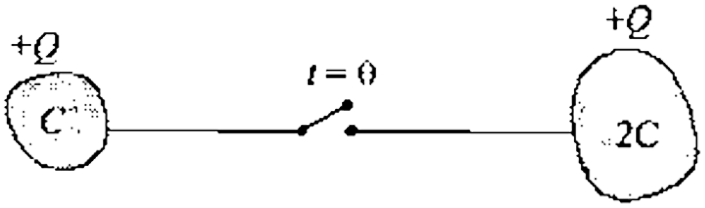
PHYSICS

BOOKS - GK PUBLICATIONS PHYSICS (HINGLISH)

CAPACITANCE

Illustration Type

1. There are two conductors of capacitance C and $2C$ are charged equally with charge $+Q$ each and connected with a thin conducting wire and a switch as shown in figure. Find the final charges on the conductors after closing the switch.



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2. Two isolated metallic solid spheres of radii R and 2R are charged such that both of these have same charge density σ. The spheres are located far away from each other and connected by a thin conducting wire. Find the new charge density on the bigger sphere.

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3. A radioavtive source in the form of a metal sphere of daimeter 10^{-3} m emits β-particles at a constant rate of 6.25×10^{10} particles per second. If the source is electrically insulated, how long will it take for its potential to rise by $1.0V$, assuming that $80\,\%$ of the emitted β-particles escape the socurce?

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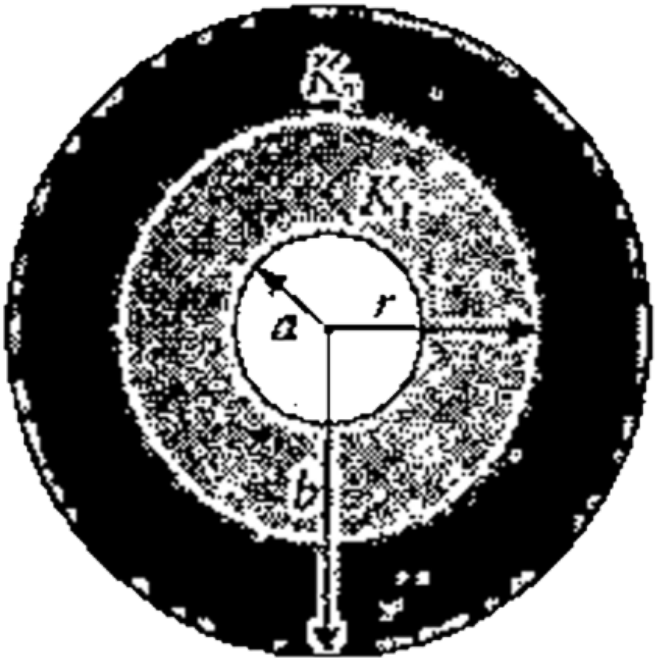
4. A capacitor is formed of two concentric spherical conducting shells ofradii a and b. If the medium between the spherical shells has a dielectric

constant K_1 from radius a to r and K_2 from radius r to b, find the capacitance of such a spherical capacitor shown in figure.



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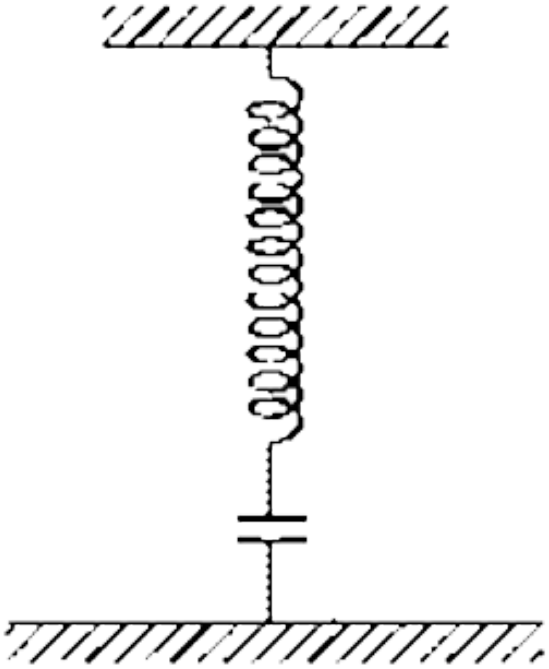
5. A parallel plate capacitor ils arrranged horizontally in a mechanical situation with the lower plate is fixed and the other connected with a perpendicular spring as shown in figure. The area of eachh plate is A and in equilibrium the distance between te plates is d_0. WHen the capacitor is

connected with a source of voltage V, a new equilibrium appears after some displacement in upper plate with the new distasnce between the plates d_1. Given that mass of the upper plate is m



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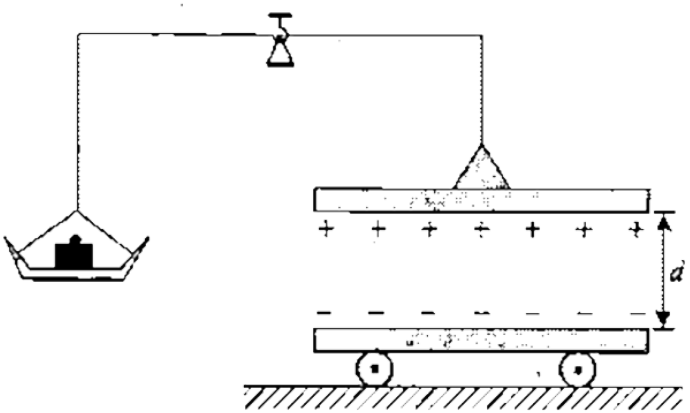
6. The lower plate of a parallel plate capacitor is fixed on an insulating plane as shown in figure. The upper plate is suspended from one end of a balance. Initially the capacitor is uncharged and balance is in equilibrium

state. A voltage V is applied between the plates, what additional weight should be placed to maintain the balance? Consider the separation between the plates to be d and the area of each plate is A.



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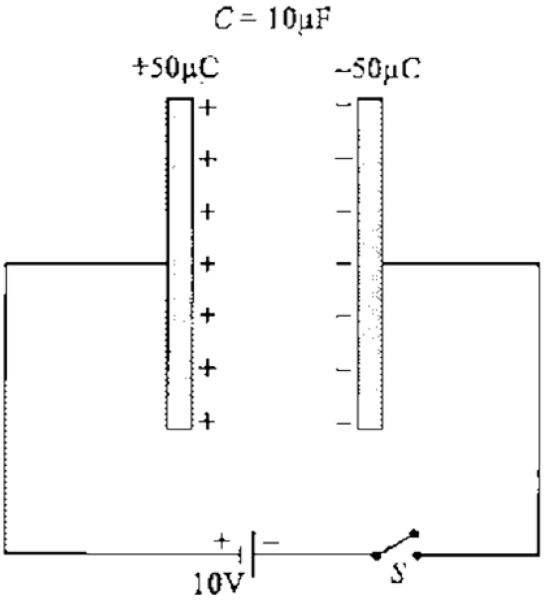
7. A capacitor of $10\mu F$ capacitance is having $50\mu C$ charge. Find amount of heat produced when this capacitor is connected across a $10V$ battery

as shown in figure and switch is closed.



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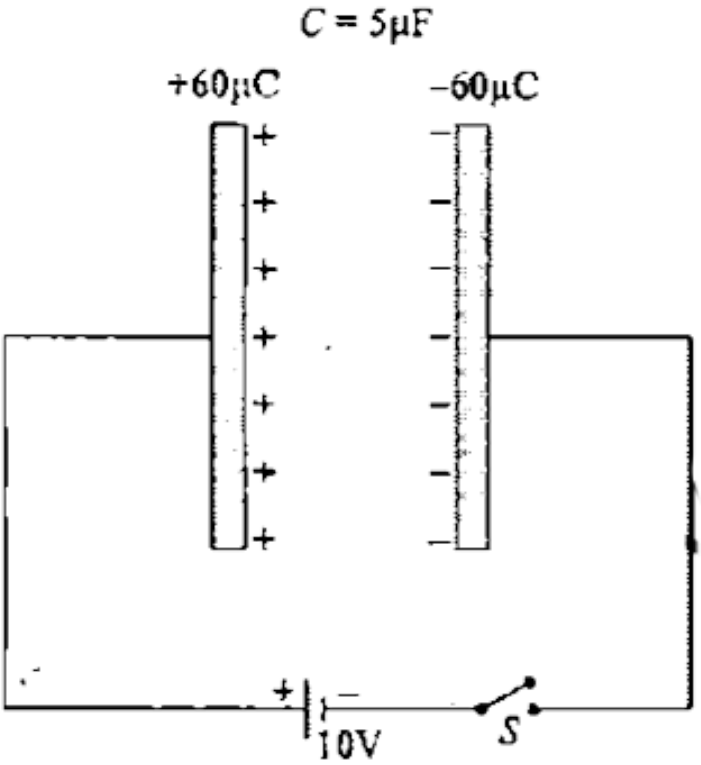
8. A capacitor of $5\mu F$ capacitance is charged with an initial charge $60\mu C$ as shown in figure and connected across a $10V$ battery. Find the amount

of heat produced when switch is closed.



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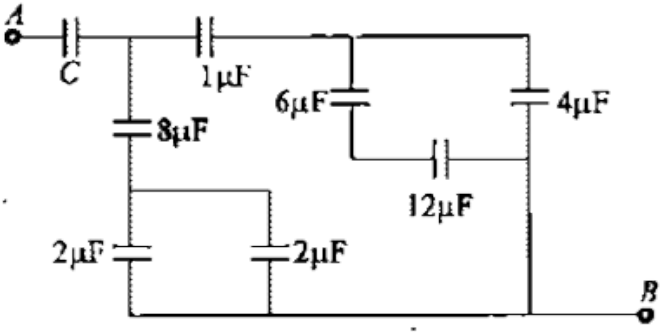
9. Find the capacitance C in the circuit shown in figure if the equivalent capacitance between points A and B is $1\mu F$.



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10. Two capacitors of capacitances $C_1 = 2\mu F$ and $C_2 = 8\mu F$ are connected in series and the resulting combination is connected across a $300V$ battery. Calculate the charge, potential difference and energy stored in the capacitor separately.

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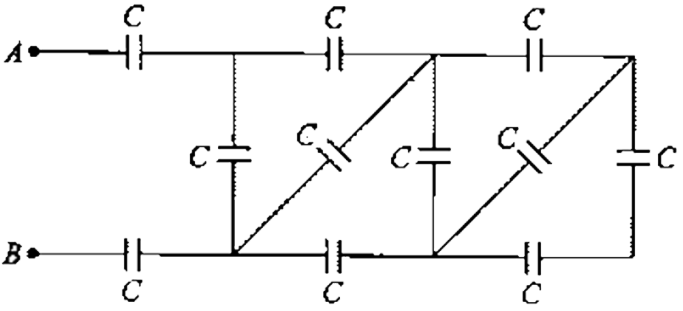
11. Find the equivalent capacitance of given network of capacitors between A and B. Each capacitor has capacitance



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12. Three conducting plates are placed parallel to one another as shown in the figure. The outer plates are neutral and connected by a conducting wire. The inner plate is isolated and carries a total charge amounting to $10\mu C$. The charge densities on upper. and lower face of middle plate are σ_1 and σ_2. Find $5\sigma_1/\sigma_2$

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13. Figure shows four parallel plates kept at equal separation forming three parallel plate capacitors. The capacitance between two adjoining plates is C. Find out equivalent capacitance between A and B.

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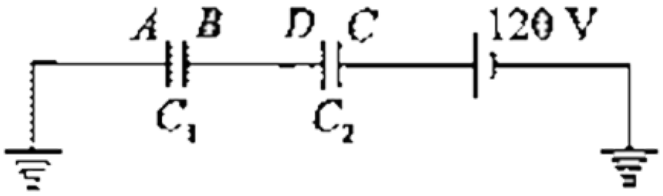
14. Two circular plates A and B of a parallel plate air capacitor have a diameter of $0.1m$ and are $2 \times 10^{-3}m$ apart. The plates C and D, of a similar capacitor have a diameter of $0.12m$ and are $3 \times 10^{-3}m$ apart. Plate A is earthed and plates B and D are connected together as shown in figure. Plate C is connected to the positive pole of a $120V$ battery whose negative terminal is earthed. Calculate.

(a) the combined capacitance of the arrangement and

(b) the energy stored in it.



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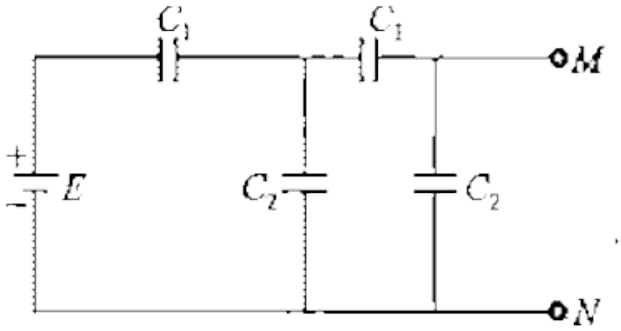
15. Find the potential difference between points M and N of the circuit shown in figure. The battery voltage is equal to ξ and the capacitance ratio C_2 / C_1 is equal to η



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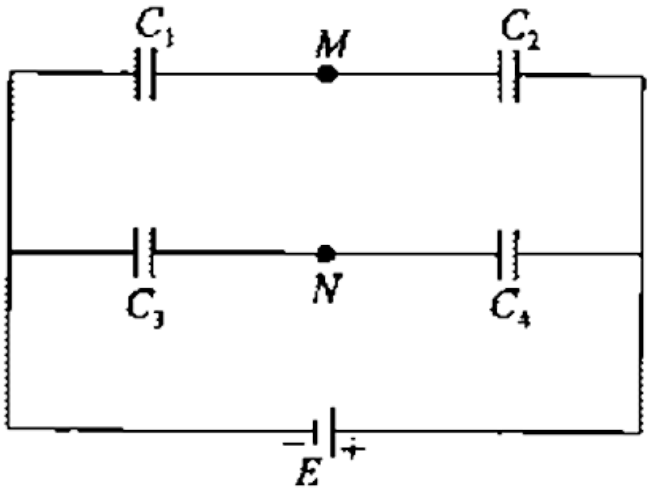
16. In the circuit shown in figure four capacitors are connected to a battery. Determine the potential difference $V_M - V_N$ between· points M and N of the circuit. Find the conditions under which it is equal to zero.



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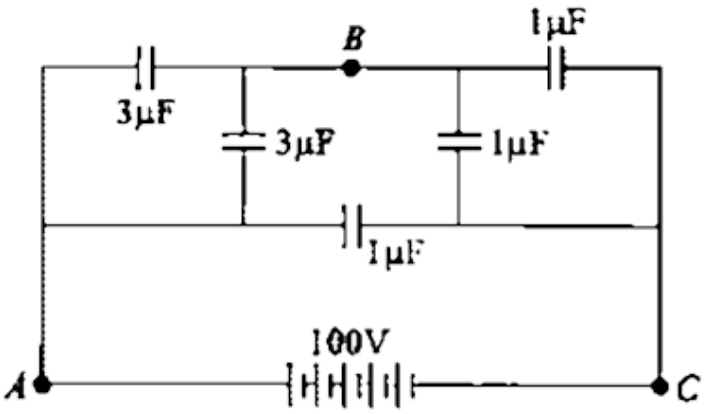
17. In circuit shown in figure calculate the potential difference between the points A and B and between the points B and C in the steady state.



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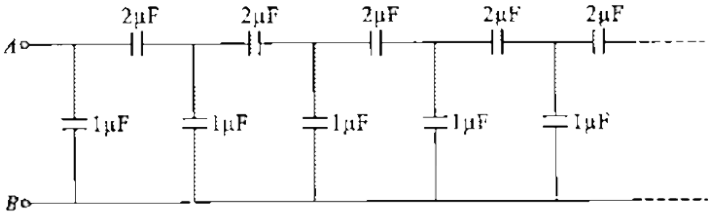
18. Find the equivalent capacitance of the infinite ladder shown in figure between the points A & B.



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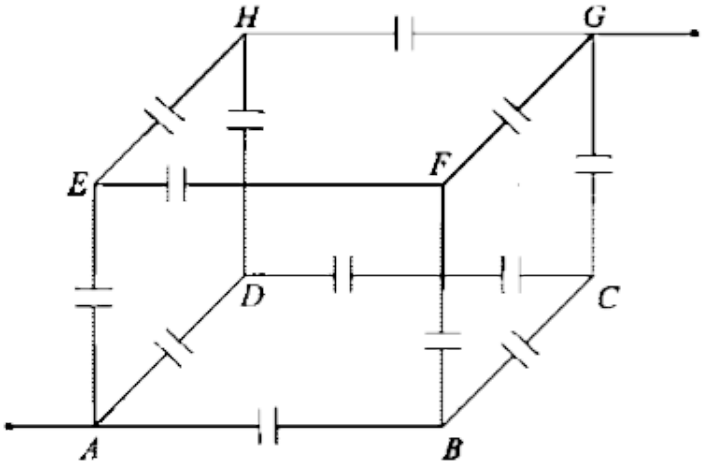
19. Figure shows a circuit of 12 capacitors each of capacitance C connected along the edges of a cubical wireframe as shown. Find the equivalent capacitance between terminals A & G.



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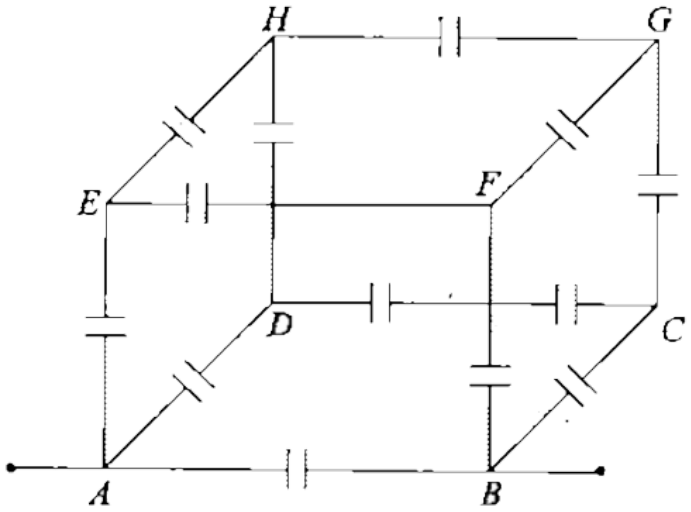
20. Figure shows a circuit of 12 capacitors each of capacitance $1C$ connected along the edges of a cubical wireframe as shown. Find the

equivalent capacitance between terminals A & B.



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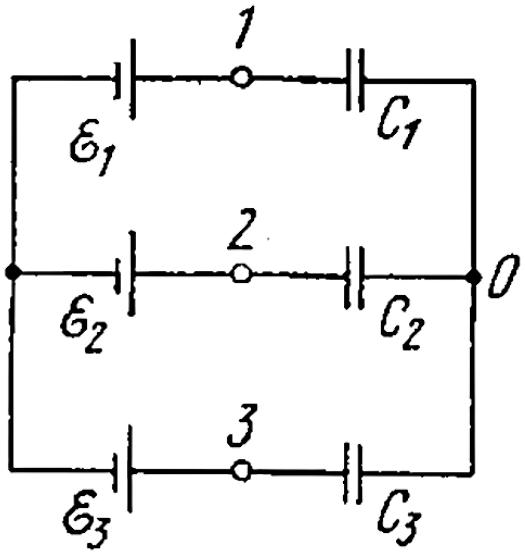
21. Determine the potential at point 1 of the circuit shown in Fig., assuming the potential at the point O to be equal to zero.



using the symmetry of the formula obtained, write the expressions for the potentials at points 2 and 3.

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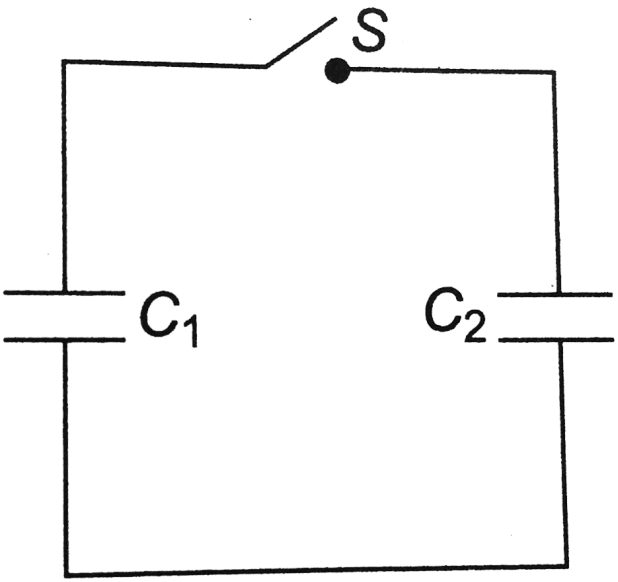
22. A μF capacitor C_1 is charged to $V_0 = 120V$. The charging battery is then removed and the capacitor is connected in parallel to an uncharged $+4\mu F$ capacitor C_2.



(a) what is the potential difference V across the combination?

(b) what is the stored energy before and after the switch S is closed?

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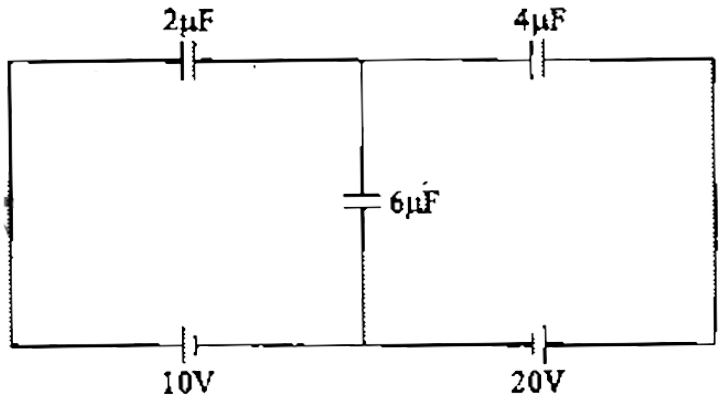
23. In the circuit shown in figure find the charges on the three capacitors in steady state.



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24. A capacitor has capacitance $10\mu F$ audit is charged to a potential $150V$. A second capacitor has a capacitance of $20\mu F$ and it is charged to a potential of $300V$. After charging, the two capacitors are connected in parallel with their same polarity plates together by using wires of negligible capacitance. Find how much energy is dissipated?

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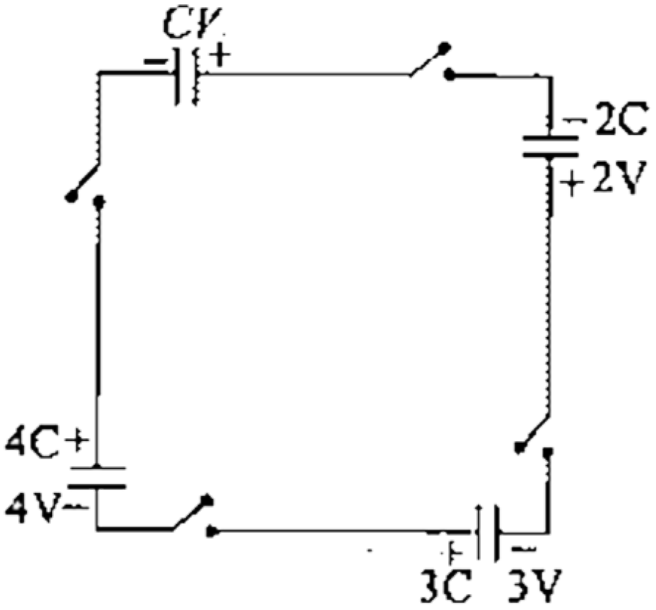
25. Figure shows four capacitors with capacities $C, 2C, 3C$ and $4C$ are charged to the voltage, $V, 2V, 3V$ and $4V$ correspondingly. The circuit is closed by closing all the switches. Find the potential difference across all capacitors in steady state.



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26. A battery of $10V$ is connected to a capacitor of capacity $0.lF$. The battery is now removed and this capacitor is connected to a second

uncharged capacitor. If the charges are distributed equally on these two capacitors, find the total energy stored in the two capacitors. Find the ratio of final energy to initial energy stored in capacitors.

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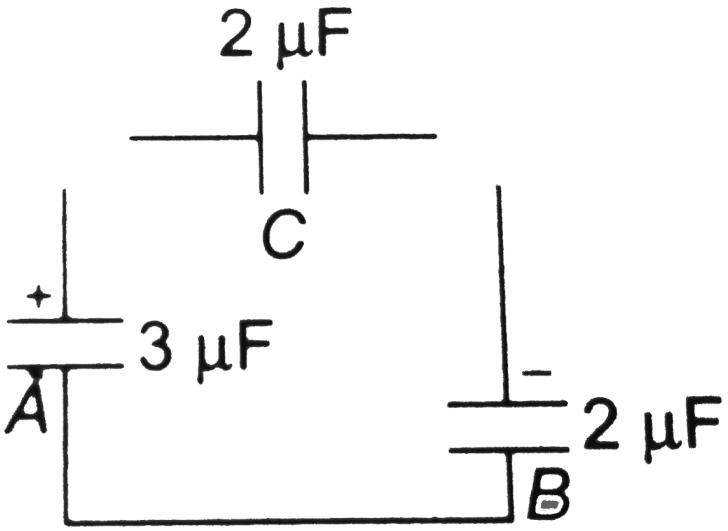
27. Two capacitors A and B with capacities $3\mu F$ and $2\mu F$ are charged to a potential difference of $100V$ and $180V$, respectively. The plates of the capacitors are connected as show in figure with one wire of each capacitor free. The upper plate of A is positive and that of B is negastive. An 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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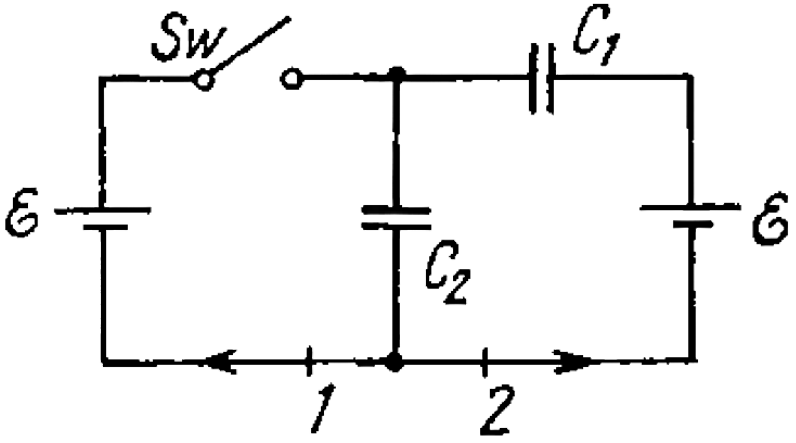
28. What charges will flow after the shorting of the swich Sw in the circuit illustrated in Fig through sections 1 and 2 in the directions

indicated by the arrown?



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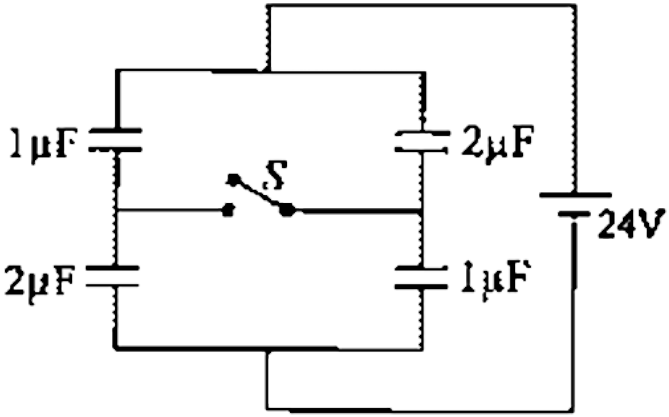
29. Four uncharged capacitors are charged by $24V$ battery as shown in the figure. How much charge flows through switch S when it is closed?



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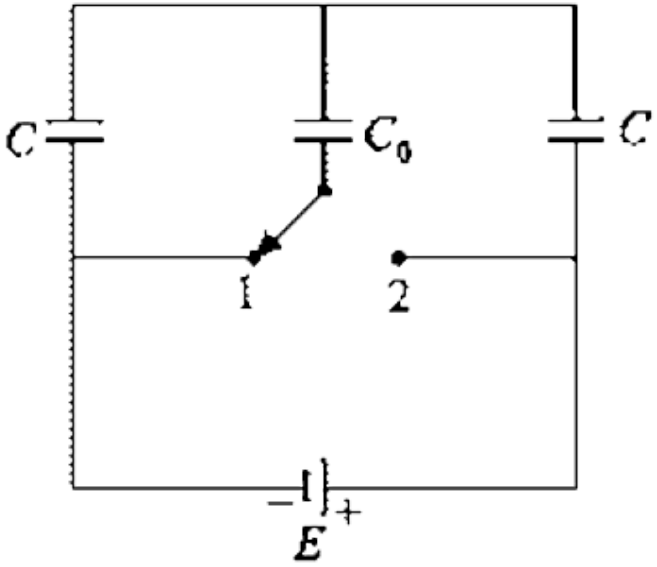
30. Figure shows a circuit with three capacitors connected with a battery.

What amount of heat will be generated in the circuit when the switch S is

shifted from position 1 to 2.



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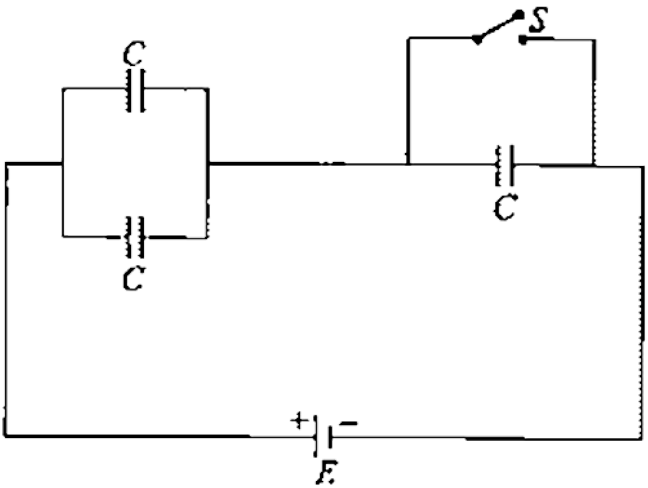
31. In the circuit shown, each capacitor has a capacitance C, The cell voltage is E, Find the amount of charge flowing through the switch when it is closed and also find the heat dissipated in the circuit when the

switch is closed.



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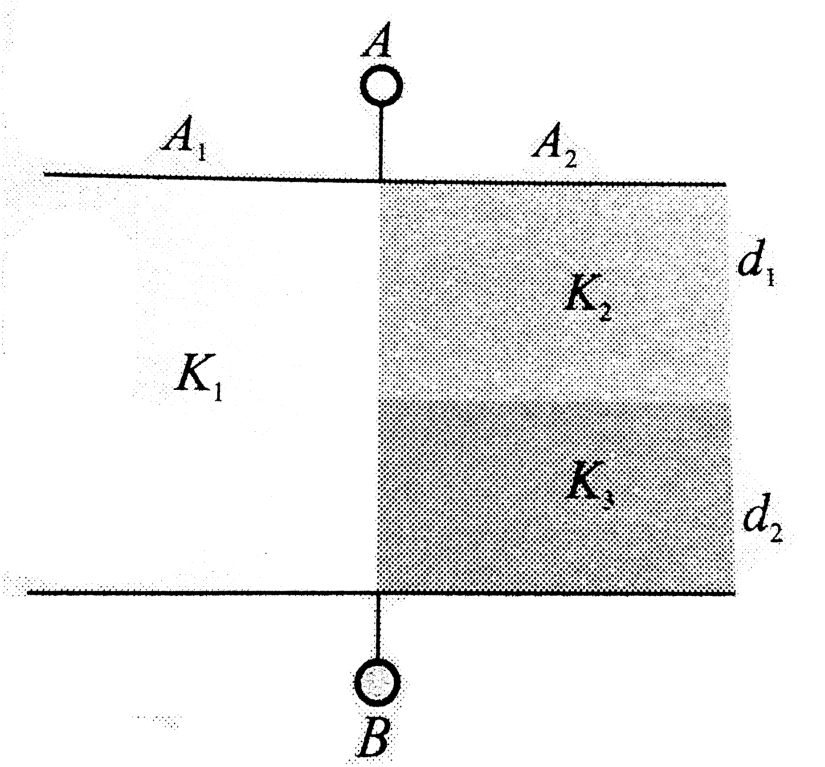
32. Find the capacitance between A and B if three dielectric slabs of dielectric constants $K_1 area$A _(2) and $thick \neq ss$d_(2) $\big)are \in sertedbetweentheplatesofaparal \leq llate \cap aci \rightarrow rofplateareaA$

d_(1)=d_(2)+d_(2)`.)



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33. A parallel plate capacitor is maintained at a certain potentail difference. When a 3mm thick slab is intorduced between the plate, in a order to maintain the same potential difference, the distance between the plates is increased by 2.4 mm. Find the dielectric constant of the slab.

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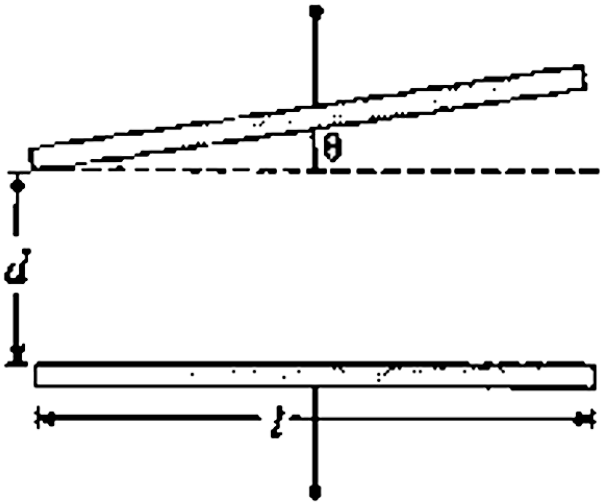
34. Figure shows a parallel plate capacitor with its plate area $A = lb$ and plate separation d at left end of the plates. Upper plate of capacitor is slightly tilted by a very small angle 8 as shown. Find the capacitance of this capacitor.



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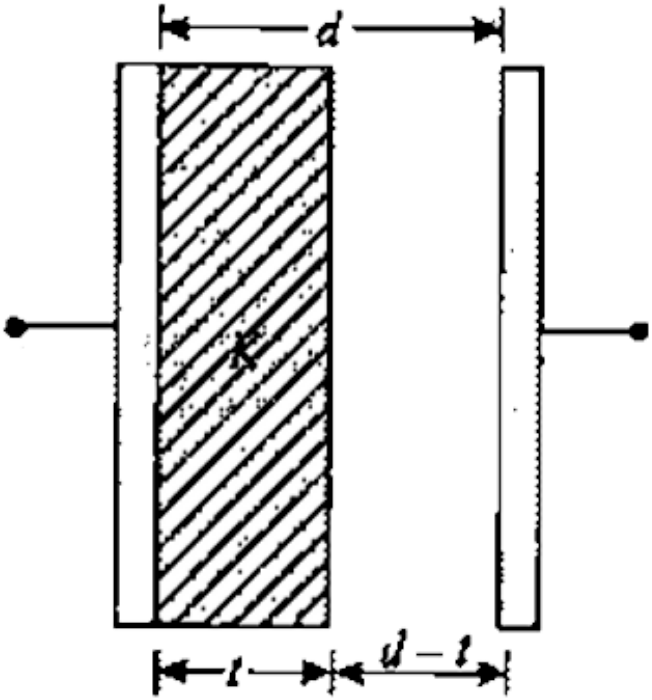
35. A parallel plate capacitor consists of two metal plates of area A and separation d. A slab of thickness t and electric constant K is inserted

between the plates with its faces parallel to the plates and having the same surface area as that of the plates. Find the capacitance of the system.

IF $K = 2$, for what value of t/d will the capacitance of the system be $3/2$ times that of the air capacitor? Calculate the energy in the two cases and account for the energy change.



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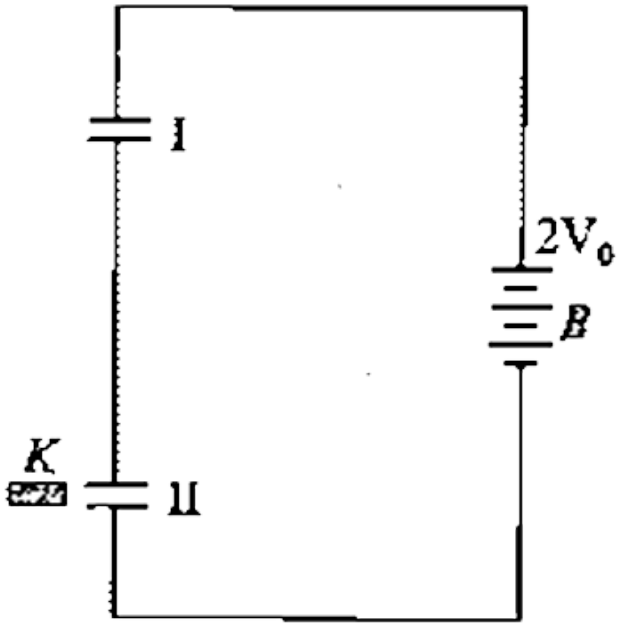
36. Two identical capacitors are connected as shown in fignre. A dielectric slab is introduced between the plates of one of the capacitors so as to fill the gap, the battery remaining connected. What will be the capacitance, the charge, potential difference and stored energy for each capacitor?



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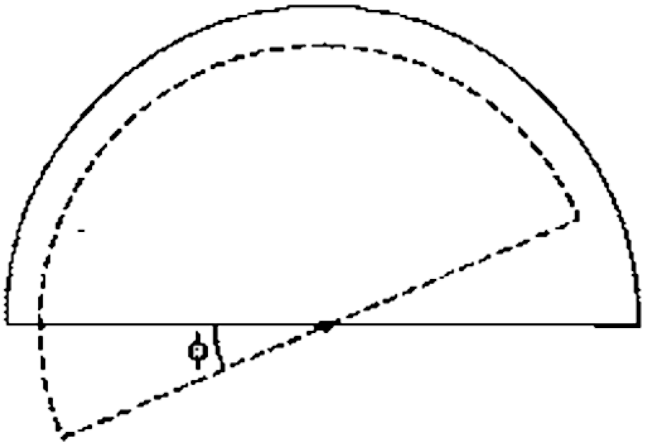
37. A capacitor consists of two stationary plates shaped as a semi-circle of radius R and a movable plate made of dielectric with permittivity K and

capable ofrotating about an axis O between the stationary plates. The thickness of movable plate is equal to d which is practically the separation between the stationary plates. A potential difference V is applied to the capacitor. Find the magnitude of the moment of forces relative to the axis O acting on the movable plate in the position shown in figure.



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38. The distance between the parallel plates of a charged condenser is $d = 5cm$ and the intensity of the field $e = 300V/cm$. A slab of dielectric constant $k = 5$ and $1cm$ wide is inserted parallel to the plates.

Determine the potential difference between the plates before and after the slab is inserted. If the slab is replaced by a metal plates so that the final potential difference remains unchanged, what be the thickness ofthe plate?

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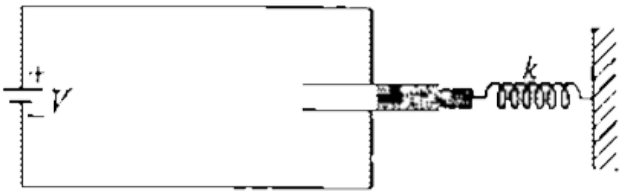
39. In the arrangement shown in figure a. dielectric slab of dielectric constant K is partially inside a parallel plate capacitor. Assuming gravity to be absent, calculate the extension in the spring if the whole system is in equilibrium. If the slab is slightly displaced will it perform SHM? If the liattery is disconnected and then the slab is slightly displaced, will it perform SHM?

Given that I is the length of the plates, b is the breadth of plates and dis the separation between the plates.



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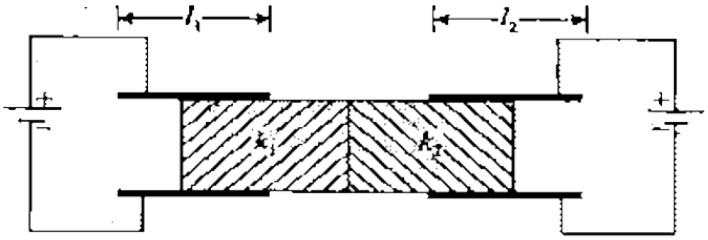
40. Figure shows two parallel plate capacitors with fixed plates and connected to two batteries. The separation between the plates is the same for the two capacitors. The plates are rectangular in shape with width b and length l_1 and l_2. The left half of the dielectric slab has a dielectric constant k_1 and the right half k_2 Neglecting any friction, find the ratio of the voltage of ihe left battery for that of the right battery for which the dielectric. slab mayremain in equilibrium.



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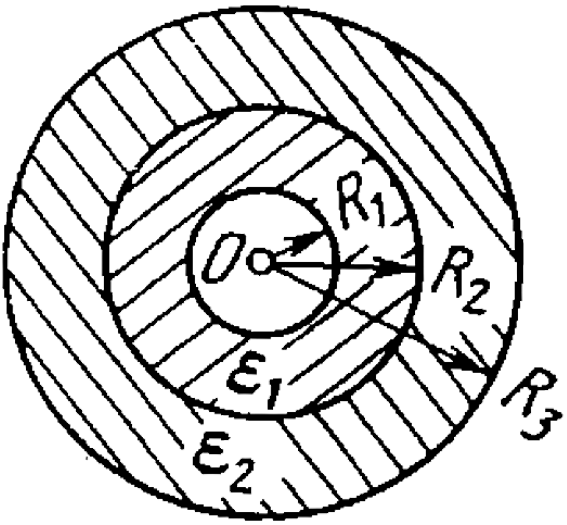
41. There is a double-layer cylindrical capacitor whose parameters are shoen in Fig. The breakdown field strength values for these dielectrics are

equal to E_1 and E_2 respectively. What is the breakdown voltage of this capacitor if $\varepsilon_1 R_1 E_1 < \varepsilon_2 R_2 E_2$?



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42. Between the plates of a parallel-plate capacitor there is a metallic plate whose thickness takes up $\eta = 0.60$ of the capacitor gap. When that plate is absent the capacitor has a capacity $C = 20nF$. The capacitor is connected to a constant voltage source. $V = 100V$. The metallic plate is slowly extracted from the gap. Find the mechanical work performed in the process of plate extraction.

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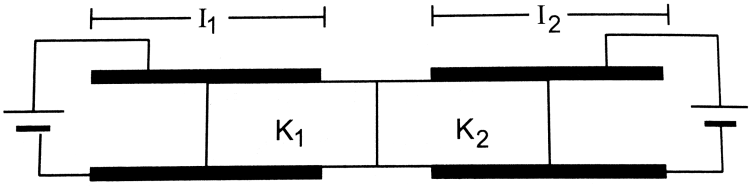
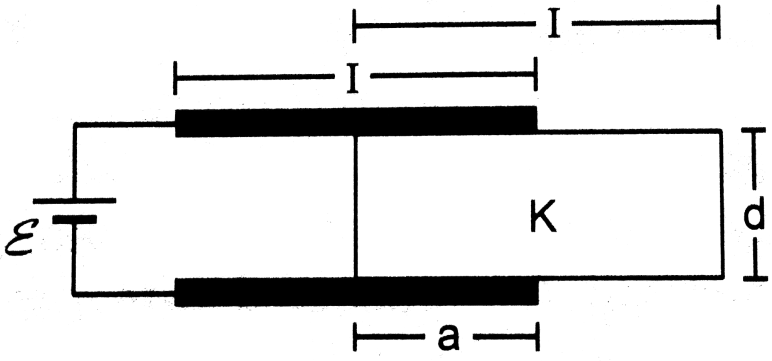
43. Consider the situation shown in figure .The plates of the capacitor have plate area A and are clamped in the laboratory . The dielectric slab is released from rest with a length a inside the capacitor. Neglecting any effect of friction or gravity, show that slab will execute periodic motion and find its time period.





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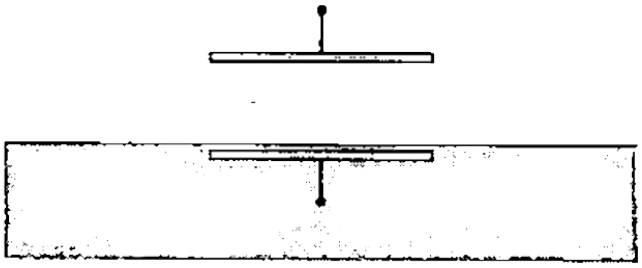
44. Figure shows a horizontal parallel plate capacitor is lowered on a liquid surface in such a way that its lower plate is just submerged in the liquid of dielectric constant k. Find the height to which the liquid level will be raised between the plates if the capacitor plates are given a surface charge density $+\sigma$ and $-\sigma$ on its plates.



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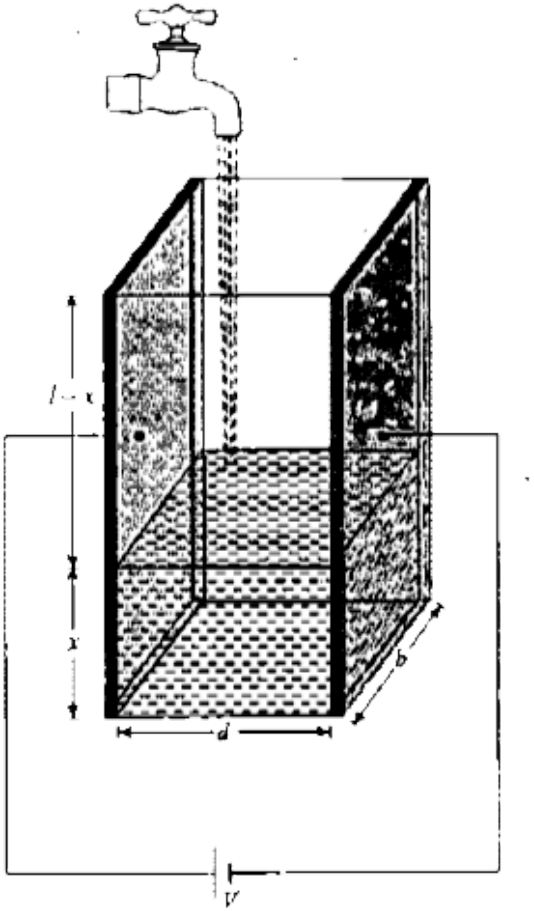
45. A parallel plate capacitor is made by fixing two plates inside of a container as shown in figure. The plates are connected to a battery of voltage V. If at $t = 0$ the tap is opened from which a liquid of dielectric constant k starts filling in the container at a constant rate of rm^3 / s, find the current in connecting wires as a function of time. Neglect any

resistance in connecting wires.



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Discussion Questions

1. What will happen if the plates of a charged capacitor are suddenly connected by metallic wire?

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2. Can we give any desired charge to a capacitor?

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3. The radius of the earth is $6400km$, what is its capacitance?

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4. Can a solid conducting sphere hold more charge than a hollow sphere of the same radius? Give reason.

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5. Why metals cannot be used as a dielectric in a capacitor?

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6. A capacitor is connected to a battery. If we move its plates further apart, work will be done against the electrostatic attraction between the plates. What will happen to this work? What will be the effect on the energy of the capacitor?

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7. If the capacitor is kept connected with the battery and then the dielectric slab is inserted between the plates, then what will be the change in the charge, the capacitance the potential difference, the electric field an the stored energy?

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8. If we know the capacitance of a given conductor then can we calculate the maximum charge which it can store?

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9. A parallel plate capacitor is charged to a certain potential difference and the battery used to charged it is disconnected. Now a dielectric slab of dimensions equal to spacing between plates is introduced between the plates. What will be the changes, if any, in the charge, potential difference, capacitance, electric field strength and the energy stored in the capacitor?

Watch Video Solution

10. A capacitor of capacitance C is charged upto a potential difference V. After removing the charging battery, the capacitor is connected (i) in parallel, (ii) in series with an uncharged capacitor of the same

capacitance. What will be the effect on the potential difference of the first capacitor in each case?

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11. When a dielectric slab is inserted between the plates of a capacitor which is initially charged and disconnected from the source then what can be concluded on the amount of heat dissipated during insertion ? What would be the answer if source remain connected to the capacitor while insertion of the dielectric slab?

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12. N identical capacitors are connected in parallel which are charged to a potential V. If these are separated and connected in series then what potential difference will be obtained?

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13. For a given potential difference across a parallel plate capacitor does a capacitor stores more or less charge with a dielectric than it does without a dielectric present between the plates?

Watch Video Solution

14. Why should circuits containing capacitor be handled cautiously even when there is no current.

Watch Video Solution

15. When a parallel plate capacitor is charged by connecting it across a battery then battery is disconnected. If one plate of capacitor is earthed and isolated then another plate is connected to earth and then isolated. What will be the final charge on the capacitor after this operation. Will it be less than, equal to or more than the initial charge? Explain why?

Watch Video Solution

16. A solid and a hollow metal spheres are given equal charges, which one will have higher electric potential.

Watch Video Solution

17. When plastic parts are removed from the metal dies on different types of printing machines then these metal parts develop high voltage. Explain why?

Watch Video Solution

18. The' distance between the plates of a parallel plate capacitor is d. A metal plate of thickness $d/2$ is placed between the plates. What will e its effect on the capacitance.

Watch Video Solution

19. A parallel plate capacitor is connected to a battery and it is in steady state. Connecting wires are considered as perfect conductors. If the plates of capacitor are moved apart by some distance and then after sometime these are brought back to the same separation. Is there any heat dissipated in the circuit in above operation? Explain why?

Watch Video Solution

20. Why do electrostatic capacitors have large capacitives?

Watch Video Solution

21. Why is it that a man sitting in an insulated metal cage does not receive a shock when it is connected to a high voltage supply?

Watch Video Solution

22. As we know in steady state charge on a capacitor is given as $Q = CV$ which also implies $C = Q/V$. So can we say in steady state capacitance is proportional to the supplied charge Q.

Watch Video Solution

Conceptual Mcqa

1. A capacitor is charged by using a battery which is then disconnected. A dielectric slab is then slipped between the plates, which results in

A. Reduction of charge on the plates and in crease of potential difference across the plates

B. Increase in the potential difference across the plates, reduction in stored energy, but no change in the charge on the plates

C. Decrease in the potential difference across the plates, reduction in stored energy, but no change in the charge on the plates

D. None of the above

Answer: C

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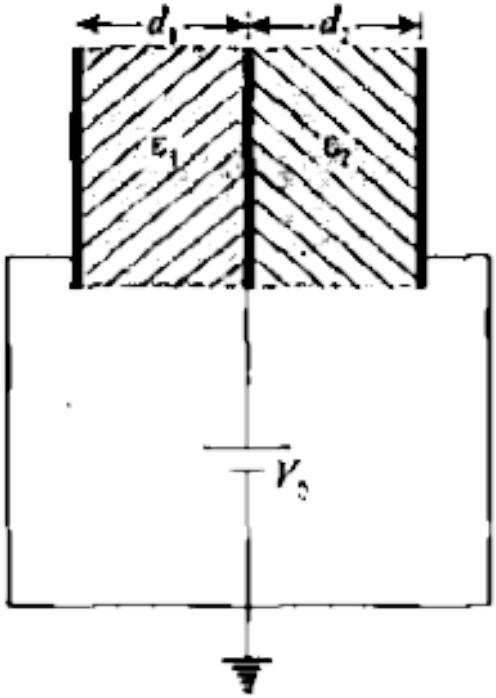
2. A capacitor is composed of three parallel conducting plates. All three plates are of same area A. The first pair of plates are kept a distance d_1 apart and the space between them is filled with a medium of a dielectric ε_1. The corresponding values for the second pair of plates are d_2. and ε_2

respectively. What is the surface charge density on the middle plate?



A. $\varepsilon_0 V\left[\frac{\varepsilon_1}{d_1}+\frac{\varepsilon_2}{d_2}\right]$

B. $-\varepsilon_0 V\left[\frac{\varepsilon_1}{d_1}+\frac{\varepsilon_2}{d_2}\right]$

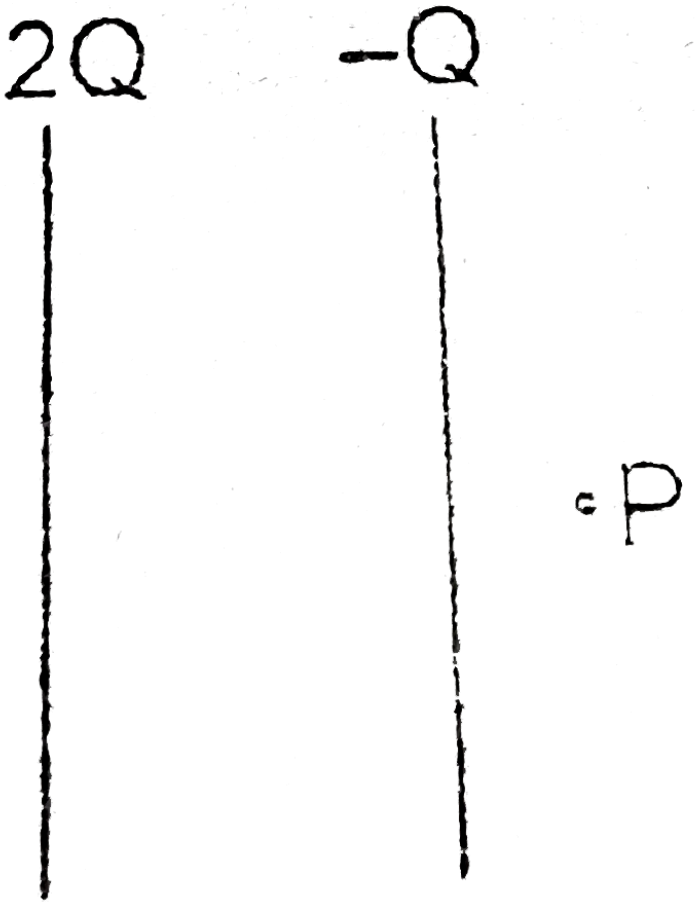
C. $2\varepsilon_2 V\left[\frac{\varepsilon_1}{d_1}+\frac{\varepsilon_2}{d_2}\right]$

D. $-2\varepsilon_0 V\left[\frac{\varepsilon_1}{d_1}+\frac{\varepsilon_2}{d_2}\right]$

Answer: A

Watch Video Solution

3. In the figure shown the plates of a parallel plate capacitor have unequal charges. Its capacitance is 'C' P is a point outside the capacitor and close to the plate of charge $-Q$. The distance between the plates is 'd'



A. A point charge atpoint P will experience and electric force due to capacitor

B. The potential difference between the plates will be $3Q/2C$

C. The energy stored in the electric field in the region between the plates is $\frac{9Q^2}{8C}$

D. The force on one plate due to the other plate is $\frac{Q^2}{2\pi\varepsilon_0 d^2}$

Answer: D

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4. You have a parallel plate capacitor, a spherical capacitor and a cylindrical capacitor. Each capacitor is charged and then removed from the same battery. Consider the following situations :

I:· Separation between the plates of parallel plate capacitor is reduced

II: Radius of the outer spherical shell of the spherical capacitor is increased

III: Radius of the outer cylinder of cylindrical capacitor is increased.

Which of the following is correct?

A. In each of these situations I, II and III, charge on the given capacitor remains the same and potential difference across it also remains the same.

B. In each ofthese situations I, II and III, charge on the given capacitor remains the same but potential difference, in situations I and III, decreases, and in situation II, increases.

C. In each of these situations I, II and III, charge on the given capacitor remains the same but potential difference, in situations I, decreases, iind in situations II and III, increases.

D. Charge on the capacitor in each situation changes. It increases in all these situations but potential difference remains the same.

Answer: C

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5. 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. Charge on the plates connected to each other is reduced to zero

B. Charge on the outer plates is doubled

C. Potential difference between outer plates terminals is $2V$

D. The energy stored in the system is doubled

Answer: C

Watch Video Solution

6. 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. 5 in parallel 2 in series

B. 4 in parallel 3 in series

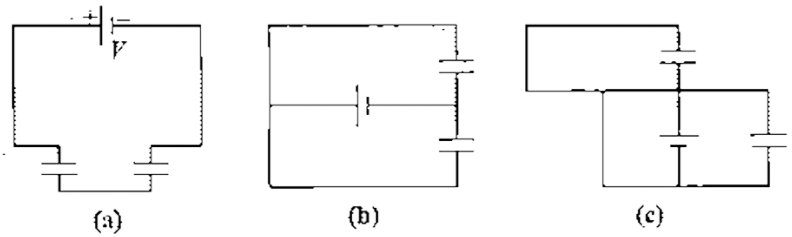
C. 3 in parallel 4 series

D. 2 in parallel 5 in series

Answer: A

Watch Video Solution

7. For the three circuit shown in figure- across the battery capacitors are connected in some combination. Which of the following is the correct order of combination :



A. series, series, parallef

B. series, parallel, parallel

C. parallel, series, parallel

D. none

Answer: B

Watch Video Solution

8. Two identical capacitors are connected in series with a source of constant voltage V. If Q is the charge on one of the capacitors, the capacitance of each capacitor is :

A. $Q/2V$

B. Q/V

C. $2Q/V$

D. None of these

Answer: C

Watch Video Solution

9. A parallel plate air capacitor is connected to a battery. After charging fully, the battery is disconnected and the plates are pnlled apart to increase their separation. Which of the following statements is correct ?

A. The electric field between the plates of capacitor decreases

B. The electric field between the plates of capacitor increases

C. The electric field between the plates of capacitor remains same

D. Potential difference between the plates remains the same

Answer: C

Watch Video Solution

10. 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. Electric potential remains the same

B. Electric potential decreases continuously

C. Electric potential increases continuously

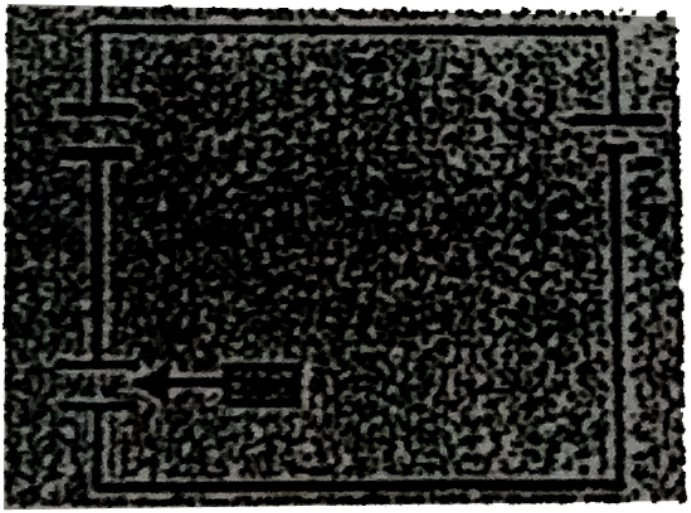
D. Electric potential increases first, then decreases and again increases

Answer: C

Watch Video Solution

11. Two identical capacitors A and B shown in the given circuit are joined in series with a battery. If a dielectric slab of dielectric constant K is slipped between the plates of capacitor B and battery remains connected,

then the energy of capacitor A will-



A. Decrease

B. Increase

C. Remain the same

D. Becomes zero

Answer: B

Watch Video Solution

12. If there are n capacitors each of capacitance C in series combination connected to a V volt source, then the energy stored in each capacitor is equal to :

A. nCV^2

B. $\frac{1}{2}nCV^2$

C. $\frac{CV^2}{2n}$

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

Answer: D

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13. The charges on two parallel copper plates separated by a small distance are $+Q$ and $-Q$. A test charge q experiences a force F when placed between these plates. Now if one of the plates is removed to infinity, then the force on the test charge will become :

A. $F/2$

B. F

C. $2F$

D. Zero

Answer: A

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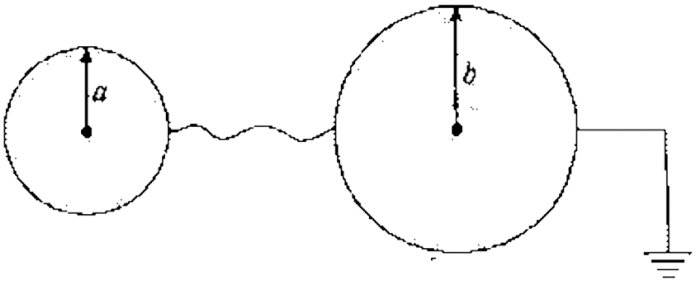
14. Two conducting shells of radius a and bare connected by conducting wire as shown in figure. The capacitance of this system is :



A. $4\pi\varepsilon_0 \frac{ab}{b-a}$

B. $4\pi\varepsilon_0(a+b)$

C. Zero

D. Infinite

Answer: D

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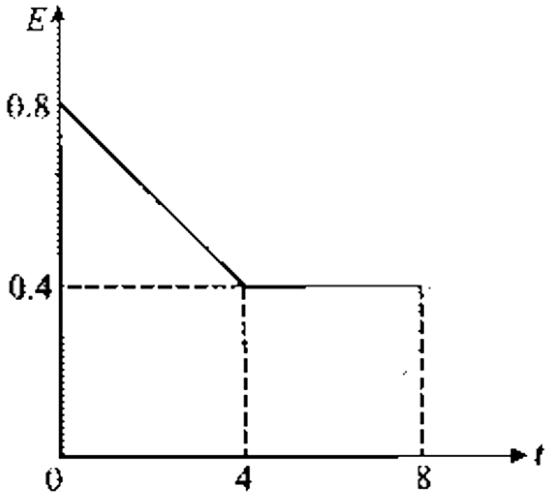
15. The graph given below shows the variation of electric field E (in MV/m) with time t (in μs) in a parallel plate capacitor



Consider the statements:

(1) The displacement current through a $1m^2$ region perpendicular to the during the time interval $t = 0$ to $t = 4\mu s$ is $0.0885A$ (given

$\varepsilon_0 = 8.85 \times 10^{-12}$ SI unit)

(2) The displacement current through $1m^2$ region perpendicular to the field during the time interval $t = 4\mu s$ to $8\mu s$ is zero.

Which of the statements given above is/are correct:

A. 1 only

B. 2 only

C. both 1 and 2

D. neither 1 nor 2

Answer: C

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16. 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. $Q = \frac{\varepsilon AV}{d}$

B. $W = \frac{\varepsilon_0 AV^2}{2kd}$

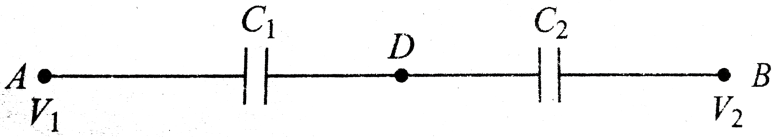
C. $E = \frac{V}{kd}$

D. $W = \frac{\varepsilon_0 AV^2}{2d}\left(1 - \frac{1}{k}\right)$

Answer: B

Watch Video Solution

17. Two condensers C_1 and C_2 in a circuit are jhioned as shown in . The potential fo point A is V_1 and that of B is V_2 . The potential of point D will be `



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

B. $\frac{C_2V_1 + C_1V_2}{C_1 + C_2}$

C. $\frac{C_1V_1 + C_2V_2}{C_1 + C_2}$

D. $\frac{C_2V_1 - C_1V_2}{C_1 + C_2}$

Answer: C

Watch Video Solution

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

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

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

Answer: C

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19. A parallel plate capacitor of capacitance C_0 is charged with a charge Q_0 to a potential difference V_0 and the battery is then disconnected Now a dielectric slab of dielectric constant k is inserted between the plates ofcapacitor. The dimensions of the slab are such that it completely fills the space between the plates, then :

A. Charge on the' plates remains the same

B. Charge on the plates decreases to Q_0 / K

C. Charge on _the plates increases to KQ_0

D. Potential difference between plates remains the same

Answer: A

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20. n identical capacitors are connected in parallel to a potential difference V. These capacitors are then reconnected in sereis, their charges being left undisturbed. The potential difference obtained is

A. Zero

B. $(n-1)V$

C. nV

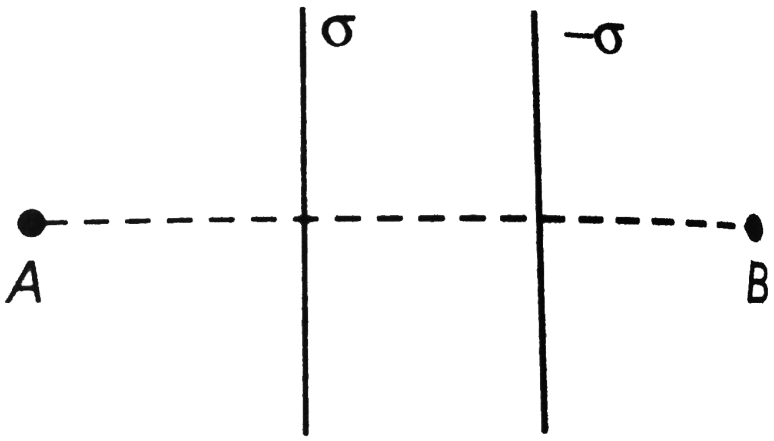
D. n^2V

Answer: C

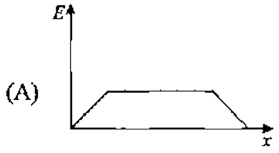
Watch Video Solution

21. Two large parallel sheets charged uniformly with surfasce charge density σ and $-\sigma$ are located as shown in the figure. Which one of the following graphs shows the variation of electric field along a line

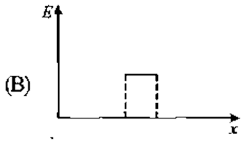
perpendicular to the sheets as one moves from A to B ?



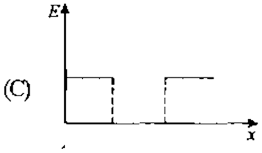
A.



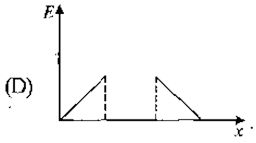
B.



C.



D.



Answer: B

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22. When a battery of emf E volts is connected across a capacitor of capacitance C, then after some time the potential difference between the plates of the capacitor becomes equal to the battery voltage. The ratio of the work done by the battery and the energy stored in the capacitor when it is fully charged is

A. $1:1$

B. $1:2$

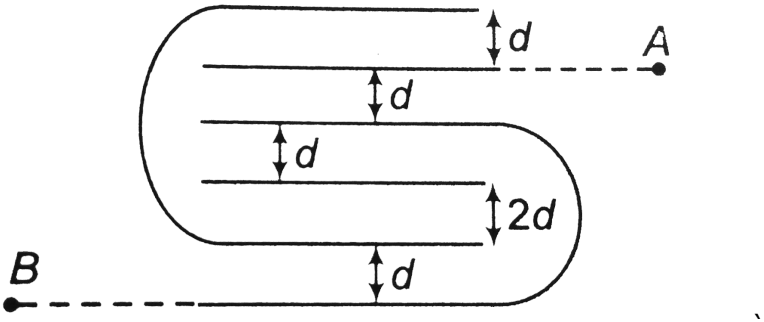
C. $2:1$

D. $4:1$

Answer: C

Watch Video Solution

23. Find equivalent capacitance between points A and B. [Assume each conducting plate is having same dimensions and neglect the thickness of the plate $\frac{\varepsilon_0 A}{d} = 7\mu F$ where A is area of plate]`



A. $2\mu F$

B. $11\mu F$

C. $12\mu F$

D. $15\mu F$

Answer: B

Watch Video Solution

24. An uncharged capacitor having capacitance C is connected across a battery of voltage V. Now the capacitor is disconnected and then reconnected across the same battery but with reversed polarity. Then which of the statement is INCORRECT

A. After reconnecting, heat energy produced in the circuit will be equal to two-third of the total energy supplied by battery

B. After reconnecting, no energy is supplied by battery

C. After reconnecting, whole of the energy supplied by the battery is converted into heat

D. After reconnecting, thermal energy produced in the circuit will be equal to $2CV^2$

Answer: B

Watch Video Solution

25. Two similar parallel plate capacitors each of capaciti C_0 are connected in series The combination is connected with a voltage source of V_0. Now, seperation between the plates of one capacitor is increased by a distance d and the separation between the plates of another capacitor is decreased by the distance $\frac{d}{2}$. The distance between the plates of each capacitor was d before the chane in sepration. Then select the correct choice.

A. The new capacitance ofthe system will increase

B. The new capacitance of the system will decrease

C. The new capacitance of the system will remain same

D. Data is not sufficient to arrive at a conclusion

Answer: B

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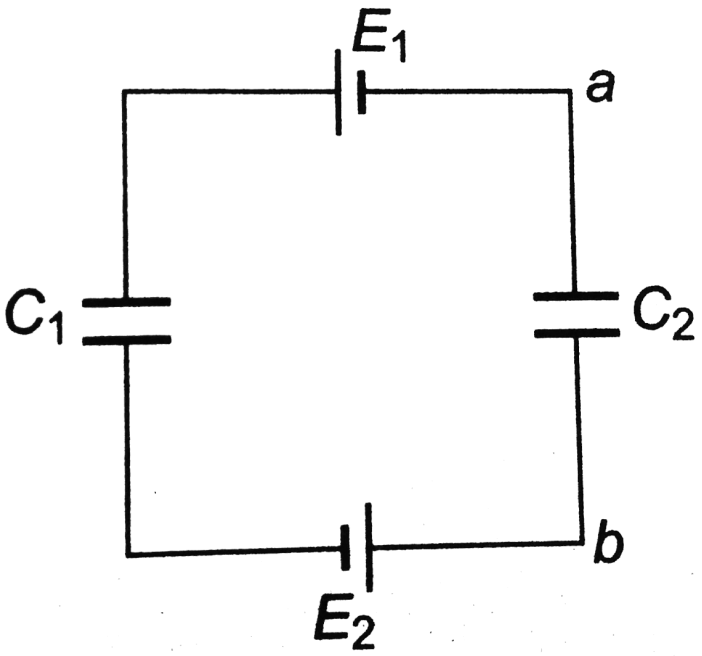
26. The potential difference between points a and b of circuits shown in figure is



A. $\left(\frac{E_1 + E_2}{C_1 + C_2}\right) C_2$

B. $\left(\frac{E_1 - E_2}{C_1 + C_2}\right) C_2$

C. $\left(\frac{E_1 + E_2}{C_1 + C_2}\right) C_1$

D. $\left(\frac{E_1 - E_2}{C_1 + C_2}\right) C_1$

Answer: C

Watch Video Solution

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

A. $1.8pF$

B. $45pF$

C. $40.5pF$

D. $20.25pF$

Answer: C

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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. Only(i), (ii) and (iii) are correct

B. Only (i) and (ii) are correct

C. Only(ii) and (iv) are correct

D. Only (iv) is correct

Answer: D

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29. A parallel plate capacitor with a dielectric slab with dielectric constant $k = 3$ filling the space between the plates is charged to potential V and isolated. Then the dielectric slab is drawn out and another dielectric slab of equal thickness but dielectric constant $k' = 2$ is introduced between

the plates. The ratio of the energy stored in the capacitor later to that initially is:

A. $2:3$

B. $3:2$

C. $4:9$

D. $9:4$

Answer: B

Watch Video Solution

30. Three capacitors each of capacity $4\mu F$ are to be connected in such a way that the effective capacitance is $6\mu F$. This can be done by

A. All of them in series

B. All of them in parallel

C. Two in series and the third parallel to the combination

D. Two in parallel and the third in series with the comb

Answer: C

Watch Video Solution

31. 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

Watch Video Solution

32. To form a composite $16\mu F, 100V$ capacitor from a supply of identical capacitors market $8\mu F, 250V$, we require a minimum number of capacitors

A. 2

B. 8

C. 16

D. 32

Answer: D

Watch Video Solution

Numerical Mcqs

1. Two capacitors $3\mu F$ and $6\mu F$ are connected in series across a potential difference of $120V$. Then the potential difference across $3\mu F$ capacitor is:

A. $40V$

B. $60V$

C. $80V$

D. $100V$

Answer: C

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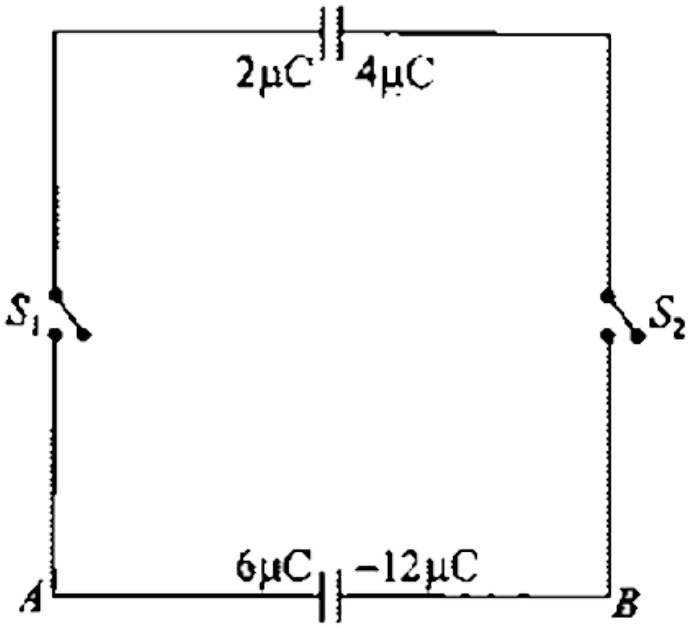
2. Initial charges (with proper sign) on the plates of two identical capacitors, each of $1\mu F$, are as shown. When both S_1 and S_2 are closed,

the potential difference between A and B will finally.become :



A. $2V$

B. $4V$

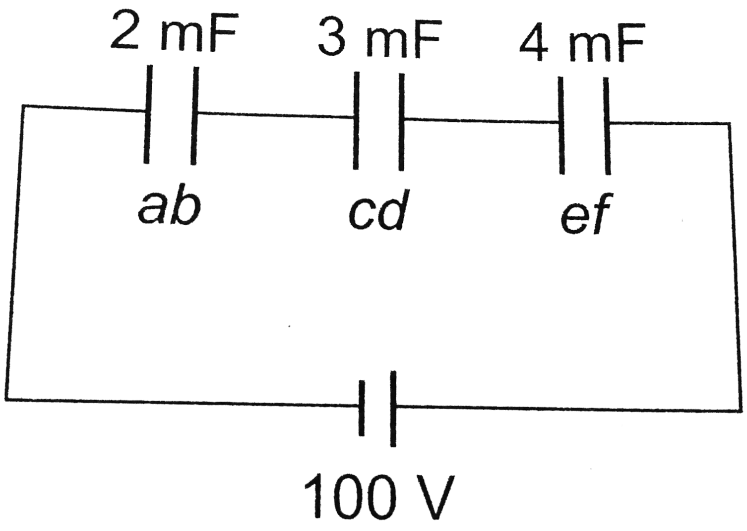
C. $6V$

D. $0V$

Answer: B

Watch Video Solution

3. Three capacitors are connected to $D.\ C$ source of 100 volts shown in the adjoining figure. If the charge accumulated on plates of C_1, C_2 and C_3 are q_a, q_b, q_c, q_d, q_e and q_f respectively, then



A. $q_b + q_d + q_f = (100/9)C$

B. $q_b + q_d + q_f = 0$

C. $q_a + q_c + q_e = 50C$

D. $q_b = q_d = q_f$

Answer: D

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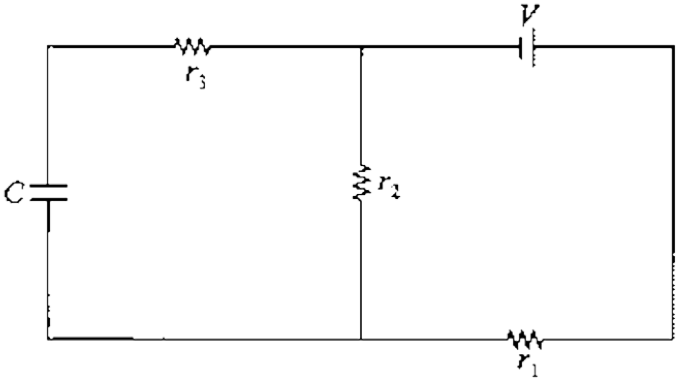
4. In the circuit shown in figure, the final voltage drop across the capacitor C is :



A. $\frac{Vr_1}{r_1 + r_2}$

B. $\frac{Vr_2}{r_1 + r_2}$

C. $\frac{V(r_1 + r_2)}{r_2}$

D. $\frac{V(r_2 + r_1)}{r_1 + r_2 + r_3}$

Answer: B

Watch Video Solution

5. The plates of a parallel plate capacitor are charged up to $100v$. Now, after removing the battery, a $2mm$ thick plate is inserted between the plates Then, to maintain the same potential deffernce, the distance betweem the capacitor plates is increase by $1.6mm$. The dielectric canstant of the plate is .

A. 5

B. 1.25

C. 4

D. 2.5

Answer: A

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6. A capacitor is charged until its stored energy is $3J$ and then the charging battery is removed. Now another uncharged capacitor is connected across it and it is found that charge is distributed equally in

the two capacitors. The final value of total energy stored in the electric fields is :

A. $1.5J$

B. $3J$

C. $2.5J$

D. $2J$

Answer: A

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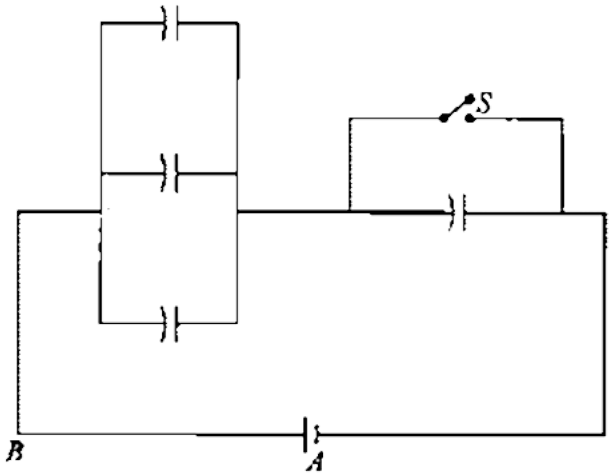
7. Four capacitors of capacitance $10\mu F$ and a battery of $200V$ are arranged as shown. How much charge will flow through AB after the

switch S is closed :



A. $6000\mu C$

B. $4500\mu C$

C. $3000\mu C$

D. $4000\mu C$

Answer: B

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8. A capacitor of capacitance of $2\mu F$ is charged to a potential difference of $200V$, after disconnecting from the battery, it is connected in parallel with another uncharged capacitor. The final common potential is $20V$ then the capacitance of second capacitor is :

A. $2\mu F$

B. $4\mu F$

C. $18\mu F$

D. $16\mu F$

Answer: C

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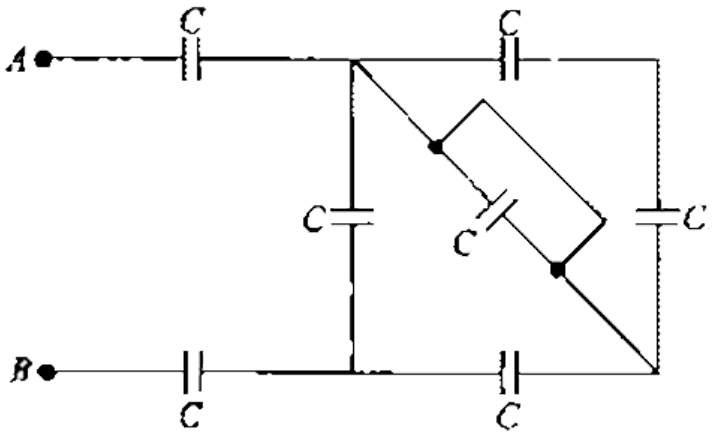
9. The equivalent capacitance between terminals A and B in the circuit shown in figure is:



A. $6C$

B. $\frac{2C}{5}$

C. $\frac{2C}{3}$

D. $None\ of\ these$

Answer: B

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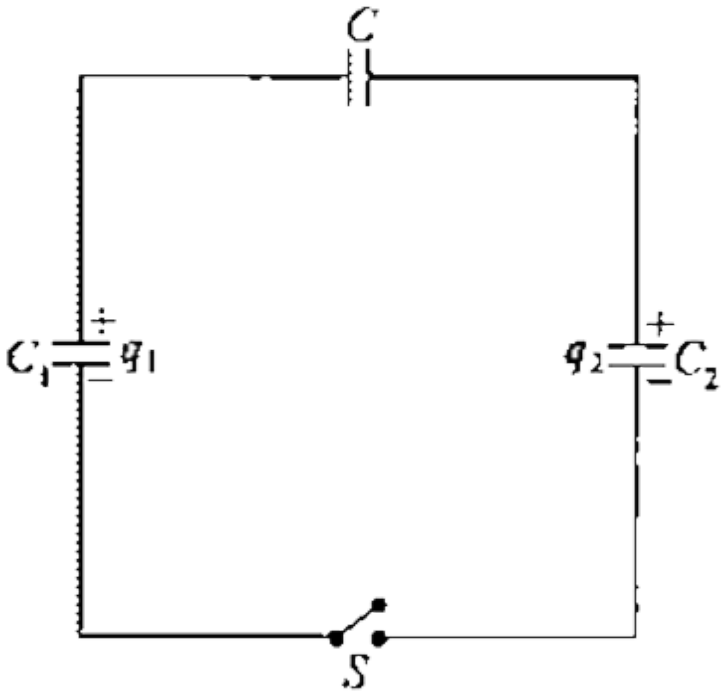
10. Two capacitor C_1 and C_2, charged with chargesq_1 and q_2 then these are connected in series with an uncharged capacitor C, as shown in

figure. As the switch S is closed :



A. C gets charged in any condition

B. C gets charged only when $q_1C_2 > q_2C_1$

C. C gets charged only when $q_1C_2 < q_2C_1$

D. C gets chharged when $q_1C_2 \neq q_2C_1$

Answer: D

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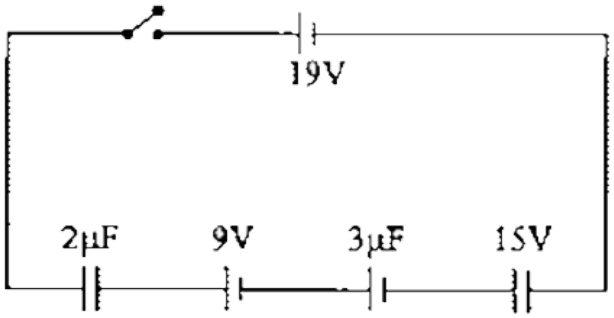
11. The two capacitors in the circuit shown in figure are initially uncharged and then connected as shown and switch is closed. What is the potential difference across $3\mu F$ capacitor?



A. $30V$

B. $10V$

C. $25V$

D. None of these

Answer: B

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12. A capacitor stores $50\mu c$ charge when connected across a battery . When the gap between the plates is filled with a dielectric , a charge of `100muc flows through the battery .Find the dielectric constant of the material inserted.

A. 2.5

B. 2

C. 4

D. 3

Answer: D

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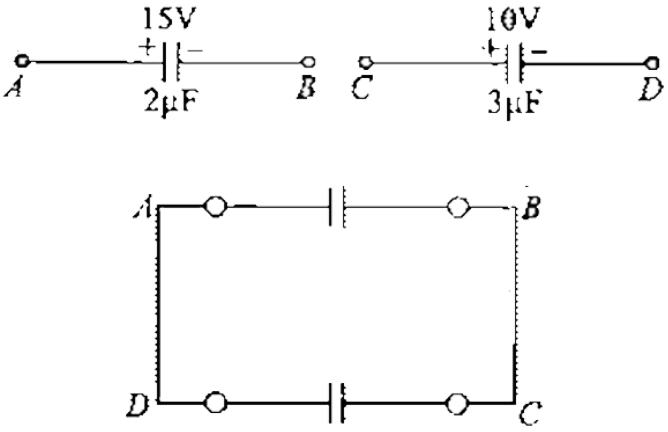
13. Initially two capacitors are charged to different potential differences as shown in figure and then connected in parallel as shown. Which of the

following is incorrect about this circuit?



A. Final charge on each capacitor will be zero

B. Final total electrical energy of the capacitors will be zero

C. Total change from A to D is $30\mu C$

D. Total charge flown from A to D is $-30\mu C$

Answer: D

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14. The two spherical shells are at large separation, one of them has radius $10cm$ and $1.25\mu C$ charge. The other is of $20cm$ radius and has

$0.75\mu C$ charge. If they are connected by a conducting wire of negligible capacitance, the final charge on the shells are :

A. $1\mu C, 1\mu C$

B. $\frac{2}{3}\mu C, \frac{4}{3}\mu C$

C. $\frac{4}{3}\mu C, \frac{2}{3}\mu C$

D. $0.25\mu C, 0.25\mu C$

Answer: B

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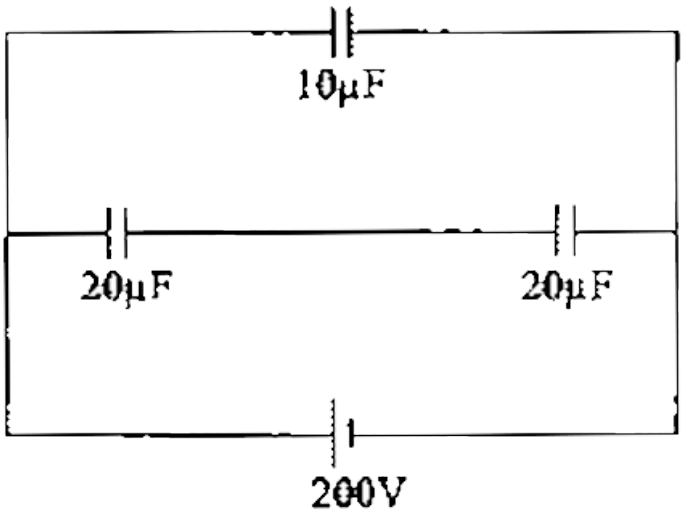
15. In the circuit shown in figure, charge on $10\mu F$ capacitor is given as



A. $2 \times 10^{-3} C$

B. $16 \times 10^{-4} C$

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

D. $8 \times 10^{-4} C$

Answer: A

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16. A capacitor consists of two parallel metal plates of area A separated by a distance d. A dielectric slab of area A, thickness b and dielectric constant k is placed inside the capacitor. If C_k is the capacitance of capacitor with dielectric, under what limits the values of k and b are to be restricted so that$C_k = 2C$, where C is capacitance without dielectric?

A. $k = \dfrac{4b}{2b-d}$ & $\dfrac{d}{3} < b \leq d$

B. $k = \dfrac{2b}{2b-d}$ & $\dfrac{d}{2} < b \leq d$

C. $k = \dfrac{2b}{2b-d}$ & $\dfrac{d}{2} \leq b \leq 2d$

D. $k = \dfrac{2b}{2b-d}$ & $\dfrac{d}{4} \leq b \leq d$

Answer: B

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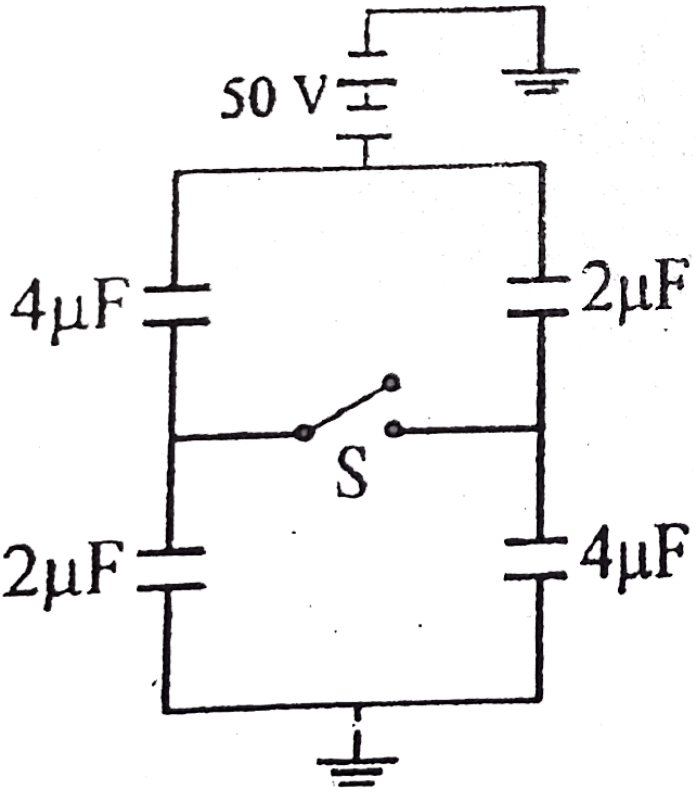
17. The circuit was in the shown state from a long time. Now the switch S is closed. The charged that flows through the switch is



A. $\frac{400}{3}\mu C$

B. $100\mu C$

C. $50\mu C$

D. $\frac{100}{3}\mu C$

Answer: C

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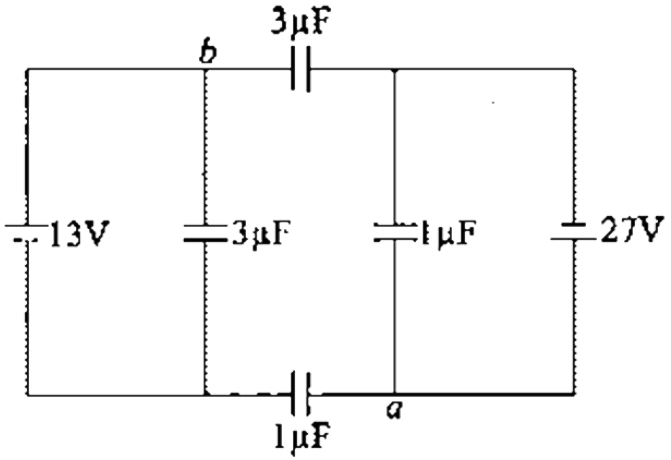
18. Four capacitors and two batteries are connected as shown in the figure. The potential difference between the points a and b is:



A. $0V$

B. $13V$

C. $17V$

D. $27V$

Answer: C

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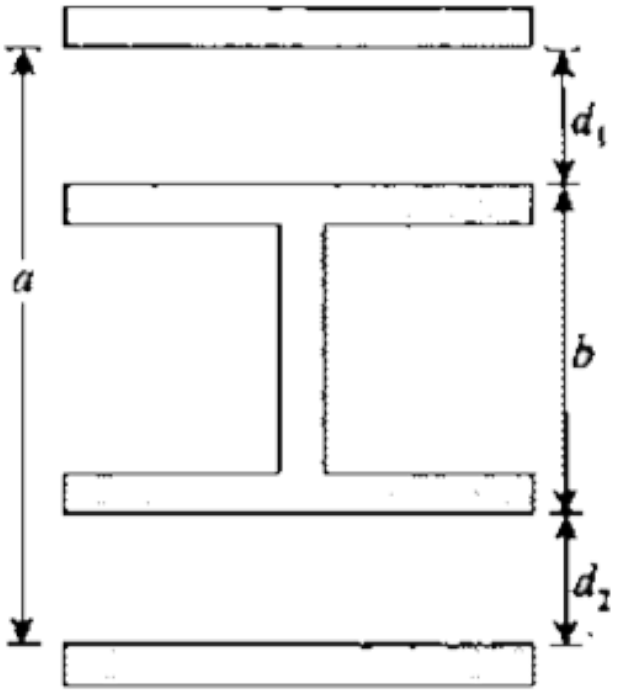
19. Two capacitors are made in series by two metal plates and one I structure as shown in figure. The area of each plate shown is A.The equivalent capacitance between top and bottom plate of this system is given as:



A. $\frac{\varepsilon_0 A}{d_1 - d_2}$

B. $\frac{\varepsilon_0 A}{a - b}$

C. $\varepsilon_0 A\left(\frac{1}{a} - \frac{1}{b}\right)$

D. $\varepsilon_0 A\left(\frac{1}{d_1}-\frac{1}{d_2}\right)$

Answer: b

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20. A $3\mu F$ and a $5\mu F$ capacitor are connected in series across a $30V$ battery. A $7\mu F$ capacitor is then connected in parallel across the $3\mu F$ capacitor. Choose the INCORRECT option :

A. Voltage across $3\mu F$ capacitor before connecting $7\mu F$ capacitor is $18.75V$.

B. Charge flown through the battery after connecting $7\mu F$ capacitor is $43.75\mu C$

C. $5\mu F$capacitor and $7\mu F$ capacitor it has a charge of $70\mu C$

D. After connecting $7\mu F$ capacitor

Answer: C

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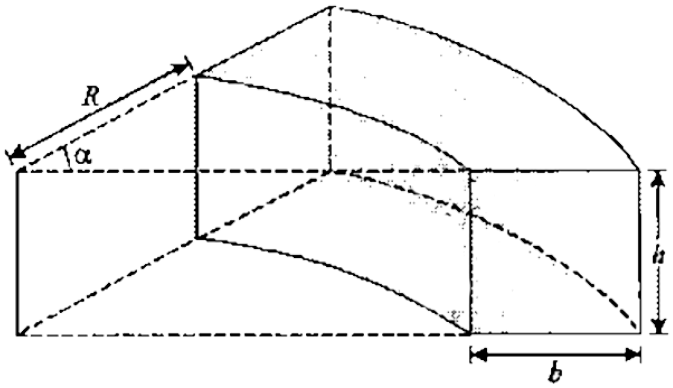
21. Find the capacitance between the inner and outer curved cylindrical conductor surface as shown in figure. Space between conductor surface is filled with dielectric of dielectric constant k. Consider $b << R$:



A. $\frac{\varepsilon_0 khR\alpha}{b}$

B. $\frac{\varepsilon_0 kbr\alpha}{h}$

C. $\frac{\varepsilon_0 khR\alpha}{2b}$

D. $\frac{\varepsilon_0 kbr\alpha}{2h}$

Answer: A

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22. Three capacitors of capacitances $3\mu F$, $9\mu F$ and $18\mu F$ are connected one in series and another time in parallel. The ratio of equivalent capacitance in the two cases $\left(\frac{C_s}{C_p}\right)$ will be

A. $1:15$

B. $15:1$

C. $1:1$

D. $1:3$

Answer: A

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23. 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. $6kV$

B. $4kV$

C. $10kV$

D. $9kV$

Answer: D

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24. A $4\mu F$ condenser is charged to $400V$ and then its plates are joined through a resistance of $1K\Omega$. The heat produced in the resistance is :

A. $0.16J$

B. $1.28J$

C. $0.64J$

D. $0.32J$

Answer: D

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25. Condenser A has a capacity of $15\mu F$ when it is filled with a medium of dielectric constant 15. Another condenser B has a capacity $1\mu F$ with air between the plates. Both are charged separately by a battery of $100V$. After charging, both are connected in parallel without the battery and the dielectric material being removed. The common potential now is

A. $400V$

B. $800V$

C. $1200V$

D. $1600V$

Answer: B

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26. Two capacitors $2\mu F$ and $4\mu F$ are connected in parallel. A third capacitor of $6\mu F$is connected in series. The combination is then connected across a $12V$ battery. The voltage across $2\mu F$ capacitor is:

A. $2V$

B. $6V$

C. $8V$

D. $1V$

Answer: B

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27. There is an air filled 1pF parallel plate capacitor. When the plate separation is doubled and the space is filled with wax, the capacitance increases to 2pF. The dielectric constant of wax is

A. 2

B. 4

C. 6

D. 8

Answer: B

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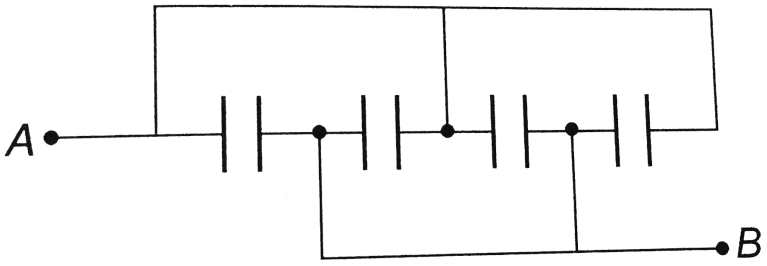
28. Four condenser are joined as shown in the adjoining figure. The capacity of each is $8\mu F$. The equivalent capacity between the points A and B will be



A. $32\mu F$

B. $2\mu F$

C. $8\mu F$

D. $16\mu F$

Answer: A

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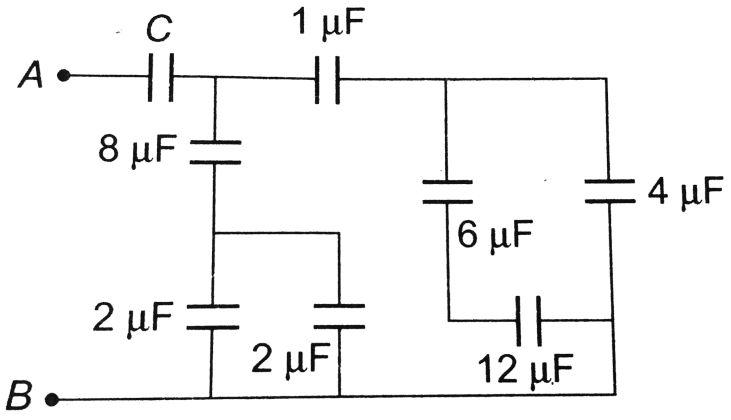
29. In the following circuit, the resultant capacitance between A and B is $1\mu F$. Then value of C is



A. $\frac{32}{11}\mu F$

B. $\frac{11}{32}\mu F$

C. $\frac{23}{32}\mu F$

D. $\frac{32}{23}\mu F$

Answer: D

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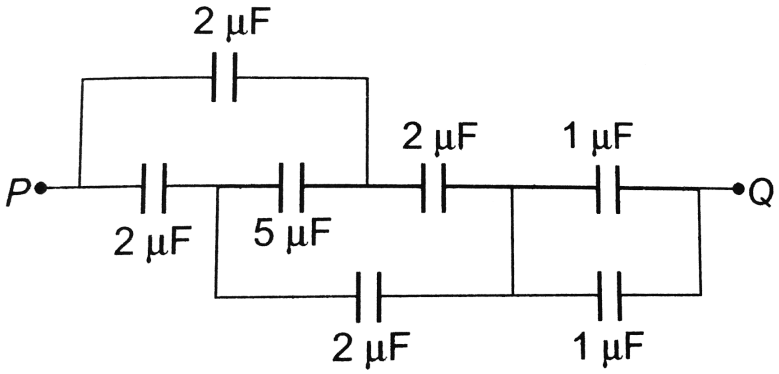
30. The effective capacitance between the points P and Q of the arrangement shown in the figure is



A. $\frac{1}{2}\mu F$

B. $1\mu F$

C. $2\mu F$

D. $1.33\mu F$

Answer: B

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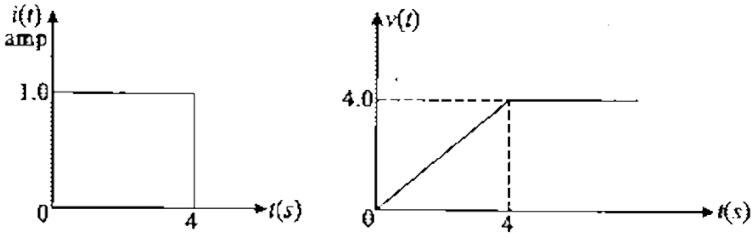
31. A circuit element is placed in a blackbox. At $t = 0$, a switch is closed and the current flowing through the circuit element and the voltage across its terminals are recorded to have the wave shapes shown in the figure here. The type of element and its magnitude are:



A. resistance of 2Ω

B. resistance of 4Ω

C. capacitance of $1F$

D. a voltage source of emf $4V$

Answer: C

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32. Two parallel plate capacitors of capacitances C and 2C are connected in parallel and charged to a potential difference V. The battery is then disconnected and the region between the plates of the capacitor C is completely filled with a material of dielectric constant K. The potential differences across the capacitors now becomes.....

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

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

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

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

Answer: C

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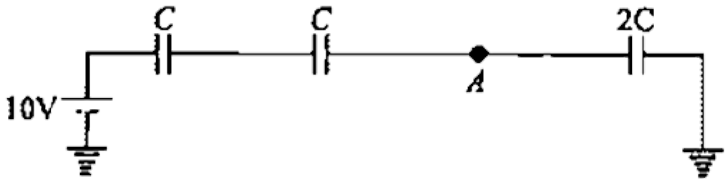
33. In a circuit shown in the figure, what is potential of point A?



A. $2V$

B. $5V$

C. $8V$

D. $4V$

Answer: A

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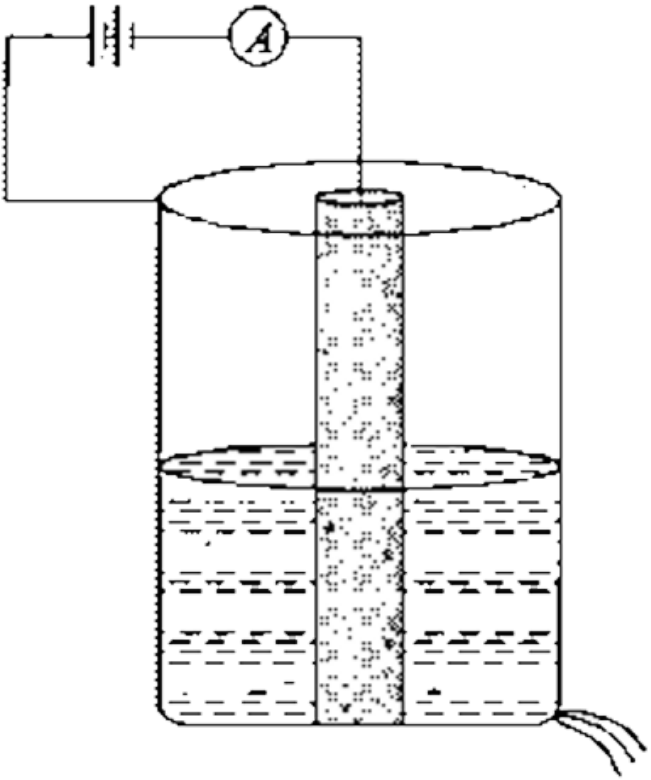
34. Two long coaxial cylindrical metal tubes stand on an insulatiog floor as shown in figure. A dielectric oil is filled in the annular region between

the tubes. The tubes are maintained at a constant potential difference V.

A small hole is opened at bottom then :



A. Reading of ammeter remain constant

B. Capacitance of system increases

C. Current in circuit is dependent on area ofhole

D. Current in circuit is inversely proportional to dielectric constant

Answer: C

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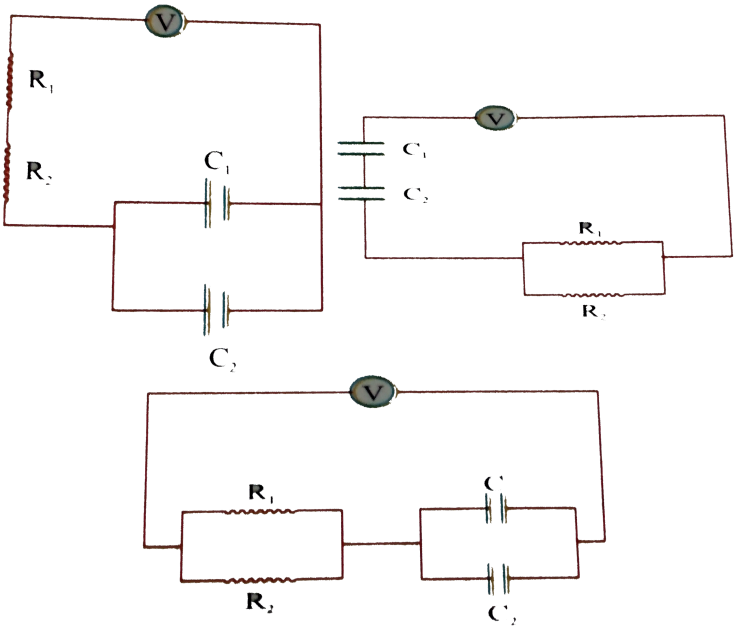

35.

Find the time constant for the given RC circuits in correct order (in μs)

$R_1 = 1\Omega, R_2 = 2\Omega, C_1 = 4\mu F, C_2 = 2\mu F$

A. $18, 8/9, 4$

B. $18, 4, 8/9$

C. $4, 8/9, 18$

D. $8/9, 18, 4$

Answer: D

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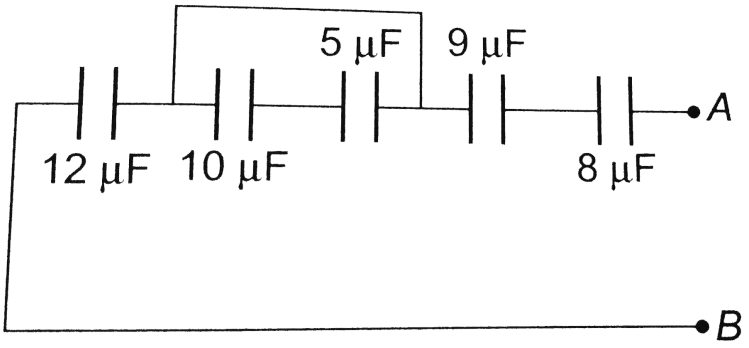
36. The capacities and connection of five capacitors are shown in the adjoining figure. The potential difference between the points A and B is 60 volts. Then the equivalent capacity between A and B and the charge on $5\mu F$ capacitance will be respectively



A. $44\mu, 300\mu C$

B. $16\mu F, 150\mu C$

C. $15\mu F, 200\mu C$

D. $4\mu F, 50\mu C$

Answer: D

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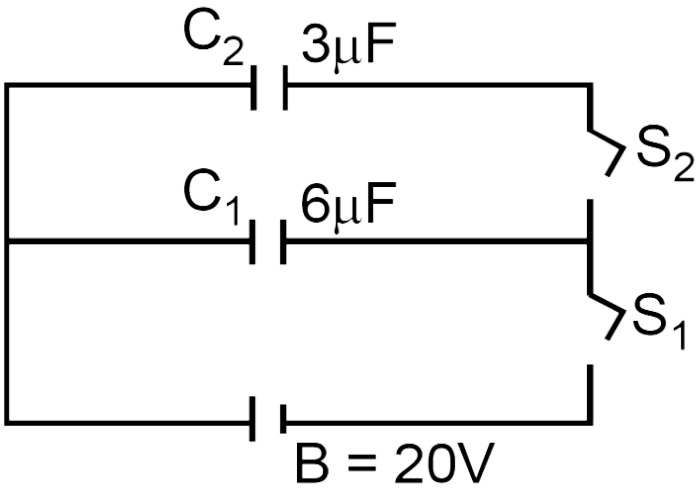
37. In the circuit shown here $C_1 = 6\mu F, C2 = 3\mu F$ and battery $B = 20V$. The Switch S_1 is first closed. It is then opened and afterwards S_2 is closed. What is the charge finally on C_2



A. $120\mu C$

B. $80\mu C$

C. $40\mu C$

D. $20\mu C$

Answer: C

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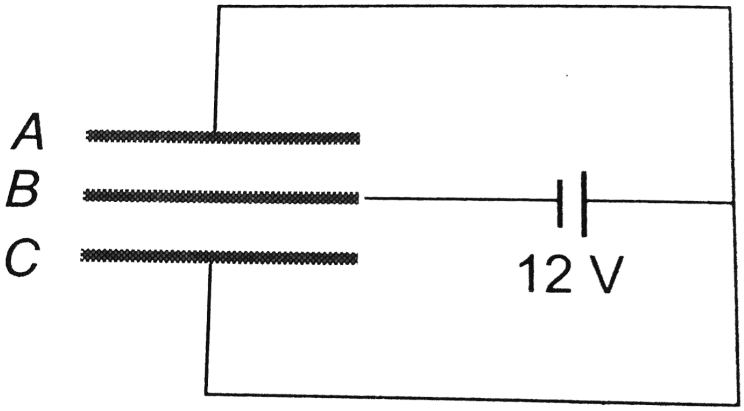
38. Three plates A, B, C each of area $50cm^2$ have separation $3mm$ between A and Bmm between B and C. The energy stored when the plates area fully charged is



A. $1.6 \times 10^{-9} J$

B. $2.1 \times 10^{-9} J$

C. $5 \times 10^{-9} J$

D. $7 \times 10^{-9} J$

Answer: B

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39. 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. $\frac{\mu s \triangle T}{C}$

B. $\sqrt{\frac{2ms \triangle T}{C}}$

C. $\sqrt{\frac{2mC \triangle T}{s}}$

D. $\frac{mC \triangle T}{s}$

Answer: B

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

A. $45pF$

B. $40.5pF$

C. $20.25pF$

D. $1.8pF$

Answer: B

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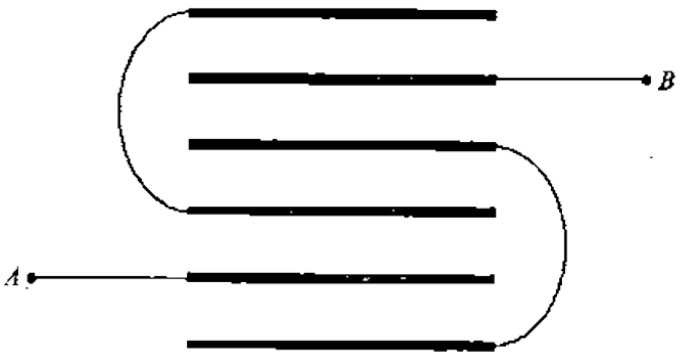
41. Six plates each of area A arranged as shown· in figure. The separation between adjoining plates is d. Find the equivalent capacitance between points A and B :



A. $\frac{\varepsilon_0 A}{d}$

B. $\frac{7\varepsilon_0 A}{d}$

C. $\frac{6\varepsilon_0 A}{d}$

D. $\frac{5\varepsilon_0 A}{d}$

Answer: A

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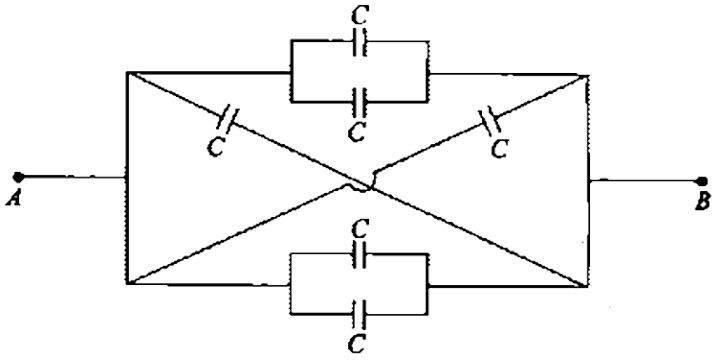
42. Six capacitors each of capacitance of $2\mu F$ are connected as shown in the figure. The effective capacitance between A and B is:



A. $12\mu F$

B. $8/3\mu F$

C. $3\mu F$

D. $6\mu F$

Answer: A

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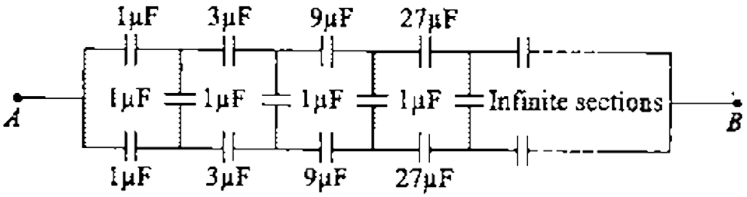
43. What is equivalent capacitance of ladder circuit shown in figure between points A and B?



A. $\frac{2}{3}\mu F$

B. $\frac{4}{3}\mu F$

C. Infinite

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

Answer: B

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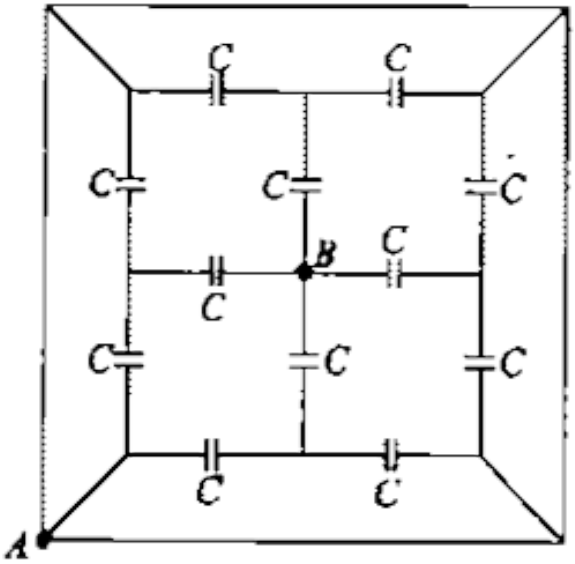
44. Find the equivalent capacitance between terminals A and B in the circuit shown in figure:



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

B. $\frac{8C}{3}$

C. $12C$

D. $\frac{5C}{12}$

Answer: B

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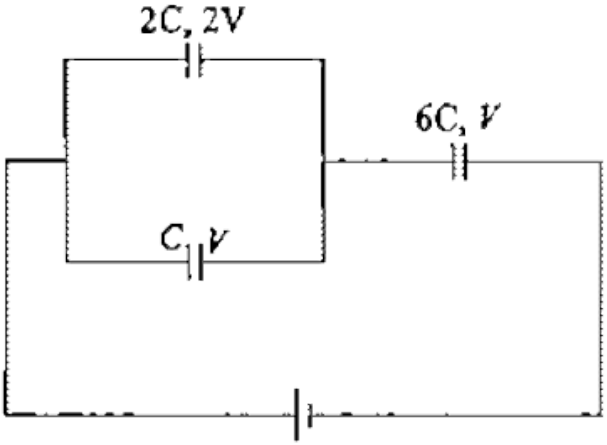
45. Circuit in figure shows three capacitors with capacitance and their breakdown voltage. What should be maximum value of the external source voltage such that no capacitor breaks down ?



A. $1V$

B. $2V$

C. $1.5V$

D. $4V$

Answer: C

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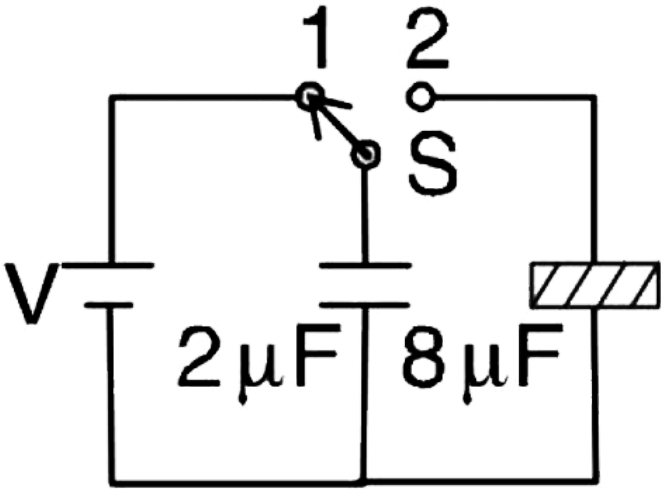
46. A $2\mu F$ capacitor is charged as shown in the figure. The percentage of its stored energy disispated after the switch S is turned to poistion 2 is



A. 0

B. 0.2

C. 0.75

D. 0.8

Answer: D

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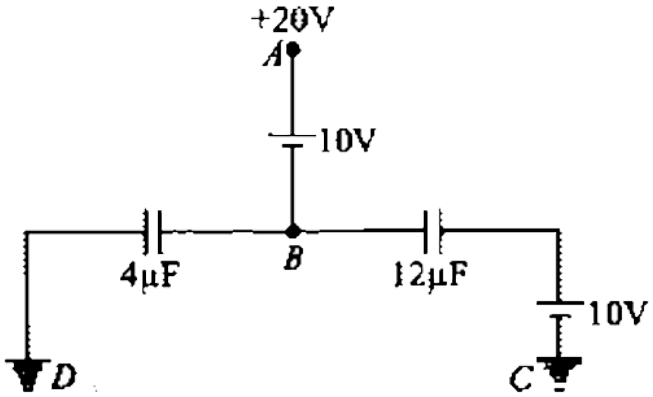
47. For the circuit shown in figure, which of the below options given is/are correct:



A. The charge on the $12\mu F$ capacitor is zero

B. The charge on the $12\mu F$ capacitor is $30\mu C$

C. The charge on thhe $4\mu F$ capacitor is $30\mu C$

D. None of these

Answer: A

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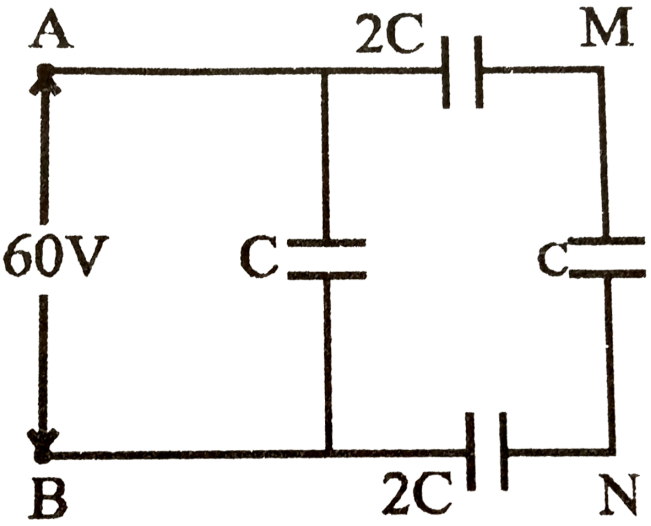
48. In the circuit shown, a potential difference of $60V$ is applied acrodd.

AB. The potential difference between the point M and N is-



A. $10V$

B. $15V$

C. $20V$

D. $30V$

Answer: D

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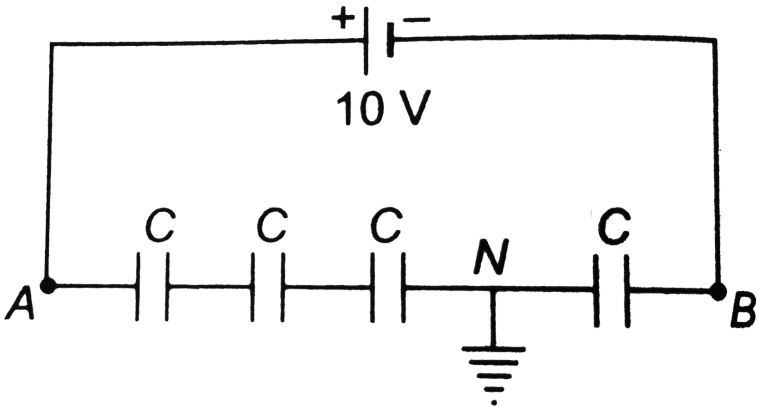
49. Four identical capacitors are connected in series with a $10V$ battery as shown in the figure. The point N is earthed. The potentials of points A and B are



A. $10V, 0V$

B. $7.5V, -2.5V$

C. $5V, -5V$

D. $7.5V, 2.5V$

Answer: B

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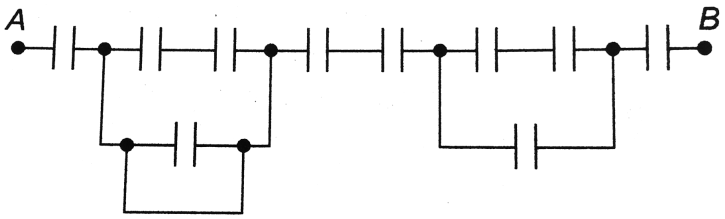
50. Find the equivalent capacitance across A and B for the arrangement shown in figure. All the capacitors are of capacitance C



A. $\frac{3C}{14}$

B. $\frac{C}{8}$

C. $\frac{3C}{16}$

D. None of these

Answer: A

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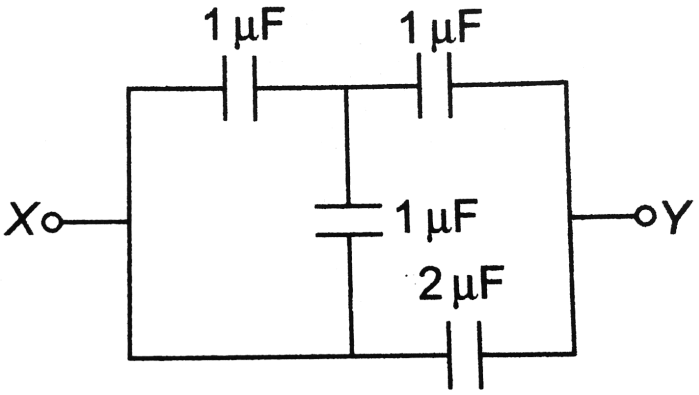
51. The equivalent capacitance between X and Y is



A. $5/6\mu F$

B. $7/6\mu F$

C. $8/3\mu F$

D. $1\mu F$

Answer: C

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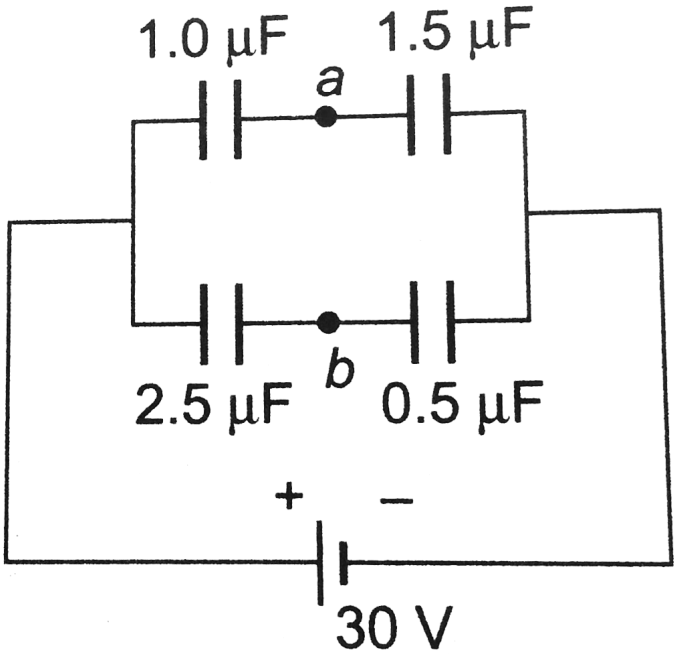
52. Four capacitors are connected as shown in figuere to a $30V$ battery.

The potential difference between points a and b



A. $5V$

B. $9V$

C. $10V$

D. $13V$

Answer: D

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53. The distance between the plates of a charged plate capacitor disconnected from the batteryis 5cm and the intensity of the field in it is $E = 300V/cm$. An uncharged metal bar $1cm$ thick is introduced into the capacitor parallel to its planes. The potential difference between the plates now is :

A. $1500V$

B. $1200V$

C. $900V$

D. Zero

Answer: B

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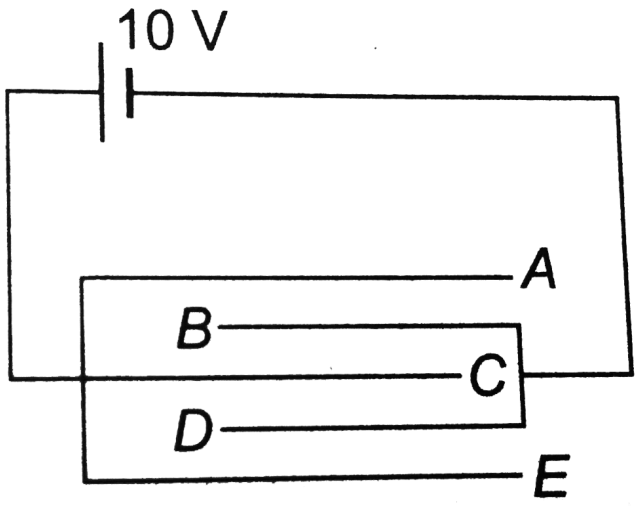
54. Five identical capacitor plates are arranged such that they make four capacitors each of $2\mu F$. The plates are connected to a source of emf $10V$. The charge on plate C is



A. $+20\mu C$

B. $+40\mu C$

C. $+60\mu C$

D. $+80\mu C$

Answer: B

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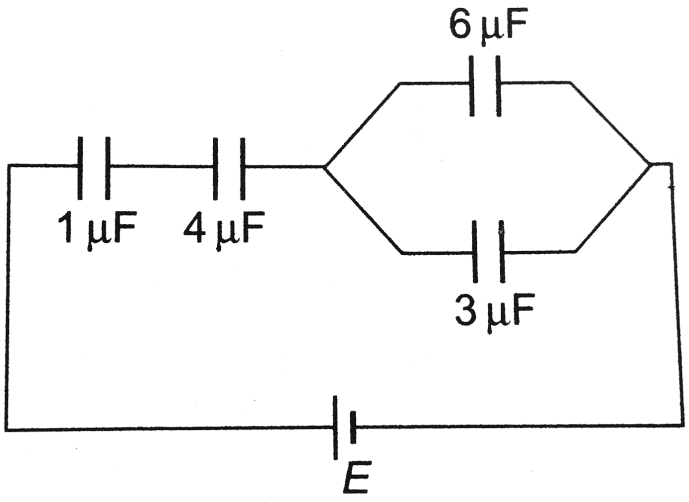
55. given that potential differene across $1\mu F$ capacitor is $10V$. Then,



A. Potential difference acros $4\mu F$ capacitor is $40V$

B. Potential difference across $4\mu F$ capacitor is $2.5V$

C. Potential difference across $3\mu F$ capacitor is $5V$

D. Value of E is $70V$

Answer: B

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56. A capacitor of capacity C is charged to a potential difference V and another capacitor of capacity $2C$ is charged to a potential difference $4V$. The charged batteries are disconnected and the two capacitors are connected with reverse polarity (i.e. positive plate of first capacitor is connected to negative plate of second capacitor). The heat produced during the redistribution of charge between the capacitors will be

A. $\frac{125CV^2}{3}$

B. $\frac{50CV^2}{3}$

C. $2CV^2$

D. $\frac{25CV^\circ}{3}$

Answer: D

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Advance Mcqs

1. While a capacitor remains connected to a battery and dielectric slab is applied between the plates, then

A. The charge supplied by the battery increases.

B. The capacitance of the system increases.

C. The electric field in the capacitor B increases.

D. The electrostatic potential energy of A decreases.

Answer: A::B

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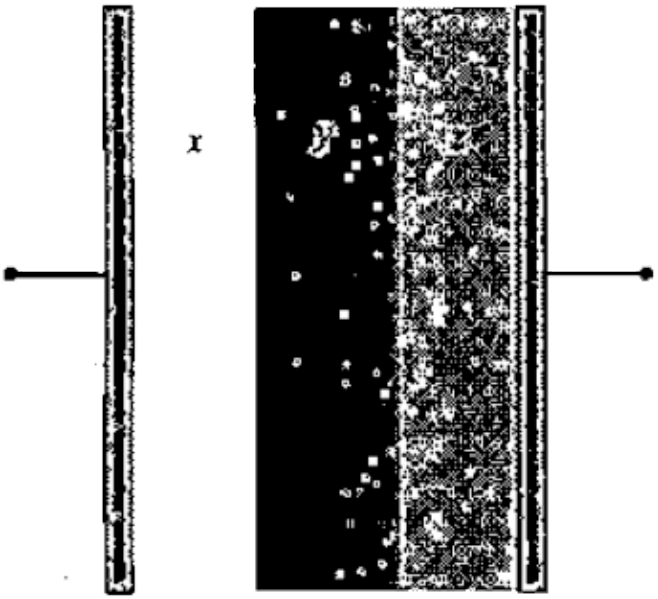
2. The figure shows a capacitor having three dielectric layers parallel to its plates. Layer x is vacuum, y is conductor and z is a dielectric. Which of the

following change(s) will result in increase in capacitance ?



A. Replace x by conductor

B. Replace y by dielectric

C. Replace z by conductor

D. Replace x by dielectric

Answer: A::C::D

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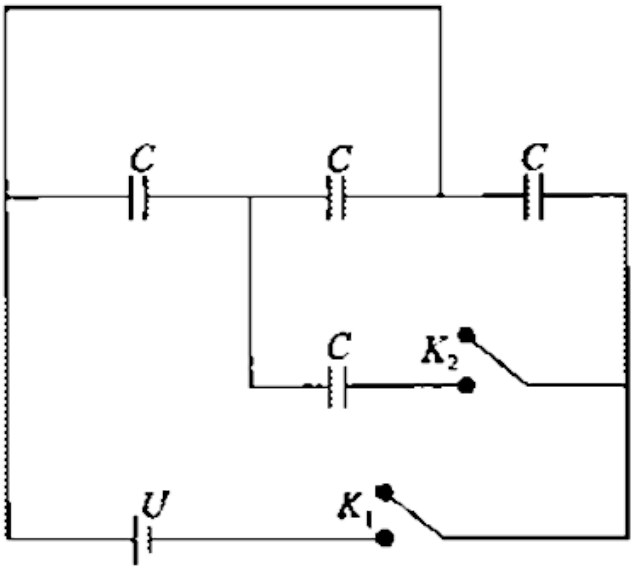
3. How does the total energy stored in the capacitors in the circuit shown in the figure change when first switch K_1 is closed (process-1) and then switch K_2 is also closed (process-2), Assume that all capacitor were initially uncharged?



A. Increases in process-1

B. Increases in process-2

C. Decreases in process-2

D. Magnitude of change in process-2 is less than that in process -1

Answer: A::B::D

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4. 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 plate increases

C. The capacitance increases

D. the electrostatic energy stored in the capacitor increases

Answer: B::D

Watch Video Solution

5. The plates of a parallel-plate capacitor are separated by a solid dielectric. This capacitor and a resistor are connected in series across the terminals ofa battery. Now the plates of the capacitor are pulled slightly further apart. After some time circuit again attains steady state.

A. The potential difference across the plates has increased

B. The energy stored on the capacitor has decreased

C. The capacitance of the capacitor has increased

D. The battery ,would have gained energy

Answer: B::D

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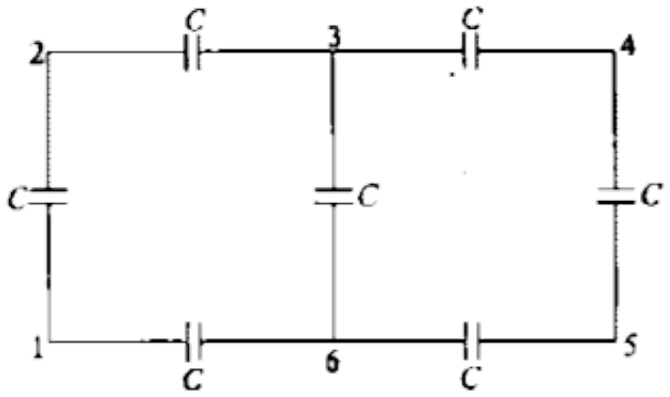
6. For the given circuit shown in figure which of the following statements is/are correct



A. The equivalent capacitance between.points 1 and 2 is $\frac{15C}{11}$

B. The equivalent capacitance between poiots 3 and 6 is $\frac{5C}{3}$

C. The equivalent capacitance between points 1 and 3 is $\frac{15C}{14}$

D. The equivalent capacitance between points 3 and 5 is $\frac{14C}{15}$

Answer: A::B::C

Watch Video Solution

7. Capacitor C_1 of the capacitance $1\mu F$ and another capacitor C_2 of capacitance $2\mu F$ are separately charged fully by a common battery.The

two capacitors are then separately allowed to discharge through equal resistors at time $t = 0$.

A. The current in each of the two discharging circuits is zero at $t = 0$

B. The current in the two discharging circuits at $t = 0$ are equal but not zero

C. The currents in the two discharging circuits at $t = 0$ are unequal

D. Capacitor C_1 loses $50\,\%$ of its initial charge sooner than C_2 loses $50\,\%$ of its initial charge

Answer: B::D

Watch Video Solution

8. A capacitor of capacity C_0 is conneted to a battery of emfV_0 When steady state is attained a dielectric slab of dielectric constant K is slowly introduced in the capacitor to fill the capacitor completely. Mark the correct statement(s), in final stady state.

A. Magnitude of induced charge on the each surface of slab is

$C_0V_0(k-1)$

B. Electric force due to induced charges on any plate is zero

C. Force of attraction between plates ofcapacitor is $\frac{k(C_0V_0)^2}{2\varepsilon_0 A}$

D. Field due to induced charges in dielectric slab is $\frac{(k-1)C_0V_0}{\varepsilon_0 A}$

Answer: A::B::D

Watch Video Solution

9. A dielectric slab fills the space between the square plates of a parallel-plate capacitor. The side of each plate of the capacitor is L. The magnitude of the bound charges on the slab is $75\ \%$ of the magnitude of the free charge on the plates. The capacitance is $480\mu F$ and the maximum charge that can be stored on the capacitor is $240\varepsilon_0 L^2 E_{\max}$, where $E_{\max}$ is the breakdown strength of the medium:

A. The dielectric constant for the dielectric slab is 4

B. Without the dielectric, the capacitance of the capacitor would be $360\mu F$

C. The plate area is $60L^2$

D. If the dielectric slab is having the same area as that of the capacitor plate but the width is half the separation between plates of capacitor, the capacitance would be $192\mu F$

Answer: A::C::D

View Text Solution

10. In a spherical capacitor,-we have two concentric spherical shells, the inner one carrying a charge Q and outer one carrying a charge of $-Q$. If the inner shell is displaced from the center without touching the outer shell :

A. The capacitance of the capacitor will increase

B. The capacitance of the capacitor will remain same

C. The energy of capacitor with decrease

D. The potential difference between inner and outershell will increase

Answer: A::C::D

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11. 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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12. A capacitor with no dielectric is connected to a battery at t=0.Consider a point A in the connecting wires and a point B in between the plates.

A. There is no current through A.

B. There is displacement current through B till electric field changes between the plates.

C. There is a current through A as long as the charging is not complete.

D. The current always flows between the plates of capacitor.

Answer: B::C

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13. Each plate of a parallel plate capacitor has a charge q on it. The capacitor is now connected to a battery. Now

A. The facing surfaces of the capacitor have equal and opposite charges.

B. The two plates of the capacitor have equal and opposite charges.

C. The battery supplies equal and opposite charges to the two plates.

D. The outer surfaces of the plates have equal charges.

Answer: A::C::D

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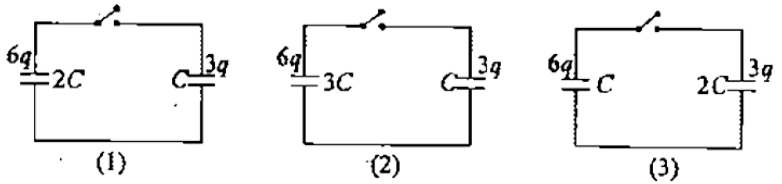
14. Figure shows three circuits, each consisting of a switch and two capacitors, initially charged as indicated in the figure. In which circuit the charge on the left hand capacitor will change after the closing of the

switch :



A. 1

B. 2

C. 3

D. All

Answer: B::C

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15. 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 $3d$:

A. The magnitude of the electric field remains the same

B. The direction of the electric field remains 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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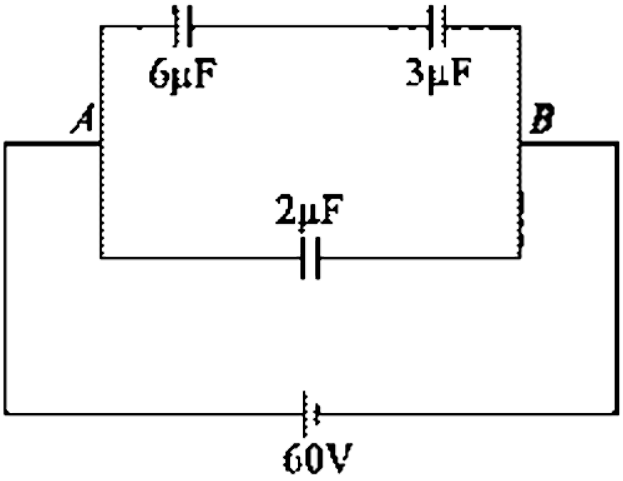
16. In the circuit shown, the potential difference across the $3\mu F$ capacitor is V and the equivalent capacitance between A and B is C Then:



A. $C = 4\mu F$

B. $C = 11\mu F$

C. $V = 20V$

D. $V = 40V$

Answer: A::D

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17. Two identical parallel plate capacitors of same dimensions joined in series are connected to a constant voltage source. When one of the

plates of one capacitor are brought closer to the other plate :

A. The voltage on the capacitor whose plates come closer is greater than the voltage on the capacitor whose plates are not moved

B. The voltage on the capacitor whose plate come closer is lesser than the voltage on the capacitor whose plates are not moved

C. The voltage on the two capacitor remain equal

D. The applied voltage is divided among the two inversely as the capacitance

Answer: B::D

Watch Video Solution

18. A parallel plate capacitor is first connected to a constant voltage source. It is then disconnected and ·then immersed in a liqnid dielectric, then:

A. The capacitance increases

B. The liquid level between the plates increases

C. The liquid level will remain same as that outside the plates

D. The potential difference between the plates will decrease

Answer: A::B::D

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19. 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 remains constant

D. A work is done by an external agent in pulling the slab out

Answer: B::C::D

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20. In a parallel plate capacitor, the region between the plates is filled by a dielectric slab. The capacitor is charged from a cell and then disconnected from it. The slab is now taken out :

A. The potential difference across the capacitor increases

B. The charge on the capacitor is increased

C. The energy stored in the capacitor increases

D. A work is done by the external agent in taking the slab out

Answer: A::C::D

Watch Video Solution

21. A parallel plate capacitor is connected across a source of covstant potential difference. If a dielectric slab is introduced between the two plates, then

A. Charge on capacitor increases

B. Some charge from the capacitor will flow back into the source

C. He electric field between the plates will decrease

D. The electric field between the plates will not change

Answer: A::D

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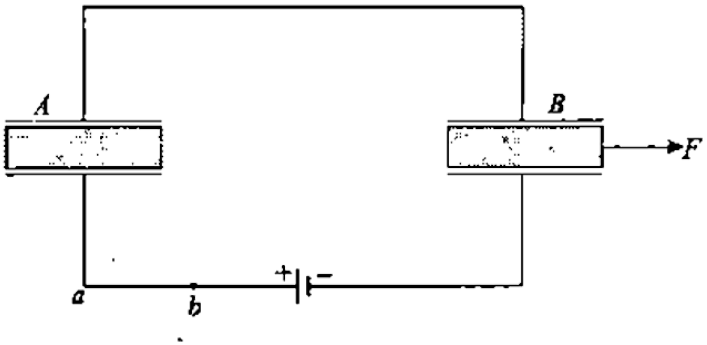
22. Identical dielectric slabs are inserted into two identical capacitors A and B. These capacitors and a battery are connected as shown in figure. Now the slab of capacitor B is pulled out with battery remaining

connected



A. During the process, charge flows from a to b

B. Finally charge on capacitor B will be less than that on capacitor A

C. During the process, work is done by the external force F, which appears as heat in the circuit

D. During the process, internal energy of the battery increases

Answer: A::C

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23. A parallel plate air capacitor is connected to a battery. If plates of the capacitor are pulled farther apart, then which of the following statements is/are correct ?

A. Strength of electric field inside the capacitor remains unchanged, if battery is disconnected before pulling the plate

B. During the process, work is done by external force applied to pull the plates either battery is disconnected or it remains connected

C. Stored energy in the capacitor decreases if the battery remains connected

D. None of these

Answer: A::B::C

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24. When two identical capacitors are charged individually to different potentials & then connected in parallel, after disconnecting from the source then

A. Net potential difference across them is equal to sum of individual potential differences

B. Net potential difference across them is not equal to sum of individual initial potential differences

C. Net energy stored in the two capacitors is less than the sum of individual initial energies

D. None of these

Answer: B::C

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25. The plates of a parallel plate capacitor are, not exactly parallel. The surface charge density therefore :

A. Is higher at the closer end

B. The surface charge densitywill not be uniform

C. Each plate will have the same potential at each point

D. The electric field is smallest where the plates are closest

Answer: A::B::C

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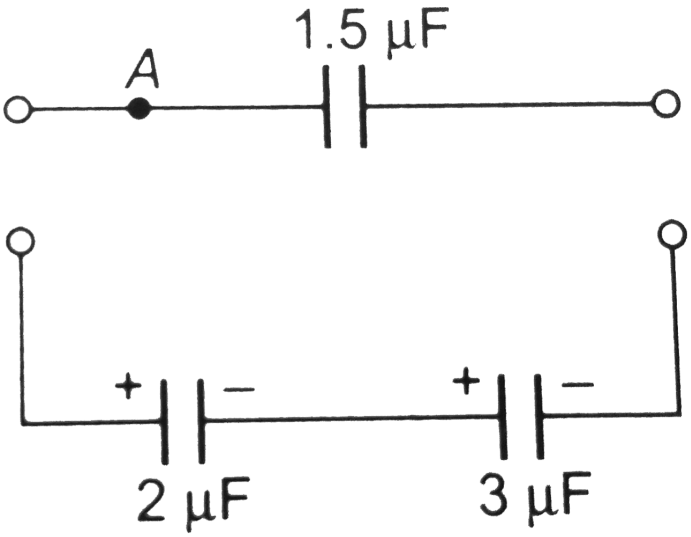
26. Two capacitors of $2\mu F$ and $3\mu F$ are charged to $150V$ and $120V$, respectively. The plates of capacitor are connected as shown in the figure. An uncharged capacitor of capacity $1.5\mu F$ falls to the free end of the

wire. Then



A. Charge on $1.5\mu F$ capacitoris $180\mu C$

B. Charge on $2\mu F$ capacitor is $120\mu C$

C. Positive charge flows through A from right to left

D. Positive charge flows through A from left to right

Answer: A::B::D

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Unsolved Numerical Problems

1. 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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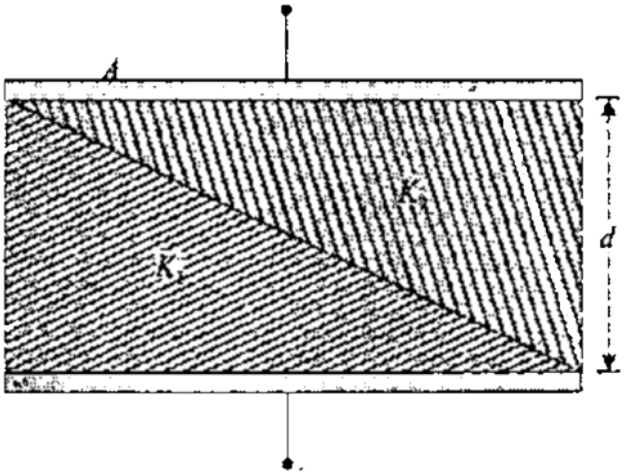
2. The capacitance of a parallel plate capacitor with plate area A and separation d is C. The space between the plates in filled with two wedges of dielectric constants K_1 and K_2 respectively. Find the capacitance of

resulting capacitor.



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3. Two conducting objects one with charge of $+Q$ and another with $-Q$ are kept on x-axis at $x = -3$ and $x = +4$ respectively. The electric field on the x-axis is given by $3Q\left(x^2 + \frac{4}{3}\right)$. What is the capacitance C of this configuration of objects?

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4. An air cylindrical capacitor eith a dc voltage $V = 200V$ applied across it is being submerged vertivally into a vessel filled with water at a velocity $v = 5.0mm/s$. The electrodes of the capacitors are separated by a distance $d = 2.0mm$, the mean curvature radius of the electrodes is equal to $r = 50mm$. Find the current flowing in this case along lead wires, if $d < < r$.

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5. Between the plates of a parallel-plate capacitor there is a metallic plate whose thickness takes up $\eta = 0.60$ of the capacitor gap. When that plate is absent the capacitor has a capacity $C = 20nF$. The capacitor is connected to a dc voltage source $V = 100V$. The metallic plate is slowly extraced from the gap. Find :

(a) the energy increment of the capacitor,

(b) the mechanical work performed in the process of plate extraction.

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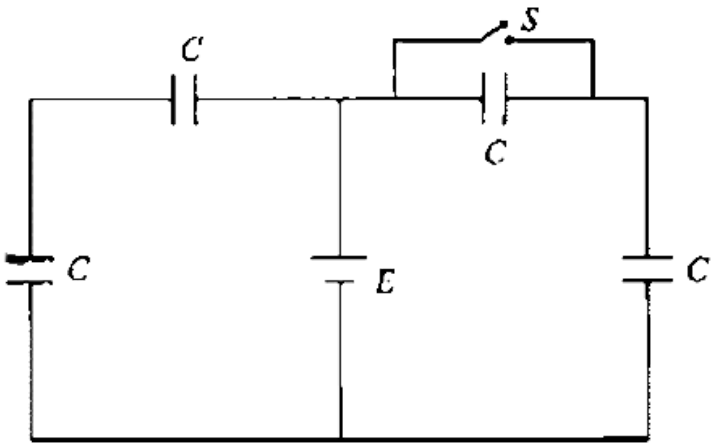
6. In the circuit shown in figure, each capacitor has a capacitance C and cell voltage is E. If switch S is closed, then calculate the work done by battery after closing the switch.



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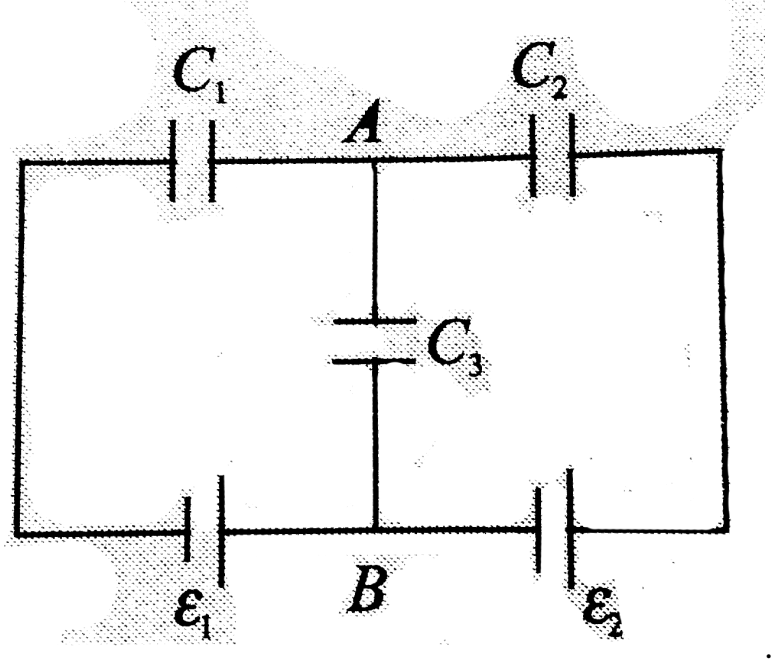
7. Find the potential differnce $V_A - V_B$ between points A and B of the circuit shown in.



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8. (a) Find the capacitance of spherical capacitor having concentric shells of radii a a and $b(b > a)$. The space between the shells is completely filled by a dielectric of constant k.

(b) Find the capacitance if dielectric is filled upto an intermediate radius $c(a < c < b)$ between the shells.

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9. If half the space between two concentric conducting spheres be filled with dielectric of dielectric constant k and the rest is filled with air. Show that the capacitance of the capacitor thus formed will be same as if the whole part is filled with the dielectric of dielectric constant $\frac{1}{2}(1+k)$:

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10. Two, capacitors A and B are connected in series across a $100V$ supply and it is observed that the potential difference across them are $60V$ and $40V$. A capacitor of $2p.\ F$ capacitance is now connected in parallel with A and the potential difference across B rises to $90V$. Determine the capacitance of A and B

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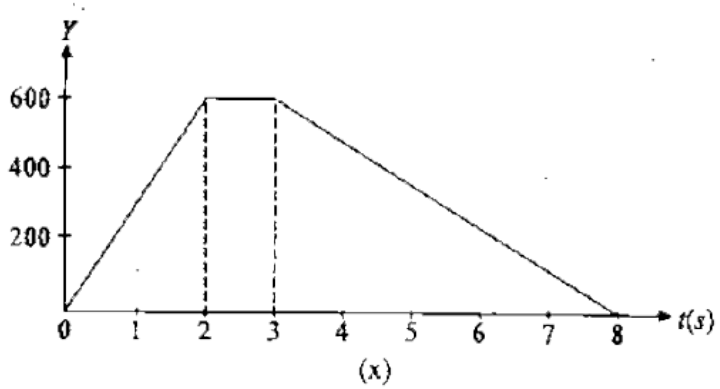
11. The voltage applied across a capacitor having a capacitance of $10\mu F$ is varies as shown in figure:



At the time instant when the terminal voltage across capacitor is 600V calculate

(a) The charge on capacitor ltBrgt (b) The energy stored in the capacitor

(c) Draw the curve of current in connecting wires as a function of time.

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12. A capacitor of capacitance C is charged by connecting it to a battery of emf epsilon. The capacitor is now disconnected and reconnected to the battery with the polarity reversed. Calculate the heat developed in the connecting wires.

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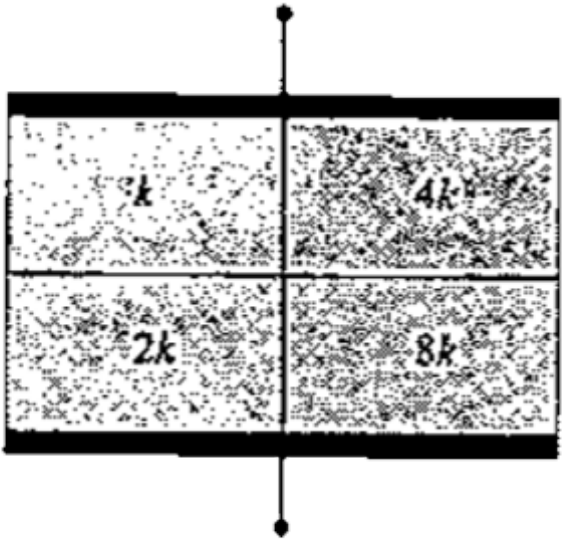
13. Find capacitance of the capacitor shown in figure: in which four same sized dielectric slabs are inserted with their



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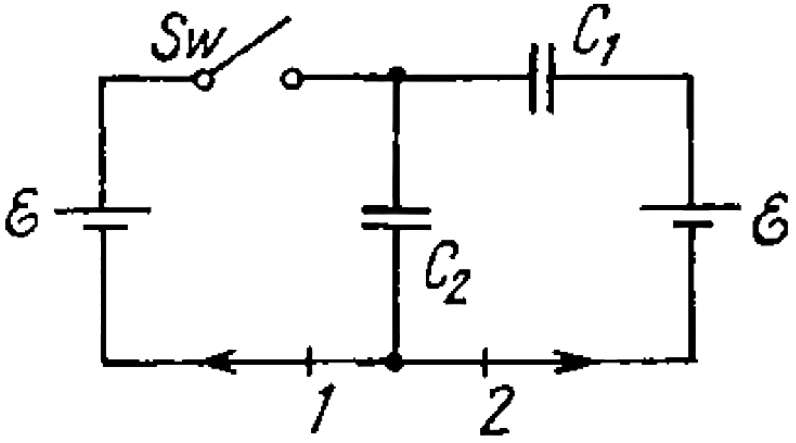
14. What charges will flow after the shorting of the swich Sw in the circuit illustrated in Fig through sections 1 and 2 in the directions indicated by

the arrown?



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15. A $1\mu F$ capacitor and a $2\mu F$ capacitor are connected in series across a $1200V$ supply line.

a. Find the charge on each capacitor and the voltage across them.

b. The charged capacitors are disconnected from the line and from each other and reconnected with terminals of like sign together. Find the final charge on each and the voltage across them.

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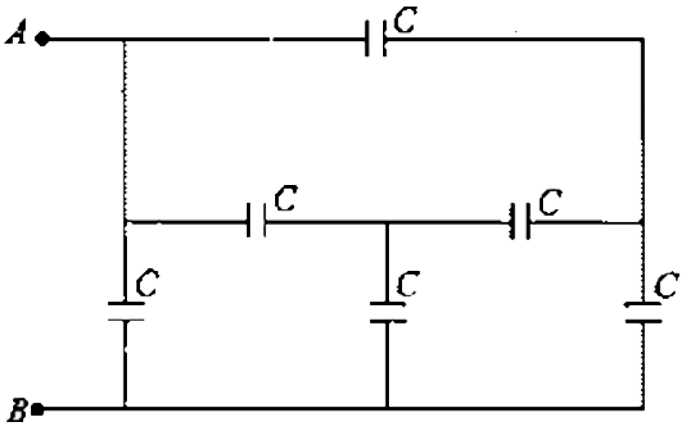
16. If the total capacitance of the combination of identical capacitors shown in figure between A and B is given by nC then find n.



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17. A $100\mu F$ capacitor is charged to $100V$. After the charging, battery is disconnected. The capacitor is then connected in parallel to another capacitor. The final voltage is $20V$. Calculate cap the capacity of second capacitor.

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18. The dielectric to be used in a parallel-plate capacitor has a dielectric constant of 3.60 and a dielectric strength of $1.60 \times 10^7 V/m$. The capacitor is to have a capacitance of $1.25 \times 10^{-9} F$ and must be able to withstand a maximum potential difference of $5500V$. What is the minimum area the plates of the capacitor may have?

Watch Video Solution

19. The space between the plates of a parallel plate air capacitor is filled with an isotropic dielectric medium of which dielectric constant varies in the direction perpendicular to the plates according to the relation given as

$$k = k_1\left[1 + \sin\frac{\pi}{dx}\right]$$

Where d is the separation, between the plates and k_1 is a constant. The area of the plates is A. Determine the capacitance of the capacitor.

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20. Two condensers A and B each having slabs of dielectric constant $K = 2$ are connected in series. When they are connected across $230V$ supply, potential difference across A is $130V$ and that across B is $100V$. If the dielectric in the condenser of smaller capacitance is replaced by one for which $K = 5$, what will be the values of potential difference across them?

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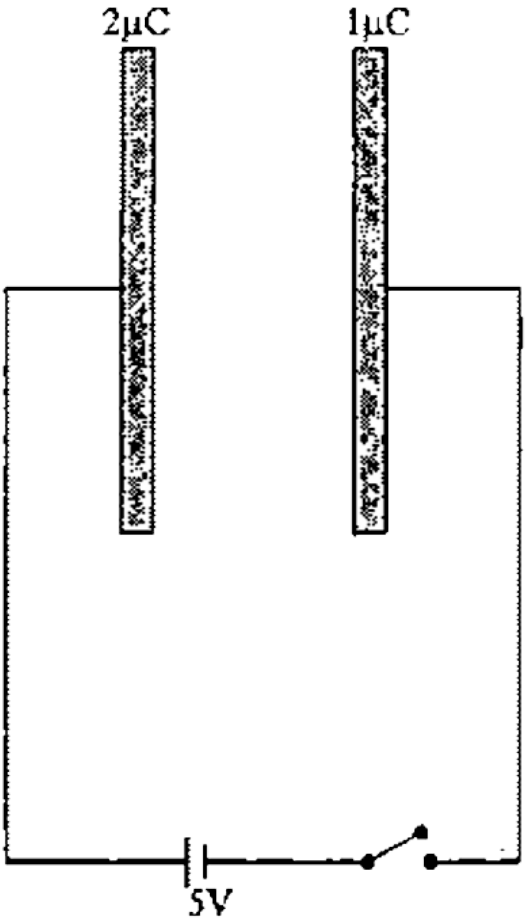
21. A parallel plate capacitor of capacitance $0.1\mu F$ is shown in the figure. Its two plates are given charges $2\mu C$ and $1\mu C$. Find the value of heat

dissipated after switch is closed :



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22. Two identical planar capacitor connected in parallel and charged to a voltage $U_0 = 12V$. When you disconnect them from the voltage source,

the distance between the plates of one of the capacitors is reduced to one third of the original distance. What will be the new voltage on the capacitors ?

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23. A parallel - plate capacitor of plate area A and plate separation d is charged to a potential difference V and then the battery is disconnected . A slab of dielectric constant K is then inserted between the plate of the capacitor so as to fill the space between the plate .Find the work done on the system in the process of inserting the slab.

Watch Video Solution

24. A parallel plate vacuum capacitor with plate area A and separation x has charges $+Q$ and $-Q$ on its plates. The capacitor is disconnected from the source of charge, so the charge on each plate remains fixed.

(a) What is the total energy stored in the capacitor?

(b) The plates are pulled apart an additional distance dx. What is the

change in the stored energy?

(c) If F is the force with which the plates attract each other, then the change in the stored energy must equal the work $dW = Fdx$ done in pulling the plates apart. Find an expression for F.

(d) Explain why F is not equal to QE, where E is the electric field between the plates.

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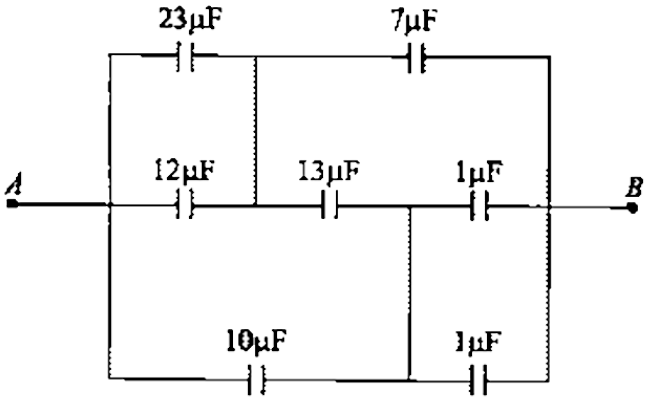
25. Find the equivalent capacitance across terminals A and B in the circuit shown in figure.



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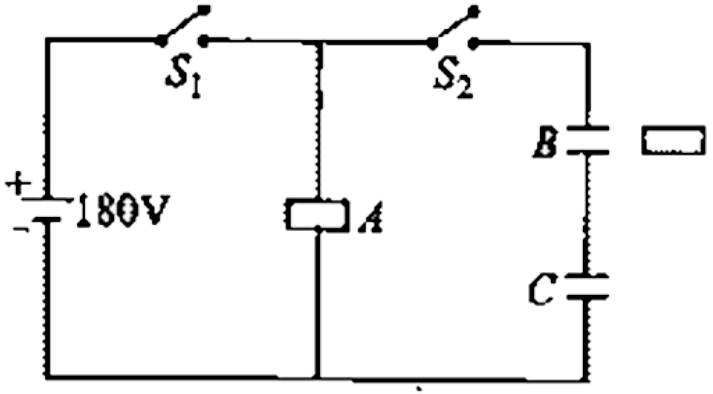
26. In the circuit shown in figure, capacitor A has capacitance $C_1 = 2\mu F$ when filled with a di-electric slab of dielectric constant $k = 2$. Capacitors B and C are air capacitors and have capacitances $C_2 = 3\mu F$ and $C_3 = 6\mu F$, respectively. A is charged by closing switch S_1 alone



(a) Calculate energy supplied by battery during process of charging. Switch S_1 is now opened and S_2 is closed.

(b) Calculate charge on B and energy stored in the system when electrical equilibrium is attained. Now switch S_2 is also opened, slab of A is removed. Another di-electric slab of $K = 2$, which can just fill the space in B, is inserted into it and then switch S_2 alone is closed.

(c) Calculate by how many times electric field in B is increased. Calculate also, loss. of energy during redistribution of charge.

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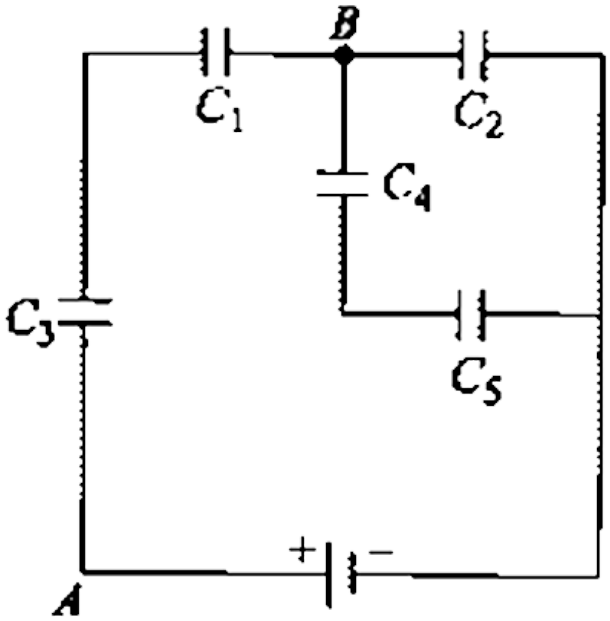
27. In the circuit shown in figure $C_1 = 5\mu F, C_2 = 29\mu C, C_3 = 6\mu F, C_4 = 3\mu F$ and $C_4 = 7\mu F$. If in steady state potential difference between points A and B is 11 volt, calculate potential difference across C_3.



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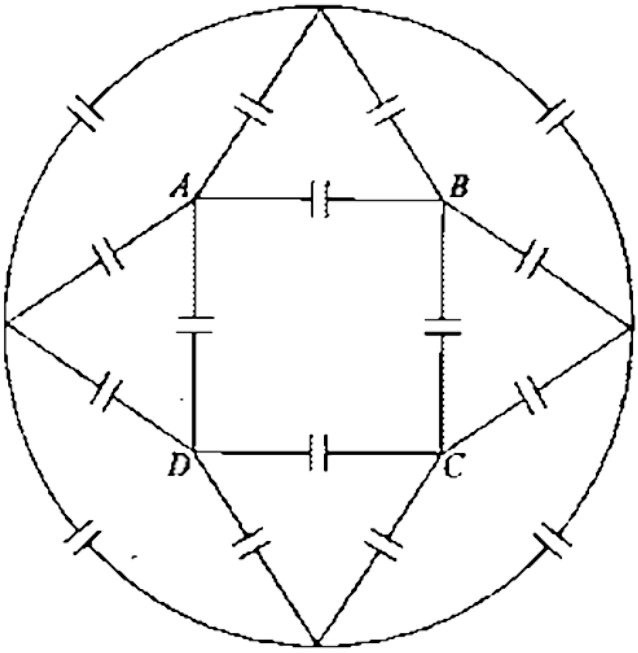
28. Find the equivalent capacitance between terminals A & C, if each capacitor is of capacitance $4\mu F$



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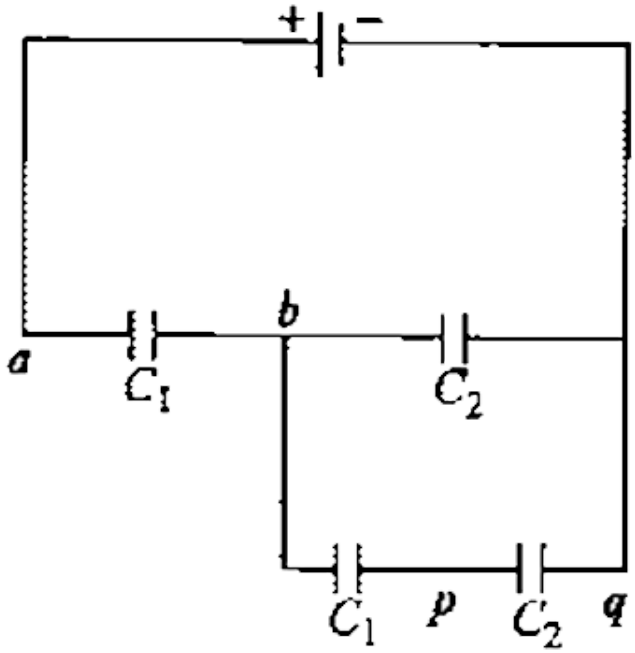
29. In the given network if potential difference between p and q is $2V$ and $C_2 = 3C_1$, find the potential difference between a & b.



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30. The plates of a parallel plate capacitor are separated by a distance $d = 1cm$. Two parallel sided dielectric slabs of thickness $0.7cm$ and $0.3cm$ fill the space between the plates. If the dielectric constants of the two slabs are 3 and 5 respectively and a potential difference of $440V$ is applied across the plates. Find (a) The electric field intensities in each of the slabs. (b) The ratio of electric energies stored in the first to that in the second dielectric slab.

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31. Two parallel plate capacitors of capacitance C and $2C$ are connected in parallel then following steps are performed.

(i) A battery of voltage V is connected across the capacitors.

(ii) A dielectric slab ofrelative permittivity k is slowly inserted in capacitor C.

(iii) Battery is disconnected.

(iv) Dielectric slab is slowly removed from capacitor.

Find the heat produced in (i) and work done by external aent in step (ii) & (iv).

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32. A charge $200mC$ is imparted to .each of the two identical parallel plate capacitors connected in parallel. At $t = 0$, the plates ofboth the capacitors are $0.1m$ apart. The plates of first capacitor move towards

each other with velocity $0.001m$ is and plates of second capacitor move apart with the same velocity. Find the current in the circuit.

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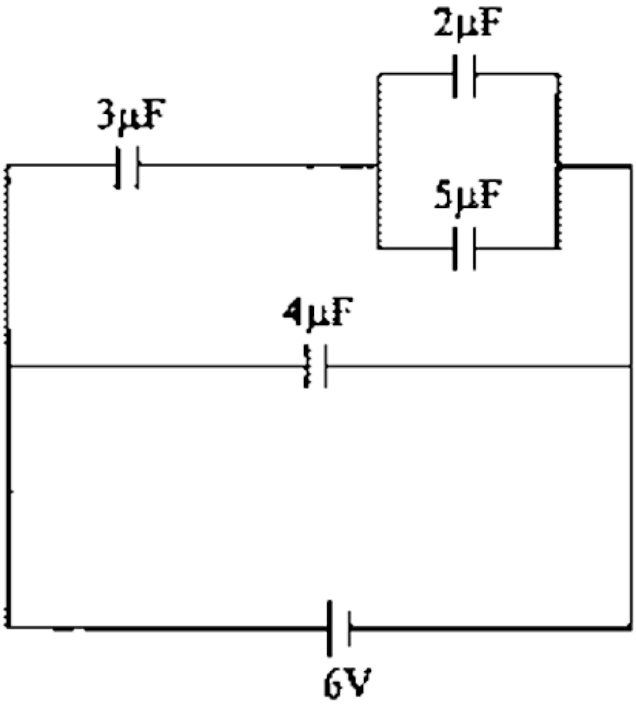
33. A circuit is shown in figure. Find the charge on the condenser having a capacity of $5\mu F$ in steady state.



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34. 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.

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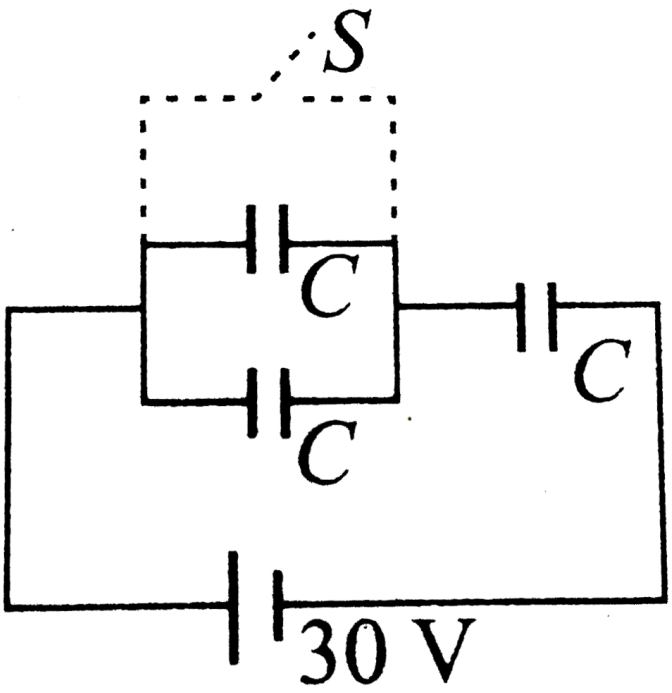
35. Three capacitors each having capacitance $C = 2\mu F$ are connected with a battery of emf$30V$ as shown in. when the switch S is closed, find

a. the amount of charge flowing through the battery ,

b. the heat generated in the circuit,

c. the energy supplied by the battery,

d. the amount of charge flowing through the switch S.



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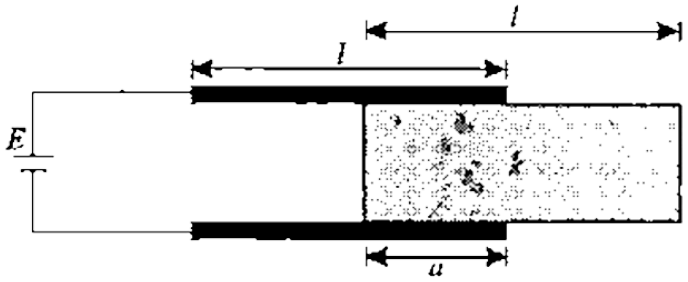
36. Consider the situation shown in figure. The plates of the capacitor have plate area $1A = lb1$ and are clamped in the laboratory. The dielectric slab is released from rest with length a inside the capacitor. Neglecting any effect of friction or gravity, show that the slab will execute

periodic motion and find its time period.



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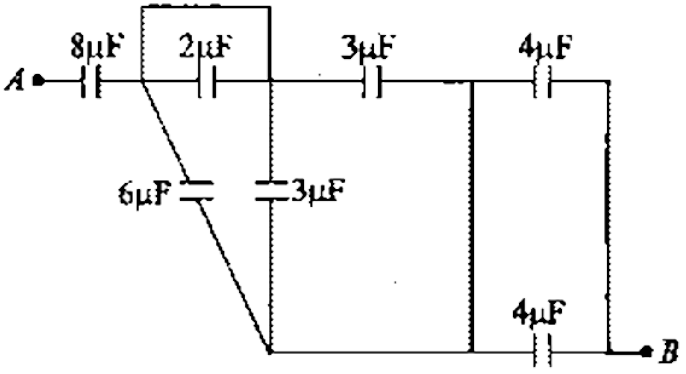
37. In the circuit shown in figure find the equivalent capacitance between terminals A and B.



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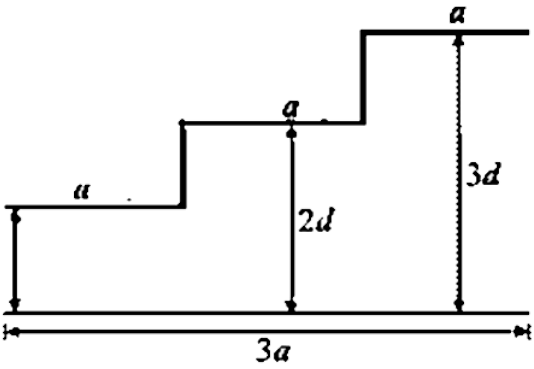
38. A capacitor is made of a flat plate of area A and another plate is bent at four points and placed above the flat plate as shown in figure. Dimension of both the plates are shown in figure. Find the capacitance of this structure between the two plates.



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39. A parallel -plate capacitor with the plate area $100cm^2$ and the separation between the plate $1.0cm$ is connected across a battery of emf 24 volts .Find the force of attraction between the plates.

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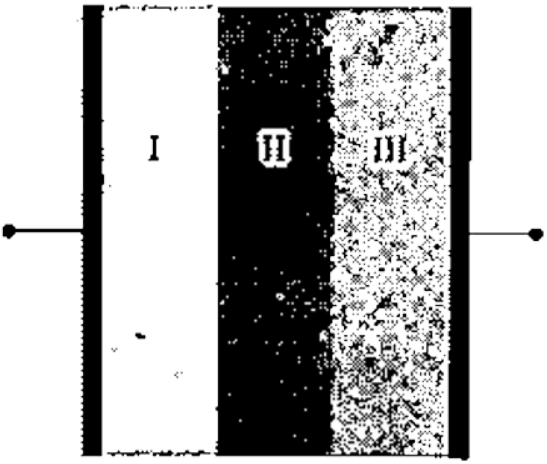
40. Figure shows a capacitor having three layers of equal thickness and same area as that of its plates. Layer-I is free space, Layer-II is a conductor and Layer-Ill is a dielectric of dielectric constant k. Calculate the ratio of energy stored in region III to total energy stored in capacitor when a potential difference is applied across the plates of capacitor.



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