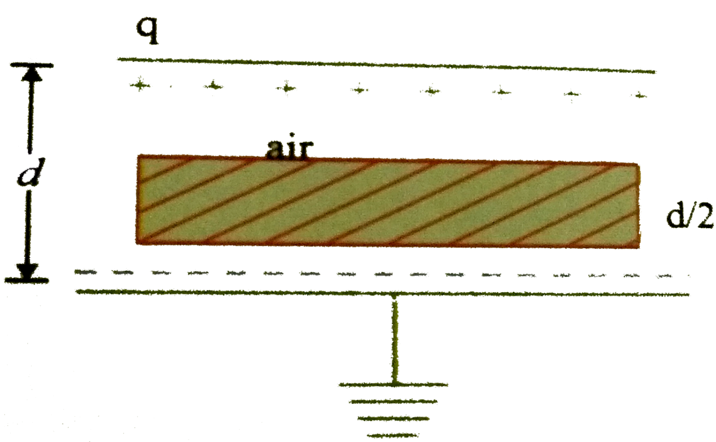
PHYSICS

FOR IIT JEE ASPIRANTS OF CLASS 12 FOR PHYSICS

CAPACITANCE

Solved Example

1. A metal slab of thickness, equal to half the distance between the plates is introduced between the plates of a parallel plate capacitor as shown. Find its capacity.



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2. Two conductors carrying equal and opposite charges produce a non uniform electric field along X- axis given by $E = \frac{Q}{\in_0 A}(1 + Bx^2)$ where A and B are constant. Separation between the conductors along X-axis is X. Find the capacitance of the capacitor formed.

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3. Find the capacitance of a system of two identical metal balls of radius a if the distance between their centres is equal to b, with $b > \ > a$. The system is located in a uniform dielectric with permittivity K.

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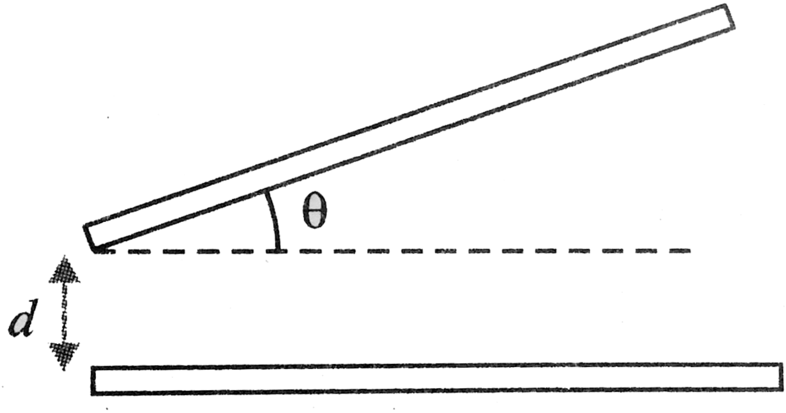
4. A capacitor has two square plates each of side l making an angle θ between them as shown in Fig. Calculate capacitor of the arrangement for small values of θ



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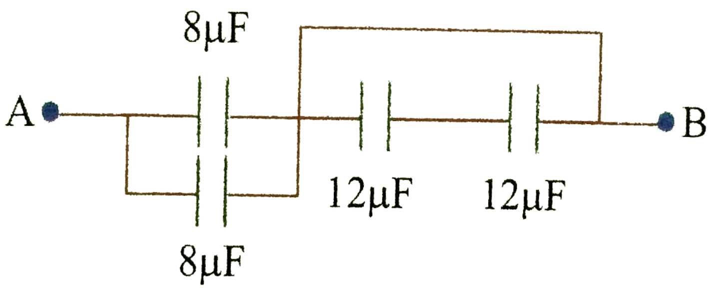
5. The equivalent capacity between A and B in the given circuit is



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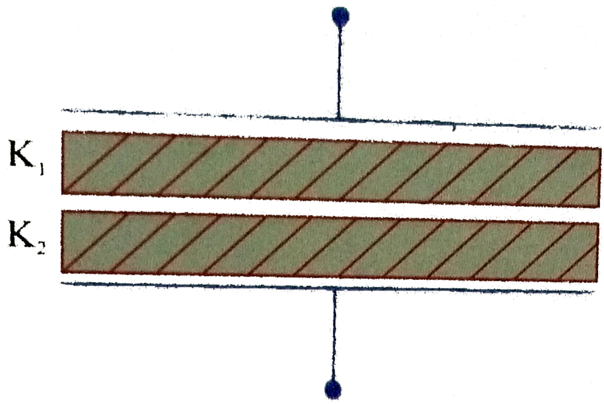
6. When the space between the plates of a parallel plate condenser is completely filled with two slabs of dielectric constants K_1 and K_2 and each slab having area A and thickness equal to $\frac{d}{2}$ as shown in the figure



he equivalent circuit is as shown

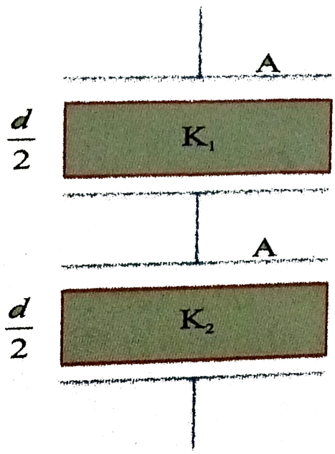


Fig. The equivalent circuit is as shown.

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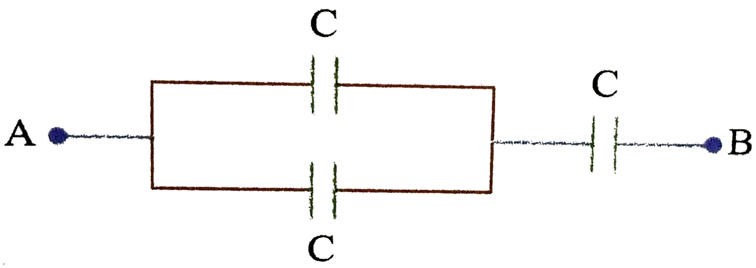
7. In the net work three identical capacitors are connected as shown. Each of them can withstand to a maximum $100V$ potential difference. What is the maximum voltage that can be applied across A and B so that no capacitor gets spoiled.



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8. Calculate the capacitance of a parallel plate capacitor, with plate area A and distance between the plates d, when filled with a dielectric whose permittivity varies as

$$\in(x) = \in_0 + kx\left(0 < x < \frac{d}{2}\right), \in(x) = \in_0 + k(d-x)\left(\frac{d}{2} < x \le d\right)$$

.

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9. When the space between the plates of a parallel plate condenser is completely filled with two slabs of dielectric constants K_1 and K_2 and each slab having area $\frac{A}{2}$ and thickness equal to distance of seperation d as shown in the figure.

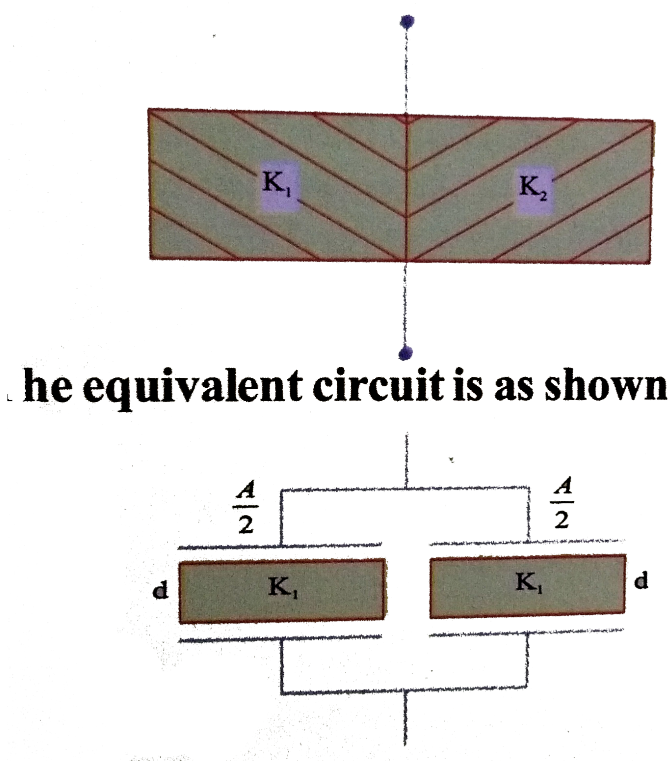

Fig. the equivalent circuit is as shown.

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10. A parallel plate capacitor of area A, plate separation d and capacitance C is filled with three different dielectric materials having dielectric constant K_1, K_2 and K_3 as shown in fig. If a single dielectric material is to be used to have the same effective capacitance as the above combination then its dielectric constant K is given by :

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11. Solve the above problem when a thin metal sheet is inserted, separating dielectric1 and 2 from 3.

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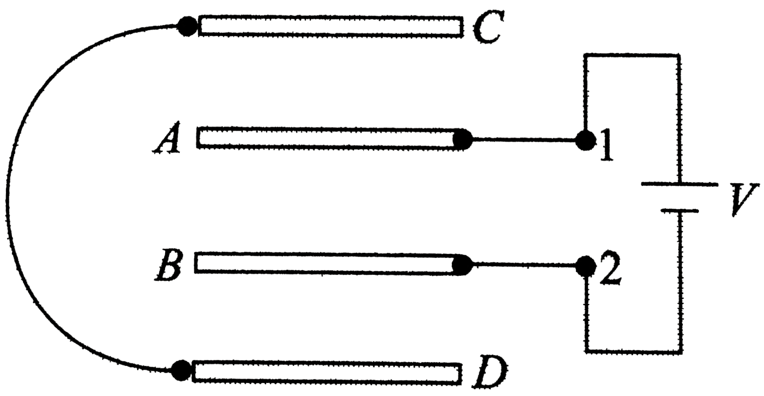
12. Four identical metal plates are arranged in air at equal distance d from each other. The area of each plate is A. A batery of emf V is connected across plates 1 distribution and find the capacitance of the system between points 1 and 2 if the other two plates are connected by a conducting wire as shown in.



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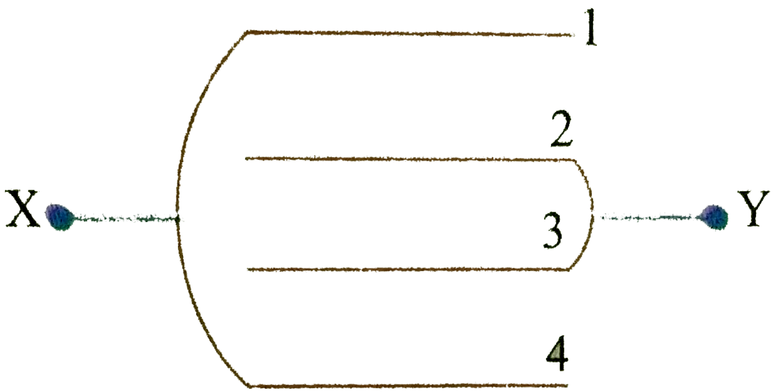
13. Find equivalent capacity between X and Y



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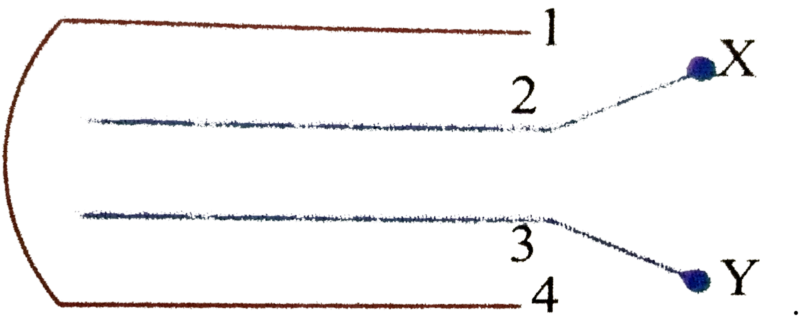
14. Find equivalent capacity X and Y



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15. A capacitor of capacitance C_o is charged to a potential V and then isolated. A small capacitor C is then charged from C_o, discharged and charged again, the process being repeated n times. Due to this, potential of the large capacitor is decreased to V. Find the capacitance of the small capacitor :

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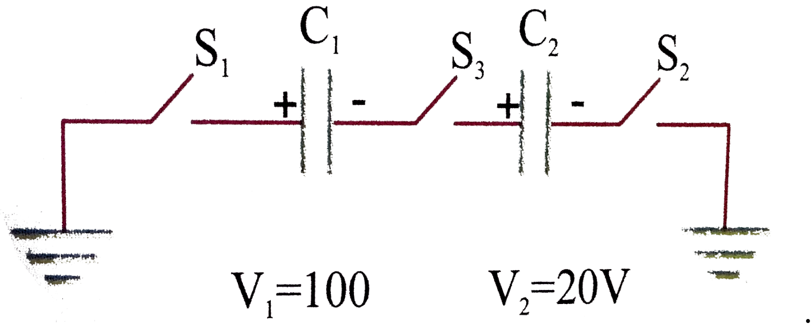
16. In the circuit shown in figure $C_1 = 1\mu F$ and $C_2 = 2\mu F$. The capacitor C_1 is charged to $100V$ and the capacitor C_2 is charged to $20V$. After charging then are connected as shown. When the switches S_1, S_2 and S_3 are closed, the charged flowing through S_1 is



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C.U.Q

1. A condenser stores.

A. potential

B. charge

C. current

D. energy in magnetic field

Answer: B

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2. Out of the following statements

(A) The capacity of a conductor is affected due to the presence of an uncharged isolated conductor

(B) A conductor can hold more charge at the same potential if it is surrounded by dielectric medium.

A. Both A and B are correct

B. Both A and B are wrong

C. A is correct and B is wrong

D. A is wrong and B is correct.

Answer: A

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3. If na earthed plate is brought near positively charged plate, the potential and capacity of charged plate.

A. increases,decreases

B. decreases,increases

C. decreases,decreases

D. increases,increases

Answer: B

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4. The plates of charged condenser are connected by a conducting wire. The quantity of heat produced in the wire is

A. Inversely proportional to the capacity of the condenser

B. Inversely proportional to the square of the potential of the condenser

C. Proportional to the length of wire

D. independent of the resistance of the wire

Answer: D

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5. A capacitor works in

A. $A.C$ circuits only

B. $D.C$ circuits only

C. both $AC\&DC$

D. neither $A.C$ nor in $D.C$ circuit

Answer: C

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6. In order to increase the capacity of a parallel plate condenser one should introduce between the plates a sheet of (assume that the space is completely filled).

A. Mica

B. Tin

C. Copper

D. Stainless steel

Answer: A

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7. In a parallel plate capacitor, the capacitance

A. increases with increase in the distance between the plates

B. decreases if a dielectric material is put between the plates

C. increases with decrease in the distance between the plates

D. increases with decrease in the area of the plates

Answer: C

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8. When a dielectric material is introduced between the plates of a charged condenser, after disconnected the battery the electric field between the plates

A. decrease

B. increases

C. does not change

D. may increase or decrease

Answer: A

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9. A parallel plate capacitor is charged and the charging battery is then disconnected. If the plates of the capacitor are moved farther apart by means of insulating handles:

A. the charge in the capacitor becomes zero

B. the capacitance becomes infinite

C. the charge in the capacitor increases

D. the voltage across the plates increases

Answer: D

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10. The ratio of charge to potential of a body is known as

A. conductance

B. capacitance

C. inductance

D. reactance

Answer: B

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11. A parallel plate capacitor filled with a material of dielectric constant K is charged to a certain voltage and is isolated. The dielectric material is removed. Then

(a) The capacitance decreases by a factor K

(b) The electric field reduces by a factor K

(c) The voltage across the capacitor increases by a factor K

(d) The charge stored in the capacitor increases by a factor K.

A. a and b are true

B. a and c are true

C. b and c are true

D. b and d are true

Answer: B

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12. Force acting upon charged particle kept between the plates of a charged condenser is F. If one of the plates of the condenser is removed, force acting on the same particle will become.

A. zero

B. $F/2$

C. F

D. $2F$

Answer: B

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

A. Q constant V and U decrease

B. Q constant V increases U decreases

C. Q increases V decreases U increases

D. Q, V and U increase

Answer: A

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14. If and uncharged capacitor is charged by connected it to a battery, then the amount of energy lost as heat is.

A. $1/2QV$

B. QV

C. $1/2QV^2$

D. QV^2

Answer: A

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15. When air is replaced by a dielectric medium of constant K, the capacity of the condenser.

A. increases K times

B. increases K^2 times

C. remains uncharged

D. decreases K times

Answer: A

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16. If we increases the distance between two plates of the capacitor, the capacitance will.

A. decrease

B. remain same

C. increase

D. first decrease then increase

Answer: A

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17. In a charged capacitor the enery is stored in (r) is less than at B.

A. both in positive and negative charges

B. positive charges

C. the edges of the capacitor plates

D. the electric field between the plates

Answer: D

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18. A metal plate of thickness half the separation between the capacitor plates of capacitance C is inserted. The new capacitance is.

A. C

B. $C/2$

C. zero

D. $2C$

Answer: D

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19. One plate of parallel plate capacitor is smaller than the other, the charge on the smaller plate will be.

A. less than other

B. more than other

C. equal to other

D. will depend upon the medium between them

Answer: C

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20. Two condensers of unequal capacities are connected in series across a constant voltage $d.c$ source. The ration of the potential difference across the condenser will be.

A. direct proportion to their capacities

B. inverse proportion to their capacities

C. direct proportion to the square of their capacities

D. inverse proportion to the square root of their capacities

Answer: B

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21. A parallel plate copacitor is first charged and then isolated, and a dielelctric slab is introduced between the plates. The quantity that remains unchanged is.

A. Charge Q

B. Potential V

C. Capacity C

D. Energy U

Answer: A

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22. The condenser used in the tuning circuit of radio receiver is.

A. paper condenser

B. electrolytic condenser

C. leygen jar

D. gang condenser

Answer: D

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23. Space between the plates of a parallel plate capacitor is filled with a dielectric slab. The capacitor is charged and then the supply is disconnected to it. If the slab is now taken out then

A. work is not done to take out the slab

B. energy stored in the capacitor reduces

C. potential difference across the capacitor is decreased

D. potential difference across the capacitor is increased

Answer: D

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24. A parallel plate condenser is charged by connected it to a battery. The battery is disconnected and a glass slab is introduced between the plates. Then

A. potential increases

B. electric intensity increases

C. energy decreases

D. capacity decreases

Answer: C

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25. A parallel plate condenser is charged by connected it to a battery. Without disconnected the battery, the space between the plates is completely filled with a medium of dielectric constant k. Then

A. potential becomes $1/k$ times

B. charge becomes k times

C. energy becomes $1/k$ times

D. electric intensity becomes k times

Answer: B

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26. A parallel plate capacitor of capacity C_0 is charged to a potential V_0, E_1 is the energy stored in the capacitor when the battery is disconnected and the plate separation is doubled, and E_2 is the energy stored in the capacitor when the charging battery is kept connected and the separation between the capacitor plates is dounled. find the ratio E_1 / E_2.

A. 4

B. $3/2$

C. 2

D. $1/2$

Answer: A

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27. Select correct statements

(a) charge cannot be isolated

(b) Repulsion is the sure test to know the presence of charge

(c) Waxed paper is dielectric in paper capacitor

(d) Variable capacitor is used in tuning circuits in ratio.

A. a, b only

B. a, c only

C. a, b, c only

D. b, c, d only

Answer: D

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28. A variable parallel plate capacitor and an electroscope are connected in parallel to a battery. The reading of the electroscope would be decreased by.

A. increasing the area of overlap of the plates

B. placing a block of paraffin wax between the plates

C. decreasing the distance between the plates

D. decreasing the battery potential

Answer: D

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29. Three idential capacitors are combined differently. For the same voltage to each combination, the one that stores the greatest energy is

A. the three in series

B. the three in parallel

C. two in series and the third in paralllel with it

D. two in parallel and the third in series with it

Answer: B

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30. The magnitude of electric field $\vec{E}$ in the annular region of a charged cylindrical capacitor.

A. is same throughout

B. is higher near the outer cylinder than near the inner cylinder

C. varies as $1/r$ where r is the distance from the axis

D. varies as r where r is the distance from the axis

Answer: C

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31. Two idential capacitors are joined in parallel, charged to a potential V and then separated and then connected in series i.e. the positive plate of one is connected to negative of the other

A. the charge on the free plates are enhanced

B. the charge on the free plates are decreased

C. the energy stored in the system increases

D. the potential difference between the free plates is $2V$

Answer: D

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32. Two parallel plate air capacitors are construted, one by a pair of iron plates and the second by a pair of copper plates of same area and same spacings. Then

A. the copper plate capacitor has a greater capacitance than the iron one

B. both capacitors will have equal non zero capacitances, in the uncharged state

C. both capacitors will have equal capacitanes only if they are charged equally

D. the capacitances of the two capacitors are unequal even they are unequally charged

Answer: B

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33. Select correct statement for a capacitor having capacitance C, is connected to a source of constant $emf E$

A. Almost whole of the energy supplied by the battery will be stored in the capacity, if resistance of connecting wire is negligibly small

B. Energy received by the capacitor will be half of energy supplied by the battery only when the capacitor was initially uncharged.

C. Stored energy in the capacitor must increases even it the capacitor had an initial charge

D. Energy stored depends on type of the source of emf.

Answer: C

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34. Van Graff genetor is used to :

A. supply electricity for industrial use

B. produce intense magnetic fields

C. generate high voltage

D. obtain highly penetrating X-rays.

Answer: C

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35. A number of spherical conductors of different radii have same potential. Then the surface charge density on them.

A. is proportional to their radii

B. is inversely proportional to their radii

C. are equal

D. is proportional to square of their radii

Answer: B

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36. Three charged particles are initially in position 1, "They are free to move and they come in position" 2 "after some time. Let" U_1 and U_2 be the electrostatic potential energies in position 1 and 2. Then

A. $U_1 > U_2$

B. $U_2 > U_1$

C. $U_1 = U_2$

D. $U_2 \geq U_1$

Answer: A

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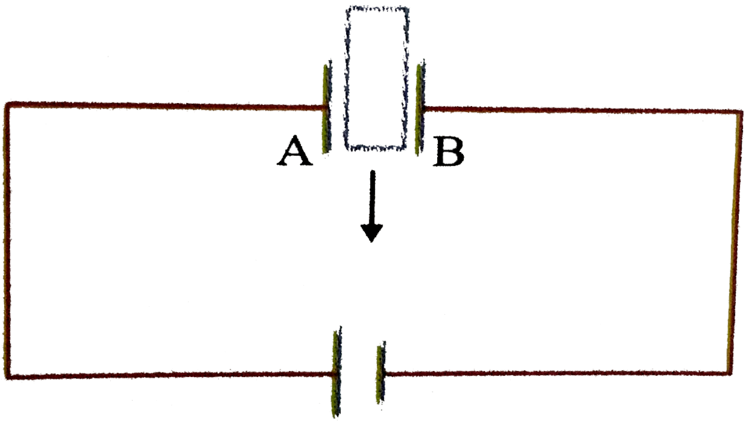
37. An insulator plate is passed between the plates of a capacitor. Then current



A. always flows from A to B

B. always flows from B to A

C. first flows from A to B and then from B to A

D. first flows from B and A and then from A to B

Answer: D

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38. Read the following statements

(a) Non polar molecules have uniform charge distribution

(b) Polar molecules have non-uniform charge distribution

(c) Polar molecules are already polarized

(d) Molecules are not already polarized without electric field in Non-polar molecules.

A. only a & b are correct

B. only c & d are correct

C. only c is wrong

D. all are correct

Answer: D

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39. The capacitance of a capacitor depends on

A. the geometry of the plates

B. separation between plates

C. the dielectric between the plates

D. above all

Answer: D

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40. The electric field $\left(\vec{E}\right)$ between two parallel plates of a capacitor will be uniform if.

A. the plate separation (d) is equal to area of the plate (A)

B. the plate separation (d) greater when compared to area of the plate (A)

C. the plate separation (d) is less when compared to area of the plate (A)

D. 2 (or) 3

Answer: C

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41. For metals the value of dielectric constant (K) is

A. One

B. Infinity

C. zero

D. Two

Answer: B

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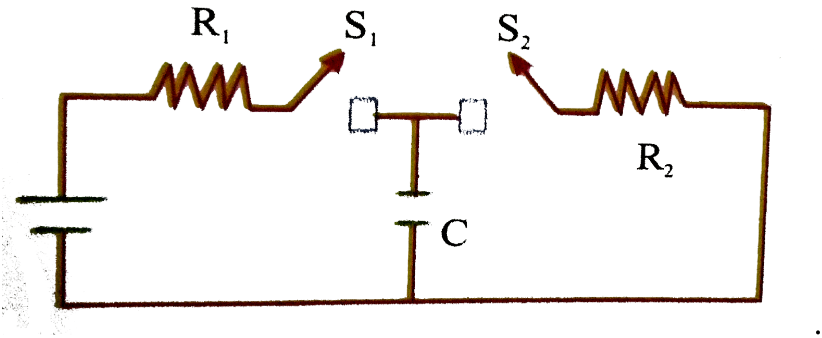
42. A capacitor C is connected to a battery circuit having two switches S_1 and S_2 and resistances R_1 and R_2. The capacitor will be fully charged when



A. both S_1 and S_2 are closed

B. S_1 is closed and S_2 is open

C. S_1 is open and S_2 is closed

D. any of the above

Answer: B

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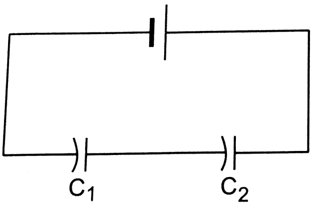
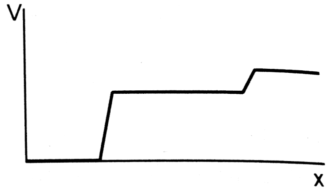
43. Figure show two capacitors connected in series and joined to a battery. The graph shows the variation in potential as one moves from left to right on the branch containing the capacitors.





A. $C_1 > C_2$

B. $C_1 = C_2$

C. $C_1 < C_2$

D. data insufficient to conclude the answer.

Answer: C

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44. Two condensers of unequal capacities are connected in series across a constant voltage $d.c$ source. The ratio of the potential difference across the condenser will be.

A. direct proportion to their capacities

B. inverse proportion to their capacities

C. direct proportion to the square of their capacities

D. inverse proportion to the square root of their capacities

Answer: A

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

A. decreases constant decreases

B. increases increases increases

C. constant decreases decreases

D. constant increases increases

Answer: D

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46. A parallel plate capacitor is charged by connecting is plates to the terminals of a battery. The battery remains connected to the condenser plates and a glass plate is interposed between the plates of the capacitor, then

A. The charge increases while the potential difference remains constant

B. the charge decreases while the potential difference remains constant

C. the charge decreases while the potential difference increases

D. the charge increases while the potential difference decreases

Answer: A

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47. A parallel plate capacitor is charged and the charging battery is then disconnected. If the plates of the capacitor are moved farther apart by means of insulating handles:

A. the charge on the capacitor increases

B. the voltage across the capacitor increases

C. the enegry stored in the capacitor decreases

D. the capacitance increases

Answer: B

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48. When a dielectric material is introduced between the plates of a charged condenser, after disconnected the battery the electric field between the plates

A. increases while its capacity increases

B. increases while its capacity decreases

C. decreases while its capacity increases

D. decreases while its capacity decreases

Answer: C

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49. When two identical condensers are connected in series choose the correct statement regarding the working voltage (the maximum $p.d$ that can be applied to a condenser) and the capacity.

A. working voltage increases, capacity increases

B. working voltage increases, capacity decreases

C. working voltage decreases, capacity increases

D. working voltage decreases, capacity decreases

Answer: B

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50. Two unequal capacitors, initially uncharged, are connected in series across a battery. Which of the following is true.

A. The potential across each is the same

B. The charge on each is the same

C. The energy stored in each is the same

D. The equivalent capacitance is the sum of the two capacitances

Answer: B

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51. Which of the following will not increase the capacitance of an air capacitor ?

A. adding a dielectric in the space between the plates

B. increasing the area of the plates

C. moving the plates closer together

D. increasing the voltage

Answer: D

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52. In a parallel-plate capacitor, the region between the plates is filled by a dielectric slab. The capacitor is connected to a cell and the slab is taken out. Then

A. some charge is drawn from the cell

B. some charge is returned to the cell

C. the potential difference across the capacitor is reduced

D. no work is done by an external agent in taking the slab out

Answer: B

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53. Which of the following statements are correct ?

(a) When capacitors are connected in parallel the effective capacitance is less than the individual capacitances

(b) The capacitances of a parallel plate capacitor can be increased by decreasing the separation of plates.

(c) When capacitors are connected in series the effective capacitance is less than the least of the individual capacities

(d) In a parallel plate capacitor the electrostatic energy is stored on the plates.

A. a & b

B. a & c

C. c and d

D. b & c

Answer: D

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54. Three identical condensers are connected together in four different ways. First all of them are connected in series and the equivalent capacity is C_1. Next all of them are connected in parallel and the equivalent capacity is C_2. Next two of them are connected in series and the third one connected in parallel to the combination and the equivalent capacity is C_3. Next two of them are connected in parallel and the third one connected in series with the combination and the equivalent capacity is C_4. Which of the following is correct ascending order of yhe equivalent capacities ?

A. $C_1 < C_3 < C_4 < C_2$

B. $C_1 < C_4 < C_3 < C_2$

C. $C_2 < C_3 < C_4 < C_1$

D. $C_2 < C_4 < C_3 < C_1$

Answer: B

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Assertion & Reasoning

1. The strength of electric filed in the charged and isolated capacitor is decreased when the dielectric slab is inserted.

When the dielectric slab is inserted between the plates of a charged capacitor, electricfield produced due to induced charged, opposite to the external field.

A. Both A and R false

B. Both A and R true and R is not correct reason for A

C. A is true and R is false

D. Both A and R are true and R is correct reason of A.

Answer: D

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2. If temperature is increased, the dielectric constant of a polar dielectric decreases whereas that of a non-polar dielectric does not change significantly

The magnitude of dipole moment of individual polar molecule decreases significantly with increase in temperature.

A. Both A and R false

B. Both A and R true and R is not correct reason for A

C. A is true and R is false

D. Both A and R are true and R is correct reason of A.

Answer: C

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3. The heat produced by a resistor in any time t during the charging of a capacitor in a series circuit is half the energy stored in the capacitor by that time.

Current in the circuit is equal to the rate of increase in charge on the capacitor.

A. Both A and R false

B. Both A and R true and R is not correct reason for A

C. A is true and R is false

D. Both A and R are true and R is correct reason of A.

Answer: D

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4. A dielectric is inserted between the plates of an isolated fully-charged capacitor. The dielectric completely fills the space between the plates. The magnitude of electrostatic force on either metal plate decreases, as it was before the insertion of dielectric medium.

Due to insertion of dielectric slab in an isolated parallel plate capacitor (the dielectric completely fills the space between the plates), the electrostatic potential energy of the capacitor decreases.

A. Both A and R false

B. Both A and R true and R is not correct reason for A

C. A is true and R is false

D. Both A and R are true and R is correct reason of A.

Answer: B

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5. If the potential difference across a plane parallel plate capacitor is doubled then the potential energy of the capacitor is doubled then the potential energy of the capacitor becomes four times under all conditions

The potential energy U stored in the capacitor is $U = \frac{1}{2}CV^2$, where C and V have usual meaning.

A. Both A and R false

B. Both A and R true and R is not correct reason for A

C. A is true and R is false

D. Both A and R are true and R is correct reason of A.

Answer: D

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6. Assertion: A parallel plate capacitor is charged to a potential difference $100V$, and disconnected from the voltage source. A slab of dielectric is then slowly inserted between the plates. Compared to the energy before the slab was inserted, the energy stored in the capacitor with the dielectric is decreased.

Reason: When we insert a dielectric the plates of a capacitor, the induced tend to draw in the dielectric into the field (just as neutral). we resist this force while slowly inserting the dielectric, and thus do negative work on the system, removing electrostatic energy from the system.

A. Both A and R false

B. Both A and R true and R is not correct reason for A

C. A is true and R is false

D. Both A and R are true and R is correct reason of A.

Answer: A

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7. The energy stored gets reduced by a factor gets reduced by a factor $'K'$ when the battery is disconnected after charging the capacitor and then the dielectric is introduced.

The energy stored in the capacitor increases by a factor $'k'$ when a dielectric is introduced between the plates with the battery present in the circuit.

A. Both A and R false

B. Both A and R true and R is not correct reason for A

C. A is true and R is false

D. Both A and R are true and R is correct reason of A.

Answer: B

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8. Assertion. A metallic shield in the form of a hollow shell, can be built to block an electric field.

Reason. In a hollow spherical shell, the electric field inside is not zero at every point.

A. Both A and R false

B. Both A and R true and R is not correct reason for A

C. A is true and R is false

D. Both A and R are true and R is correct reason of A.

Answer: A

Watch Video Solution

9. When two spheres carrying same charge but a different radii are connected by a conducting wire, the charge flows from smaller sphere to large sphere.

Smaller sphere is at high potential when equal charges are imparted to both the spheres.

A. Both A and R false

B. Both A and R true and R is not correct reason for A

C. A is true and R is false

D. Both A and R are true and R is correct reason of A.

Answer: D

Watch Video Solution

10. Two capacitors are connected in parallel to a battery. If a dielectric medium is inserted between the plates of one of the capacitors then the enegry stored in the system will increase.

On inserting dielectric medium between the plates of a capacitors, its capacity increases.

A. Both A and R false

B. Both A and R true and R is not correct reason for A

C. A is true and R is false

D. Both A and R are true and R is correct reason of A.

Answer: D

Watch Video Solution

11. When a charged capacitor is discharged through a resistor, heat is produced in the resistor

In charging a capacitor, energy is stored in the capacitor.

A. Both A and R false

B. Both A and R true and R is not correct reason for A

C. A is true and R is false

D. Both A and R are true and R is correct reason of A.

Answer: B

Watch Video Solution

12. A capacitor of capacitance C is connected across a battery of potential difference V. The energy stored in the capacitor is $\frac{1}{2}CV^2$

The energy supplied by the battery is $\frac{1}{2}CV^2$.

A. Both A and R false

B. Both A and R true and R is not correct reason for A

C. A is true and R is false

D. Both A and R are true and R is correct reason of A.

Answer: C

Watch Video Solution

13. Two metal plates each of area A form a parallel plate capacitor. Now one plate is displaced. Up, then the capacitance of capacitor decreases.

Due to displacing on plate, the overlapping area decreases, capacitance $C = \frac{\varepsilon_0 A}{d}$ decreases.

A. Both A and R false

B. Both A and R true and R is not correct reason for A

C. A is true and R is false

D. Both A and R are true and R is correct reason of A.

Answer: D

Watch Video Solution

14. Two plates of a parallel plate capacitor are drawn apart, keeping them connected to a battery. Next the same plates are drawn apart from the same initial condition, keeping the battery disconnected, then the work done in both cases are same.

Capacitor plates have same charge in both cases and displacements of plates in both cases are also same.

A. Both A and R false

B. Both A and R true and R is not correct reason for A

C. A is true and R is false

D. Both A and R are true and R is correct reason of A.

Answer: D

Watch Video Solution

15. Two metallic plates placed side by side form three capacitors.

The infinity and first face of first plate is one capacitor, the second face of first plate and first face second plate forms second capacitor and the second face of second plate and infinity forms the third capacitor, but the capacitance of first and third capacitance are extremely small.

A. Both A and R false

B. Both A and R true and R is not correct reason for A

C. A is true and R is false

D. Both A and R are true and R is correct reason of A.

Answer: A

Watch Video Solution

16. The energy stored gets reduced by a factor gets reduced by a factor $'K'$ when the battery is disconnected after charging the capacitor and then the dielectric is introduced.

The energy stored in the capacitor increases by a factor $'k'$ when a dielectric is introduced between the plates with the battery present in the circuit.

A. Both A and R false

B. Both A and R true and R is not correct reason for A

C. A is true and R is false

D. Both A and R are true and R is correct reason of A.

Answer: B

Watch Video Solution

Level-I (C.W)

1. The capacity of a parallel plate condenser consisting of two plates each $10cm$ square and are seperated by a distance of $2mm$ is (Take air as the medium between the plates).

A. $8.85 \times 10^{-13} F$

B. $4.42 \times 10^{-12} F$

C. $44.25 \times 10^{-12} F$

D. $88.5 \times 10^{-13} F$

Answer: B

Watch Video Solution

Watch Video Solution

2. Sixty four spherical drops each of radius $2cm$ and carrying $5C$ charge combine to form a bigger drop. Its capacity is.

A. $\frac{8}{9} \times 10^{-11}F$

B. $90 \times 10^{-11}F$

C. $1.1 \times 10^{-11}F$

D. $9 \times 10^{11}F$

Answer: A

Watch Video Solution

3. A highly conducting sheet of aluminium foil of negligible thickness is placed between the plates of a parallel plate capacitor. The foil is parallel to the plates. If the capacitance before the insertion of foil was $10\mu F$, its value after the insertion of foil will be.

A. $20\mu F$

B. $10\mu F$

C. $5\mu F$

D. Zero

Answer: B

Watch Video Solution

4. Two metal plates are separated by a distance d in a parallel plate condenser. A metal plate of thickness t and of the same area is inserted between the condenser plates. The value of capacitance increases by ....times.

A. $\dfrac{d-t}{d}$

B. $\left(1-\dfrac{t}{d}\right)$

C. $\left(t-\dfrac{t}{d}\right)$

D. $\dfrac{1}{\left(1-\frac{t}{d}\right)}$

Answer: D

Watch Video Solution

5. A radio capacitor of variable capacitance is made of n parallel plates each of area A and separated from each other by a distanced. The alternate plates are connected together. The capacitance of the combination is.

A. $\dfrac{nA \in_o}{d}$

B. $\dfrac{(n-1)A \in_o}{d}$

C. $\dfrac{(2n-1)A \in_o}{d}$

D. $\dfrac{(n-2)A \in_o}{d}$

Answer: B

Watch Video Solution

6. The radius of the circular plates of a parallel plate condenser is $'r'$. Air is there as the dielectric. The distance between the plates if its capacitance is equal to that of an isolated sphere of radius r' is.

A. $\dfrac{r^2}{4r'}$

B. $\dfrac{r^2}{r'}$

C. $\dfrac{r}{r'}$

D. $\dfrac{r^2}{4}$

Answer: A

Watch Video Solution

7. When two capacitors are joined in series the resultance capacity is $2.4\mu F$ and when the same two are joined in parallel the resultant capacity is $10\mu F$. Their individual capacities are.

A. $7\mu F, 3\mu F$

B. $1\mu F, 9\mu F$

C. $6\mu F, 4\mu F$

D. $8\mu F, 2\mu F$

Answer: C

Watch Video Solution

8. Three condensers $1\mu F, 2\mu F$ and $3\mu F$ are connected in series to a $p. d$ of 330 volt. The $p. d$ across the plates of $3\mu F$ is.

A. 180 V

B. 300 V

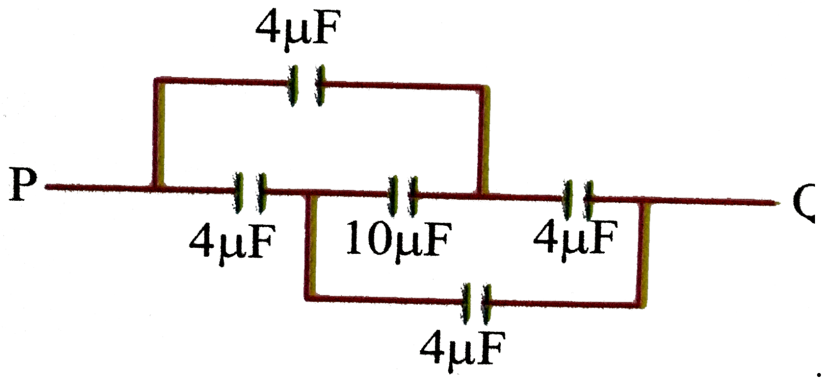
C. 60 V

D. 270 V

Answer: C

Watch Video Solution

9. The effective capacitance between the point P and Q in the given figure is.



A. $4\mu F$

B. $16\mu F$

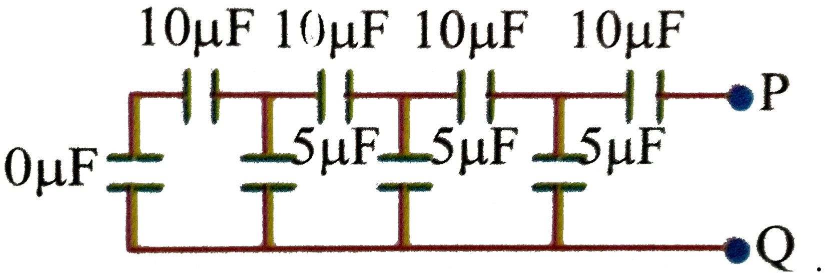
C. $26\mu F$

D. $10\mu F$

Answer: A

Watch Video Solution

10. The equivalent capacitance between P and Q is.



A. $10\mu F$

B. $20\mu F$

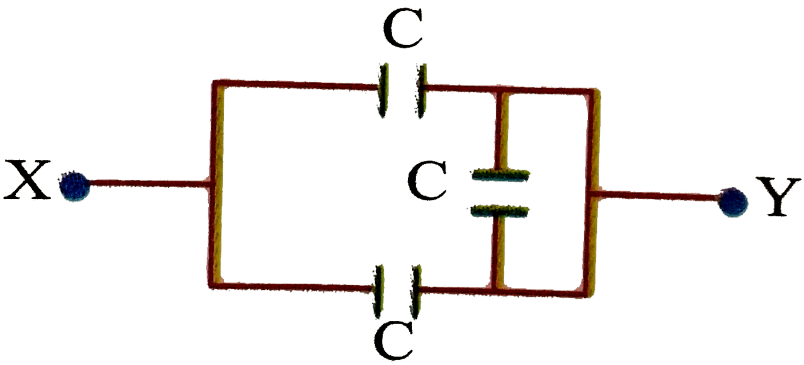
C. $5\mu F$

D. $15\mu F$

Answer: C

Watch Video Solution

11. The equivalent capacity between the points X and Y in the circuit with $C = 1\mu F$.



A. $2\mu F$

B. $3\mu F$

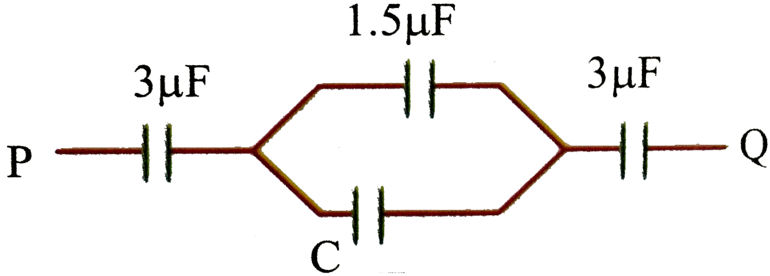
C. $1\mu F$

D. $0.5\mu F$

Answer: A

Watch Video Solution

12. The equivalent capacitance of the network given below is $1\mu F$. The value of $'C'$ is.



A. $3\mu F$

B. $1.5\mu F$

C. $2.5\mu F$

D. $1\mu F$

Answer: B

Watch Video Solution

13. Three capacitors of $3\mu F$, $2\mu F$ and $6\mu F$ are connected in series. When a battery of $10V$ is connected to this combination then charge on $3\mu F$ capacitor will be.

A. $5\mu C$

B. $10\mu C$

C. $15\mu C$

D. $20\mu C$

Answer: B

Watch Video Solution

14. Two spheres of radii $12cm$ and $16cm$ have equal charge. The radii of their energies is.

A. $3:4$

B. $4:3$

C. $1:2$

D. $2:1$

Answer: B

Watch Video Solution

15. A condenser of capacity $10\mu F$ is charged to a potential of $500V$. Its terminals are then connected to those of an uncharged condenser of capacity $40\mu F$. The loss of energy in connecting them together is.

A. 1 J

B. $2.5J$

C. 10 J

D. 12 J

Answer: A

Watch Video Solution

16. A $2\mu F$ condenser is charged to $500V$ and then the plates are joined through a resistance. The heat produced in the resistance is joule is.

A. 50×10^{-2} Joule

B. 25×10^{-2} Joule

C. 0.25×10^{-2} Joule

D. 0.5×10^{-2} Joule

Answer: B

Watch Video Solution

Level-II (C.W)

1. A parallel plate condenser has initially air medium between the plates. If a slab of dielectric constant 5 having thickness half the distance of separation between the plates is introduced, the percentage increase in its capacity is.

A. 33.3%

B. 66.7%

C. 0.5

D. 0.75

Answer: B

Watch Video Solution

2. When a dielectric slab of thickness $4cm$ is introduced between the plates of parallel plate condenser, it is found the distance between the plates has to be increased by $3cm$ to restore to capacity to original value. The dielectric constant of the slab is.

A. 1//4

B. 4

C. 3

D. 1

Answer: B

Watch Video Solution

3. The area of the positive plate is A_1 and the area of the negative plate is $A_2 (A_2 < A_1)$. They are parallel to each other and are separated by a distance d. The capacity of a condenser with air dielectric is.

A. $\dfrac{\varepsilon_0 A_1}{d}$

B. $\dfrac{\varepsilon_0 A_2}{d}$

C. $\dfrac{\varepsilon_0 A_1 A_2}{d}$

D. $\dfrac{\varepsilon_0 A_1}{A_2 d}$

Answer: B

Watch Video Solution

4. The cross section of a cable is shown in fig. The inner conductor has a radius of $10mm$ and the dielectric has a thickness of $5mm$. The cable is $8km$. Long. Then the capacitance of the cable is $[\log_e 1.5 = 0.4]$.

A. $3.8\mu F$

B. $1.1\mu F$

C. $4.8 \times 10^{-10} \mu F$

D. $3.3\mu F$

Answer: B

Watch Video Solution

5. Two condensers of capacity C and $2C$ are connected in parallel and these are charged upto V volt. If the battery is removed and dielectric medium of constant K is put between the plates of first condenser, then the potential at each condenser is.

A. $\frac{V}{k+2}$

B. $2+\frac{k}{3V}$

C. $\frac{2V}{k+2}$

D. $\frac{3V}{k+2}$

Answer: D

Watch Video Solution

6. Given a number of capacitors labelled as C, V. Find the minimum number of capacitors needed to get an arrangement equivalent to $C_{\neq t}, V_{\neq t}$.

A. $n = \frac{C_{\text{net}}}{C} \times \frac{V_{\text{net}}^2}{V^2}$

B. $n = \frac{C}{C_{\text{net}}} \times \frac{V^2}{V_{\text{net}}^2}$

C. $n = \frac{C}{C_{\text{net}}} \times \frac{V}{V_{\text{net}}}$

D. $n = \frac{C_{\text{net}}}{C} \times \frac{V_{\text{net}}}{V}$

Answer: A

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7. Two capacitors of capacitances $3\mu F$ and $6\mu F$ are connected in series and connected to $120V$. The potential difference across $3\mu F$ is V_0 and the charge here is q_0. We have

(A) $q_0 = 40\mu C$

(B) $V_0 = 60V$

(C) $V_0 = 80V$

(D) $q_0 = 240\mu C.$

A. A,C are correct

B. A,B are correct

C. B,D are correct

D. C,D are correct

Answer: D

Watch Video Solution

8. n Capacitors of $2\mu F$ each are connected in parallel and a $p.d$ of $200V$ is applied to the combination. The total charge on them was $1c$ then n is equal to.

A. 3333

B. 3000

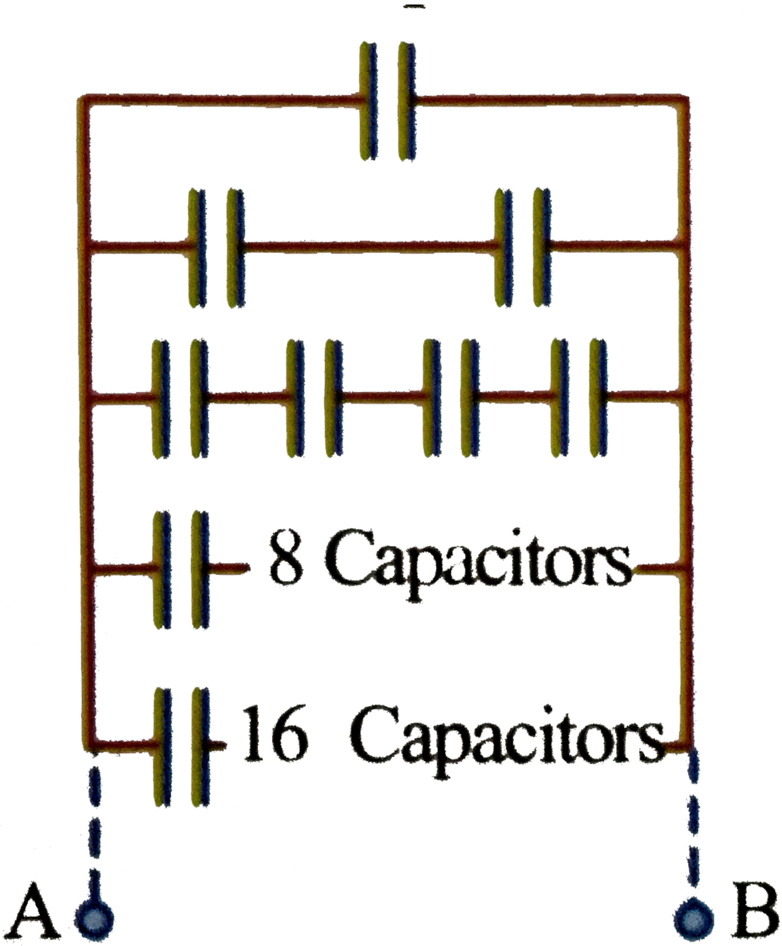
C. 2500

D. 25

Answer: C

Watch Video Solution

9. An infinite number of identical capacitors each of capacitance $1mF$ are connected as shown in the figure. Then the equivalent capacitance between A and B is.



A. $1 mF$

B. $2 mF$

C. $1/2 mF$

D. $0.75 mF$

Answer: B

Watch Video Solution

10. Two capacitors of capacites $1\mu F$ and $C\mu F$ are connected in series and the combination is charged to a potential difference of $120V$. If the charge on the combination is $80\mu C$, the energy stored in the capacitor C in micro joules is :

A. 1800

B. 1600

C. 14400

D. 7200

Answer: B

Watch Video Solution

11. 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 inserted between the plates of the capacitor then energy and capacitance will become.

A. 6E,6C

B. E,C

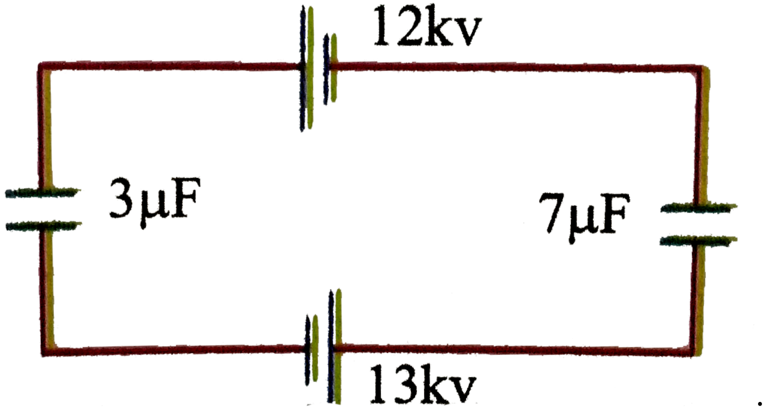
C. $E/6, 6C$

D. E,6C

Answer: C

Watch Video Solution

12. In the circuit diagram given below, the value of the potential difference across the plates of the capacitors are.



A. $17.5KV, 7.5KV$

B. 10 KV,15 KV

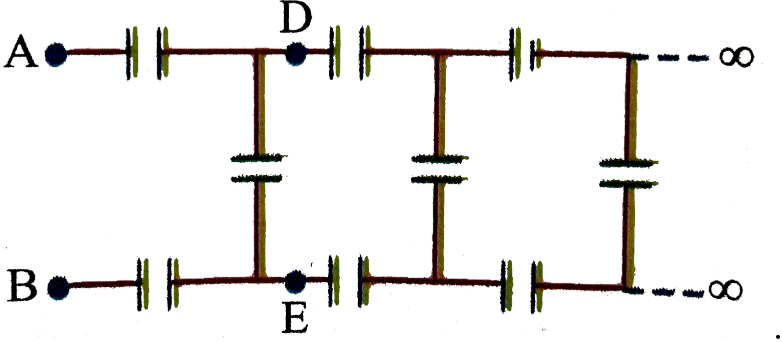
C. 5 KV,20 KV

D. $16.5KV, 8.5KV$

Answer: A

Watch Video Solution

13. The equivalent capacity of the infinite net work shown in the figure (across AB) is (Capacity of each capacitor is $1\mu F$)



A. ∞

B. $1\mu F$

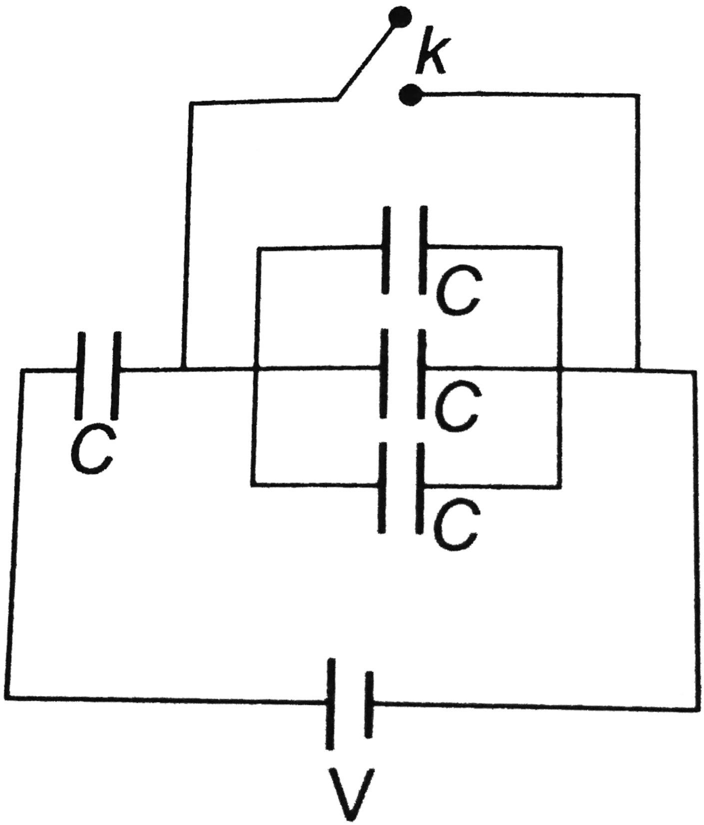
C. $\left(\frac{\sqrt{3}-1}{2}\right)\mu F$

D. $\left(\frac{\sqrt{3}+1}{2}\right)\mu F$

Answer: C

Watch Video Solution

14. The charge flowing through the cell on cloing the key k is equal to :



A. $\frac{CV}{4}$

B. CV

C. $\frac{4}{3}CV$

D. $\frac{3}{4}CV$

Answer: A

Watch Video Solution

Level-III (C.W)

1. The time in seconds required to produce a $P.D$ at $20V$ across a capacitor at $1000\mu F$ when it is charged at the steady rate of $200\mu C/\sec$ is.

A. 50

B. 100

C. 150

D. 200

Answer: B

Watch Video Solution

2. A parallel plate capacitor of capacity $5\mu F$ and plate separation $6cm$ is connected to a $1V$ battery and is charged. A dielectric of dielectric constant 4 and thickness $4cm$ is introduced into the capacitor. The additional charge that flows into the capacitor from the battery is.

A. $2\mu C$

B. $3\mu C$

C. $5\mu C$

D. $10\mu C$

Answer: C

Watch Video Solution

3. The force between the plates of a parallel plate capacitor of capacitance C and distance of separation of the plates d with a potential difference V between the plates, is.

A. $\dfrac{CV^2}{2d}$

B. $\dfrac{C^2V^2}{2d^2}$

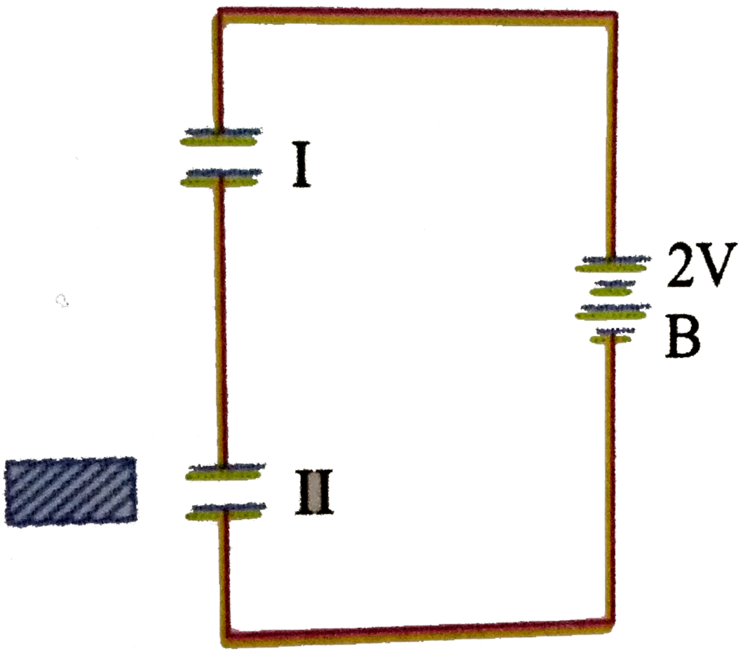
C. $\dfrac{C^2V^2}{d^2}$

D. $\dfrac{V^2d}{C}$

Answer: A

Watch Video Solution

4. Two identical capacitors are connected as shown in the figure. A dielectric slab is introduced between the plates of one of the capacitors so as to fill the gap, the battery remaining connected. The charge on each capacitor will be (charge on each condenser is $q_0, k =$ dielectric constant).



A. $\dfrac{2q_0}{1+{}^{1}/_{k}}$

B. $\dfrac{q_0}{1+{}^{1}/_{k}}$

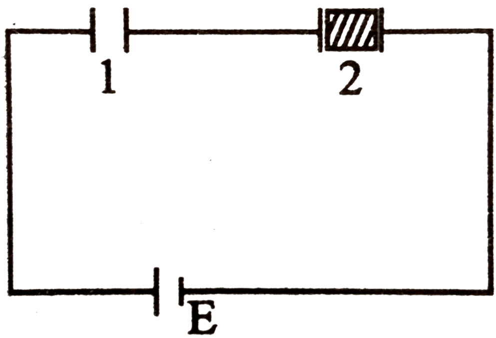
C. $\dfrac{2q_0}{1+k}$

D. $\dfrac{2q_0}{1+k}$

Answer: A

Watch Video Solution

5. Two identical capacitors 1 and 2 are connected in series to a batery as shown in figure. Capacitor 2 contains a dielectric slab of dieletric constant k as shown. Q_1 and Q_2 are the charges stored in the capacitors. Now the dielectirc slab us removed and the corresponding charges are Q'_1 and Q'_2. Then



A. $\frac{Q^{/}}{Q_1} = \frac{K+1}{K}$

B. $\frac{Q^{/}}{Q_2} = \frac{K+1}{2}$

C. $\frac{Q^{/}2}{Q_2} = \frac{K+1}{2K}$

D. $\frac{Q^{/}2}{Q_2} = \frac{K}{2}$

Answer: C

Watch Video Solution

6. A capacitor of capacitance $C_1 = 1\mu F$ withstand a maximum voltage of $V_1 = 6KV$, and another capacitor of capacitance $C_2 = 2\mu F$, can with stand a maximum voltage of $V_2 = 4KV$. If they are connected in series, what maximum voltage will the system withstand?

A. 3 kV

B. 6 kV

C. 10 kV

D. 9 kV

Answer: D

Watch Video Solution

7. Energy $'E'$ is stored in a parallel plate capacitor $'C_1'$. An identical uncharged capacitor $'C_2'$ is connected to it, kept in contact with it for a

while and then disconnected, the enegry stored in C_2 is.

A. $E/2$

B. $E/3$

C. $E/4$

D. Zero

Answer: C

Watch Video Solution

8. A parallel plate capacitor has area of each plate A, the separation between the plates is d. It is charged to a potential V and then disconnected from the battery. The amount of work done in the filling the capacitor Completely with a dielectric constant k is.

A. $\frac{1}{2}\frac{\varepsilon_0 AV^2}{d}\left[1-\frac{1}{k^2}\right]$

B. $\frac{1}{2}\frac{V^2\varepsilon_0 A}{kd}$

C. $\frac{1}{2}\frac{V^2\varepsilon_0 A}{k^2 d}$

D. $\frac{1}{2}\frac{\varepsilon_0 AV^2}{d}\left[1-\frac{1}{K}\right]$

Answer: D

Watch Video Solution

9. A capacitor of capacitance $10\mu F$ is charged to a potential $50V$ with a battery. The battery is now disconnected and an additional charge $200\mu C$ is given to the positive plate of the capacitor. The potential difference across the capacitor will be.

A. 50 V

B. 80 V

C. 100 V

D. 60 V

Answer: D

Watch Video Solution

10. A capacitor is filled with an insulator and a certain potential difference is applied to its pltaes. 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

Answer: C

Watch Video Solution

11. 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. $V - \frac{Q}{C}$, if $V < CV$

Answer: C

Watch Video Solution

12. A parallel plate capacitor with plates separated by air acquires $1\mu C$ of charge when connected to a battery of $500V$. The plates still connected to the battery are then immersed in benzene $[k = 2.28]$. Then a charge that flows from the battery is.

A. $1.28 \cdot 500\mu C$

B. $2.28 \cdot 500\mu C$

C. $1/4\mu C$

D. $4.56 \mu C$

Answer: A

Watch Video Solution

13. An air capacitor with plates of area $1m^2$ and $0.01 metre$ apart is charged with $10^{-6} C$ of electricity. When the capacitor is submerged in oil of relative permittivity 2, then the energy decreases by.

A. 0.2

B. 0.5

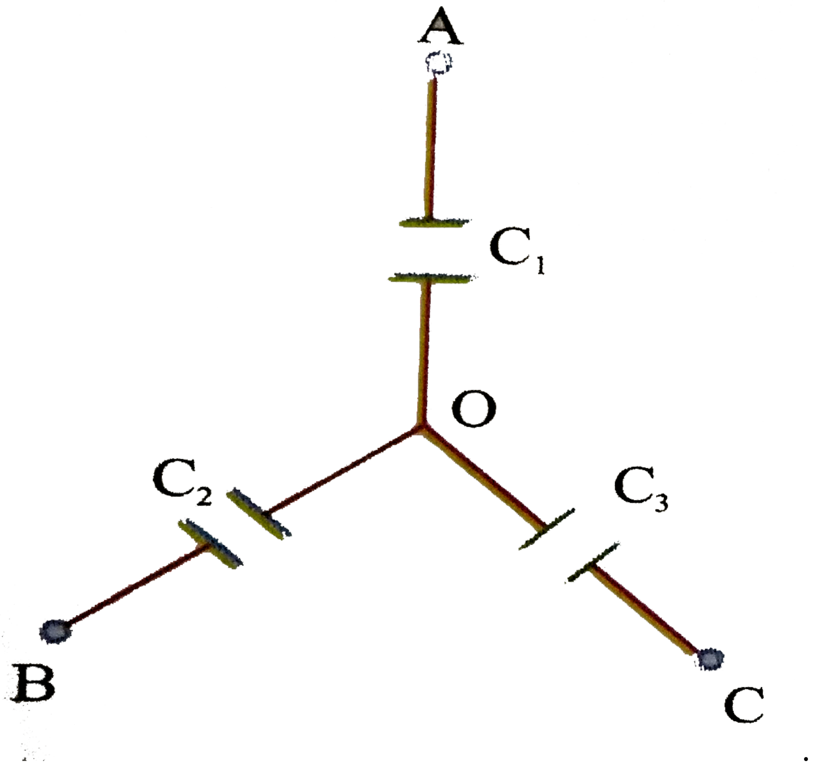
C. 0.6

D. 0.75

Answer: B

Watch Video Solution

14. Three uncharged capacitors of capacities C_1, C_2 and C_3 are connected as shown in the figure to one another and the potentials V_1, V_2 and V_3 respectively. Then the potential at O will be



A. $\dfrac{V_1C_1 + V_2C_2 + V_3C_3}{C_1 + C_2 + C_3}$

B. $\dfrac{V_1 + V_2 + V_3}{C_1 + C_2 + C_3}$

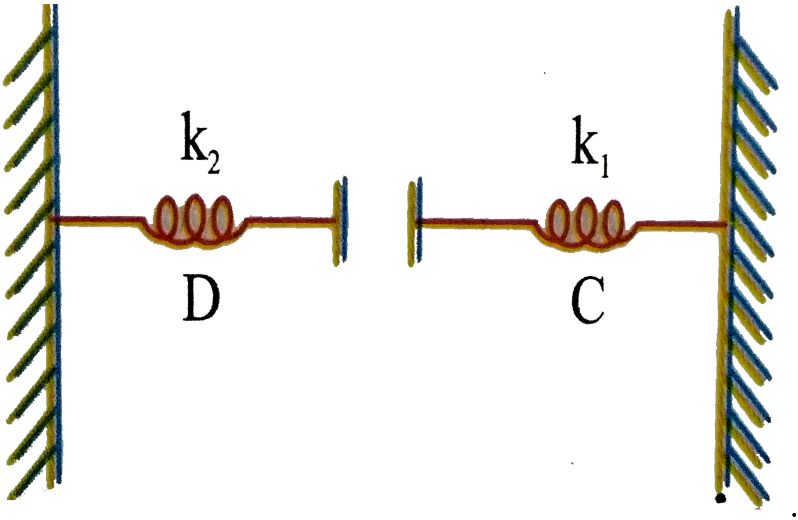
C. $\dfrac{V_1(V_2 + V_3)}{C_1(C_2 + C_3)}$

D. $\dfrac{V_1V_2V_3}{C_1C_2C_3}$

Answer: A

Watch Video Solution

15. In the given figure the capacitor of plate area A is charged upto charge q. The ratio of elongations (neglect force gravity) in springs C and D at equilibrium position is.



A. $\frac{k_1}{k_2}$

B. $\frac{k_2}{k_1}$

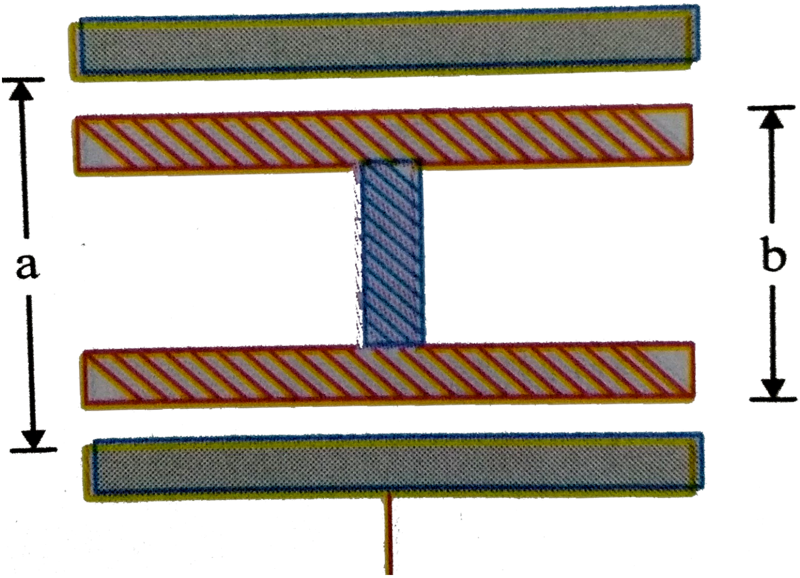
C. $k_1 k_2$

D. $\sqrt{\dfrac{k_1}{k_2}}$

Answer: B

Watch Video Solution

16. If metal section of shape H is inserted in between two parallel plates as shown in figure and A is the area of each plate then the equivalent capacitance is.



A. $\dfrac{A \in_0}{a} - \dfrac{A \in_0}{b}$

B. $\dfrac{A \in_0}{a+b}$

C. $\dfrac{A \in_0}{a} + \dfrac{A \in_0}{b}$

D. $\dfrac{A \in_0}{a-b}$

Answer: D

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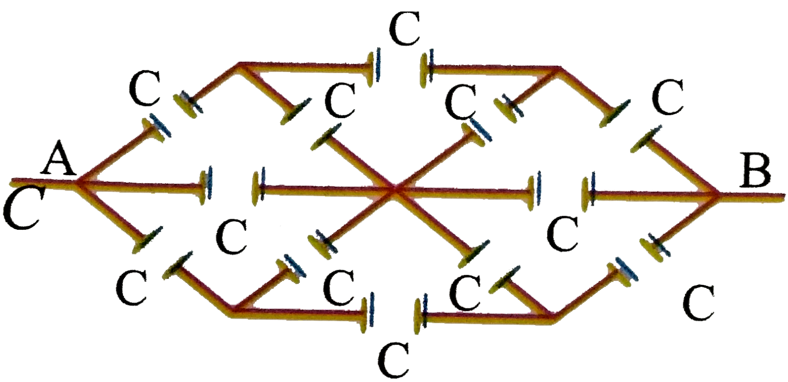
17. The equivalent capacitance C_{AB} of the circuit shown in the figure is.



A. $\dfrac{5}{4}C$

B. $\dfrac{4}{5}C$

C. 2 C

D. C

Answer: A

Watch Video Solution

18. A solid conducting sphere of radius $10cm$ is enclosed by a thin metallic shell of radius $20cm$. A charge $q = 20\mu C$ is given to the inner sphere is connected to the shell by a conducting wire.

A. 12 J

B. 9 J

C. 24 J

D. Zero

Answer: B

Watch Video Solution

19. A condenser of capacity $500\mu F$ is charged at the rate of $400\mu F$ per second. The time required to raise its potential by $40V$ is.

A. 50 s

B. 100 s

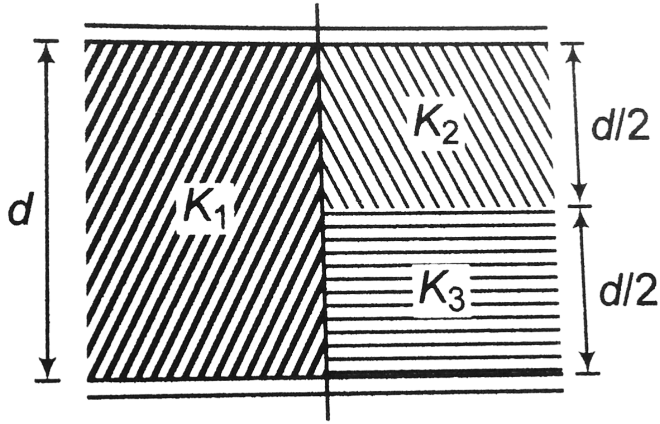
C. 20 s

D. 10 s

Answer: A

Watch Video Solution

20. The equivalent capacitance of the arrangement shown in figure, if A is the area of each plate is



A. $\frac{a \in_0}{d}\left[\frac{K_1}{2} + \frac{K_2 K_3}{K_2 + K_3}\right]$

B. $\frac{a \in_0}{2d}\left[\frac{K_2}{2} + \frac{K_1 K_3}{K_1 + K_3}\right]$

C. $\frac{a \in_0}{3d}\left[\frac{K_3}{2} + \frac{K_1 K_2}{K_1 + K_2}\right]$

D. $\frac{a \in_0}{d}\left[\frac{K_1}{2} + \frac{K_1 + K_2}{K_2 K_3}\right]$

Answer: A

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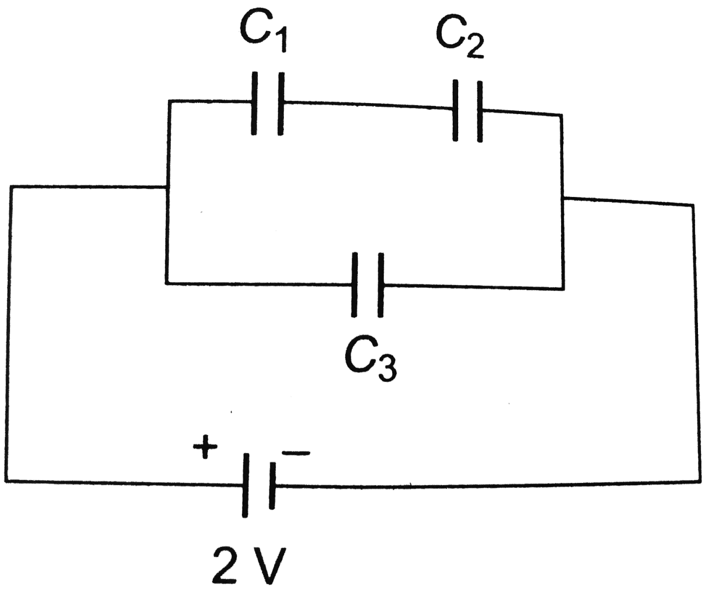
21. Two capacitors $C_1 = 2\mu F$ and $C_2 = 6\mu F$ in series, are connected in parallel to a third capacitor $C_3 = 4\mu F$. This arrangement is then connected to a battery of e.m.f $= 2V$, as shown in the figure. How much energy is lost by the battery in charging the capacitors



A. $22 \times 10^{-6} J$

B. $11 \times 10^{-6} J$

C. $\left(\frac{32}{2}\right) \times 10^{-6} J$

D. $\left(\frac{16}{3}\right) \times 10^{-6} J$

Answer: B

Watch Video Solution

22. A capacitor is chared to store an energy U. The charging battery is disconnected. An edentical is now connected to the first capacitor in parallel. The energy in each capacitor is now.

A. $\frac{U}{2}$

B. U

C. $\frac{U}{4}$

D. $3U\frac{)}{2}$

Answer: C

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23. 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 volt. The dielectric slab is slowly removed from between the plates and then reinserted. The net work done by the system in this process is

A. $\frac{1}{2}(K-1)CV^2$

B. $CV^2(K-1)/K$

C. $(K-1)CV^2$

D. zero

Answer: D

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24. 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 'DeltaT', the potential difference 'V' across the capacitance is

A. $\sqrt{\frac{2mC\Delta T}{s}}$

B. $\frac{mC\Delta T}{s}$

C. $\frac{ms\Delta T}{C}$

D. $\sqrt{\frac{2ms\Delta T}{C}}$

Answer: D

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25. A parallel plate capacitor of capacitty $100\mu F$ is charged by a battery at 50 volts. The battery remains connected and if the plates of the capacitor are separated so that the distance between them is halved the original distance, the additional energy gives by the battery to the capacitor in Joules is .....

A. 125×10^{-3}

B. 12.5×10^{-3}

C. 1.25×10^{-3}

D. 0.125×10^{-3}

Answer: A

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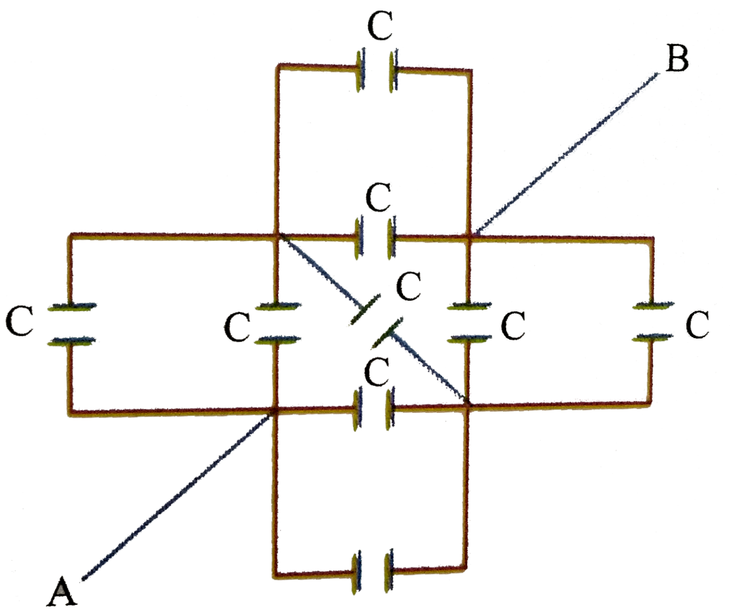
26. The equivalent capacity between the points A and B in the adjoining circuit will be.



A. C

B. 2C

C. 3 C

D. 4

Answer: B

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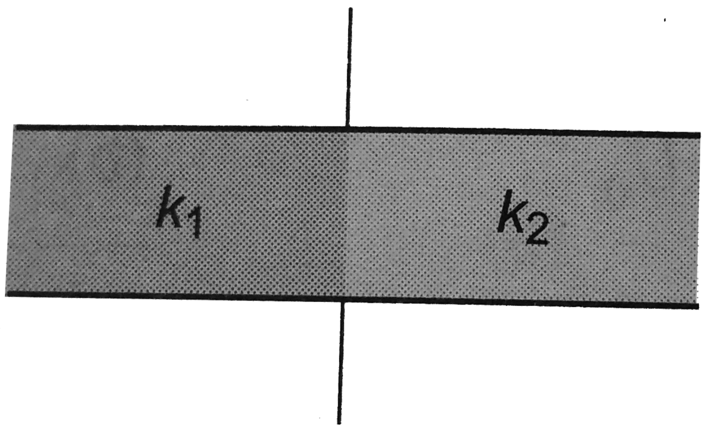
27. A parallel plate capacitor with air as medium between the plates has a capacitance of $10\mu F$. The area of capacitor is divided into two equal halves and filled with two media as shown in the figure having dielectric constnt $k_1 = 2$ and $k_2 = 4$. the capacitance of the system will now be



A. $10\mu F$

B. $20\mu F$

C. $30\mu F$

D. $40\mu F$

Answer: C

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28. The capacity of a parallel plate condenser with air medium is $60\mu F$ having distance of seperation d. If the space between the plates is filled with two slabs each of thickness $\hat{} \, (d)/_2$ and dielectric constant 4 and 8, the effective capacity becomes.

A. $160\mu F$

B. $320\mu F$

C. $640\mu F$

D. $360\mu F$

Answer: B

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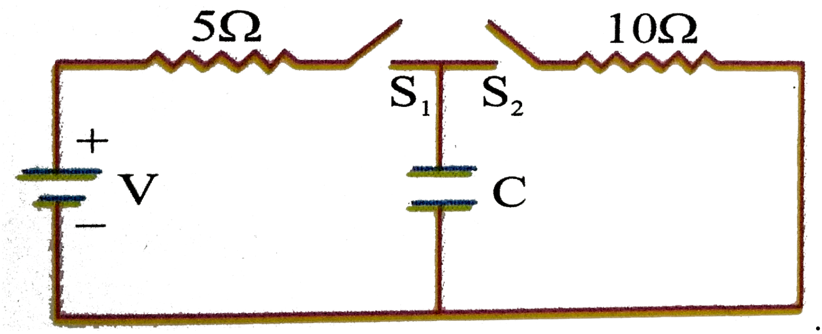
29. In the adjoining diagram, the condenser C will be fully charged to potential V if



A. S_1 and S_2 both are open

B. S_1 and S_2 both are closed

C. S_1 is closed and S_2 is open

D. S_1 is open and S_2 is closed.

Answer: C

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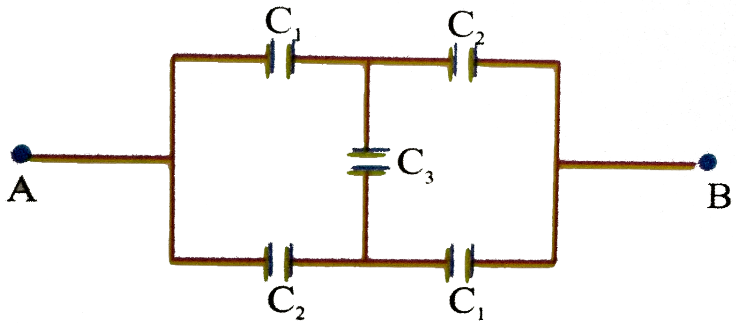
30. The capacity between the point A and B in the adjoining circuit will be.



A. $\dfrac{2C_1C_2 + C_3(C_1 + C_2)}{C_1 + C_2 + 2C_3}$

B. $\dfrac{C_1C_2 + C_2C_3 + C_3C_1}{C_1 + C_2 + C_3}$

C. $\dfrac{C_1(C_2 + C_3) + C_2(C_1 + C_3)}{C_1 + C_2 + 3C_3}$

D. $\dfrac{C_1C_2C_3}{C_1C_2 + C_2C_3 + C_3C_1}$

Answer: A

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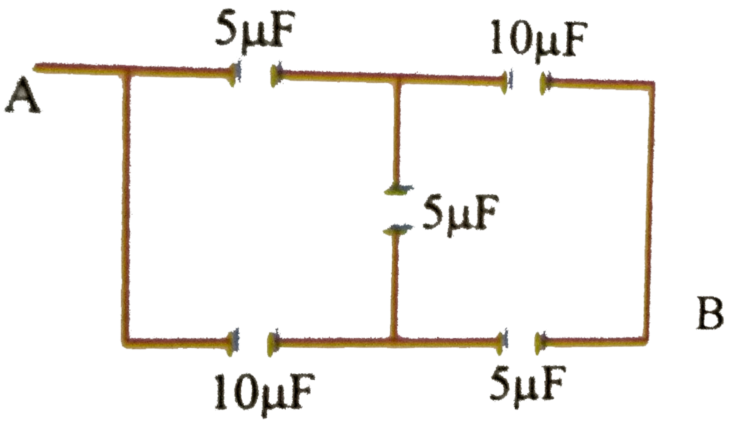
31. The capacitance C_{AB} in the given network.



A. $7\mu F$

B. $\frac{50}{7}\mu F$

C. $7.5\mu F$

D. $\frac{7}{50}\mu F$

Answer: A

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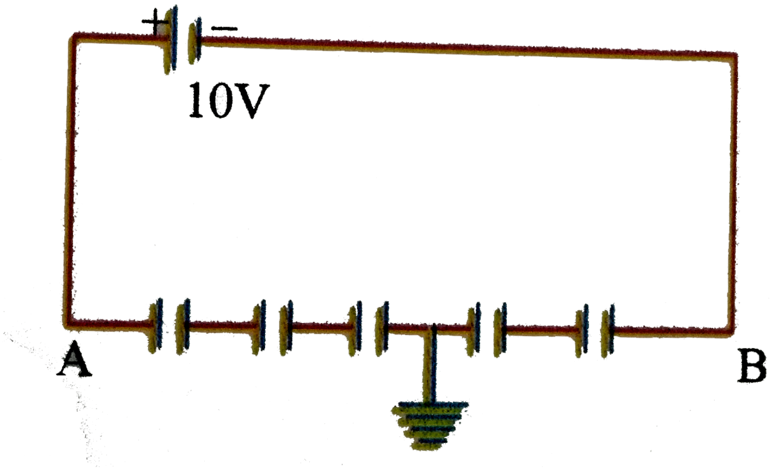
32. In the following circuit , find the potentials at points A and B is.



A. 10 V,0V

B. $6V, \; - 4V$

C. $4V, \; - 6V$

D. $5V, \; - 5V$

Answer: B

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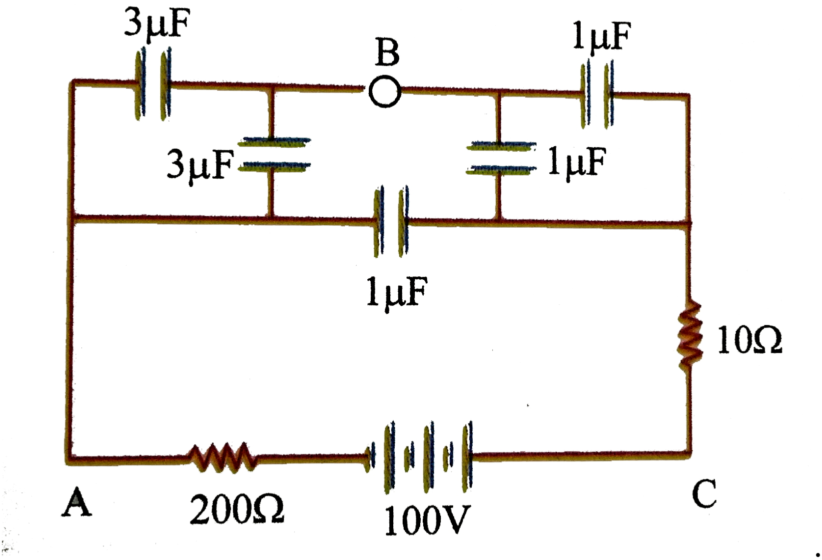
33. The potential difference between the points A and B in the following circuit in steady state will be



A. $V_{AB} = 100vo <$

B. $V_{AB} = 75vo <$

C. $V_{AB} = 25vo <$

D. $V_{AB} = 50vo <$

Answer: C

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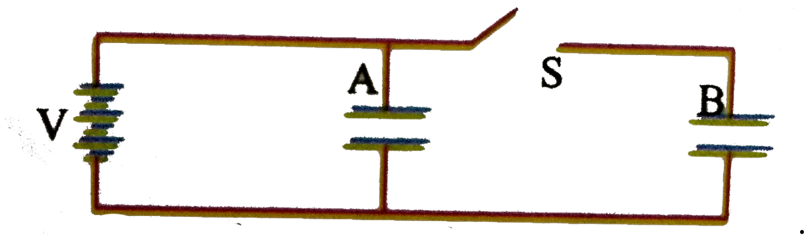
34. In the following circuit two identical capacitors, a battery and a switch (s) are connected as shown. The switch (s) is opened and dielectric of constant $(K = 3)$ are inserted in the condensers. The ratio of electrostatic energies of the system before and after filling the dielectric will be.



A. $3 : 1$

B. $5 : 1$

C. $3 : 5$

D. $5 : 3$

Answer: C

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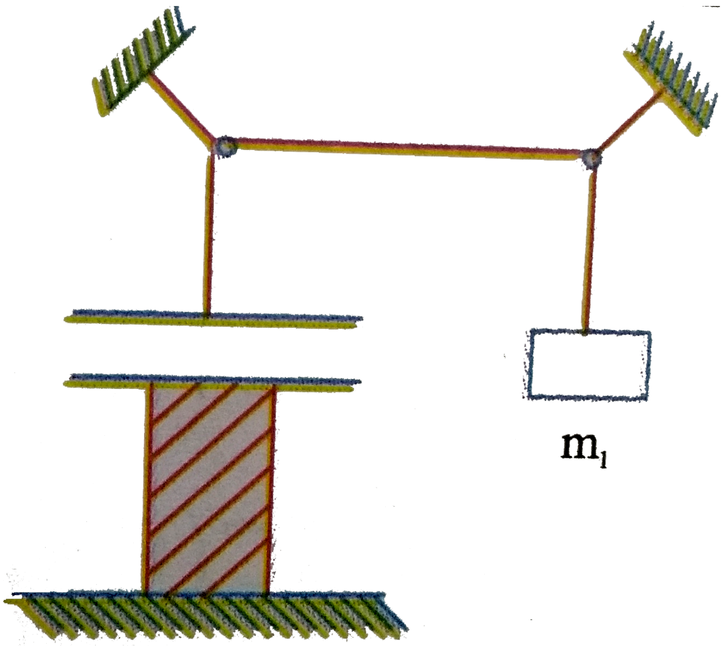
35. In the given figure a capacitor of plate are A is charged upto charge q.

The mass of each plate is m_2. The lower plate is rigidly fixed. The value of m_1 if the system remains in equilibrium is.



A. $m_2 + \dfrac{q^2}{\in_0 Ag}$

B. m_2

C. $\dfrac{q^2}{\in_0 Ag}$

D. $2m_2$

Answer: C

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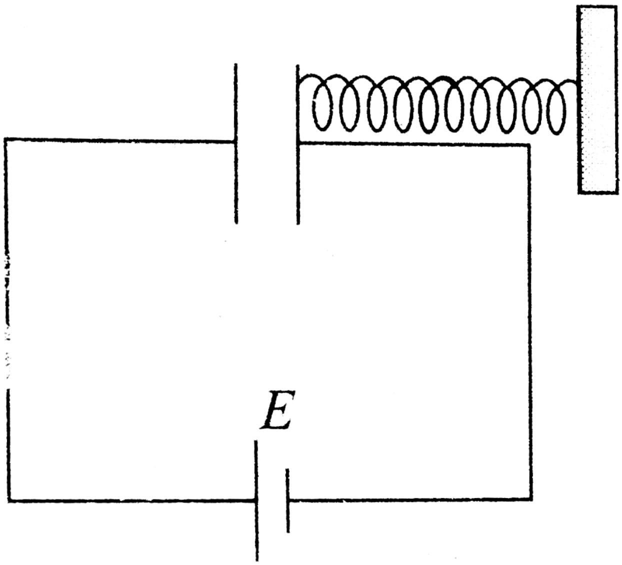
36. One plate of a capacitor is fixed, and the other is connected to a spring as shown in. Area of both the plates is A In strady state (equilibrium), separation between the plates is $0.8d$ (spring was unstretched , and the distance between the plates was d when capacitor was uncharged). The force conntant of the spring is approximately.



A. $\dfrac{4 \in_0 AE^2}{d^3}$

B. $\dfrac{2 \in_0 AE}{d^2}$

C. $\dfrac{6 \in_0 E^2}{Ad^3}$

D. $\dfrac{\in_0 AE^3}{2d^3}$

Answer: A

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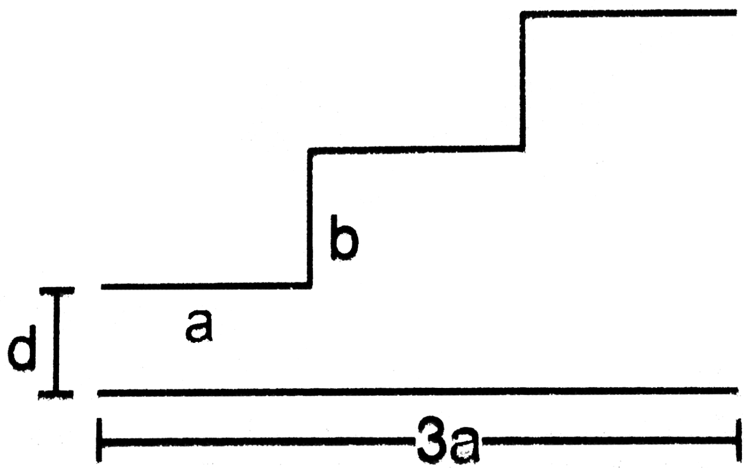
37. A capacitor is made of a flat plate of area A and a second plate having a stair -like structure as shown in figure. The width of each stair is a and the height is b. Find the capacitance of the assembly.



A. $\dfrac{2A \in_0}{2(d+b)}$

B. $\dfrac{A \in_0 \left(3d^2 + 6bd + 2b^2\right)}{3d(b + d)(d + 2b)}$

C. $\dfrac{A \in_0 \left(d^2 + 2bd + b^2\right)}{3d(d + b)(d + 2b)}$

D. $\dfrac{2A \in_0 \left(d^2 + 2bd + b^2\right)}{3d(d + b)(d + 2b)}$

Answer: B

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38. 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 isimilarly charged to a potential difference 2V. The charging battery is now disconnected and the capacitors are connected in parallel to each other in such a way that the poistive terminal of one is connected to the negative terminal of the other. The final energy of the configuration is

A. zero

B. $\dfrac{3}{2}CV^2$

C. $\frac{35}{6}CV^2$

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

Answer: B

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

A. $1/4C(V_1^2 - V_2^2)$

B. $1/4C(V_1^2 + V_2^2)$

C. $1/4C(V_1 - V_2)^2$

D. $1/4C(V_1 + V_2)^2$

Answer: C

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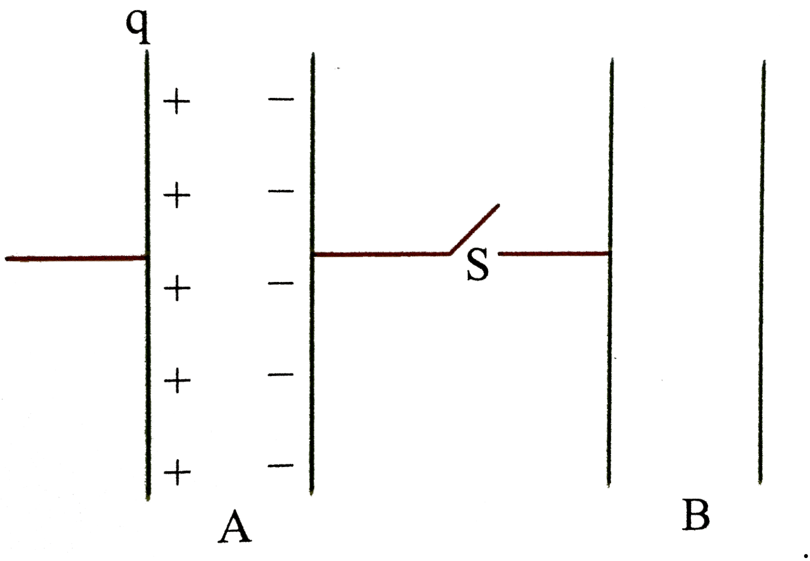
40. Consider the situation shown in the figure. The capacitor A has a charge q on it whereas B is uncharged. The charge appearing on the capacitor B a long 7 time after the switch is closed is :



A. zero

B. q//2

C. q

D. 2q

Answer: A

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41. Find the capacitance of a system of two identical metal balls of radius a if the distance between their centres is equal to b, with $b > > a$. The system is located in a uniform dielectric with permittivity K.

A. $\pi \in_0 Ka$

B. $\pi \in_0 Ka$

C. $2\pi \in_0 Ka$

D. $2/3\pi \in_0 Ka$

Answer: C

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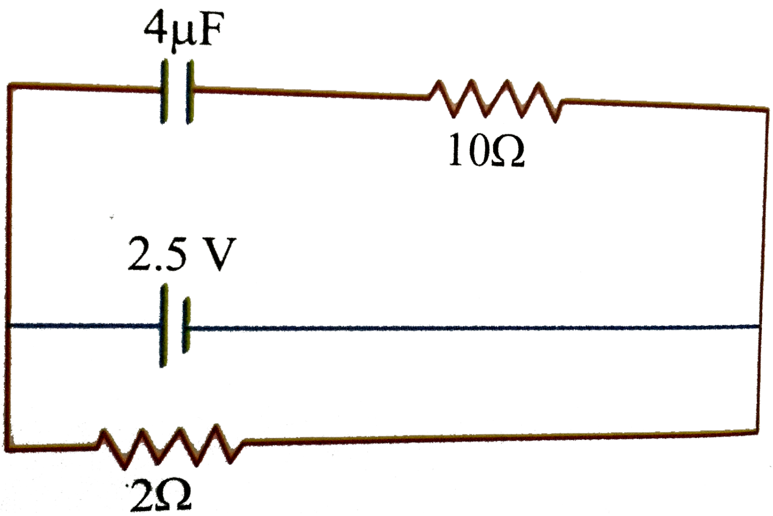
NCERT Based

1. A capacitor of $4\mu F$ is connected as shown in the circuit. The internal resistance of the battery is 0.5Ω. The amount of charge on the capacitor plates will be



A. 0

B. $4\mu C$

C. $16\mu C$

D. $8\mu C$

Answer: D

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2. A positively charged particle is released from rest in a uniform electric field. The electric potential energy of the charge.

A. remains a constant because the electric field is uniform.

B. increase because the charge moves along the electric field.

C. decreases because the charge moves along the electric field.

D. decreases because the charge moves opposite to the electric field.

Answer: C

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3. Figure shows some equipotential lines distributed in space. A charged object is moved from point A to point 5.

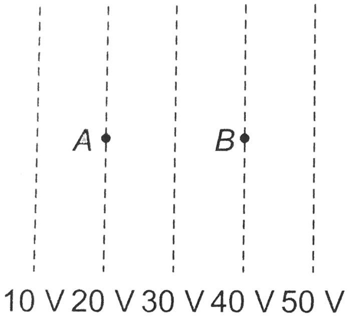

Fig. (i)

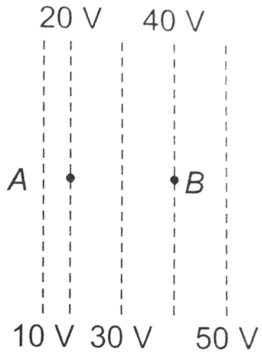

Fig. (ii)

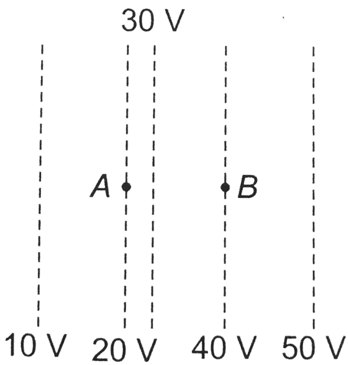

Fig. (iii)

A. The work done in figure (i) is the greatest.

B. The work done in figure (ii(is the least

C. The work done is the same in figure (i),(ii) and (iii).

D. The work done in figure (iii) is greater than figure (ii) but equal to that in figure (i).

Answer: C

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4. The electrostatic potential on the surface of a charged concducting sphere is $100V$. Two statements are made in this regard

$S_1:$ at any inside the sphere, electric intensity is zero.

$S_2:$ at any point inside the sphere, the electrostatic potential is $100V$.

A. S_1 is true but S_2 is false.

B. Both S_1 and S_2 are false

C. S_1 is true, S_2 is also true and S_2 is the cause of S_2.

D. S_1 is true, S_2 is also true but the statements are independent.

Answer: C

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5. Equipotentials at a great distance from a collection of charges whose total sum is not zero are approximately

A. spheres

B. planes

C. paraboloids

D. ellipsoids

Answer: A

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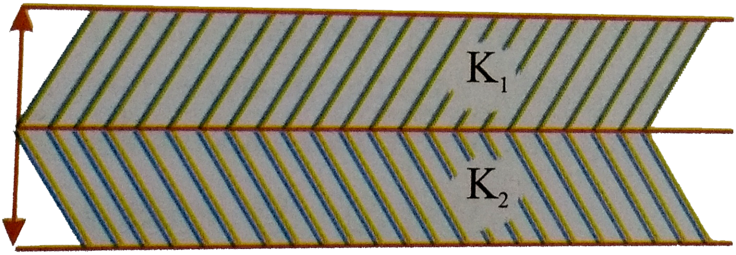
6. A parallel plate capacitor is made of two dielectric blocks in series. One of the blocks has thickness d_1 and dielectric constant K_1 and the other has thickness d_2 and dielectric constant K_2 as shown in figure. This arrangement can be through as a dielectric slab of thickness

$d(=d_1+d_2)$ and effective dielectric constant K. The K is.



.

A. $\dfrac{K_1d_1+K_2d_2}{d_1+d_2}$

B. $\dfrac{K_1d_1+K_2d_2}{K_1+K_2}$

C. $\dfrac{K_1K_2(d_1+d_2)}{K_2d_1+K_1d_2}$

D. $\dfrac{2K_1K_2}{K_1+K_2}$

Answer: C

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7. Consider a uniform electric field in the $\hat{z}$ direction. The potential is a constant.

A. in all space

B. for any x for a given z

C. for any y for a given z

D. on the $x - y$ plane for a given z

Answer: B::C::D

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8. Equipotential surfaces

A. are closer in regions of large electric fields compared to regions of lower electric fields

B. will be more crowded near sharp edges of a conductor.

C. will be more crowded near regions of large charge densities

D. will aways be equally spaced

Answer: A::B::C

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9. The work done to move a charge along an equipotential from A to B

A. cannot be defined as $-\int_{A}^{B} \overrightarrow{E} \overrightarrow{dl}$

B. must be defined as $-\int_{A}^{B} \overrightarrow{E} . \overrightarrow{dl}$

C. is zero

D. can have a non-zero value

Answer: B::C

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10. In a region of constant potential

A. the electric field is uniform

B. the electric field is zero

C. there can be no charge inside the region

D. the electric field shall necessarily change if a charge is placed outside the region

Answer: B::C

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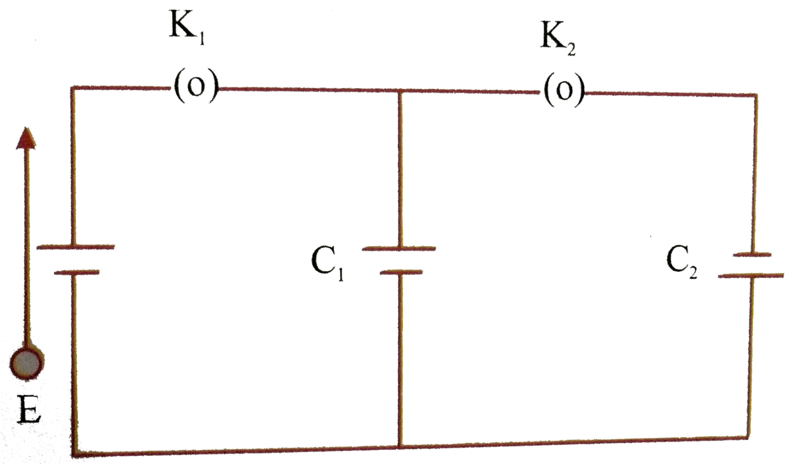
11. In the circuit shown in figure , initially key K_1 is closed and key K_2 is open. Then K_1 is opened and K_2 is closed (order is important). [Take Q_1' and Q_2' as charges on C_1 and C_2 and V_1 and V_2 as voltage respectively].



Then

A. charge on C_1 gets redistributed such that $V_1 = V_2$

B. charge on C_1 gets redistributed such that $Q_1' = Q_2'$

C. charge on C_1 gets redistributed such that $C_1V_1 + C_2V_2 = C_1E$

D. charge on C_1 gets redistributed such that $Q_1' + Q_2' = Q$.

Answer: A::D

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12. If a conductor has a potential $V \neq 0$ and there are no charges anywhere else outside, then

A. there must be charges on the surface or inside itself

B. there cannot be any charge in the body of the conductor

C. there must be charges only on the surface

D. there must be charges inside the surface.

Answer: A::B

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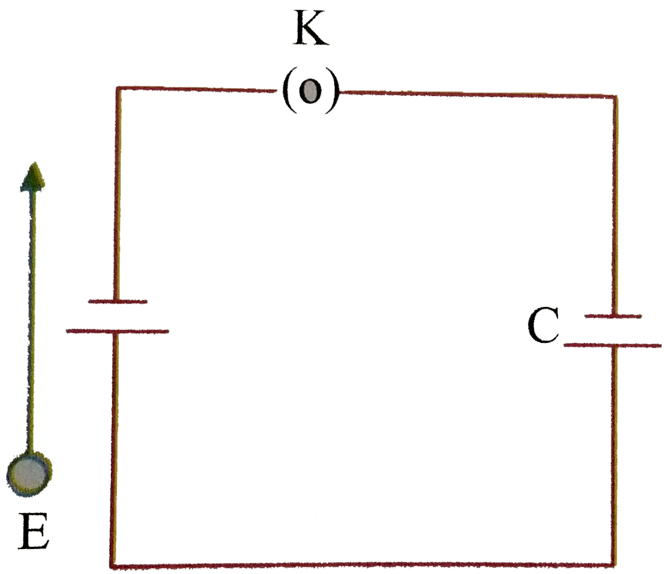
13. A parallel plate capacitor is connected to a battery as shown in figure.

Consider two situations :



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

B : Key K is opened and plates of capacitors are moved apart using insulting handle. Choose the correct options (s).

A. In $A: Q$ remains same but C changes

B. In $B: V$ remains same but C changes

C. In $A : V$ remains same and hence Q changes.

D. In $B : Q$ remains same and hence V changes

Answer: C::D

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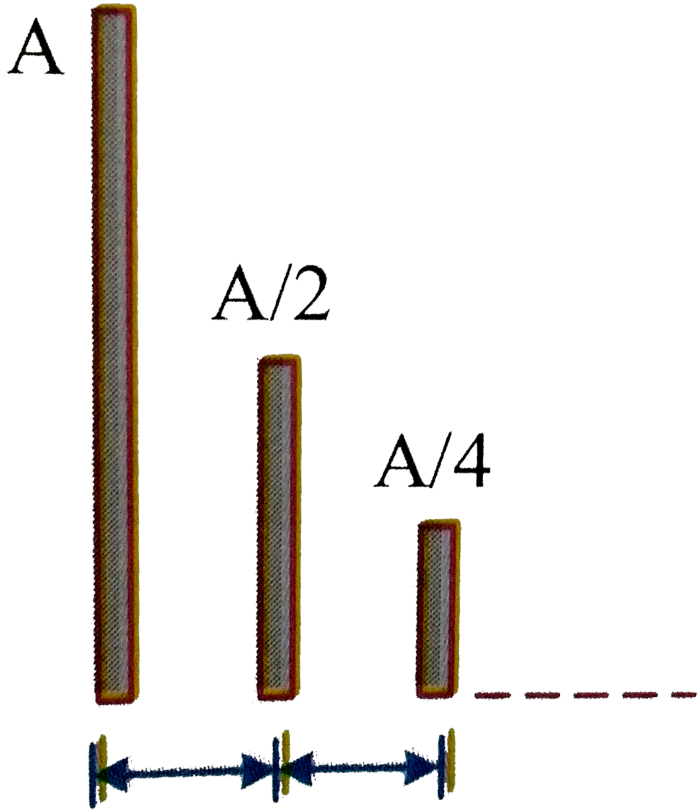
Level-V

1. n conducting plates are placed face to face. Distance between two consecutive plates is d.

Area of plates is $A, \frac{A}{2}, \frac{A}{4}, \frac{A}{8} \dots \left(\frac{1}{2^{n-1}}\right)A$

A dielectric slab of dielectric constant k is inserted between the first and second plates and the assembly is charged by a battery of $emf\xi$. Find the charge stored in the assembly.



A. $\dfrac{\varepsilon_0 A \xi}{2d\left[\frac{1}{k} + 2^{n-1} - 2\right]}$

B. $\dfrac{\varepsilon_0 A \xi}{2d\left[\frac{1}{k} + 2^{n-1} - 1\right]}$

C. $\dfrac{\varepsilon_0 A \xi}{d\left[\frac{1}{k} + 2^{n-1} - 2\right]}$

D. $\dfrac{\varepsilon_0 A \xi}{3d\left[\frac{1}{k} + 2^{n-1} - 2\right]}$

Answer: A

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2. A capacitor of capacitance $10mF$ is charged up a potential difference of $2V$ and then the cell is removed. Now it is connected to a cell of $emf4V$ and is charged fully. In both cases the polarities of the two cells are in the same directions. Total heat produced in the second charging process is :

A. 10 mJ

B. 20 mJ

C. 40 mJ

D. 80 mJ

Answer: B

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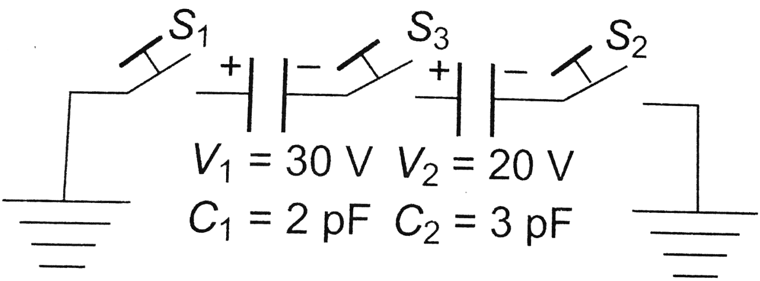
3. For the circuit shown in figure, which of the following statements is true ?



A. With S_1 closed $V_1 = 15V, V_2 = 20V$

B. With S_3 closed $V_1 = V_2 = 25V$

C. With S_1 and S_2 closed $V_1 = V_2 = 0$

D. With S_3 closed $V_1 = 30V, V_2 = 20V$

Answer: D

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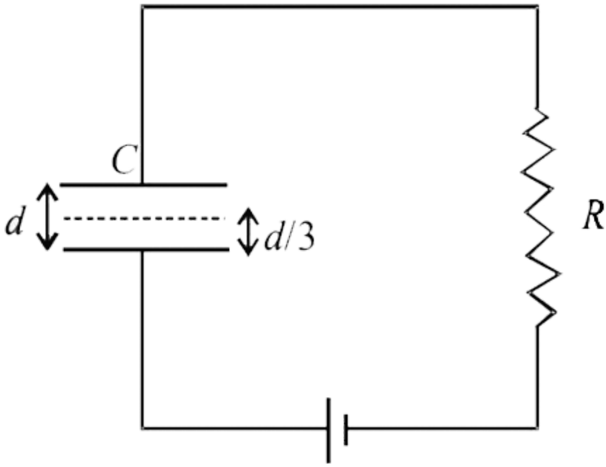
4. A parallel plate capacitor C with plates of unit area and separation d is filled with a liquid of dielectric constant $K = 2$. The level of liquid is $d/3$

initially. Suppose the liquid level decreases at a constant speed v, the time constant as a function of time t is-



A. $\dfrac{6 \in_0 R}{5d + 3vt}$

B. $\dfrac{(15d + 9vt) \in_0 R}{2d^2 - 3dvi - 9v^2t^2}$

C. $\dfrac{6 \in_0 R}{5d - 3vt}$

D. $\dfrac{(15d - 9vt)\varepsilon_0 R}{2d^2 + 3dvt - 9v^2t^2}$

Answer: A

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5. 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 one goes from 0 to $3d(1998)$.

A. the magnitude of the electric field remains the same

B. the direction of the electric field remains of the same

C. the electric potential increases continuously

D. the electric potential increases at first, then decreases and again increases

Answer: B,C

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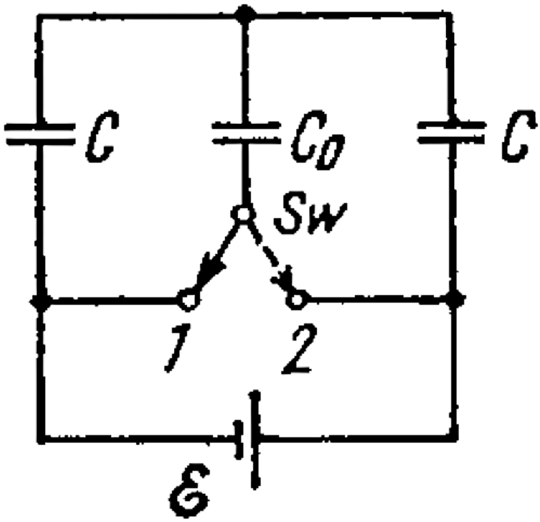
6. What amount of heat will be generated in the circuit shown in Fig. after the swich Sw is shifted from position 2 ?



A. $\dfrac{\varepsilon_0 C C_0}{(2C + C_0)}$

B. $\dfrac{\varepsilon^2 C C_0}{(C + C_0)}$

C. $\dfrac{\varepsilon^2 C C_0}{(C + 2C_0)}$

D. $\dfrac{2\varepsilon^2 C C_0}{(C + 2C_0)}$

Answer: A

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7. A parallel plate capacitor was lowered into water in a horizontal position, with water filling up the gap between the plates. The distance between the plates is d. Then a constant voltage V was applied to the capacitor. Find the water pressure increment in the gap. Dielectric constant of water is k.

A. $\Delta p = \dfrac{\varepsilon_0 (k-1) V^2}{2d^2}$

B. $\Delta p = \dfrac{\varepsilon_0 k (k-1) V^2}{2d^2}$

C. $\Delta p = \dfrac{\varepsilon_0 (k-1) V^2}{4d^2}$

D. $\Delta p = \dfrac{2\varepsilon_0 (k-1) V^2}{d^2}$

Answer: B

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8. The gap between the plates of a parallel plate capacitor is filled with glass of dielectric constant $k = 6$ and of specific resistivity $100 G\Omega m$. The capacitance of the capacitor is $4.0 mF$. When a voltage of $2.0 kV$ is applied to the capacitor, the leakage current of the capacitor will be.

A. $2.0 \times 10^{-6} A$

B. $3.0 \times 10^{-6} A$

C. $1.5 \times 10^{-3} A$

D. Zero

Answer: C

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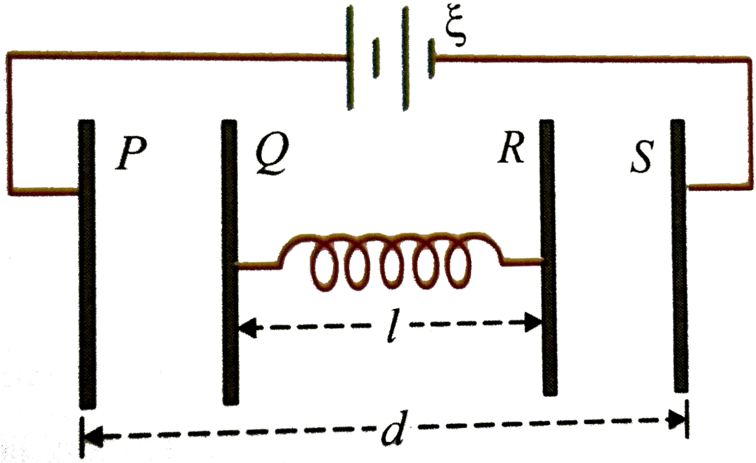
9. Two parallel plate capacitors with area A are connected through a conducting spring of natural length 1 in series as shown. Plates P and save fixed positions at separation d. Now the plates are connected by a battery of $emf \xi$ as shown. If the extension in the spring in equilibrium is equal to the separation between the plates, find the spring constant k.



A. $k = \frac{27}{8} \frac{A\varepsilon_0 \xi^2}{(d-l)^3}$

B. $k = \frac{27}{8} \frac{A\varepsilon_0 \xi}{(d-l)^3}$

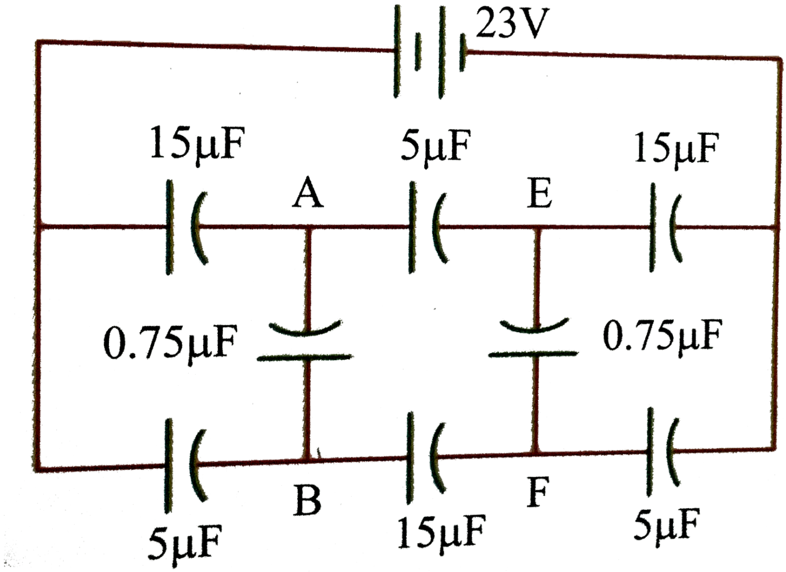
C. $k = \frac{28}{8} \frac{A\varepsilon_0 \xi}{(d-l)^3}$

D. $k = \frac{27}{8} \frac{A\varepsilon_0 \xi}{(d-l)^2}$

Answer: A

Watch Video Solution

10. The potential difference between the points A and B and that between E and F of the circuit shown in figure respectively are :



A. 5V,5V

B. 10V,5V

C. 15 V,5V

D. 0V,0V

Answer: A

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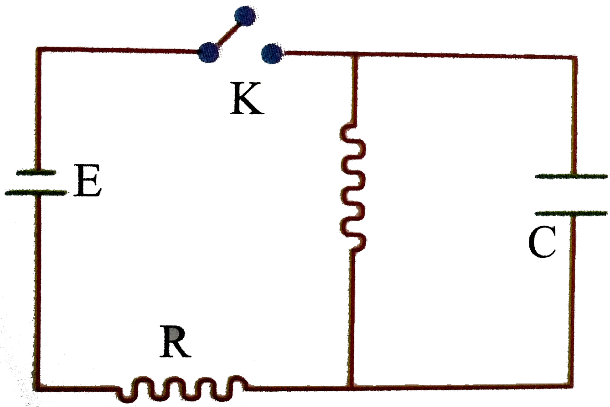
11. In the circuit shown in the diagram, E is the e.m.f of the cell, connected to two resistances. Each of magnitude R and a capacitor of capacitance C as shown in the diagram. If the switch key K is closed at time $t = 0$, the growth of potential V across the capacitor with be correctly given by



A. $V(t) = E\left[1 - \exp\left(-\frac{t}{RC}\right)\right]$

B. $V(t) = \frac{E}{2}\left[1 - \exp\left(-\frac{2t}{RC}\right)\right]$

C. $V(t) = E\left[1 - \exp\left(-\frac{2t}{RC}\right)\right]$

D. $V(t) = \frac{E}{2}\left[1 - \exp\left(-\frac{t}{RC}\right)\right]$

Answer: B

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12. A capacitor of capacitance C is given a charge Q. At $t = 0$,it is connected to an uncharged of equal capacitance through a resistance R. Find the charge on the second capacitor as a function of time.

A. $Q\left(1 - e^{-\frac{2t}{RC}}\right)$

B. $\frac{Q}{2}\left(1 - e^{-\frac{2t}{RC}}\right)$

C. $\frac{Q}{2}\left(1 - e^{-\frac{t}{RC}}\right)$

D. $Q\left(1 - e^{-\frac{t}{RC}}\right)$

Answer: B

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13. A capacitor of capacitance as C is given a charge Q. At $t = 0$,it is connected to an ideal battery of emf (ε)through a resistance R. Find the charge on the capacitor at time t.

A. $CEe^{-t/CR} + Qe^{-t/CR}$

B. $CE\left(1 - e^{-t/CR}\right) - Qe^{-t/CR}$

C. $CE\left(1 - e^{-t/CR}\right) + Qe^{-t/CR}$

D. $CE\left(1 - e^{-t/CR}\right)$

Answer: C

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14. A circuit consists of a source of a constant $emf\xi$ and a resistance R amd a capacitor with capacitance C connected in series. The internal resistance of the source is negligible. At a moment $t = 0$ the capacitance of the capacitor is abruply decreased η-fold. FInd the current flowing through the circuit as a function of time t.

A. $\frac{E}{R}(\eta - 1)e^{\frac{\eta t}{CR}}$

B. $\frac{E}{R}(\eta - 1)e^{\frac{t}{CR}}$

C. $\frac{E}{R}(\eta - 1)\left(1 - e^{-\frac{\eta t}{CR}}\right)$

D. $\frac{E}{R}(\eta-1)\left(1-e^{-\frac{t}{CR}}\right)$

Answer: A

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15. A parallel plate capacitor of plate area A and plate separation d is charged to potential difference V and then the battery is disconnected. A slab of dielectric constant K is then inserted between the plates of the capacitor so as to fill the space between the plates. If Q, E and W denote respectively, the magnitude of charge on each plate, the electric field between the plates (after the slab is inserted), and work done on the system, in question, in the process of inserting the slab, then

A. $Q=\frac{\varepsilon_0 AV}{d}$

B. $Q=\frac{\varepsilon_0 KAV}{d}$

C. $Q=\frac{V}{Kd}$

D. $Q=\frac{\varepsilon_0 AV^2}{2d}\left[1-\frac{1}{K}\right]$

Answer: A::C::D

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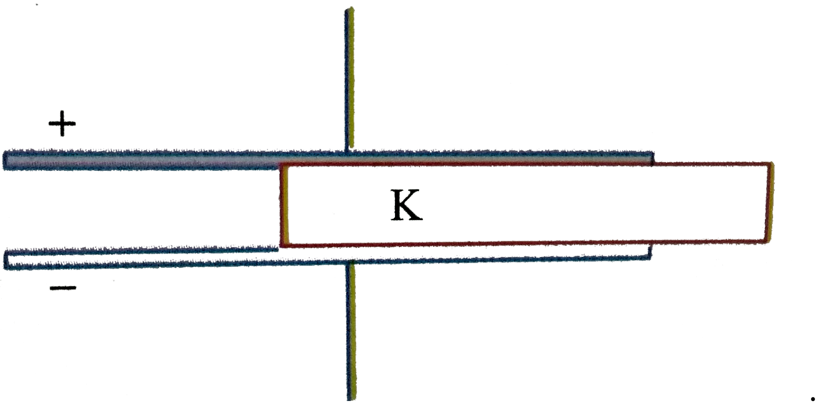
16. A parallel plate capacitor has smooth square plates of side "a". It is charged by a battery so that, the charge density becomes σ. After charging, the battery is disconnected. Now a smooth dielectric slab of length a which can fill the space between the plates is introduced between the plates from one side between the plates.



A. The slab can execute SHM between the plates.

B. The plate can execute oscillatory motion which is not SHM

C. The magnitude of the force experienced by the slab is constant

D. The magnitude of the force experienced by the slab is not constant.

Answer: B::D

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17. The plates of a capacitor are connected to a source of $e.m.f 320V$. Between the platesm there are two dielectric slabs each of uniform thickness filling the whole space. One slab A is of thickness $4mm$ and dielectric constant 8. The other slab B is of thickness $3mm$ and dielectric constant 10.

A. The electric field intensity in A is $5 \times 10^4 N/C$

B. The electric field intensity in B is $4 \times 10^4 N/C$

C. The energy stored per unit area of the capacitor is $5.7 \times 10^{-4} J$.

D. The (induced) bound charge on B is more than in A.

Answer: A::B::C::D

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18. The plates of a capacitor are connected to a source of emf and the energy stored is U_0. When dielectric material dielectric constant K is introduced between the plates filling the whole space, the energy stored becomes U Now.

A. $U > U_0$

B. $U = U_0$

C. $U < U_0$

D. The electric field intensity between the plates is less after the dielectric material is introduced.

Answer: A

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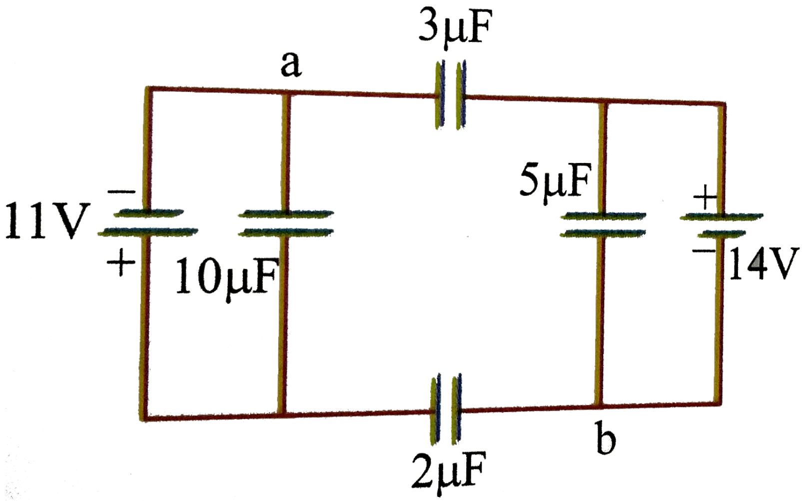
19. Four capacitors and two batteries are connected as shown in the diagram. If V_a and V_b denote the potentials of the points 'a' and 'b' then



A. $V_a - V_b = 15V$

B. $V_b - V_a = 4V$

C. $V_a - V_b = 4V$

D. $V_a - V_b = 10V$

Answer: C

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20. There are 10 identical capacitors each of capacitance C.

A. If all of them are connected in series, their equivalent capacitance is $C/10$

B. If all of them are connected in parallel, their equivalent capacitance is $10C$

C. If two series combinations each having 5 capacitors are connected in parallel, their equivalent capacitance is $2C/5$

D. If they are connected as five parallel combinations each one having two capacitors in series, their equivalent capacitance is $5C/2$.

Answer: A::B::C::D

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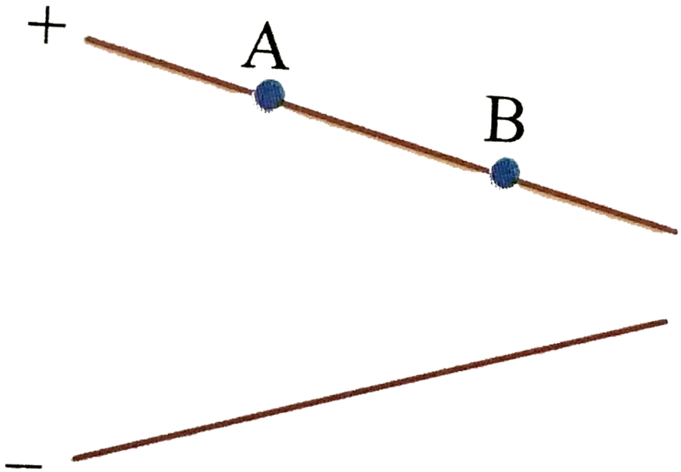
21. The plates of a parallel plate capacitor are charged by a battery and the battery is disconnected after the charging. Now, the plates are placed as shown in the figure. Then (plates are not parallel to each other).



A. the surface charge density is greater at point A

B. the surface charge density is greater at point B

C. the potential at points A and B is same

D. the potential at point A is greater

Answer: A::C::D

View Text Solution

22. Select the correct statements (s).

A. Capacitance of a capacitor depends on the charge on it.

B. Capacitance of a capacitor does not depend on the charge on it.

C. Capacitance of a capacitor does not depend on the potential difference

D. Capacitance of a capacitor does not depend on the material with which the capacitor plates are prepared.

Answer: B::C::D

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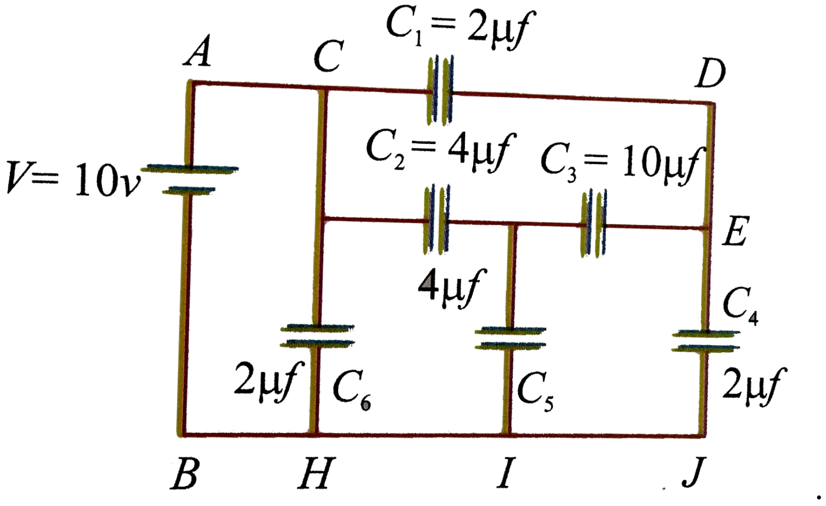
23. In the given circuit, find the charge on C_1, C_2, C_3, C_4 and C_5. A battery is connected as shown in the figure.



Select of correct options.

A. The charge on $C_1 = 10\mu C$

B. The charge on $C_2 = 20\mu C$

C. The charge on $C_3 = zero$

D. The charge on $C_4 = 10\mu C$

Answer: A::B::C::D

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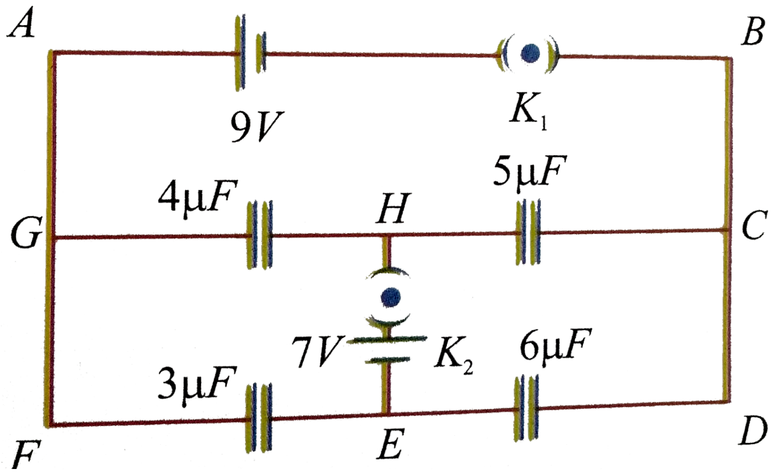
24. In the given circuit, K_1 and K_2 are open initially and the capacotors are uncharged, After K_1 and K_2 are closed and steady state is attained. Now answer the following questions.



The charge on $4\mu F$ capacitor is :

A. $8\mu c$

B. $35\mu c$

C. $6\mu c$

D. zero

Answer: A

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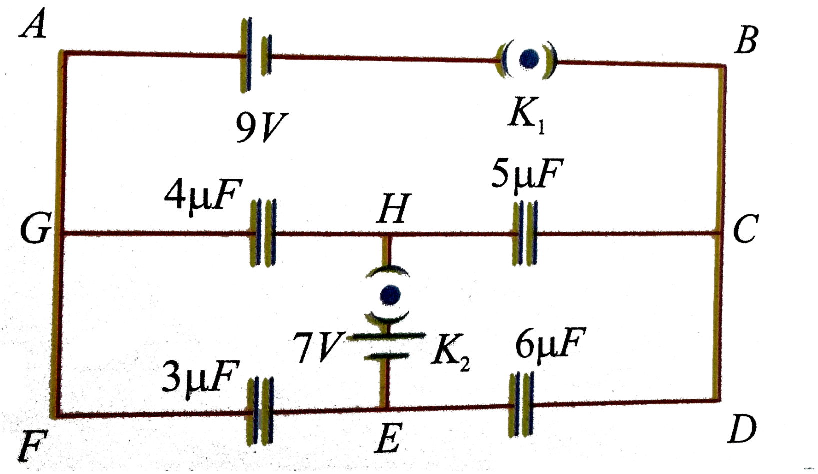
25. In the given circuit, K_1 and K_2 are open initially and the capacotors are uncharged, After K_1 and K_2 are closed and steady state is attained. Now answer the following questions.



The charge on $5 \mu c$ capacitor is :

A. $8 \mu c$

B. $35 \mu c$

C. $6 \mu c$

D. zero

Answer: B

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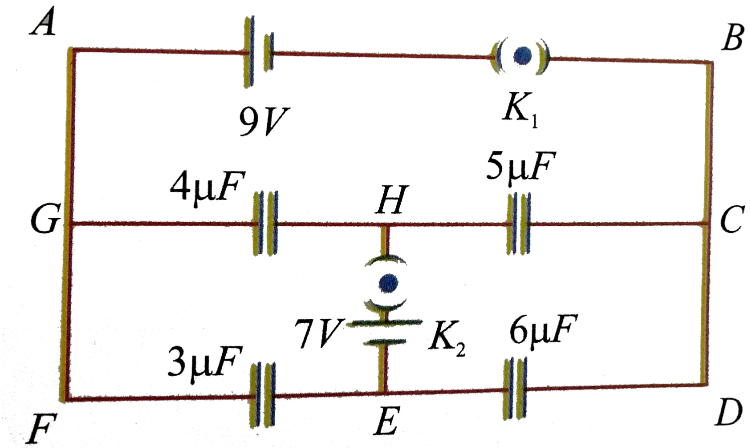
26. In the given circuit, K_1 and K_2 are open initially and the capacotors are uncharged, After K_1 and K_2 are closed and steady state is attained. Now answer the following questions.



The charge in $3\mu F$ capacitor is :

A. $8\mu c$

B. $35\mu c$

C. $27\mu c$

D. zero

Answer: C

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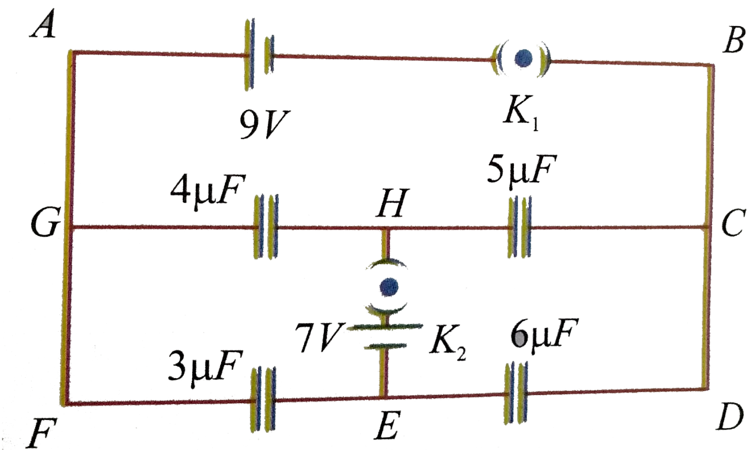
27. In the given circuit, K_1 and K_2 are open initially and the capacotors are uncharged, After K_1 and K_2 are closed and steady state is attained. Now answer the following questions.



The charge on $6\mu F$ capacitor is :

A. $8\mu c$

B. $35\mu c$

C. $6\mu c$

D. zero

Answer: D

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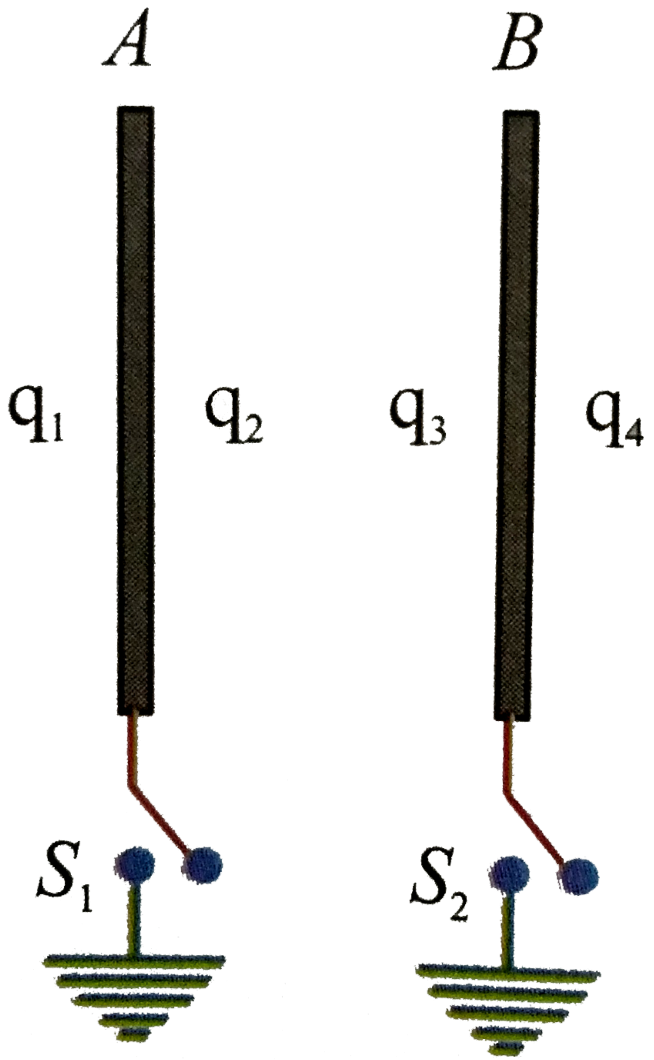
28. In Figure the plate A has $100\mu C$ charge, while the plate B has $60\mu C$ charge.



When both switches are open, then.

A. $q_1 = 80\mu C$

B. $q_2 = 20\mu C$

C. $q_3 = -20\mu C$

D. $q_4 = 10 \mu C$

Answer: A::B::C

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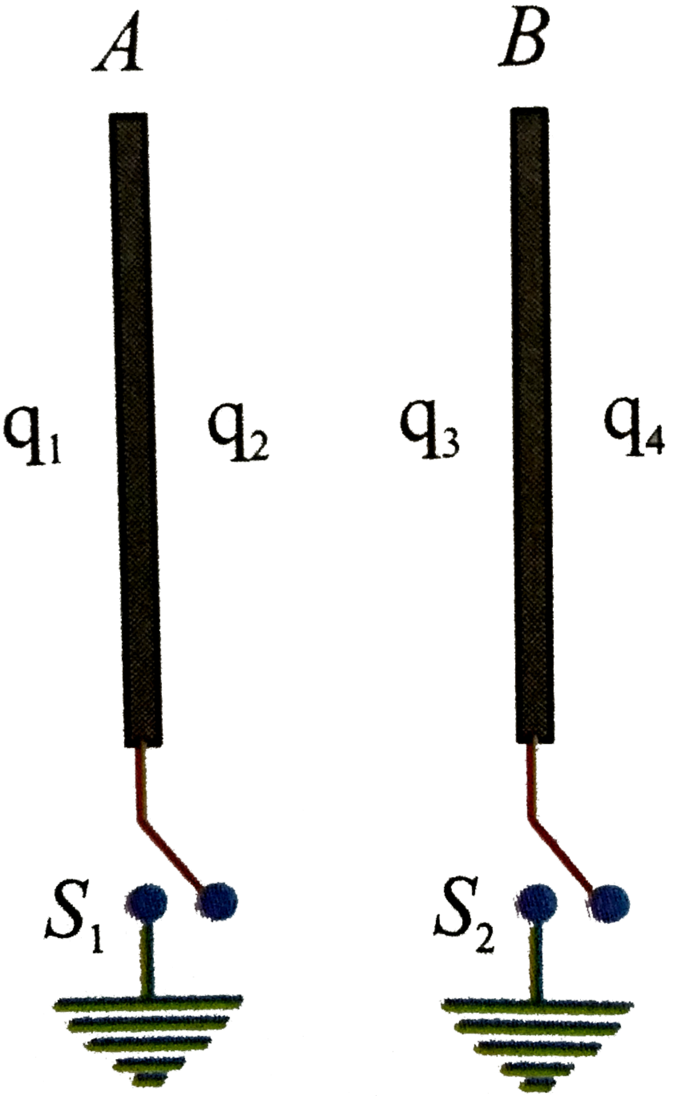
29. In Figure the plate A has $100 \mu C$ charge, while the plate B has $60 \mu C$ charge.



When only switch S_1 is closed , then

A. $q_1 = 10\mu C$

B. $q_2 = -60\mu C$

C. $q_3 = 50\mu C$

D. $q_4 = 10\mu C$

Answer: B

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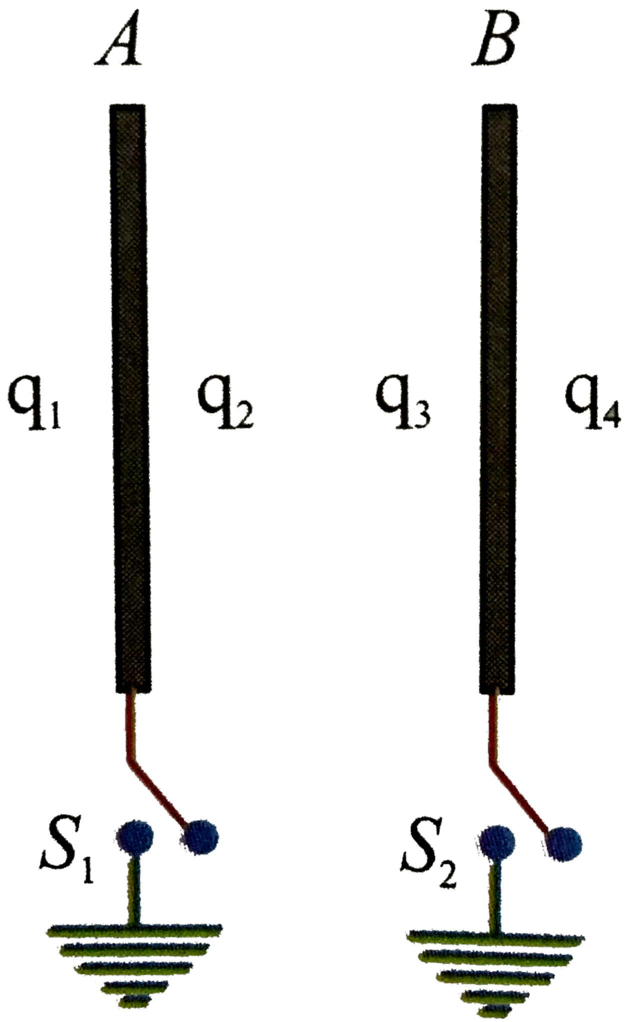
30. In Figure the plate A has $100\mu C$ charge, while the plate B has $60\mu C$ charge.



When switch S_2 is also closed, then.

A. $q_1 = 10 \mu C$

B. $q_2 = -60 \mu C$

C. $q_3 = 0 \mu C$

D. $q_4 = 10\mu C$

Answer: C

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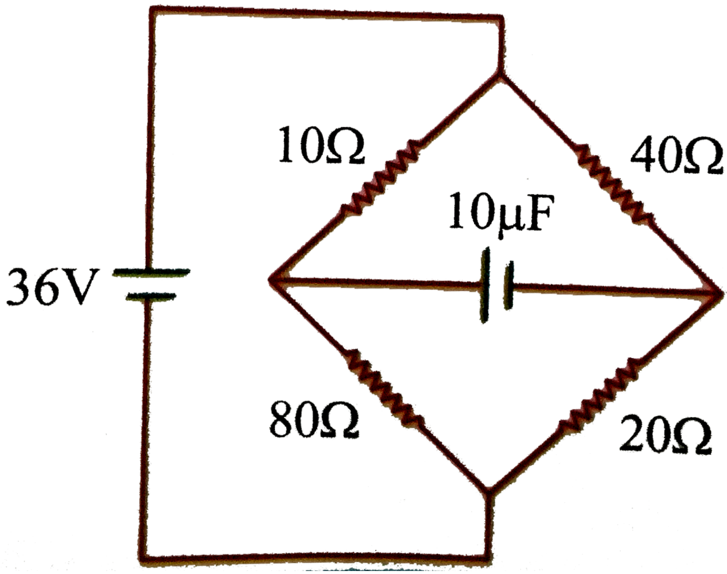
31. In the fig. shown the circuit is in steady state.



what is the potential difference across the capacitor in steady state ?

A. 5 V

B. 10 V

C. 20 V

D. 40 V

Answer: C

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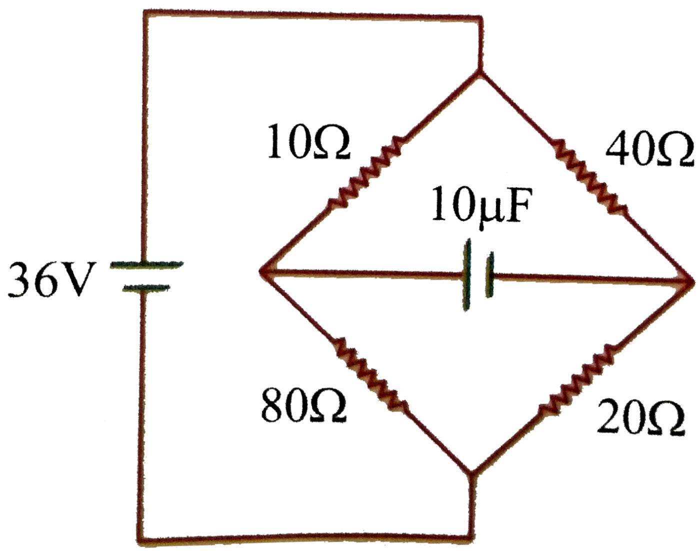
32. In the fig. shown the circuit is in steady state.



If the battery is disconnected give the capacitor charge as a function of time.

A. $Q = 200e^{-3t/10}$

B. $Q = 200e^{-3t/1000}$

C. $Q = 200e^{-3t}$

D. $Q = 100e^{-3000t}$

Answer: B

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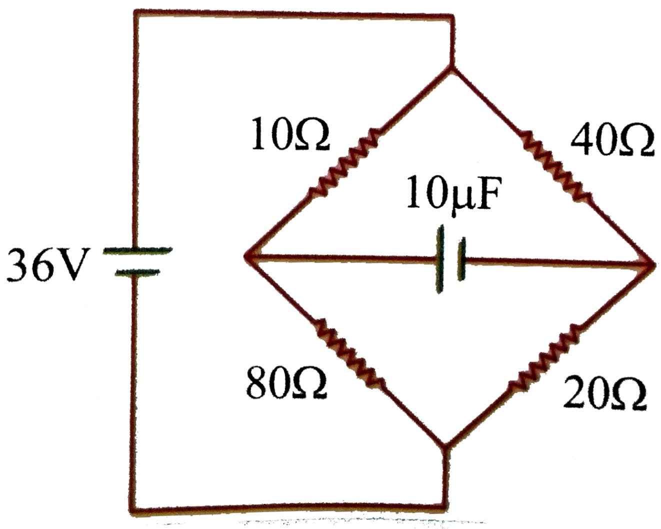
33. In the fig. shown the circuit is in steady state.



How long does it take for the capacitor to discharge until the potential difference across it becomes $1V$?

A. $1766.1\mu s$

B. $333.34\mu s$

C. $1000\mu s$

D. $333.34s$

Answer: C

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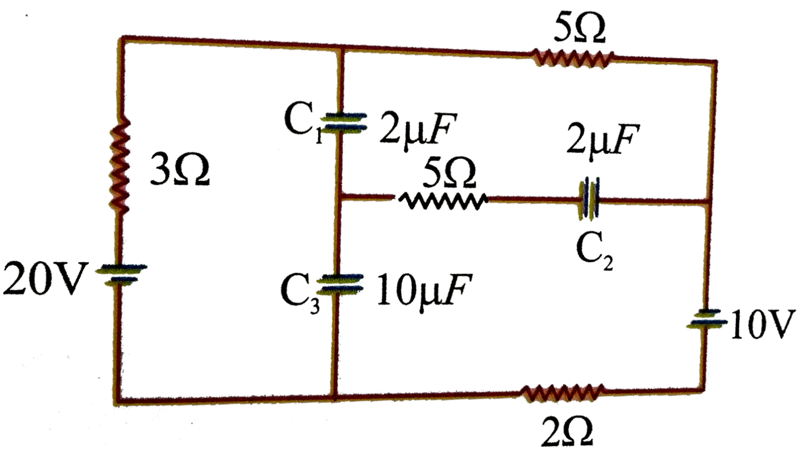
34. In the circuit shown in figure. The charge on capacitor C_2 in steady state is $10^x \mu C$. Find the value of x.



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35. The electric field between the plates of a parallel-plate capacitor of capacitance$2.0(\mu)F$ drops to one third of its initial value in $(4.4\mu)s$ when the plates are connected by a thin wire. Find the resistance of the wire.

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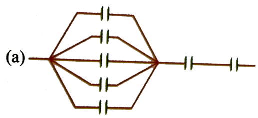
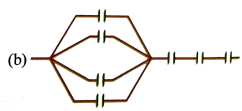
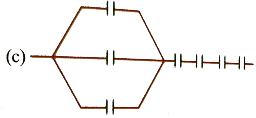
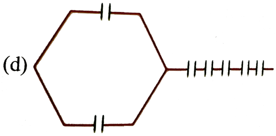
Level-VI

1. Seven capacitors each of capacitance $2\mu F$ are to be connected in a configuration to obtain an effective capacitance of $\left(\frac{10}{11}\right)\mu F$. Which of the combination (s) shown in figure will achieve the desired result?

A. 

B. 

C. 

D. 

Answer: A

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2. 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 ismilarly charged to a potential difference 2V. The charging battery is now disconnected and the capacitors are connected in parallel to each other in such a way that the poistive terminal of one is connected to the negative terminal of the other. The final energy of the configuration is

A. zero

B. $\frac{3}{2}CV^2$

C. $\frac{25}{6}CV^2$

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

Answer: B

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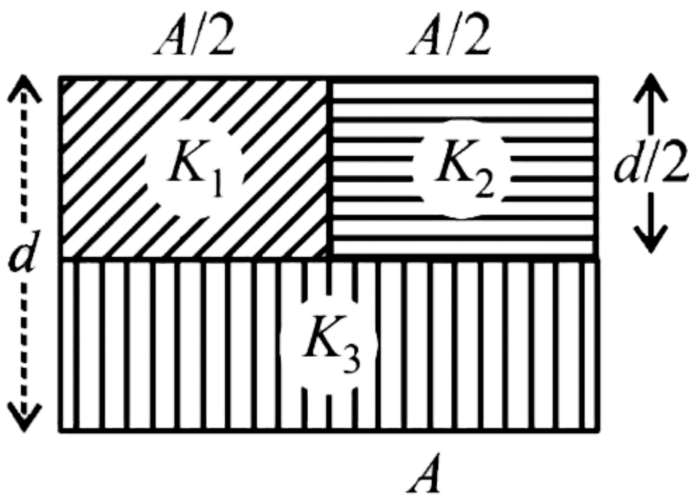
3. A parallel plate capacitor of area A, plate separation d and capacitance C is filled with three different dielectric materials having dielectric constants k_1, k_2 and k_3 as shown. If a isngle dielectric material is to be used to have the same capacitance C in this capacitor, then its dielectic constant k is given by



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. $\frac{1}{K} = \frac{K_1 K_2}{K_1 + K_2} + 2K_3$

D. $K = \frac{K_1 K_3}{K_1 + K_3} + \frac{K_2 K_3}{K_2 + K_3}$

Answer: D

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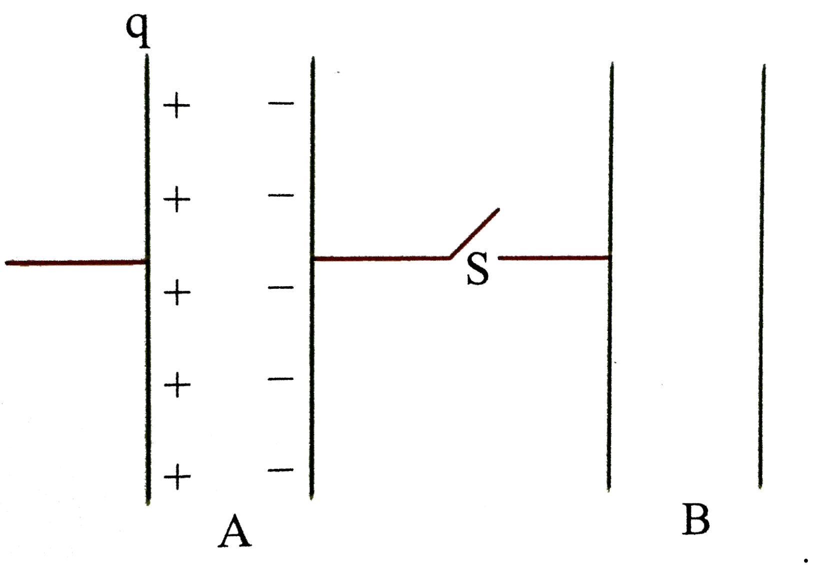
4. Consider the situation shown in the figure. The capacitor A has a charge q on it whereas B is uncharged. The charge appearing on the capacitor B a long 7 time after the switch is closed is :



A. zero

B. $q/2$

C. q

D. q

Answer: A

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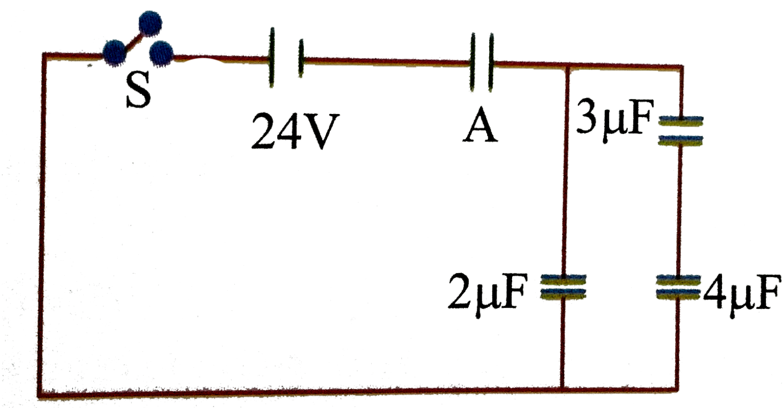
5. Four capacitor and a battery of $emf 24V$ are connected as shown in the figure. Initially, S is open and the capacitors are uncharged. After S is closed and steady state is attained, the potential difference across the $4\mu f$ capacitor is $7.5V$. The capacitance in μf of the capacitor A is.



A. 5

B. 7

C. 8

D. 10

Answer: D

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

A. $\frac{1}{4}C\left(V_1^2 - V_2^2\right)$

B. $\frac{1}{4}C\left(V_1^2 + V_2^2\right)$

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

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

Answer: C

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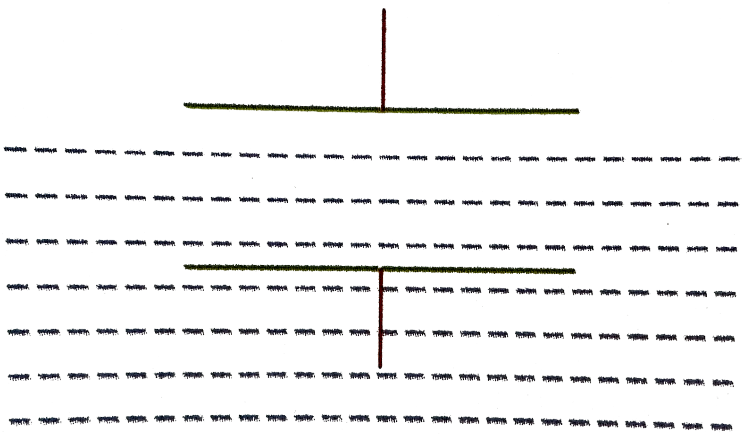
7. A parallel plate capacitor is located horizontally, so that one of its plates is submerged into liquid while the other is over the surface. The dielectric constant of the liquid is equal to k. Its density is equal to ρ. To what height will the level of the liquid in the capacitor rise after its plates gets a charge of surface density σ ?



A. $h = \dfrac{(k^2 - 1)\sigma^2}{2\varepsilon_0 k^2 \rho g}$

B. $h = \dfrac{(k - 1)\sigma^2}{\varepsilon_0 k \rho g}$

C. $h = \frac{2(k-1)\sigma^2}{\varepsilon_0 k \rho g}$

D. $h = 0$

Answer: A

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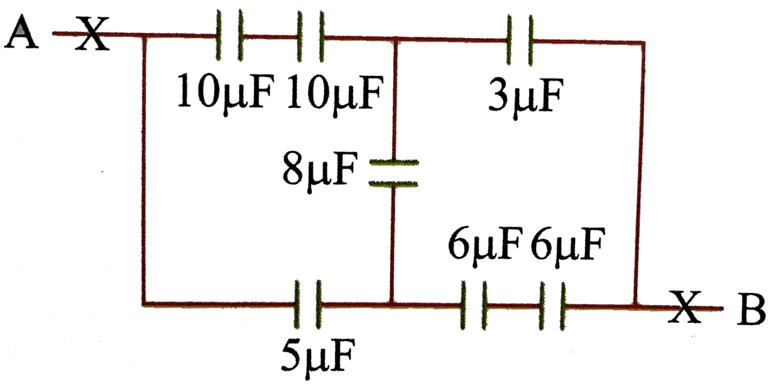
8. Seven capacitor are connected as shown in the figure.



The equivalent capacitance in μF between A and B is.

A. 3.75

B. 8.5

C. 10.25

D. 15

Answer: A

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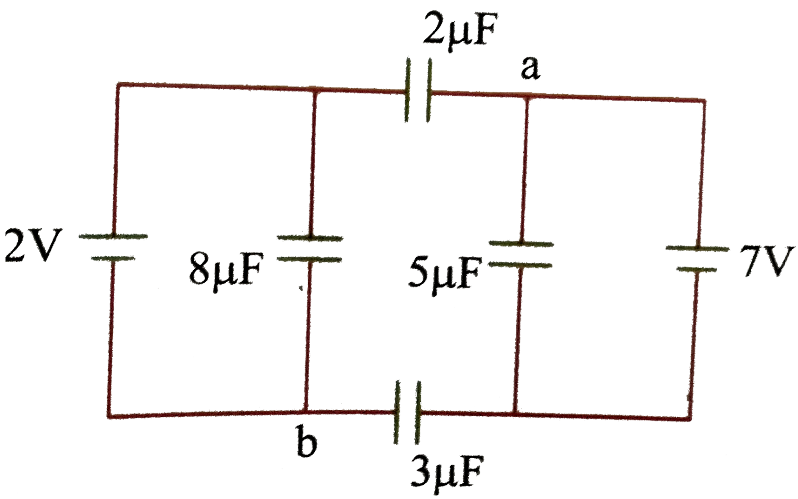
9. Four capacitors and two batteries are connected as shown in the diagram. The $p.\,d$ between the points a and b is



A. 22 V

B. 15 V

C. 13 V

D. 0 V

Answer: C

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10. A parallel plate air capacitor is connected to a battery. The quantities charge, voltage, electric field and energy associated with this capacitor are given by Q_0 , V_0, E_0 and U_0 respectively. A dielectric slab is now introduced to fill the space between the plates with battery still in connection. The corresponding quantities now given by Q, V, E and U are related to the previous one as

A. $Q > Q_0$

B. $V > V_0$

C. $E > E_0$

D. $U > U_0$

Answer: A::D

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11. A parallel plate capacitor is charged and the charging battery is then disconnected. If the plates of the capacitor are moved farther apart by means of insulating handles:

A. the charges on the capacitor increases

B. the voltage across the capacitor increases

C. the capacitance increases

D. the electrostatic energy stored in the capacitor increases.

Answer: B::D

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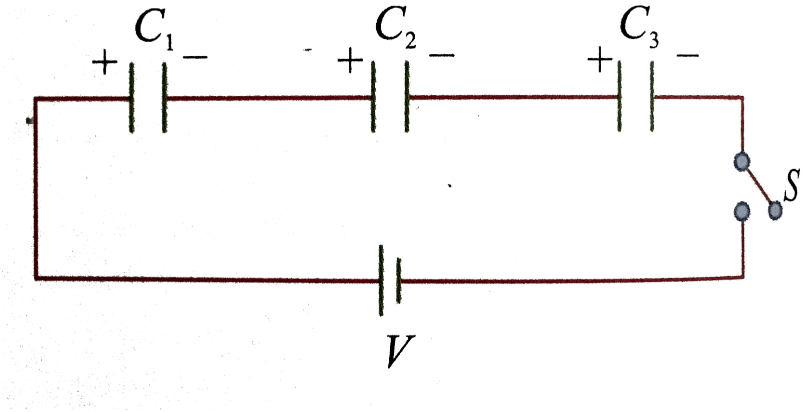
12. Three parallel plate capacitors $C_1 = 4\mu F, C_2 = 2\mu F, C_3 = 6\mu F$ with respective charges $q_1 = 20\mu C, q_2 = 10\mu C, q_3 = 5\mu C$ are connected in series with a battery of $emf 10V$ through an open switch as shown. Now the switch is closed and steady state is reached.



A. The final charge on $C_1 = 30\mu C$

B. The final charge on $C_2 = 20\mu C$

C. The final charge on $C_2 = zero$

D. The final charge on $C_3 = 15\mu C$

Answer: A::C::D

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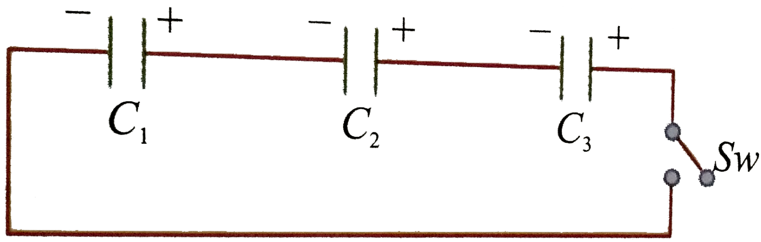
13. Three parallel plate capacitors $C_1 = 4\mu F, C_2 = 2\mu F, C_3 = 6\mu F$ with respective charges $q_1 = 20\mu C, q_2 = 10\mu C, q_3 = 5\mu C$ are connected in series with a battery of $emf 10V$ through an open switch as shown. Now the switch is closed and steady state is reached.



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A. The final charge on $C_1 = \frac{210}{11} \mu C$

B. The final charge on $C_2 = \frac{120}{11} \mu C$

C. The final charge on $C_2 = zero$

D. The final charge on $C_3 = \frac{45}{11} \mu C$

Answer: A::B::D

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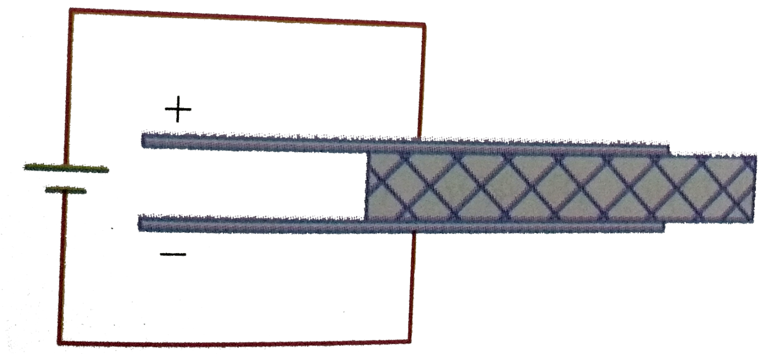
14. A parallel plate capacitor has smooth square plates of side "a". It is connected to battery of $emf. V$. Now a smooth dielectric slab of length a which can fill the space between the plates is introduced between the plates from one side as shown in the figure. Now



A. The slab can execute SHM between the plates.

B. The plates can execute oscillatory motion which in not SHM

C. The magnitude of the force experienced by the slab is constant

D. The magnitude of the force experienced by the slab is not constant.

Answer: B::D

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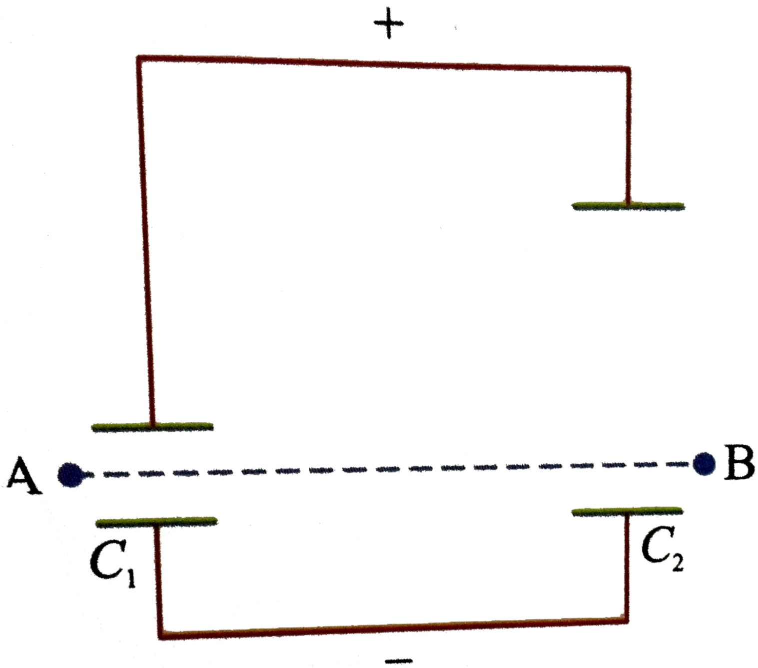
15. Two parallel-plate capacitors with different distances between the plates are connected in parallel to a voltage source. A point positive charge is moved from a point A, that is exactly in the middle between the plates of a capacitor C_1 to a point B(or a capacitor C_2 that lies at a distance from the negative plate of C_2 equal to half the distance between the plates of C_1) During this process of moving the charge.



A. The potential at A is greater than point at B

B. The potential at A is less than potential at B

C. The work done to move that point positive charge from A to B is greater than zero.

D. The work done to move the point positive charge from A to B is zero.

Answer: B::C

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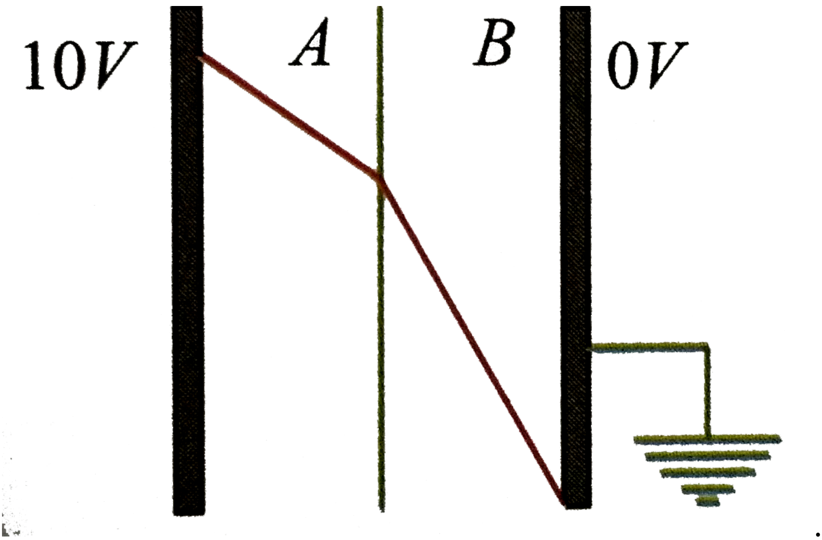
16. A parallel-plate capacitor is filled with a dielectric upto one-half of the distance between the plates. The manner in which, the potential between the plates varies is illustrated in the figure



A. The electroc field strength is greater in part A

B. The electric field strength is greater in part B

C. Dielectric slab fills the space of part A

D. Dielectric slab fills the space of part B

Answer: B::C

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17. A capacitor of capacitance $2\mu F$ is initially connected to a battery of emf 10 volt and steady state is reached. Now, $10V$ battery is removed and another battery of emf $20V$ is connected with like polarities together. Find the amount of heat energy developed (after the steady state is reached).

A. $10^{-4}J$

B. $2 \times 10^{-4}J$

C. $3 \times 10^{-4}J$

D. Zero

Answer: A

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18. Solve the above problem, if $20V$ battery is connected with unlike polarities together.

A. $4 \times 10^{-4} J$

B. $9 \times 10^{-4} J$

C. $2 \times 10^{-4} J$

D. $10^{-4} J$

Answer: B

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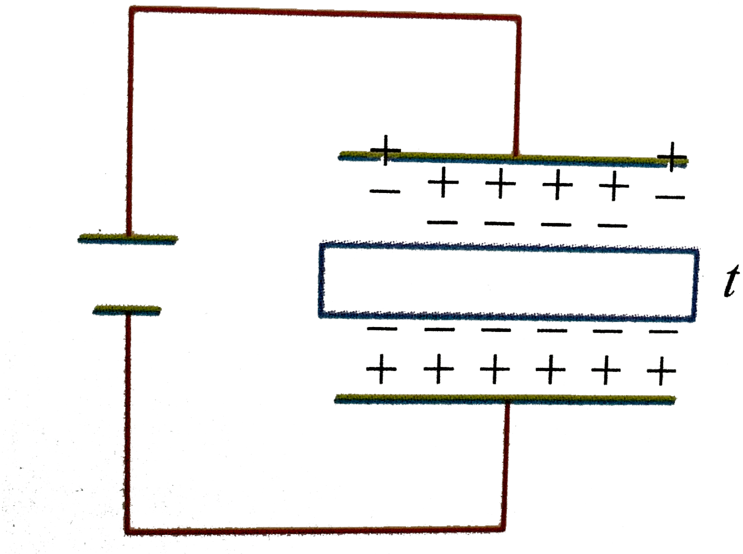
19. A conducting slab is in between a parallel plate capacitor. The thickness of the slab is t. The distance between the plates is $d(d > t)$. A battery of emf 'v' volt is connected across the plates (see diagram). The system attains steady state. Now select the correct options.



A. The electric field inside the conducting slab is zero.

B. The charge density induced on the surface of the slab should be equal to the charge density on the plates of the capacitor.

C. The electric field inside the slab always be zero, whatever be the metal with which the slab is prepared.

D. The capacitance of the capacitor is increased after the introduction of the slab.

Answer: A::B::C::D

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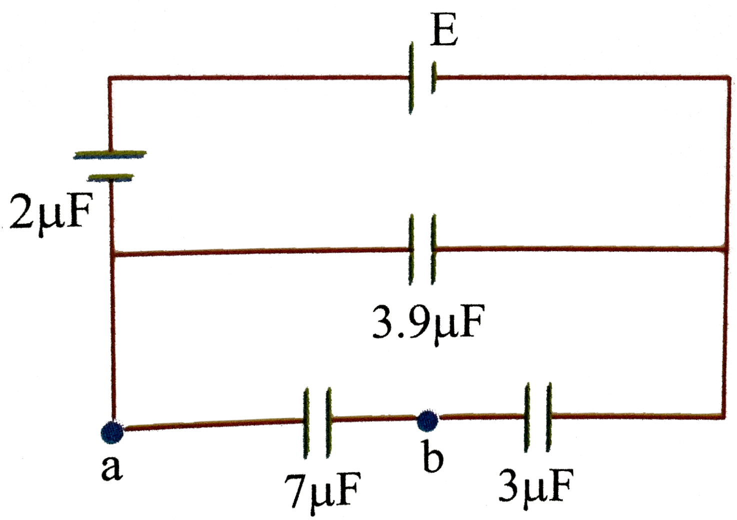
20. In the circuit shown in the figure four capacitors are connected to a battery. The $p.\ d$ across the $7\mu F$ capacitor is $6V$.



A. The p.d across the $12\mu F$ capacitor is $10V$

B. The charge on the $3\mu F$ capacitor is $42\mu C$

C. The p.d across $3.9\mu F$ capacitor is $10V$

D. The emf of the battery is $30V$

Answer: A::B::D

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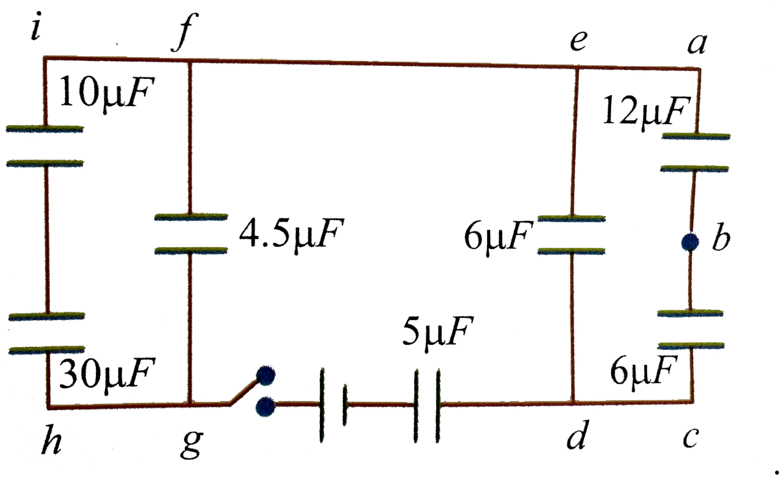
21. In the circuit diagram shown here seven capacitors are connected to a source of emf E. Initially, the switch S is closed and steady state attained. Now, the potential difference between the points 'a' and 'b' is 4 volt. Now, answer the following :



The emf E of the battery is :

A. 46 V

B. 26 V

C. 14 V

D. 10 V

Answer: A

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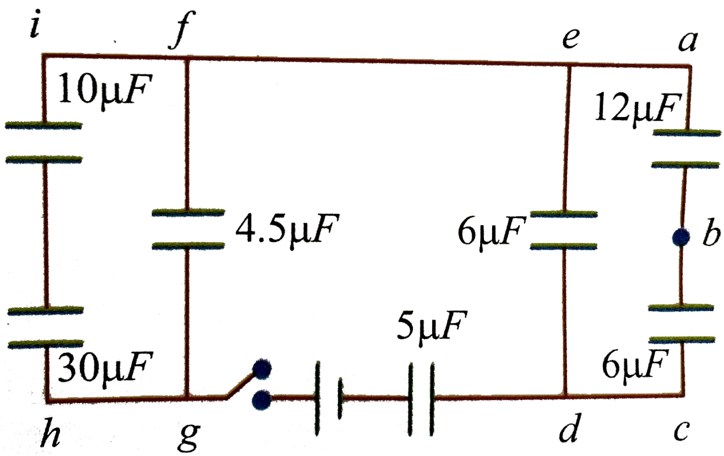
22. In the circuit diagram shown here seven capacitors are connected to a source of emf E. Initially, the switch S is closed and steady state attained. Now, the potential difference between the points 'a' and 'b' is 4 volt. Now, answer the following :



The charge on $4.5\mu F$ is :

A. $90\mu C$

B. $45\mu C$

C. $54\mu C$

D. Zero

Answer: B

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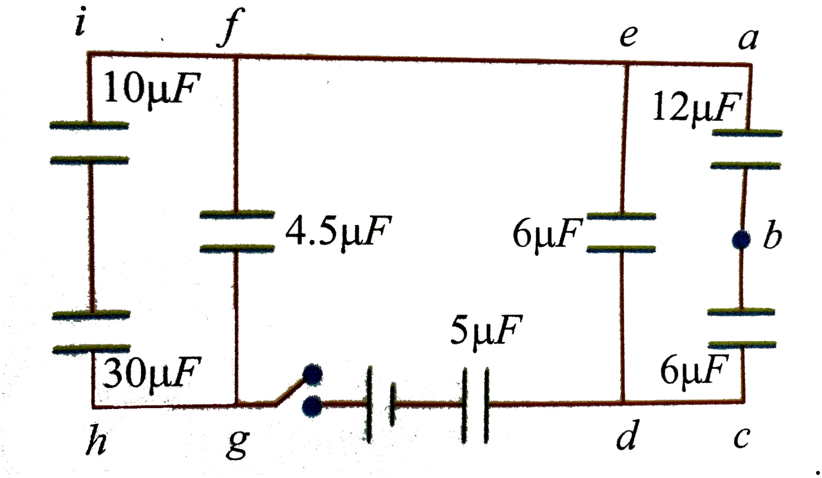
23. In the circuit diagram shown here seven capacitors are connected to a source of emf E. Initially, the switch S is closed and steady state attained. Now, the potential difference between the points 'a' and 'b' is 4 volt. Now, answer the following :



The charge on $10\mu F$ is :

A. $70\mu c$

B. $45\mu c$

C. $75\mu c$

D. $120\mu c$

Answer: C

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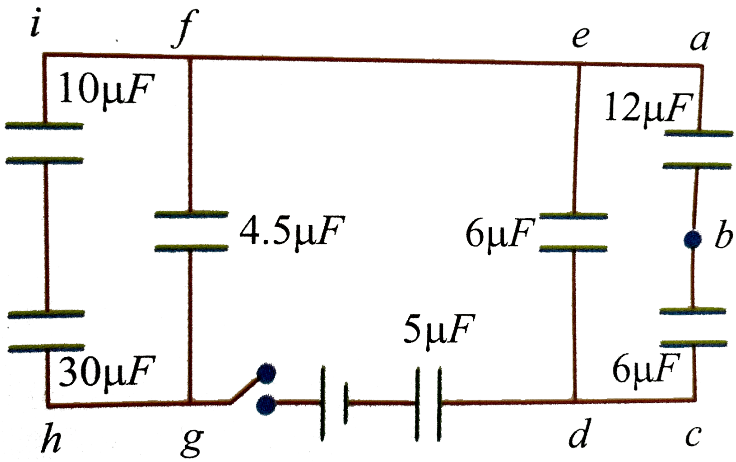
24. In the circuit diagram shown here seven capacitors are connected to a source of emf E. Initially, the switch S is closed and steady state attained. Now, the potential difference between the points 'a' and 'b' is 4 volt. Now, answer the following :



The charge on $5\mu C$ is :

A. $70\mu c$

B. $45\mu c$

C. $75\mu c$

D. $120\mu c$

Answer: D

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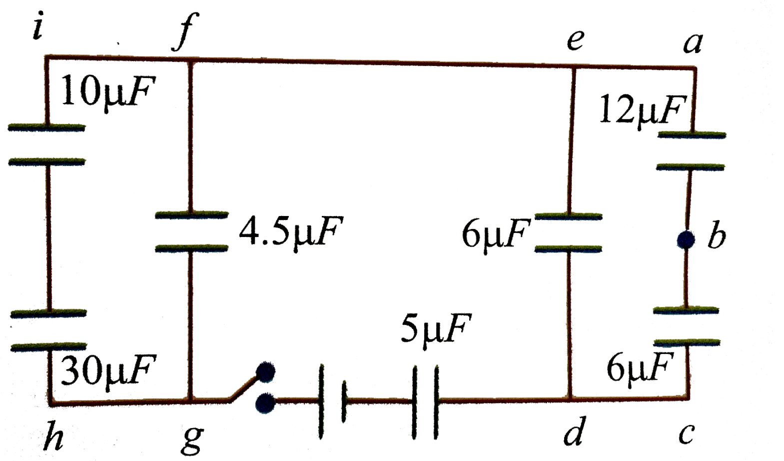
25. In the circuit diagram shown here seven capacitors are connected to a source of emf E. Initially, the switch S is closed and steady state attained. Now, the potential difference between the points 'a' and 'b' is 4 volt. Now, answer the following :



The charge on $12\mu F$ is :

A. $48\mu c$

B. $90\mu c$

C. $120\mu c$

D. $60\mu c$

Answer: A

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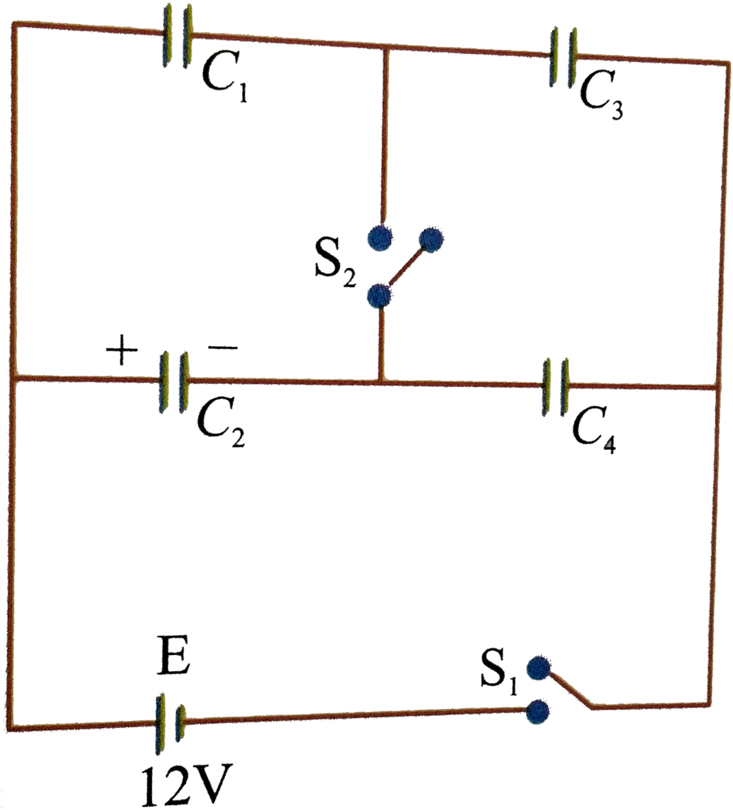
26. Four capacitors $C_1(=1\mu F), C_2(=2\mu F), C_3(=3\mu F)$ and $C_4(=4\mu F)$ are connected in a network as shown in the diagram. The emf of the battery is $E=12V$ and its internal resistance is negligible. The keys S_1 and S_2 can be independetly put on or off. Indicate the charge on the capacitors by q_1, q_2, q_3 and q_4 respectively and the potential drops across them by V_1, V_2, V_3 and V_4 respectively.



Initially both the keys are open. Then the key S_1 is closed. Then the charges on the capacitors are.

A. $q_1 = q_2 = 16\mu C, q_3 = q_4 = 9\mu C$

B. $q_1 = q_3 = 16\mu C, q_2 = q_4 = 9\mu C$

C. $q_1 = q_4 = 9\mu C, q_2 = q_3 = 16\mu C$

D. $q_1 = q_3 = 9\mu C, q_2 = q_4 = 16\mu C$

Answer: D

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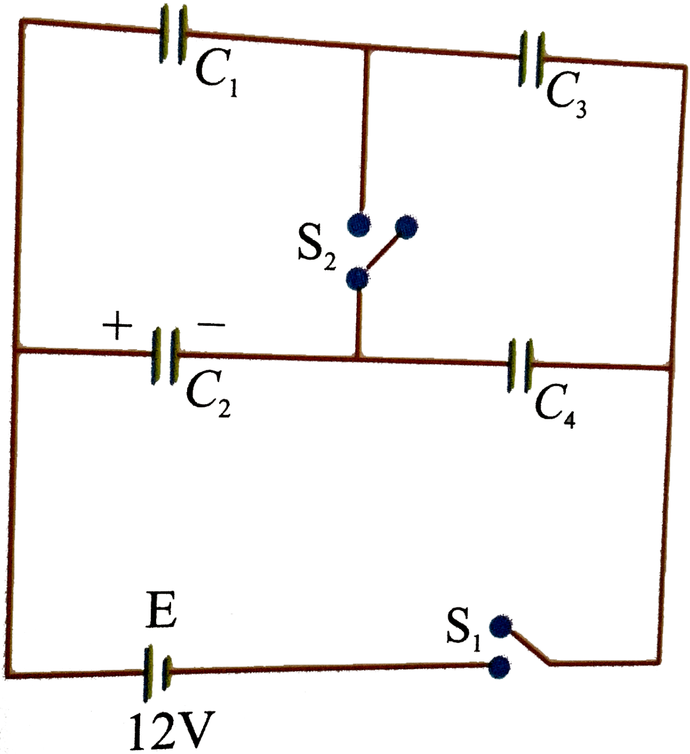
27. Four capacitors $C_1(=1\mu F), C_2(=2\mu F), C_3(=3\mu F)$ and $C_4(=4\mu F)$ are connected in a network as shown in the diagram. The emf of the battery is $E=12V$ and its internal resistance is negligible. The keys S_1 and S_2 can be independetly put on or off. Indicate the charge on the capacitors by q_1, q_2, q_3 and q_4 respectively and the potential drops across them by V_1, V_2, V_3 and V_4 respectively.



Initially key S_2 is closed. Then the key S_1 is now closed. Then the charges on the capacitors are.

A. $q_1 = q_2 = 24\mu C, q_3 = q_4 = 12\mu C$

B. $q_1 = q_2 = 12\mu C, q_3 = q_4 = 24\mu C$

C. $q_1 = 10.8\mu C, q_2 = 14.4\mu C, 3q_3 = 2q_4, 2q_4 = 25.2\mu C$

D. $2q_1 = q_2 = 16.8\mu C, 4q_3 = 3q_4 = 43.3\mu C$

Answer: D

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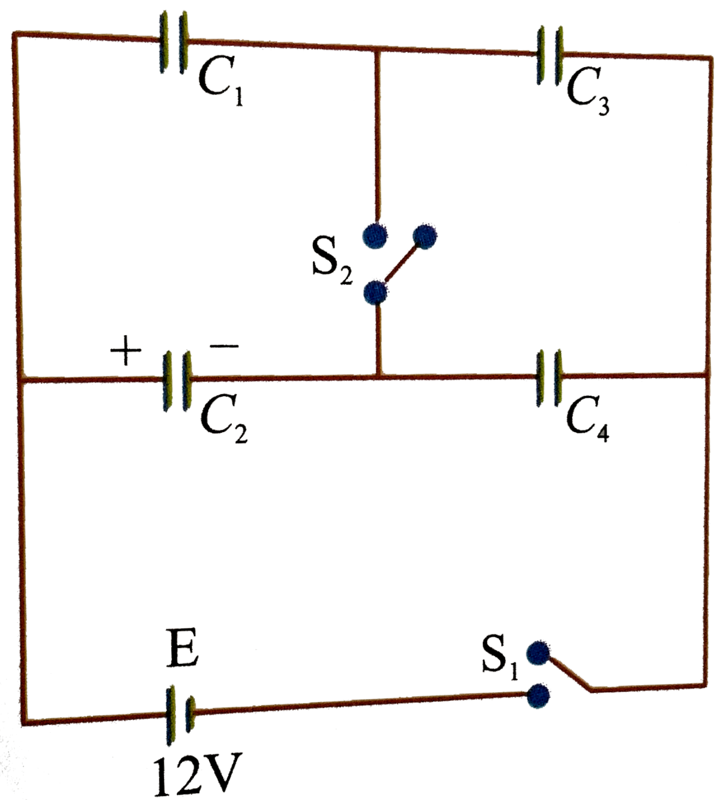
28. Four capacitors $C_1(=1\mu F), C_2(=2\mu F), C_3(=3\mu F)$ and $C_4(=4\mu F)$ are connected in a network as shown in the diagram. The emf of the battery is $E=12V$ and its internal resistance is negligible. The keys S_1 and S_2 can be independetly put on or off. Indicate the charge on the capacitors by q_1, q_2, q_3 and q_4 respectively and the potential drops across them by V_1, V_2, V_3 and V_4 respectively.



Initially key S_2 is open. The key S_1 is closed and teh capacitors are charged. If now key S_2 be closed, the charge that will flow across this key is.

A. $2.4\mu C$

B. $0.4\mu C$

C. $0.2\mu C$

D. $1.2\mu C$

Answer: A

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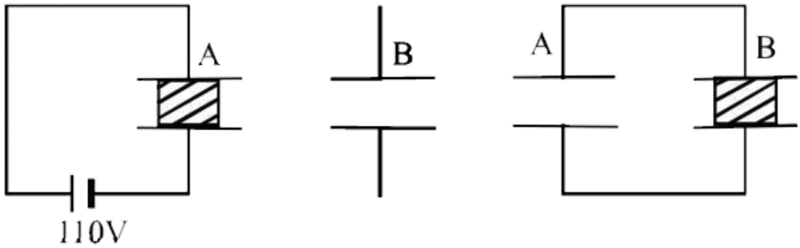
Subjective

1. Two parallel plate capacitors A and B have the same separation $d = 8.85 \times 10^{-4} m$ between the plates. The plate area of A and B are $0.04m^2$ and $0.02m^2$ respectively. A slab of dielectric constant (relative permittivity) $K = 9$ has dimensions such that it can exactly fill the space between the plates of capacitor B.



(i) The dielectric slab is placed inside. A as shown in figure (a). A is then charged to a potential difference of 110V. Calculate the capacitance of A and the energy stored in it.

The battery is disconnected and then the dielectric slab is moved from A. Find the work done by the external agency in removing the slab from A.

(iii) The same dielectric slab is now placed inside B, filling it completely, The two capacitors A and B are then connected as shown in figure(c). Calculate the energy stored in the system.

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2. Two square metal plates of side $1m$ are kept $0.01m$ apart like a parallel plate capacitor in air in such a way that one of their edges is perpendicualr to an oil surface in the a tank filled with an insulating oil. The plates are connected to a battery of emf $55V$. The plates are then lowered vertically into the oil at a speed of $0.001ms^{-1}$. Calculate the current drawn from the battery during the process.

(Dielectric constant of oil $= 11, \varepsilon_0 = 8.85 \times 10^{-12} N^{-1} m^{-2}$).

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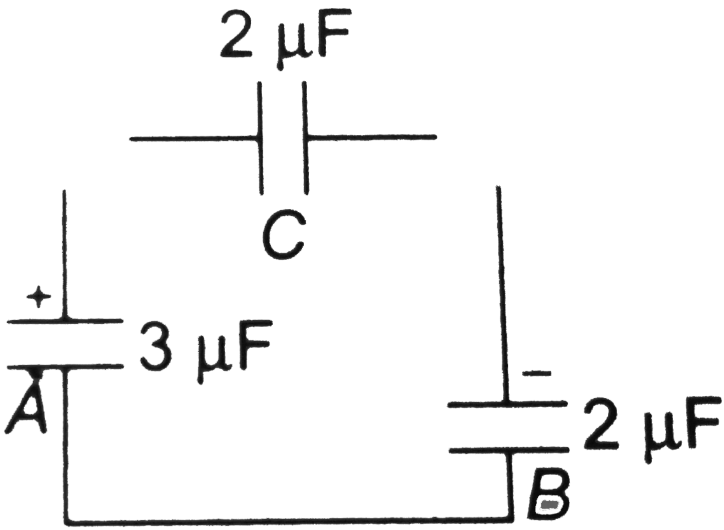
3. Two capacitors A and B with capacities $3\mu F$ and $2\mu F$ are charged to a potential difference of $100V$ and $180V$, respectively. The plates of the capacitors are connected as show in figure with one wire of each capacitor free. The upper plate of A is positive and that of B is negastive. An uncharged $2\mu F$ capcitor C with lead wires falls on the free ends to complete the circuit. Calculate

a. the final charge on the three capacitors.

b. the amount of electrostatic energy stored in the system before and after completion of the circuit.



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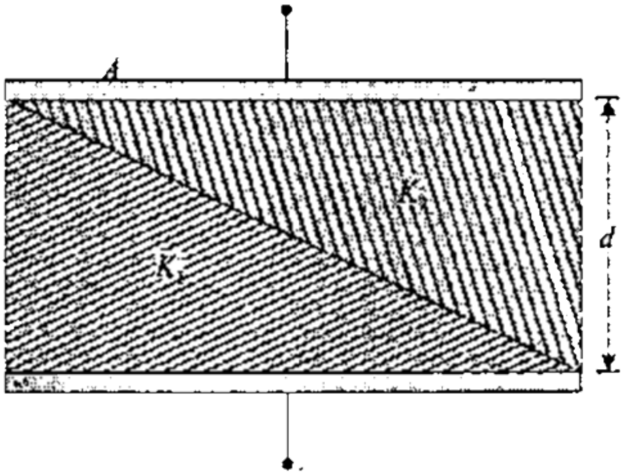
4. The capacitance of a parallel plate capacitor with plate area A and separation d is C. The space between the plates in filled with two wedges of dielectric constants K_1 and K_2 respectively. Find the capacitance of resulting capacitor.



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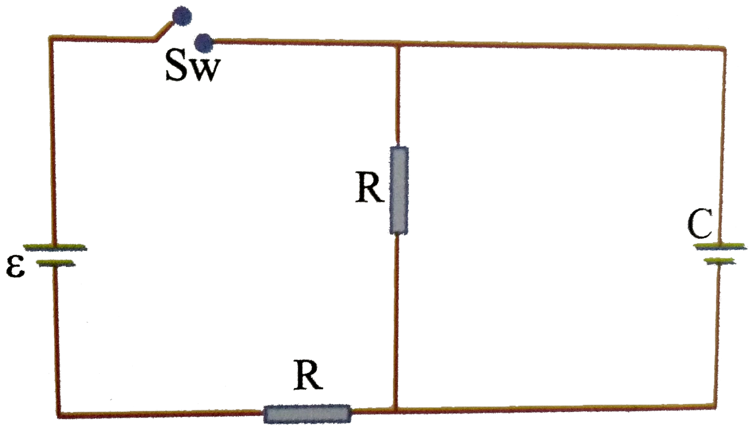
5. Find how the voltage across the capacitor C varies with time t after closing of the switch S_w at the moment $t = 0$.



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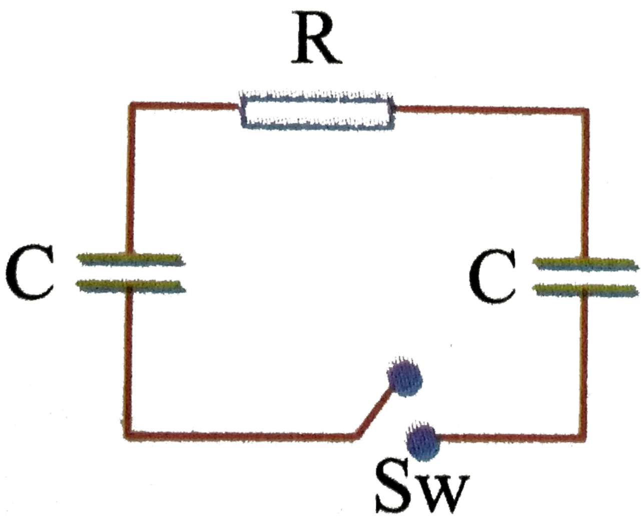
6. In the circuit shown, a capacitor charged to a potential difference V_0 is connected to an uncharged capacitor through a resistor at $t = 0$, by closing the switch. Find current in the circuit as function of time.



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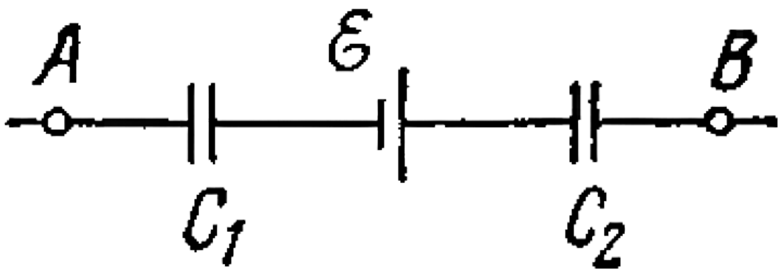
7. A circuit has a section Ab shown in fig. The emf of the source equals $E = 10V$, the capacitances are equal to $C_1 = 1.0\mu F$ and $C_2 = 2.0\mu F$, and the potential difference $\varphi_A - \varphi_B = 5.0V$. Find the voltage across each capacitor.



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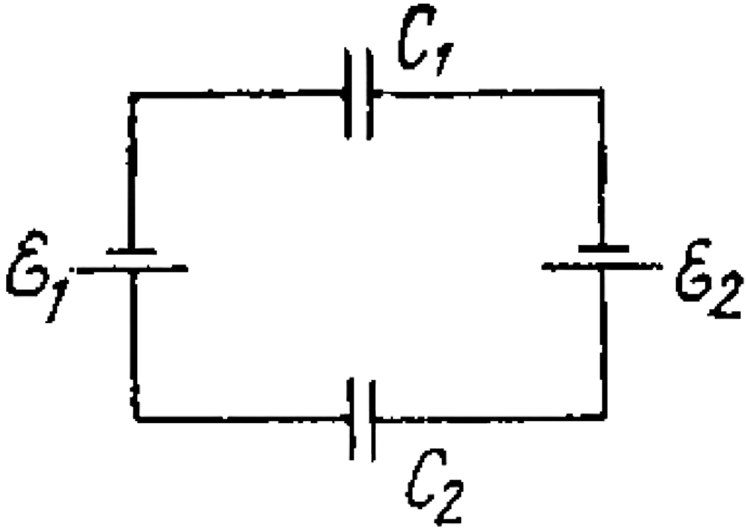
8. In a circuit shown in fig find the potentail difference between the left and right plates of each capacitor.



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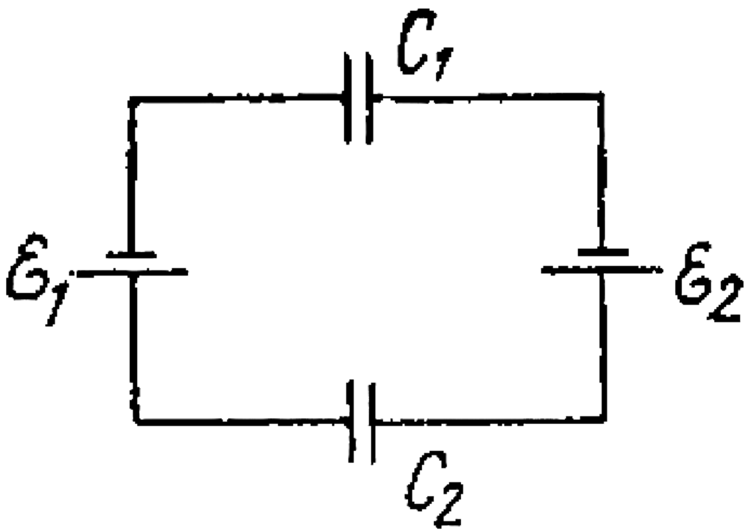
9. Find the charge of each capacitor in the circuit shown in Fig.



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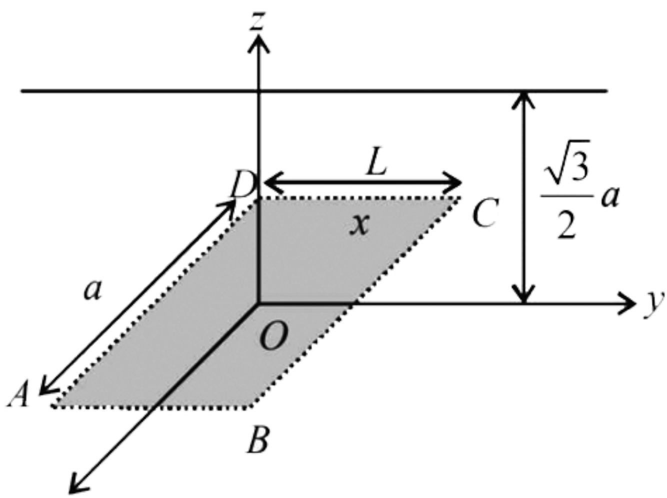
Previous IIT-JEE

1. An infinity long uniform line charge distribution of charge per unit length λ lies parallel to the y-axis in the $y-z$ plane at $z=\frac{\sqrt{3}}{2}$ a(see figure). If the magnitude of the flux of the electric field through the rectangular surface ABCD lying in the $x-y$ plane with its centre at the origin is $\frac{\lambda L}{\neq \psi lon_0}$ $(\varepsilon_0 =$ permittivity of free space), then the value of n is



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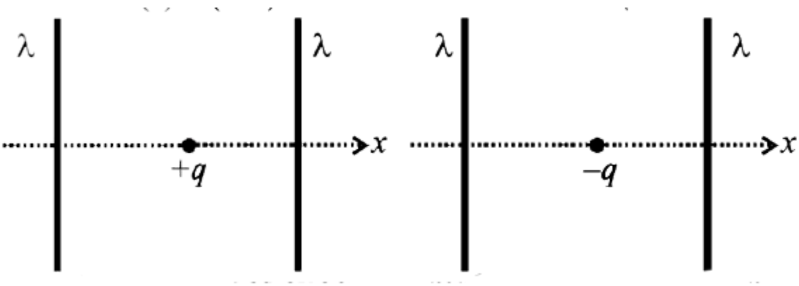
2. The figure below depict two situations in which two infinitely long static line charges of constant positive line charge density λ are kept parallel to each other. In their resulting electric field, point charges q and $-q$ are kept in equilibrium between them. The point charges are confined to move in the x direction only. If they are given a small displacement about their equilibrium positions, then the correct statement(s) is(are)



A. Both charges execute simple harmonic motion

B. Both charges will continue moving in the direction of their displacement

C. Charge $+q$ executes simple harmonic motion while charge $-q$ continues moving in the direction of its displacement.

D. Charge $-q$ executes simple harmonic motion while charge $+q$ continues moving the direction of its displacement.

Answer: C

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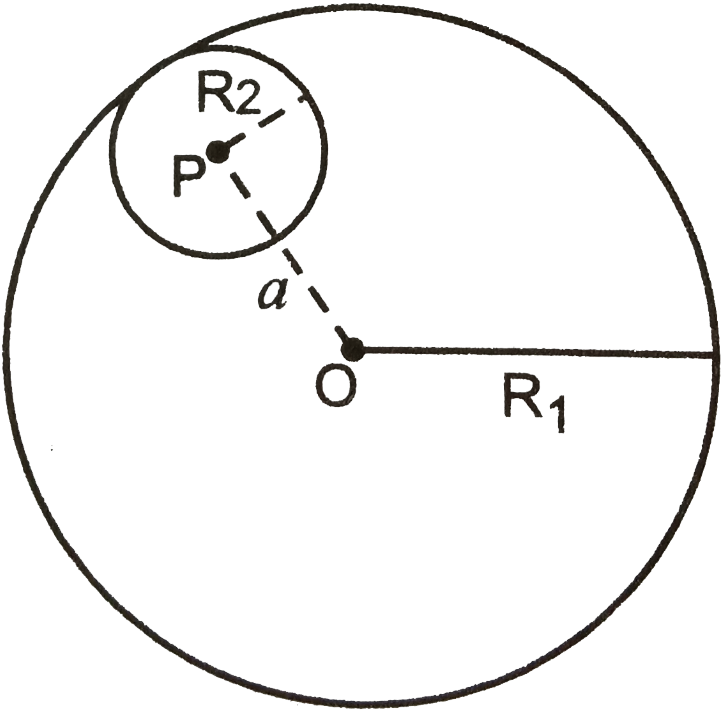
3. Consider a uniform spherical charge distribution of radius R_1 centred at the origin O. In this distribution a spherical cavity of radius R_2, centred at P with distance $OP = a = R_1 - R_2$ (fig) is made.If the electric field inside the cavity at position $\vec{r}$, then the correct statement is



A. $\vec{E}$ is uniform,its magnitude is independent of R_2 but its r direction depends on $\vec{r}$.

B. $\vec{E}$ is uniform, its magnitude depends on R_2 and its direction depends on $\vec{r}$

C. $\vec{E}$ us uniform, its magnitude is independent of a but its direction depends on $\vec{a}$.

D. $\vec{E}$ is uniform and both its magnitude and direction depend on $\vec{a}$.

Answer: D

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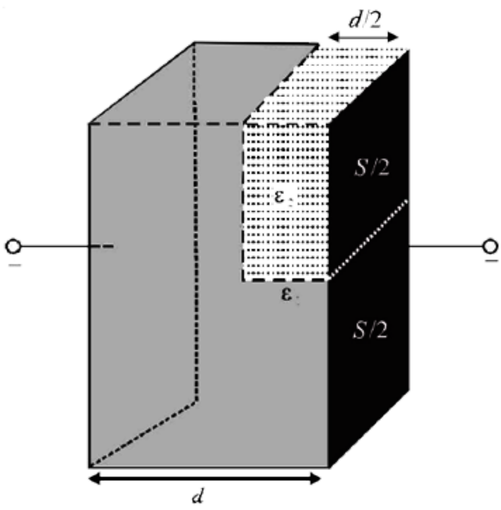
4. A parallel plate capacitor having plates of area S and plate separation d, has capacitance C_1 in air. When two dielectrics of different relative primitivities ($\varepsilon_1 = 2$ and $\varepsilon_2 = 4$) are introduced between the two plates as shown in the figure, the capacitance becomes C_2. The ratio $\frac{C_2}{C_1}$ is



A. $6/5$

B. $5/3$

C. $7/5$

D. $7/3$

Answer: D

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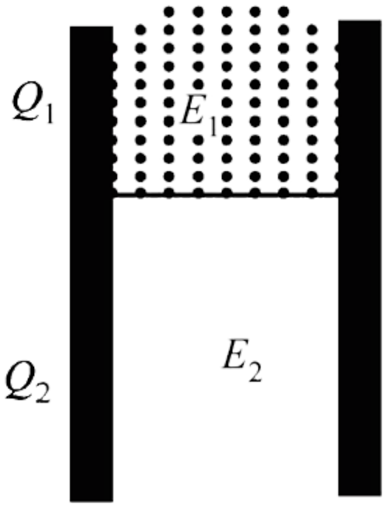
5. A parallel plate capacitor has a dielectric slab of dielectric constant K between its plates that covers $1/3$ of the area of its plates, as shown in the figure. The total capacitance of the capacitor is C while that of the portion with dielectric in between is C_1. When the capacitor is charged, the plate area covered by the dielectric gets charge Q_1 and the rest of the area gets charge Q_2. The electric field in the dielectric is E_1 and that in the other portion is E_2. Choose the correct option/options, ignoring edge effects.



A. $\dfrac{E_1}{E_2} = 1$

B. $\dfrac{E_1}{E_2} = \dfrac{1}{K}$

C. $\dfrac{Q_1}{Q_2} = \dfrac{3}{K}$

D. $\dfrac{C}{C_1} = \dfrac{2+K}{K}$

Answer: A::D

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6. Let $E_1(r)$, $E_2(r)$ and $E_3(r)$ be the respectively electric field at a distance r from a point charge Q, an infinitely long wire with constant linear charge density λ, and an infinite plane with uniform surface charge density σ. If $E_1(r_0) = E_2(r_0) = E_3(r_0)$ at a given distance r_0, then

A. $Q = 4\sigma\pi r_0^2$

B. $r_0 = \dfrac{\lambda}{2\pi\sigma}$

C. $E_1(r_0/2) = 2E_2(r_0/2)$

D. $E_2(r_0/2) = 4E_3(r_0/2)$

Answer: C

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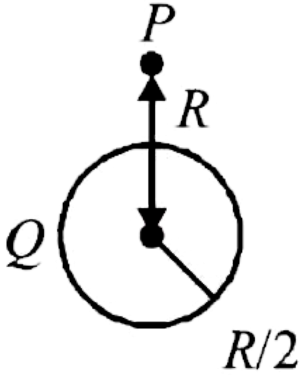
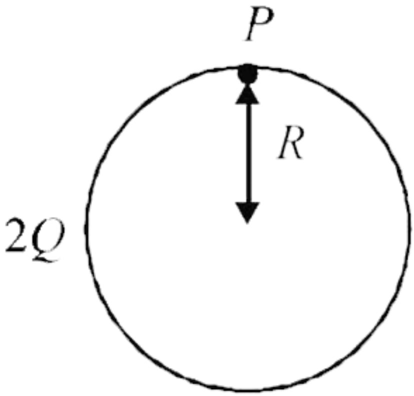
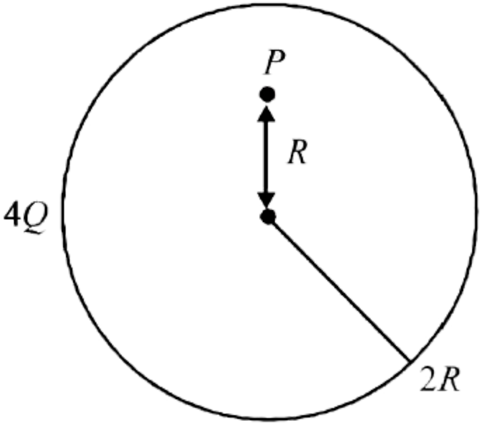
7. Charges Q, 2Q and 4Q are uniformly distributed in three dielectric solid spheres 1, 2 and 3 of radii $R/2$, R and 2R respectively, as shown in figure. If magnitude of the electric fields at point P at a distance R from the centre of sphere 1,2 and 3 are E_1, E_2 and E_3 respectively, then



Sphere 1



Sphere 2



Sphere 3

A. $E_1 > E_2 > E_3$

B. $E_3 > E_1 > E_2$

C. $E_2 > E_1 > E_3$

D. $E_3 > E_2 > E_1$

Answer: A

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8. Two non-conducting solid spheres of radii R and 2R, having uniform volume charge densities ρ_1 and ρ_2 respectively, touch each other. The net electric field at a distance 2R from the centre of the smaller sphere, along the line joining the centres of the spheres, is zero. The ratio $\frac{\rho_1}{\rho_2}$ can be

A. -4

B. $-\frac{32}{25}$

C. $\frac{32}{25}$

D. 4

Answer: B::D

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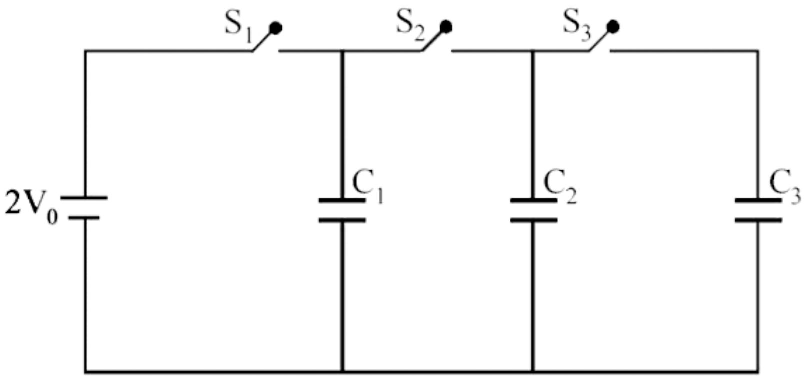
9. In the circuit shown in the figure, there are two parallel plate capacitors each of capacitance C. The switch S_1 is pressed first to fully charge the capacitor C_1 and then released. The switch S_2 is then pressed to charge the capacitor C_2. After some time, S_2 is released and then S_3 is pressed.

After some time



A. the charge on the upper plate of C_1 is $2CV_0$

B. the charge on the upper plate of C_1 is CV_0.

C. the charge on the upper plate of C_2 is 0.

D. the charge on the upper plate of C_2 is $-CV_0$.

Answer: B::D

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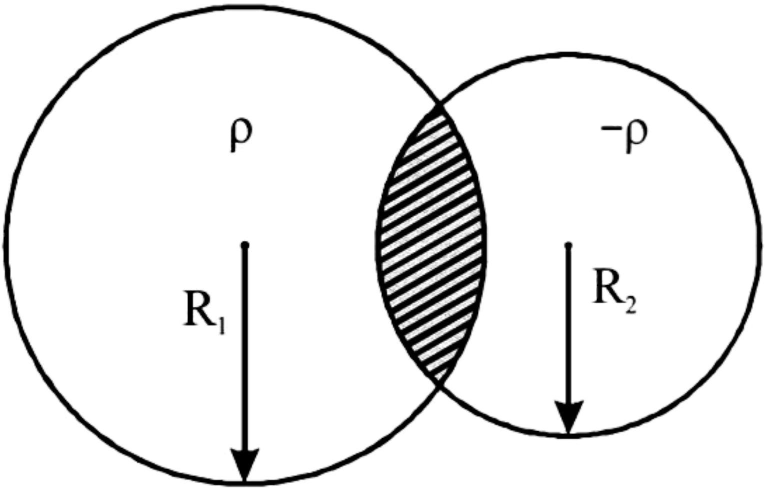
10. Two non-conducting spheres of radii R_1 and R_2 and carrying uniform volume charge densities $+\rho$ and $-\rho$, respectively, are placed such that they partially overlap, as shown in the figure. At all points in the overlapping region



A. the electrostatic field is zero

B. the electrostatic potential is constant

C. the electrostatic field is constant in magnitude

D. the electrostatic field has some direction.

Answer: C::D

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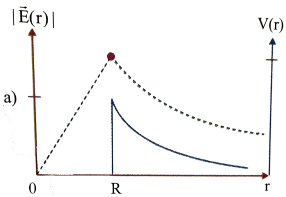
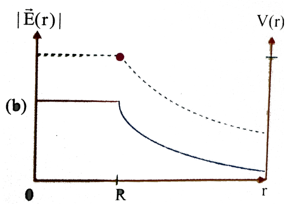
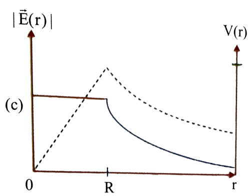
11. Conisder a thin spherical shell of radius R with centre at the origin, carrying uniform poistive surface charge denisty. The variation of the magnitude of the electric field $\left|\overrightarrow{E}(r)\right|$ and the electric potential V(r) with the distance r from the centre, is best represented by which graph?



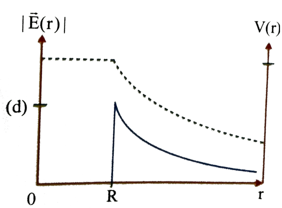
A.



B.



C.



D.

Answer: D

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12. Two large vertical and parallel metal plates having a separation of 1cm are connected to a DC voltage source of potential difference X. A proton is released at rest midway between the two plates. It is found to move at 45° to the vertical JUST after release. Then X is nearly

A. $1 \times 10^{-5} V$

B. $1 \times 10^{7} V$

C. $1 \times 10^{-9} V$

D. $1 \times 10^{-10} V$

Answer: C

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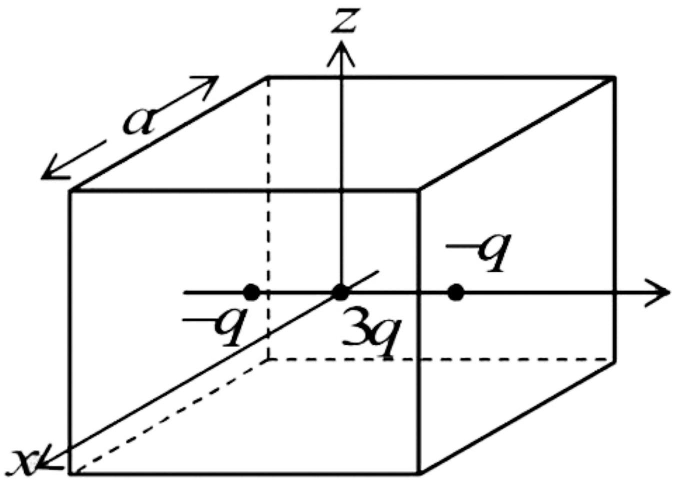
13. A cubical region of side a has its centre at the origin. It encloses three fixed point charges, $-q$ at $(0, -a/4, 0)$, $+3q$ at $(0, 0, 0)$ and $-q$ at $(0, +a/4, 0)$. Choose the correct options(s)



A. The net electric flux crossing the plane $x = a/2$

B. The net electric flux crossing the plane $y = +a/2$ is more than the net electric flux crossing the plane $y = -a/2$.

C. The net electric flux crossing the entire region is $\frac{q}{\varepsilon_0}$.

D. The net electric flux crossing the plane $z = +a/2$ is equal to the net electric flux crossing the plane $x = +a/2$.

Answer: A::C::D

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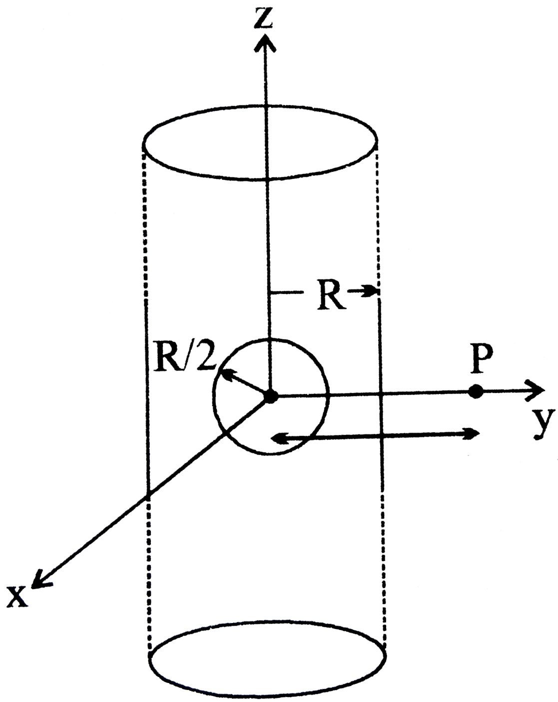
14. An infinitely long solid cylinder of radius R has a uniform volume charge density ρ. It has a spherical cavity of radius $R/2$ with its centre on the axis of cylinder, as shown in the figure. The magnitude of the electric field at the point P, which is at a distance $2R$ form the axis of the cylinder, is given by the expression $\frac{23rR}{16ke_0}$. The value of k is .



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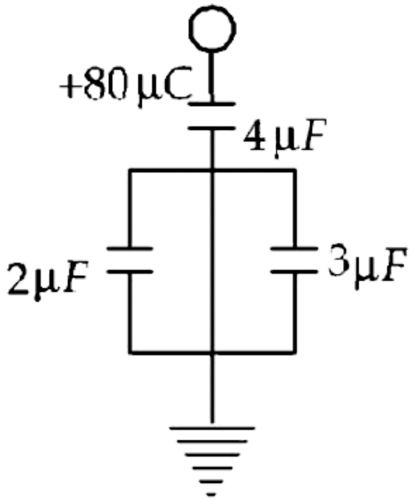
15. In the given circuit, a charge of $+80\mu C$ is given to the upper plate of the $4\mu F$ capacitor. Then in the steady state, the charge on the upper

plate of the $3\mu F$ capacitor is



A. $+32\mu C$

B. $+40\mu C$

C. $+48\mu C$

D. $+80\mu C$

Answer: C

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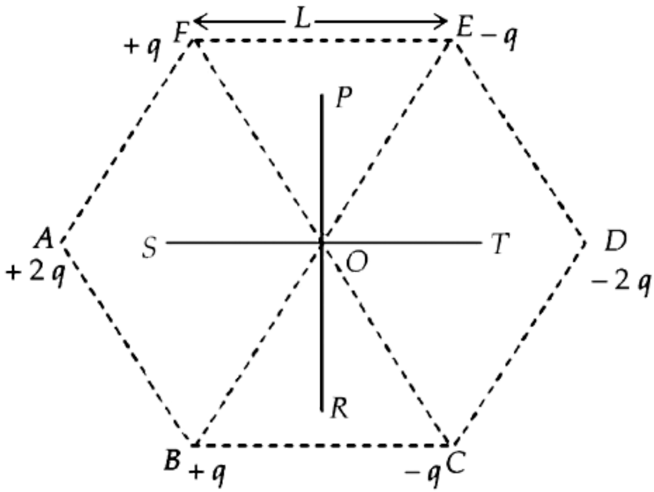
16. Six point charges are kept at the vertices of a regular hexagon of side L and centre O, as shown in the figure. Given that $K = \frac{1}{4\pi\varepsilon_0}\frac{q}{L^2}$, which of the following statements(s) is (are) correct?



A. The electric field at O is $6K$ along OD

B. The potential at O is zero

C. The potential at all points on the line PR is same

D. the point at all points on the line ST is same.

Answer: A::B::C

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