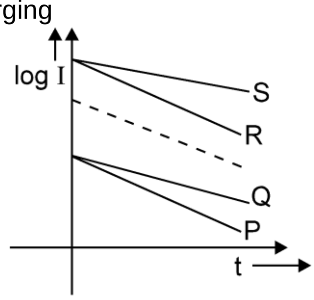
9. The plates of a capacitor of capacitance 10 μF, charged to 60 μC, are joined together by a wire of resistance 10 Ω at t = 0, then

(i) the charge on the capacitor in the circuit at t = 0 is :
(1) 120 μC (2) 60 μC (3) 30 μC (4) 44 μC

(ii) the charge on the capacitor in the circuit at t = 100 μs is :
(1) 120 μC (2) 60 μC (3) 22 μC (4) 18 μC

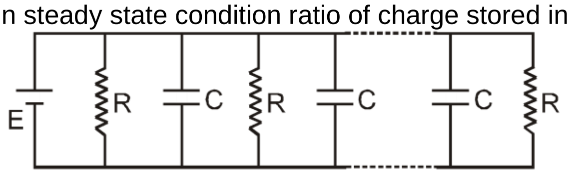
(iii) the charge on the capacitor in the circuit at t = 1.0 ms is : (take e_{10} = 20000)
(1) 0.003 μC (2) 60 μC (3) 44 μC (4) 18 μC

10. Dotted line represents the charging of a capacitor with resistance X. If resistance is made 2X then which will be the graph of charging



(1) P (2) Q (3) R (4) S

11. n resistances each of resistance R are joined with capacitors of capacity C (each) and a battery of emf E as shown in the figure. In steady state condition ratio of charge stored in the first and last capacitor is



(1) n : 1 (2) (n – 1) : (n + 1) (3) $(n_2 + 1) : (n_2 - 1)$ (4) 1 : 1

SECTION (E) : CAPACITOR WITH DIELECTRIC

1. The distance between the plates of a parallel plate condenser is d. If a copper plate of same area but thickness $\frac{d}{2}$ is placed between the plates then the new capacitance will become-
(1) half (2) double (3) one fourth (4) unchanged

2. On placing a dielectric slab between the plates of an isolated charged condenser its–

	Capacitance	Charge	Potential Difference	Energy stored	Electric field
(1)	decreases	remains unchanged	decreases	increases	increases
(2)	increases	remains unchanged	increases	increases	decreases
(3)	increases	remains unchanged	decreases	decreases	decreases
(4)	decreases	remains unchanged	decreases	increases	remains unchanged

3. A parallel plate condenser is connected to a battery of e.m.f. 4 volt. If a plate of dielectric constant 8 is inserted into it, then the potential difference on the condenser will be-
(1) 1/2 V (2) 2V (3) 4V (4) 32V

4. In the above problem if the battery is disconnected before inserting the dielectric, then potential difference will be-
(1) 1/2 V (2) 2V (3) 4V (4) 32V

5. A parallel plate condenser with plate separation d is charged with the help of a battery so that U_0 energy is stored in the system. A plate of dielectric constant K and thickness d is placed between the plates of condenser while battery remains connected. The new energy of the system will be-

(1) KU_0 (2) K_2U_0 (3) $\frac{U_0}{K}$ (4) $\frac{U_0}{K^2}$

6. In the above problem if the battery is disconnected before placing the plate, then new energy will be–

(1) K_2U_0 (2) $\frac{U_0}{K^2}$ (3) $\frac{U_0}{K}$ (4) KU_0

7. A parallel plate capacitor is first charged and then disconnected from battery and then a dielectric slab is introduced between the plates. The quantity that remains unchanged is

(1) Charge Q (2) Potential V (3) Capacity C (4) Energy U

8. A parallel capacitor of capacitance C is charged and disconnected from the battery. The energy stored in it is E. If a dielectric slab of dielectric constant 6 is ineserted between the plates of the capacitor then energy and capacitance will become

(1) 6E, 6C (2) E, C (3) $\frac{E}{6}$,6C (4) E, 6C

9. When a dielectric material is introduced between the plates of a charged condenser, the electric field between the plates

(1) decreases (2) increases (3) does not change (4) may increase or decrease

10. A condenser is charged and then battery is removed. A dielectric plate is put between the plates of condenser, then correct statement is

(1) Q constant V and U decrease (2) Q constant V increases U decreases
(3) Q increases V decreases U increases (4) None of these

11. While a capacitor remains connected to a battery, a dielectric slabis slipped between the plates. Then

(1) the energy stored in the capacitor decreases
(2) the electric field between the plates increases
(3) charges flow from the battery to the capacitor
(4) the potential difference between the plates is changed

12. In a parallel plate capacitor of capacitance C, a metal sheet is inserted between the plates, parallel to them. The thickness of the sheet is half of the seperation between the plates. The capacitance now becomes

(1) C/4 (2) C/2 (3) 2C (4) 4C

13. The plates of parallel plate capacitor are charged upto 100 V. A 2 mm thick plate is inserted between the plates. Then to maintain the same potential difference, the distance between the plates is increases by 1.6 mm. The dielectric constant of the plate is-

(1) 5 (2) 1.25 (3) 4 (4) 2.5

14. Between the plates of parallel plate condenser a plate of thickness t_1 and dielectric constant K_1 is placed. In the rest of the space, there is another plate of thickness t_2 and dielectric constant k_2. The potential difference across the condenser will be-

(1) $\frac{Q}{A\varepsilon_0}\left(\frac{t_1}{k_1}+\frac{t_2}{k_2}\right)$ (2) $\frac{\varepsilon_0 Q}{A}\left(\frac{t_1}{k_1}+\frac{t_2}{k_2}\right)$ (3) $\frac{Q}{A\varepsilon_0}\left(\frac{k_1}{t_1}+\frac{k_2}{t_2}\right)$ (4) $\frac{\varepsilon_0 Q}{A}$ $(k_1t_1 + k_2t_2)$

15. A sheet of aluminium is inserted in the air gap of a parallel plate capacitor, without touching any of the two plates of the capacitor. The capacitance of the capacitor is-

(1) Invariant for all positions of the sheet
(2) Maximum when the sheet is midway between the 2 plates
(3) Maximum when the sheet is just near the +ve plate.
(4) Maximum when the sheet is just near the –ve plate.

16. The value of a capacitor formed by a thin metallic foil is 2 μF. The foil is folded with a layer of paper having a thickness of 0.015 mm. The dielectric constant of the paper is 2.5 and its breadth is 40 mm. The length of the foil used is-

(1) 0.34 m (2) 1.33 m (3) 13.4 mm (4) 33.9 m

17. A parallel plate air capacitor is charged by connecting its plates to a battery. Without disconnecting the battery, a dielectric is introduced between its plates. As a result-
(1) P.D. between the plates increases (2) Charge on the plates decreases
(3) Capacitance of the capacitor decreases (4) None of the above

18. A capacitor is charged using a battery, and battery is withdrawn later on. Now a dielectric slab is introduced between the capacitor plates then the correct statement is-
(1) Q increase, V decrease, U increase
(2) Q remains constant, V increases, U decreases
(3) Q remains constant, V and U both decreases
(4) None of these

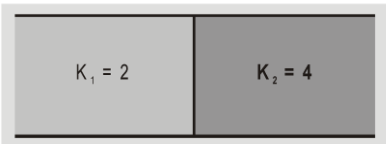
19. A dielectric slab of thickness d is inserted in a parallel plate capacitor whose negative plate is at X = 0 and positive plate is at X = 3d. The slab is equidistant from the plates. The capacitor is given some charge. As X goes from 0 to 3 d-
[a] The electric potential increases at first, then decreases and again increases.
[b] The electric potential increases continuously.
[c] The direction of the electric field remains the same
[d] The magnitude of the electric field remains the same
(1) a, b (2) b, c (3) b, d (4) a, b, d

20. A parallel plate condenser with oil between the plates (dielectric constant of oil K = 2) has a capacitance C. If the coil is removed, then capacitance of the capacitor becomes-
(1) $\frac{C}{2}$ (2) $\frac{C}{\sqrt{2}}$ (3) 2C (4) $\sqrt{2}$ C

21. Plate separation of a 15μF capacitor is 2 mm. A dielectric slab (K = 2) of thickness 1 mm is inserted between the plates. Then new capacitance is given by-
(1) 15 μF (2) 20 μF (3) 30 μF (4) 25 μF

22. The capacity of a parallel plate capacitor with no dielectric substance but with a separation of 0.4 cm is 2 μF. The separation is reduced to half and it is filled with a substance dielectric of value 2.8. The new capacity of the capacitor is-
(1) 11.2 μF (2) 15.6 μF (3) 19.2 μF (4) 22.4 μF

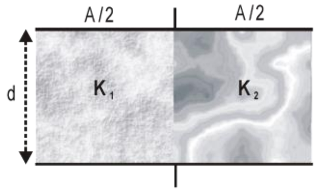
23. Effective capacitance if C_{air} = 10 μF-



(1) 30 μF (2) 15 μF (3) 5 μF (4) 10 μF

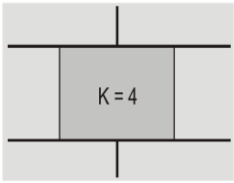
24. While a capacitor remains connected to a battery, a dielectric slab is slipped between the plates-
(1) The electric field between the plates increases
(2) The energy stored in the capacitor decreases
(3) The potential difference between the plates is changed
(4) Charges flow from the battery to the capacitor.

25. A parallel plate condenser is filled with two dielectric as shown in fig. Area of each plate is A m^2 and the separation is d metre. The dielectric constants are K_1 and K_2 respectively. Its capacitance in farad will be-



(1) $\frac{A\varepsilon_0\,(K_1 \times K_2)}{d\,(K_1+K_2)}A$ (2) $\frac{A\varepsilon_0\,(K_1-K_2)}{d}$ (3) $\frac{A\varepsilon_0\,K_1K_2}{(K_1+K_2)}$ (4) $\frac{A\varepsilon_0\,(K_1+K_2)}{2d}$

26. Capacity of air capacitor (parallel plate) is 10µC. Now a dielectric of dielectric constant 4 is filled in the half space between the plates, then new capacity will be-



(1) 25 µF (2) 20 µF (3) 40 µF (4) 5 µF

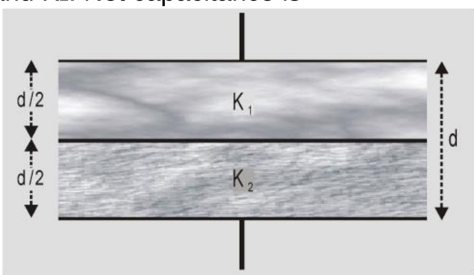
27. A parallel plate capacitor is filled by copper plate of thickness b. The new capacity will be-

(1) $\frac{\varepsilon_0 A}{2d-b}$ (2) $\frac{\varepsilon_0 A}{d-b}$ (3) $\frac{\varepsilon_0 A}{d-b/2}$ (4) $\frac{\varepsilon_0 A}{d}$

28. Putting a dielectric substance between two plates of a condenser, the capacity, potential and potential energy respectively-

(1) Increases, decreases, decreases (2) Decreases, increases, increases
(3) Increases, increases, increases (4) Decreases, decreases, decreases

29. A parallel plate capacitor of plate area A, separation d is filled with dielectrics as shown in fig. The dielectric constants are K_1 and K_2. Net capacitance is-

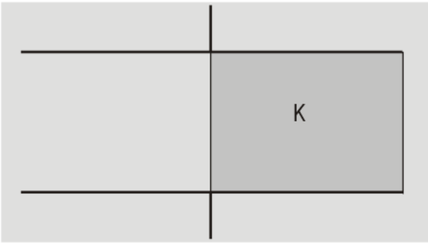


(1) $\frac{\varepsilon_0 A}{d}(K_1+K_2)$ (2) $\frac{\varepsilon_0 A}{d}\left(\frac{K_1+K_2}{K_1K_2}\right)$ (3) $\frac{2\varepsilon_0 A}{d}\left(\frac{K_1K_2}{K_1+K_2}\right)$ (4) $\frac{2\varepsilon_0 A}{d}\left(\frac{K_1+K_2}{K_1K_2}\right)$

30. Two parallel plates capacitors of value C and 2C are connected in parallel and are charged to a potential difference V. If now battery is disconnected and a medium of dielectric constant K is introduced between the plates of the capacitor C, then the potential between the capacitors plates will become-

(1) 3V [K + 2] (2) $\frac{[K+2]}{3V}$ (3) $\frac{3V}{[K+2]}$ (4) $\frac{3[K+2]}{V}$

31. As shown in the figure half the space between plates of a capacitor is filled with an insulator material of dielectric constant K, if initial capacity was C then the new capacity is-



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

32. Two materials of dielectric constant k_1 and k_2 are filled between two parallel plates of a capacitor as shown in figrue. The capacity of the capacitor is :

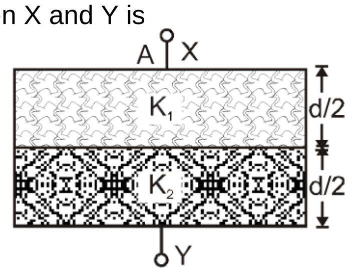
(1) $\frac{A\in_0(k_1+k_2)}{2d}$ (2) $\frac{2A\in_0}{d}\left(\frac{k_1k_2}{k_1+k_2}\right)$ (3) $\frac{A\in_0}{d}\left(\frac{k_1k_2}{k_1+k_2}\right)$ (4) $\frac{A\in_0}{2d}\left(\frac{k_1+k_2}{k_1k_2}\right)$

33. A parallel plate condenser with a dielectric of dielectric constant *K* between the plates has a capacity *C* and is charged to a potential *V* volts. The dielectric slab is slowly removed from between the plates and then reinserted. The net work done by the system in this process is

(1) $\frac{1}{2}(K-1)CV^2$ (2) $CV^2(K-1)/K$ (3) $(K-1)CV^2$ (4) zero

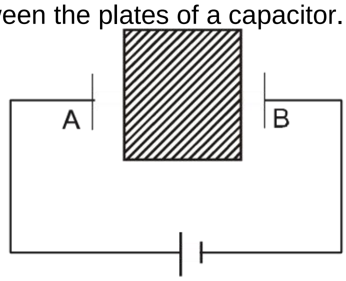
34. After charging a capacitor the battery is removed. Now by placing a dielectric slab between the plates
(1) the potential difference between the plates and the energy stored will decrease but the charge on plates will remain same
(2) the charge on the plates will decrease and the potentaial difference between the plates will increase
(3) the potential difference between the plates will increase and energy stored will decrease but the charge on the plates will remain same
(4) the potential difference, energy stored and the charge will remain unchanged

35. A parallel plate capacitor is filled with two dielectrics as shown in figure. If A is area of each plate, then the effective capacitance between X and Y is



(1) $\frac{\varepsilon_0 A}{d}\left(\frac{K_1+K_2}{2}\right)$ (2) $\frac{2\varepsilon_0 A}{d}(K_1+K_2)$ (3) $\frac{2\varepsilon_0 A}{d}\left(\frac{K_1+K_2}{K_1K_2}\right)$ (4) $\frac{2\varepsilon_0 A}{d}\left(\frac{K_1K_2}{K_1+K_2}\right)$

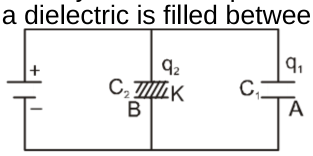
36. An insulator plate is passed between the plates of a capacitor. Then current



(1) first flows from A to B and then from B to A
(2) first flows from B to A and then from A to B
(3) always flows from B to A
(4) always flows from A to B

37. A sheet of aluminium foil of negligible thickness is introduced between the plates of a capacitor. The capacitance of the capacitor .
(1) decreases (2) remains unchanged (3) becomes infinite (4) increases

38. In the adjoining diagram two geometrically identical capacitors A and B are connected to a battery. Air is filled between the plates of C_1 and a dielectric is filled between the plates of C_2, then -



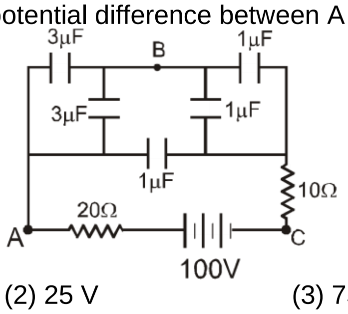
(1) $q_1 < q_2$ (2) $q_1 > q_2$ (3) $q_1 = q_2$ (4) None of these

39. The electric field between two parallel plates of a capacitor is 2.1×10^{-5}. If a medium is inserted between the plates than the electric field becomes 1.0×10^{-5}. Now, the value of dielectric will be
(1) 2 (2) 3 (3) 4 (4) 5

40. The capacity of a parallel plate condenser without any dielectric is C. If the distance between the plates is doubled and the space between the plates is filled with a substance of dielectric constant 3, the capacity of the condenser becomes :
(1) $\frac{3}{4}C$ (2) $\frac{9}{2}C$ (3) $\frac{2}{3}C$ (4) $\frac{3}{2}C$

Exercise-2

1. In the figure given, the potential difference between A and B in steady state will be

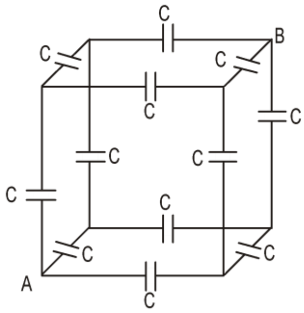


(1) 20 V (2) 25 V (3) 75 V (4) 100 V

2. In the above question, the potential difference between B and C in steady state will be
(1) 20 V (2) 25 V (3) 50 V (4) 75 V

3. Three capacitors of same capacitance are connected in parallel. When they are connected to a cell of 2 volt, total charge of 1.8μC is accumulated on them. Now they are connected in series and then charged by the same cell. The total charge stored in them will be
(1) 1.8μC (2) 0.9μC (3) 0.6μC (4) 0.2μC

4. Each edge of the cube contains a capacitance C. The equivalent capacitance between the points A and B will be –

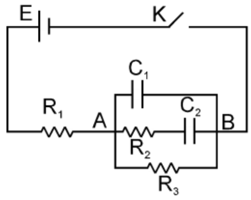


(1) $\frac{6C}{5}$ (2) $\frac{5C}{6}$ (3) $\frac{12C}{7}$ (4) $\frac{7C}{12}$

5. A capacitor of capacitance 500μF is charged at the rate of 100μC/s. The time in which the potential difference will become 20 V, is

(1) 100 s (2) 50 s (3) 20 s (4) 10 s

6. A network of uncharged capacitors and resistances is shown



Current through the battery immediately after key K is closed and after a long time interval is :

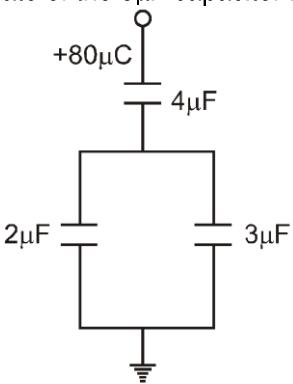
(1) $\frac{E}{R_1}$, $\frac{E}{R_1+R_3}$

(2) $\frac{E}{R_1+R_3}$, $\frac{E}{R_1+\frac{R_2R_3}{R_2+R_3}}$

(3) zero , $\frac{E}{R_1}$

(4) $\frac{E}{R_1+\frac{R_2R_3}{R_2+R_3}}$, $\frac{E}{R_1}$

7. In the given circuit, a charge of +80 μC is given to the upper plate of the 4μF capacitor. Then in the steady state, the charge on the upper plate of the 3μF capacitor is :



(1) +32 μC (2) +40 μC (3) +48 μC (4) +80 μC

Exercise-3

PART - I : NEET / AIPMT QUESTION (PREVIOUS YEARS)

1. Three capacitors each of capacitance C and of breakdown voltage V are joined in series. The capacitance and breakdown voltage of the combination will be **[AIPMT-2009]**

(1) $\frac{C}{3}, \frac{V}{3}$ (2) $3C, \frac{V}{3}$ (3) $\frac{C}{3}$, 3V (4) 3C , 3V

2. A series combination of n_1 capacitors, each of value C_1 is charged by a source of potential difference 4V. When another parallel combination of n_2 capacitors, each of value C_2, is charged by a source of potential difference V, it has the same (total) energy stored in it, as the first combination has. The value of C_2, in terms of C_1, is then **[AIPMT Pre-2010]**

(1) $\frac{2C_1}{n_1n_2}$ (2) $16\frac{n_2}{n_1}C_1$ (3) $2\frac{n_2}{n_1}C_1$ (4) $\frac{16C_1}{n_1n_2}$

3. A parallel plate condenser has a uniform electric field E(V/m) in the space between the plates. If the distance between the plates is d(m) and area of each plate is A(m_2) the enrgy (joules) stored in the condenser is : **[AIPMT Pre-2011]**

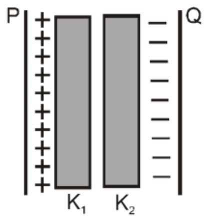
(1) E_2Ad/ϵ_0 (2) $\frac{1}{2}\epsilon_0 E_2$ (3) $\epsilon_0 EAd$ (4) $\frac{1}{2}\epsilon_0 E_2Ad$

4. A parallel plate capacitor has a uniform electric field E in the space between the plates. If the distance between the plates is d and area of each plate is A, the energy stored in the capacitor is :

[AIPMT 2012 (Mains)]

(1) $\frac{1}{2}\varepsilon_0E^2$ (2) E2 Ad/ε0 (3) $\frac{1}{2}\varepsilon_0E^2Ad$ (4) ε0EAd

5. Two thin dielectric slabs of dielectric constants K1 and K2 (K1 < K2) are inserted between plates of a parallel plate capacitor, as shown in the figure. The variation of electric field 'E' between the plates with distance 'd' as measured from plate P is correctly shown by: **[AIPMT-2014]**



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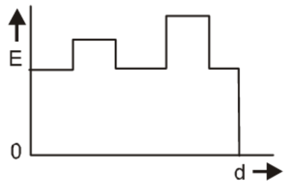

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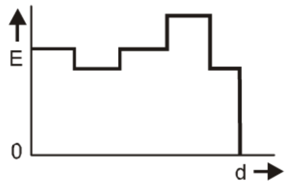

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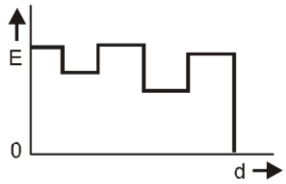

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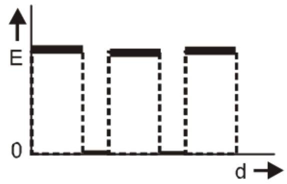


6. A parallel plate air capacitor of capacitance C is connected to a cell of emf V and then disconnected from it. A dielectric slab of dielectric constant K, which can just fill the air gap of the capacitor, is now inserted in it. Which of the following is incorrect? **[AIPMT-2015]**

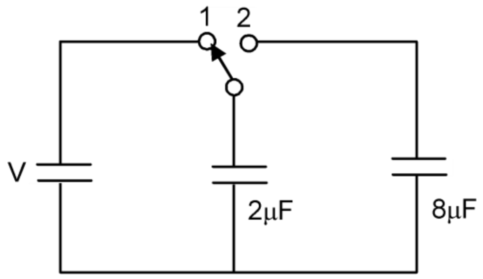
(1) The energy stored in the capacitor decreases K times.

(2) The chance in energy stored is $\frac{1}{2}CV^2\left(\frac{1}{K}-1\right)$

(3) The charge on the capacitor is not conserved.

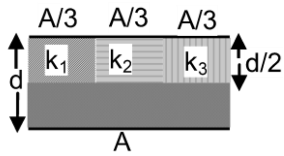
(4) The potential difference between the plates decreases K times.

7. A capacitor of 2μF is charged as shown in the diagram. When the switch S is turned to position 2, the percentage of its stored energy dissipated is : **[AIPMT-2016]**



(1) 80% (2) 0% (3) 20% (4) 75%

8. A parallel- plate capacitor of area A, plate separation d and capacitance C is filled with four dielectric materials having dielectric constant k_1, k_2, k_3 and k_4 as shown in the figure below. 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 **[NEET 2016]**



(1) $\frac{1}{k}=\frac{1}{k_1}+\frac{1}{k_2}+\frac{1}{k_3}+\frac{3}{2k_4}$

(2) $k = k_1 + k_2 + k_3 + 3k_4$

(3) $k = \frac{2}{3}(k_1 + k_2 + k_3) + 2k_4$

(4) $\frac{2}{k}=\frac{3}{k_1+k_2+k_3}+\frac{1}{k_4}$

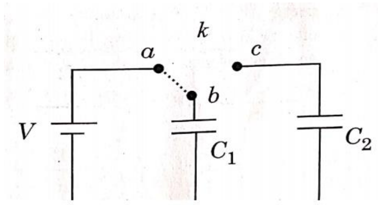
9. A capacitor is charged by a battery. The battery is removed and another identical uncharged capacitor is connected in parallel. The total electrostatic energy of resulting system : **[NEET 2017]**

(1) increases by a factor of 4
(2) decreases by a factor 2
(3) remains the same
(4) increases by a factor of 2

10 The electrostatic force between the metal plates of an isolated parallel plate capacitor C having a charge Q and area A, is : **[NEET 2018]**

(1) independent of the distance between the plates
(2) inversely proportional to the distance between the plates
(3) proportional to the square root of the distance the plates
(4) linearly proportional to the distance between the plates

11. Two identical capacitors C_1 and C_2 of equal capacitance are connected as shown in the circuit. Terminals a and b of the key k are connected to charge capacitor C_1 using battery of emf V volt. Now disconnecting a and b the terminals b and c are connected. Due to this, what will be the percentage loss of energy? **[NEET_2019-II]**



(1) 75% (2) 0% (3) 50% (4) 25%

PART - III : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

1. Let C be the capacitance of a capacitor discharging through a resistor R. Suppose t_1 is the time taken for the energy stored in the capacitor to reduce to half its initial value and t_2 is the time taken for the charge to reduce to one-fourth its initial value. Then the ratio t_1/t_2 will be **[AIEEE-2010, 8/144]**

(1) 1 (2) $\frac{1}{2}$ (3) $\frac{1}{4}$ (4) 2

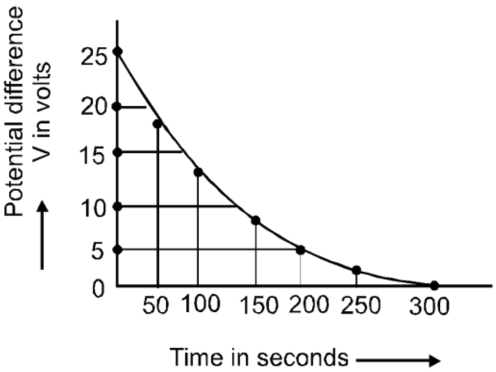
2. A resistor 'R' and 2μF capacitor in series is connected through a switch to 200 V direct supply. Across the capacitor is a neon bulb that lights up at 120 V. Calculate the value of R to make the bulb light up 5s after the switch has been closed. ($\log_{10}2.5 = 0.4$) **[AIEEE - 2011, 4/120, –1]**

(1) $1.3 \times 10^4\,\Omega$ (2) $1.7 \times 10^5\,\Omega$ (3) $2.7 \times 10^6\,\Omega$ (4) $3.3 \times 10^7\,\Omega$

3. Combination of two identical capacitors, a resistor R and a dc voltage source of voltage 6V is used in an experiment on a (C – R) circuit. It is found that for a parallel combination of the capacitor the time in which the voltage of the fully charged combination reduces to half its original voltage is 10 second. For series combination the time needed for reducing the voltage of the fully charged series combination by half is : **[AIEEE 2011, 11 May; 4, –1]**

(1) 10 second (2) 5 second (3) 2.5 second (4) 20 second

4. The figure shows an experimental plot discharging of a capacitor in an RC circuit. The time constant τ of this circuit lies between : **[AIEEE 2012 ; 4/120, –1]**



(1) 150 sec and 200 sec (2) 0 and 50 sec (3) 50 sec and 100 sec (4) 100 sec and 150 sec

5. Two capacitors C_1 and C_2 are charged to 120 V and 200 V respectively. It is found that by connecting them together the potential on each one can be made zero. Then : **[JEE-Mains 2013, 4/120]**

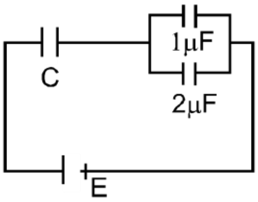
(1) $5C_1 = 3C_2$ (2) $3C_1 = 5C_2$ (3) $3C_1 + 5C_2 = 0$ (4) $9C_1 = 4C_2$

6. A parallel plate capacitor is made of two circular plates separated by a distance of 5 mm and with a dielectric of dielectric constant 2.2 between them. When the electric field in the dielectric is 3×10^4 V/m, the charge density of the positive plate will be close to : **[JEE- Main - 2014]**

(1) $6 \times 10^{-7} C/m^2$ (2) $3 \times 10^{-7} C/m^2$ (3) $3 \times 10^4 C/m^2$ (4) $6 \times 10^4 C/m^2$

7. In the given circuit, charge Q_2 on the 2μF capacitor changes as C is varied from 1μF to 3μF. Q_2 as a function of 'C' is given properly by : (figures are drawn schematically and are not to scale)

[JEE(Main)-2015; 4/120, –1]



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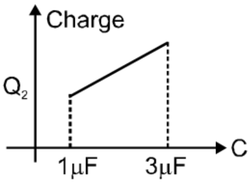

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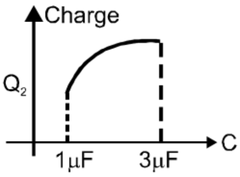

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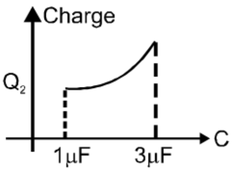

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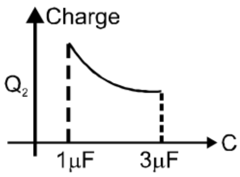
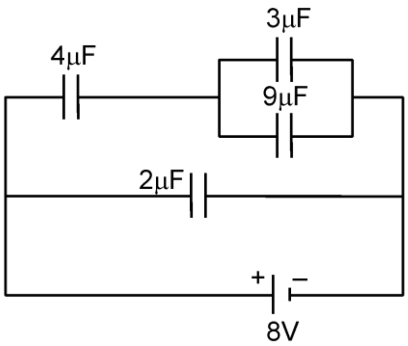


8. A combination of capacitors is set up as shown in the figure. The magnitude of the electric field, due to a point charge Q (having a charge equal to the sum of the charges on the 4μF and 9μF capacitors), at a point distance 30 m from it, would equal : **[JEE Main 2016]**



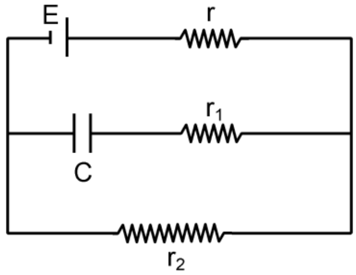
(1) 360 N/C (2) 420 N/C (3) 480 N/C (4) 240 N/C

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

The minimum number of capacitors required to achieve this is : **[JEE Main 2017]**

(1) 32 (2) 2 (3) 16 (4) 24

10. In the given circuit diagram when the current reaches steady state in the circuit, the charge on the capacitor of capacitance C will be : **[JEE Main 2017]**

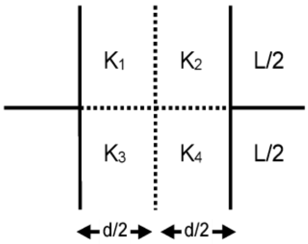


(1) $CE\frac{r_1}{(r_1+r)}$ (2) CE (3) $CE\frac{r_1}{(r_2+r)}$ (4) $CE\frac{r_2}{(r+r_2)}$

11. A parallel plate capacitor of capacitance 90 pF is connected to a battery of emf 20V. If a dielectric material of dielectric constant K = $\frac{5}{3}$ is inserted between the plates, the magnitude of the induced charge will be : **[JEE-Main-2018]**

(1) 2.4 n C (2) 0.9 n C (3) 1.2 n C (4) 0.3 n C

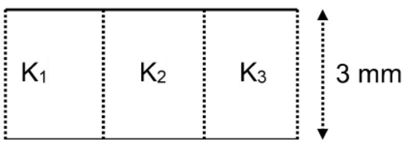
12. A parallel plate capacitor with square plates is filled with four dielectrics of dielectric constants K_1, K_2, K_3, K_4 arranged as shown in the figure. The effective dielectric constant K will b :**[JEE-Main-2019]**



(1) $K=\frac{(K_1+K_4)(K_2+K_3)}{2(K_1+K_2+K_3+K_4)}$ (2) $K=\frac{(K_1+K_3)(K_2+K_4)}{K_1+K_2+K_3+K_4}$

(3) $K=\frac{(K_1+K_2)(K_3+K_4)}{2(K_1+K_2+K_3+K_4)}$ (4) $K=\frac{(K_1+K_2)(K_3+K_4)}{K_1+K_2+K_3+K_4}$

13. A parallel plate capacitor is of area 6 cm^2 and a separation 3 mm. The gap is filled with three dielectric materials of equal thickness (see figure) with dielectric constants K_1 = 10, K_2 = 12 and K_3 = 14. The dielectric constant of a material which when fully inserted in above capacitor, gives same capacitance would be : **[JEE-Main-2019]**

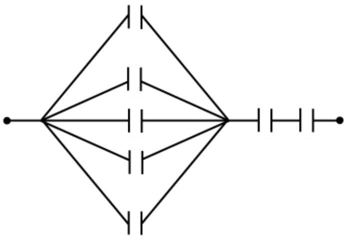


(1) 4 (2) 14 (3) 36 (4) 12

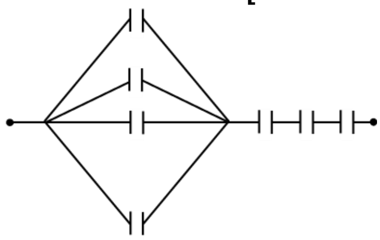
14. A parallel plate capacitor having capacitance 12 pF is charged by a battery to a potential difference of 10 V between its plates. The charging battery is now disconnected and a porcelain slab of dielectric constant 6.5 is slipped between the plate. The work done by the capacitor on the slab is **[JEE-Main-2019]**

(1) 692 pJ (2) 600 pJ (3) 508 pJ (4) 560 pJ

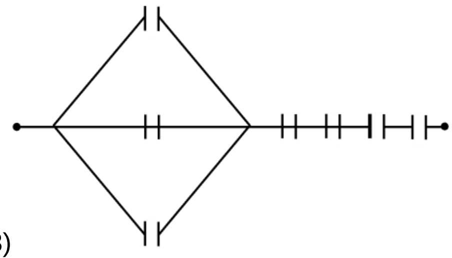
15. Seven capacitors, each of capacitance 2μF. are to be connected in a configuration to obtain an effective capacitance of $\left(\frac{6}{13}\right)\mu F$. Which of the combinations, shown in figures below, will achieve the desired value? **[JEE-Main-2019]**



(1)

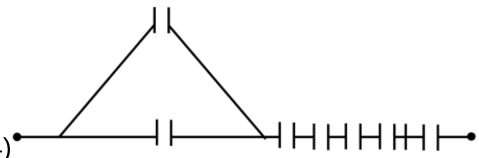


(2)

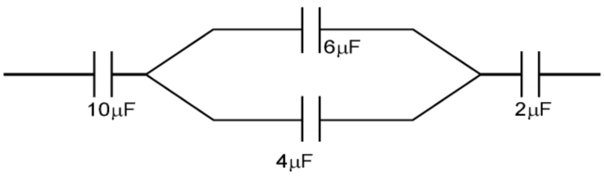


(3)

(4)



16. In the figure shown below, the charge on the left plate of the 10 μF capacitor is –30 μC. The charge on the right plate of the 6 μF capacitor is : **[JEE-Main-2019]**

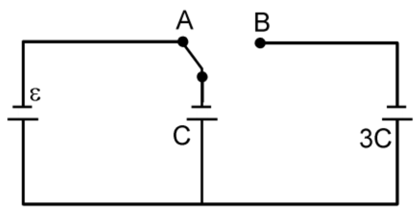


(1) –12 μC (2) +12 μC (3) –18 μC (4) + 18 μC

17. A parallel plate capacitor with pates of area 1 m^2 each, are at a separation of 0.1 m. If the electric field between the plates is 100 N/C, the magnitude of charge on each plate. (Take $\epsilon_0 = 8.85 \times 10^{-12} \frac{C^2}{N-m^2}$) **[JEE-Main-2019]**

(1) 6.85×10^{-10} C (2) 7.85×10^{-10} C (3) 9.85×10^{-10} C (4) 8.85×10^{-10} C

18. In the figure shown, after the switch 'S' is turned position 'A' to position 'B', the energy dissipated in the circuit in terms of capacitance 'C' and total charge 'Q' is: **[JEE-Main-2019]**



(1) $\frac{3}{8}\frac{Q^2}{C}$ (2) $\frac{5}{8}\frac{Q^2}{C}$ (3) $\frac{1}{8}\frac{Q^2}{C}$ (4) $\frac{3}{4}\frac{Q^2}{C}$

Answers

EXERCISE # 1

SECTION (A) :

1.	(1)	**2.**	(4)	**3.**	(2)	**4.**	(2)	**5.**	(2)	**6.**	(1)	**7.**	(3)
8.	(1)	**9.**	(2)	**10.**	(1)	**11.**	(1)	**12.**	(3)	**13.**	(3)	**14.**	(1)
15.	(4)	**16.**	(1)										

SECTION (B) :

1.	(2)	**2.**	(3)	**3.**	(4)	**4.**	(1)	**5.**	(2)	**6.**	(3)	**7.**	(2)
8.	(4)	**9.**	(1)	**10.**	(1)	**11.**	(3)	**12.**	(4)	**13.**	(2)	**14.**	(3)
15.	(1)	**16.**	(1)	**17.**	(2)	**18.**	(4)	**19.**	(3)	**20.**	(4)	**21.**	(2)
22.	(2)	**23.**	(2)	**24.**	(4)	**25.**	(3)	**26.**	(3)	**27.**	(2)	**28.**	(2)
29.	(4)	**30.**	(2)	**31.**	(2)	**32.**	(2)	**33.**	(3)	**34.**	(2)	**35.**	(3)
36.	(3)	**37.**	(3)										

SECTION (C) :

1.	(2)	**2.**	(3)	**3.**	(4)	**4.**	(2)	**5.**	(4)	**6.**	(2)	**7.**	(4)
8.	(2)	**9.**	(3)	**10.**	(2)	**11.**	(3)	**12.**	(1)	**13.**	(1)	**14.**	(4)
15.	(1)	**16.**	(2)	**17.**	(2)	**18.**	(2)	**19.**	(2)	**20.**	(2)	**21.**	(1)
22.	(4)	**23.**	(3)	**24.**	(4)	**25.**	(1)	**26.**	(3)	**27.**	(4)	**28.**	(3)
29.	(3)	**30.**	(1)	**31.**	(3)	**32.**	(4)	**33.**	(3)	**34.**	(3)	**35.**	(2)
36.	(1)	**37.**	(2)	**38.**	(1)	**39.**	(2)	**40.**	(4)	**41.**	(3)	**42.**	(1)
43.	(4)	**44.**	(i)	(1)		(ii)	(4)	**45.**	(3)	**46.**	(4)	**47.**	(3)
48.	(4)												

SECTION (D) :

1.	(i) (2)	(ii) (3)	(iii) (1)	**2.**(i) (1)	(ii) (2)	**3.**	(i) (3)	(ii) (2)	(iii) (3)	(iv) (4)	**4.**	(3)	
5.	(1)	**6.**	(3)	**7.**	(3)	**8.**	(4)	**9.**	(i) (2)	(ii) (3)	(iii) (1)	**10.**	(2)
11.	(4)												

SECTION (E) :

1.	(2)	**2.**	(3)	**3.**	(3)	**4.**	(1)	**5.**	(1)	**6.**	(3)	**7.**	(1)
8.	(3)	**9.**	(1)	**10.**	(1)	**11.**	(3)	**12.**	(3)	**13.**	(1)	**14.**	(1)
15.	(1)	**16.**	(4)	**17.**	(4)	**18.**	(3)	**19.**	(2)	**20.**	(1)	**21.**	(2)
22.	(1)	**23.**	(1)	**24.**	(4)	**25.**	(4)	**26.**	(1)	**27.**	(2)	**28.**	(1)
29.	(3)	**30.**	(3)	**31.**	(1)	**32.**	(1)	**33.**	(4)	**34.**	(1)	**35.**	(4)
36.	(2)	**37.**	(2)	**38.**	(1)	**39.**	(1)	**40.**	(4)				

EXERCISE # 2

1.	(2)	**2.**	(4)	**3.**	(4)	**4.**	(1)	**5.**	(1)	**6.**	(1)	**7.**	(3)

EXERCISE # 3

PART - I

1.	(3)	**2.**	(4)	**3.**	(4)	**4.**	(3)	**5.**	(3)	**6.**	(3)	**7.**	(1)
8.	(4)	**9.**	(2)	**10**	(1)	**11.**	(3)						

PART - II

1.	(3)	**2.**	(3)	**3.**	(3)	**4.**	(4)	**5.**	(2)	**6.**	(1)	**7.**	(2)
8.	(2)	**9.**	(1)	**10.**	(4)	**11.**	(3)	**12.**	(4 or Bonus)	**13.**	(4)	**14.**	(3)

15. (3) **16.** (4) **17.** (4) **18.** (1)