PHYSICS

BOOKS - DC PANDEY ENGLISH

CAPACITORS

Solved Examples

1. Capacitance of a conductor is $1\mu F$. What charge is required to raise its potential to $100V$?

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2. Radius of a spherical conductor is $2m$, This is kept in dielectric medium of dielectric constant $10^6 N/C$. Find

a. capacitance of the conductor

b. maximum charge which can be stored on this conductor.

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3. Two isolated sphereical conductors have radii $5cm$ and $10cm$, espctively They have charges of $12\mu C$ and $-3\mu C$. Find the charges after they are connected by a conductng wire. Also find the common potential after resistribution.

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4. An insulated conductor initiallly free from charge is charged by repeated contacts with a plate which after each contact is replenished to a charge Q. If q is the charge on the conductor after first operation prove that the maximum charge which can be given to the conductor in this way is $\dfrac{Qq}{Q-q}$

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5. A conducting sphere S_1 of radius r is attached to an insulating handle. Another conduction sphere S_2 of radius R is mounted on an insulating stand. S_2 is initially uncharged. S_1 is given a charge Q brought into contact with S_2 and removed. S_1 is recharge such that the charge on it is again Q and it is again brought into contact with

S_2 and removed. This procedure is repeated n times.

a. Find the electrostatic energy of S_2 after n such contacts with S_1.

b. What is the limiting value of this energy as $n \rightarrow \infty$?

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6. A parallel plate capacitor has capacitance of $1.0F$. If the plates are $1.0mm$ apart, what is the area of the plates?

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7. Two parallel plate vacuum capacitors have areas A_1 and A_2 and equal plate spacing d. Show that when the capacitors are connected in parallel, the equivalent capacitance is the same as for a single capacitor with plate area $A_1 + A_2$ and spacing d.

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8. a. Two spheres have radii a and b and their centres are at a distance d apart. Show that the capacitance of this system is

$$C = \frac{4\pi\varepsilon_0}{\frac{1}{a} + \frac{1}{b} \pm \frac{2}{d}}$$

provided that d is large compared with a and b.

b. Show that as d approaches infinity the above result reduces to that of two islotated spheres inseries.

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9. A capacitor is given a charge q. The distance between the plates of the capacitor is d. One of the plates is fixed and the other plate is moved away from the other till the distance between them becomes $2d$. Find the work done by the external force.

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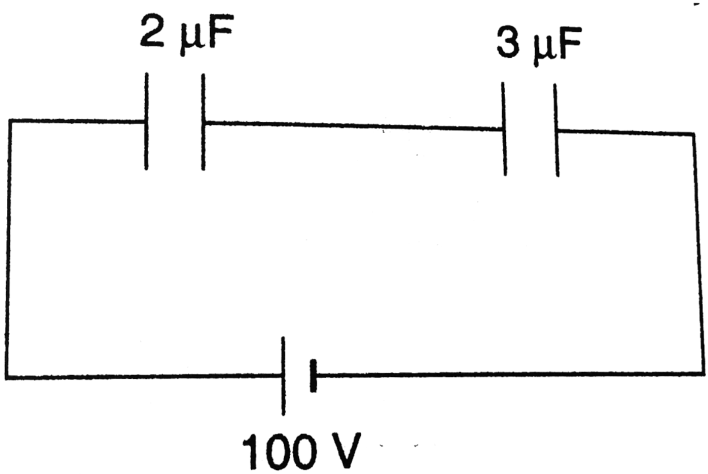
10. In the circuit shown in figure find



a. the equivalent capacitance

b. the charge stored in each capacitor and

c. the potential difference across each capacitor.

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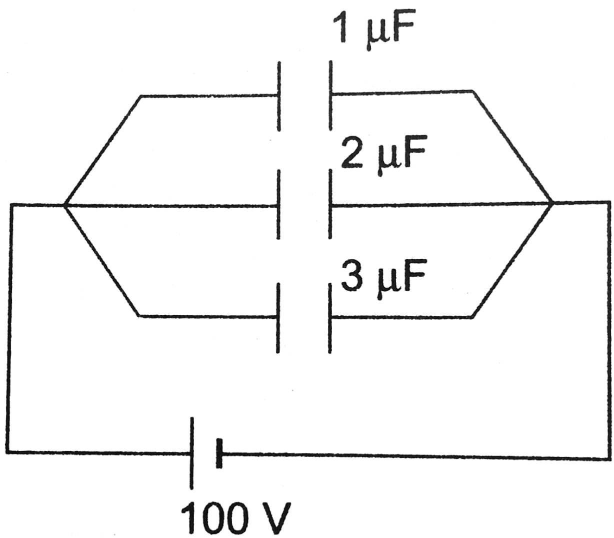
11. In the circuit shown in figure find



a. the equivalent capacitance and

b. the charge stored in each capacitor.

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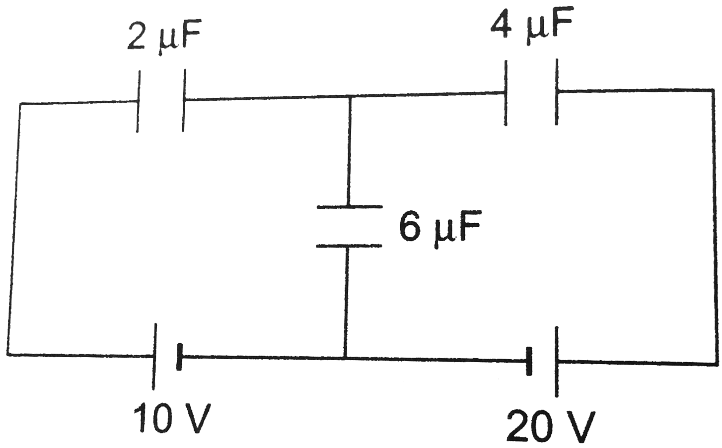
12. Find the charges on the three capacitors shown in figure



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13. Using the concept of energy density, find the total energy stored in a

a. parallel plate capacitor

b. charged spherical conductor.

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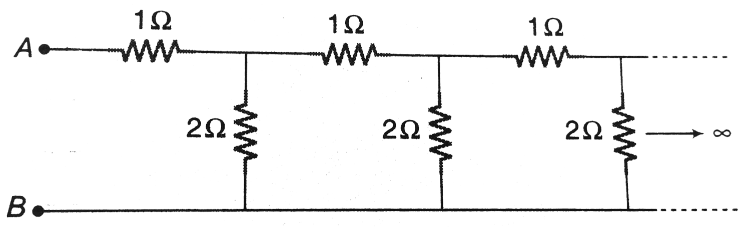
14. An infinite ladder network is constructed with 1Ω and 2Ω resistors as shown. Find the equivalent resistance points A and B.



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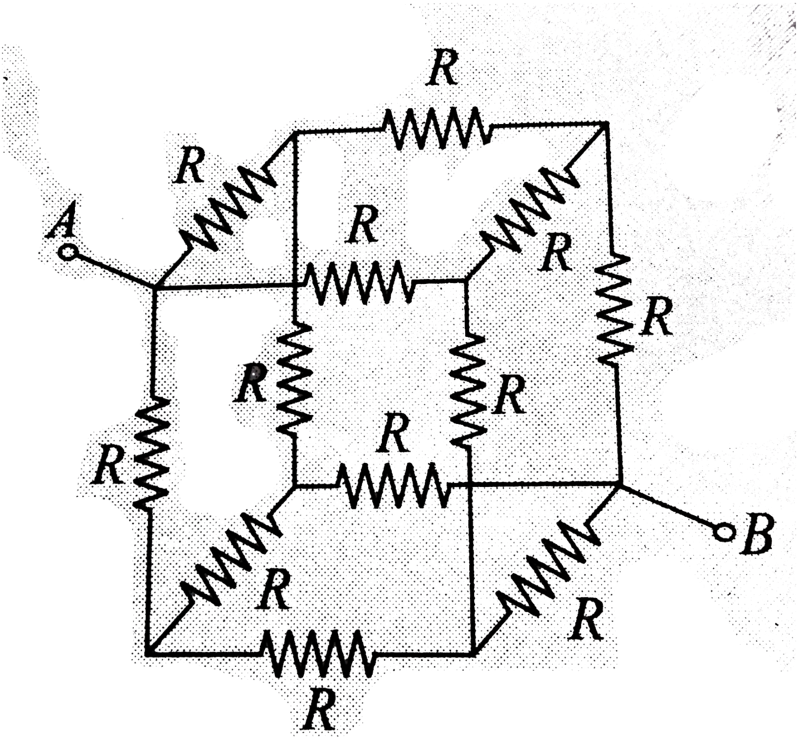
15. Twelve identical resistances arranged on all edges of a cube. The resistors are all the same. Then find the equivalent resistance between the edges A and B as shown in figure.



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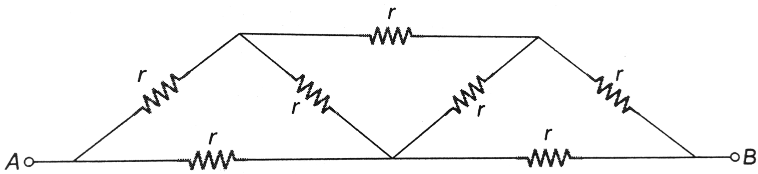
16. Find the the equivalent resistance between points A and B.



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17. Find the equivalent capacitance between the point A and B in figure .

equivalent capacitance of the given system is

$$2C = \frac{2\,C_1C_2}{C_1 + C_2}\,.$$

7. *Find the equivalent capacitance between the point A and B in figure (31-W5a).*

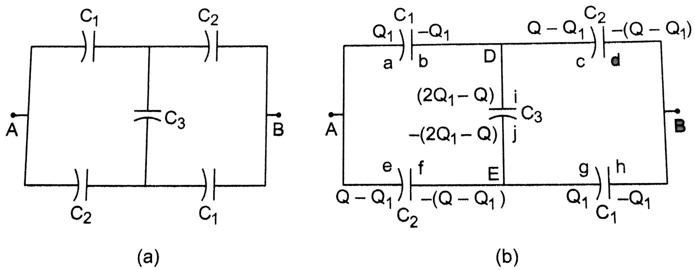

Figure 31-W5

Solution : Let us connect a battery between the points A and B. The charge distribution is shown in figure (31-W5b). Suppose the positive terminal of the battery supplies a charge $+Q$ and the negative terminal a charge $-Q$. The charge Q is divided between plates a and e. A charge Q_1 goes to the plate a and the rest $Q - Q_1$ goes to the plate e. The charge

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18. An air capacitor is first charged through a battery. The charging battery is then removed and a electric slab of dielectric constant $K = 4$ is inserted between the plates.

Simultaneously, the distance between the plates is reduced to half, then find change, C, E, V and U.

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19. Find the electric potential energy of a uniformly charged sphere.

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20. Find the electric potential energy of a unifomly charged then spherical shell.

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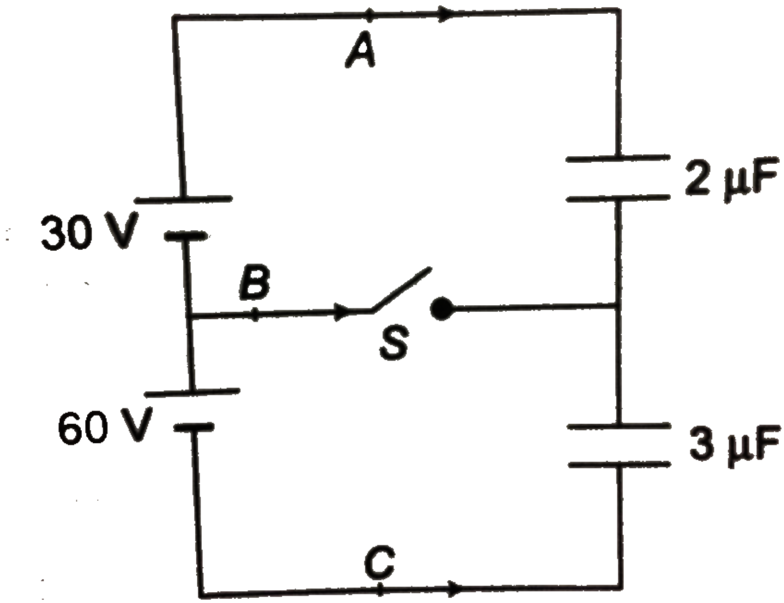
21. What charges will flow through A, B and C in the direction shown in the figure when switch S is closed?



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22. Prove that in charging a capacitor half of the energy supplied by the battery is stored in the capacitor and remaining half is lost during charging.

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23. Three capcaitors of capacities $1\mu F, 2\mu F$ and $3\mu F$ are charged by $10V, 20V$ and $30V$ respectively. Now positive plates of first two capacitors are connected with the negative plate of third capacitor on one side and negative plates of first wo capacitors are connectes with positive of third capacitor on the other side. Find

a. common potential V

b. final charges on different capacitors.

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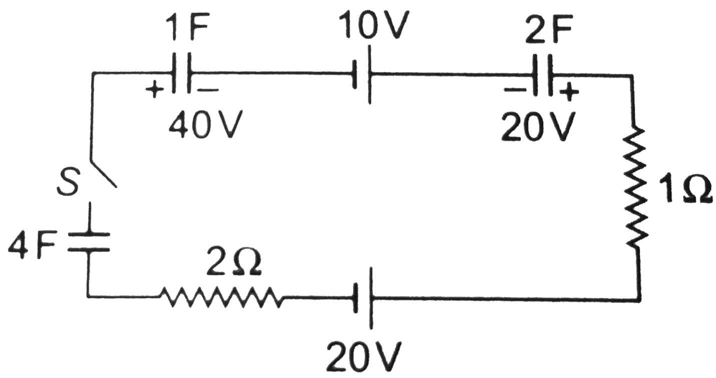
24. In the circuit shown in figure switch S is closed at time $t = 0$. Find



a. Initial current at $t = 0$ and final current at $t = \infty$ in the loop.

b. total charge q flown from the switch.

c. Final charges on capacitors in steady state at time $t = \infty$

d. Loss of energyduring resistribution of charges

e. Individual loss across 1Ω and 2Ω resistance.

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25. Switch S is closed at time $t = 0$. in the circuit shown in

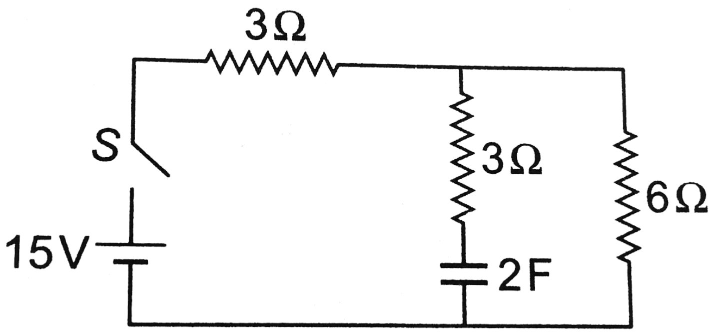

figure.

a. Find the time varying quantities in the circuit.

b. Find the their values at time $t = 0$

c. Find their vales at time $t = \infty$

Find the time constant of all time varying function

e. Make their exponetial graphs and write their exponential equations.

f. just write the equations to slove them to find different time varying functions.

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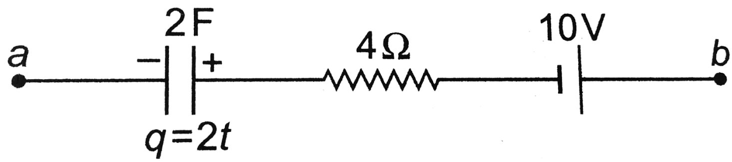
26. In the circuit shown in figure find V_{ab} at $1s$



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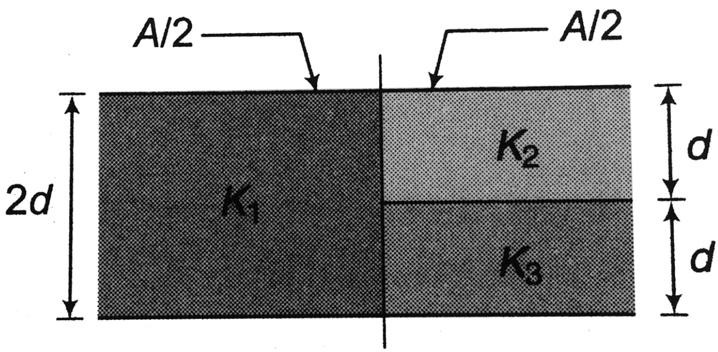
27. What is capacitance of the capacitor shown in figure?



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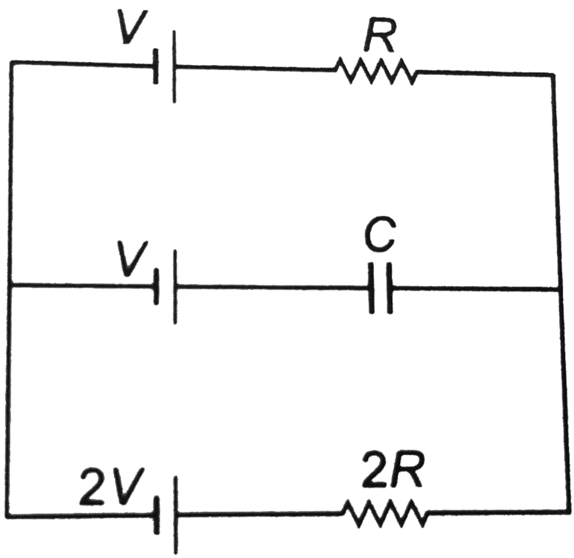
28. Find potential differece across the capacitor (obviously in steady state)



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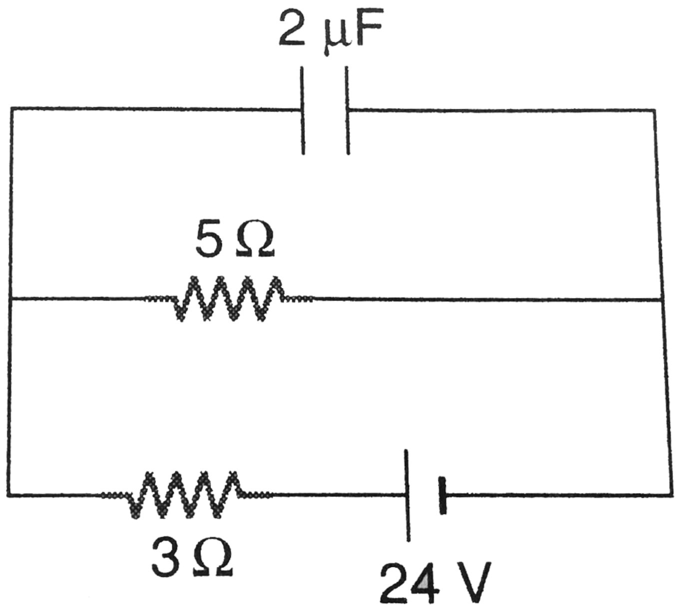
29. Find the charge stored in the capacitor.



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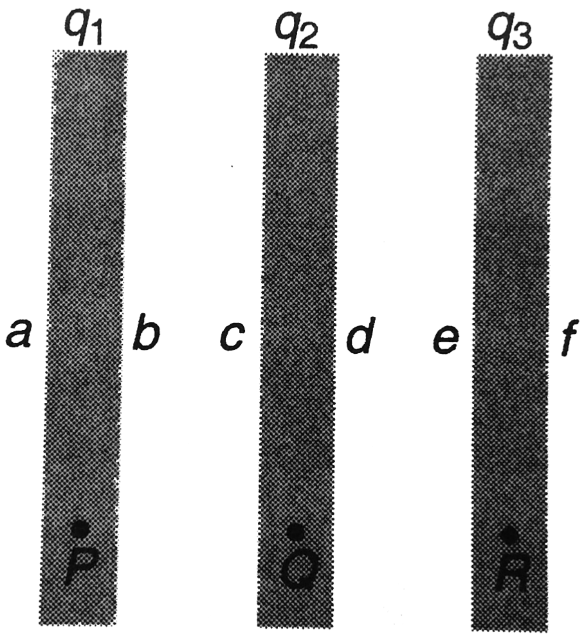
30. Three parallel metalic plates each of area A are kept as shown in figure and charges q_1, q_2 and q_3 are given to them. Find the resulting charge distribution on the six surfaces, neglecting edge effects as usual,



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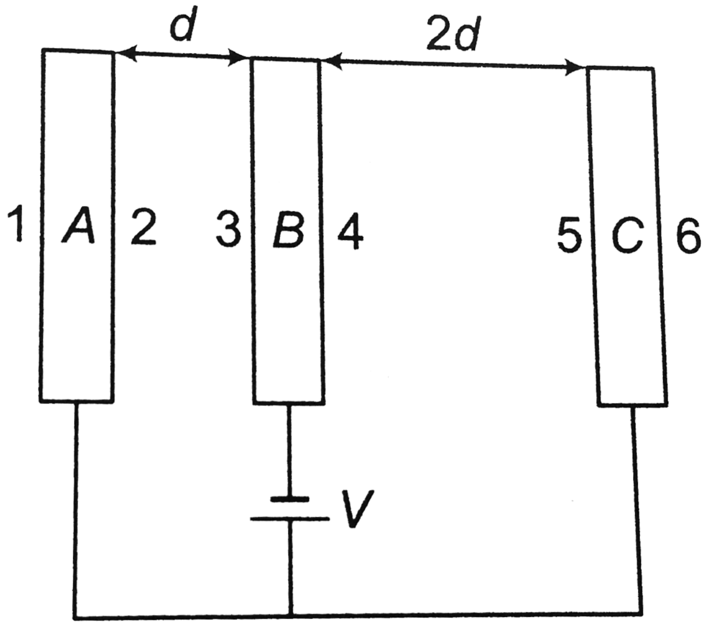
31. Area of each plate is A. The conducting plates are connected to a battery of emf V volts. Find charges q_1 to

q_t.



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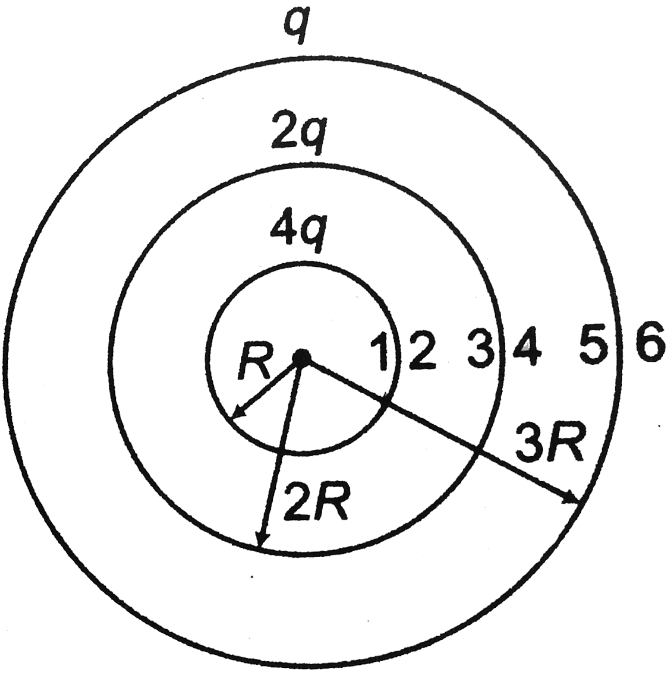
32. In the shown figure shown



a. Find q_1 and q_6

b. total electrostatic potential energy .

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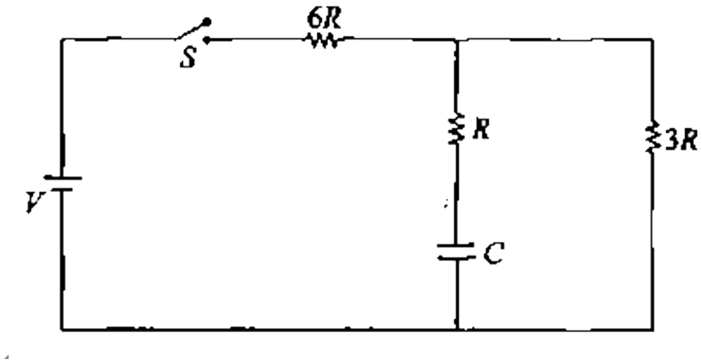
33. In the circuit shown in figure-3.240 switch S is closed at time t=0. find the current through different wires and charge stored on the capacitor at any time t.



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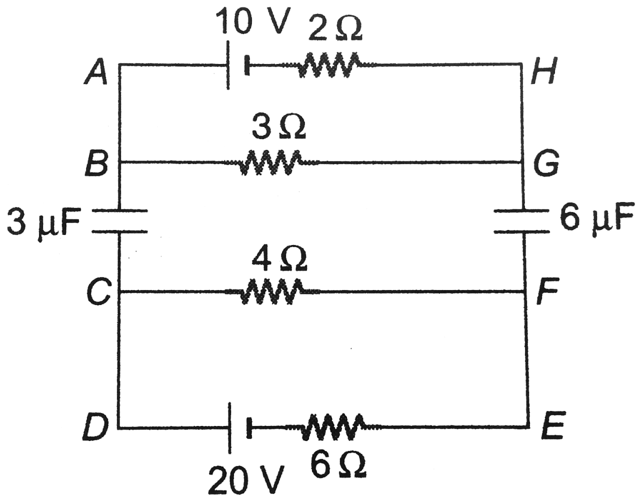
34. In the circuit shown in figure, find the steady state charges on oth the capacitors.



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35. An isolated parallel plate capacitor has circular plates of radius $4.0cm$. If the gap is filled with a partially conducting material of dielectric constant K and conductivity $5.0 \times 10^{-14} \Omega^{-1} m^{-1}$. When the capacitor is charged to a surface charge density of $15 \mu C / cm^2$, the initial current between the plates is $1.0 \mu A$?

a. Determine the value of dielectric constant K.

b. If the total joule heating produced is $7500J$, determine the separation of the capacitor plates.

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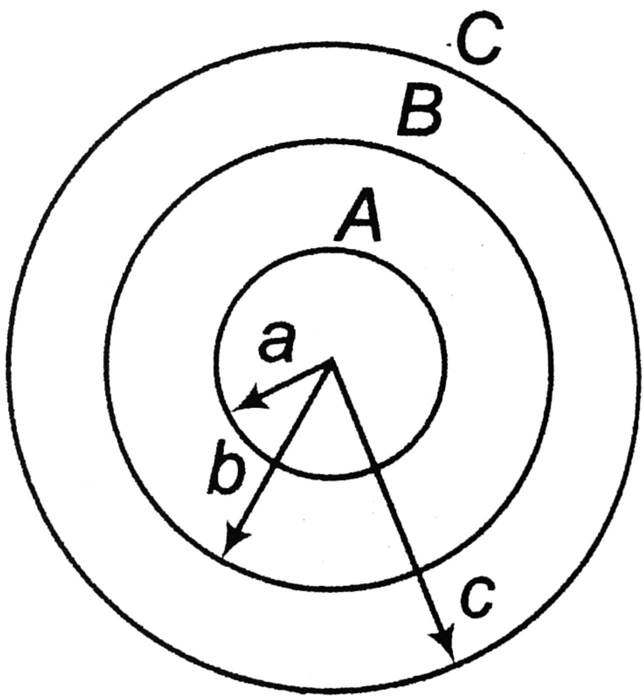
36. Three concentric conducting shells A, B and C of radii a, b and c are as shown in figure. A dielectric of dielectric constant K is filled between A and B. Find the capacitance between A and C.



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Exercise

1. The dimensions of the formula of capacitance are

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2. No charge will flow when two conductors having the same charge are connected to each other. this statement true or false?

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3. Two conductors of capacitance $1\mu F$ and $2\mu F$ are charged to $+10V$ and $-20V$ They are now connected by a conducting wire. Find

(a) their common potential

(b) the final charges on them

(c) the loss of energy during, redistribution of charges.

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4. A capacitor has a capacitance of $7.28\mu F$. What amount of charge must be placed on each of its plates to make the potential difference between its plates equAl to $25.0V$?

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5. A parallel air capacitance $245\mu F$ has a charge of magnitude $0.48\mu C$ on each plate. The plates are $0.328mm$ apart.

(a) What is the potential difference between the plates?

(b) What is the area of each plate?

(c) What is the surface charge density on each plate?

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6. Two parallel plates have equal and opposite charges. When the space between the plates is evacuated, the electric field is $E_0 = 3.20 \times 10^5 V/m$. When the space is filled with electric the electric field is $E - 2.50 \times 10^5 V/m$

a. What is the dielectric constant?

b. What is the charge density on each surface of the dielectric?

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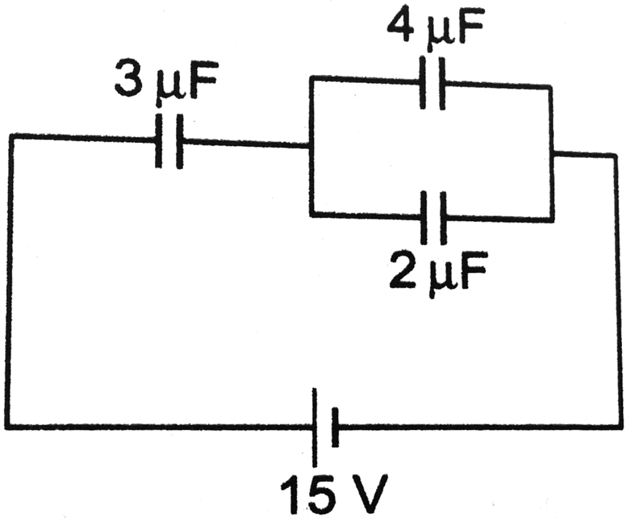
7. Find charges on different capacitors.



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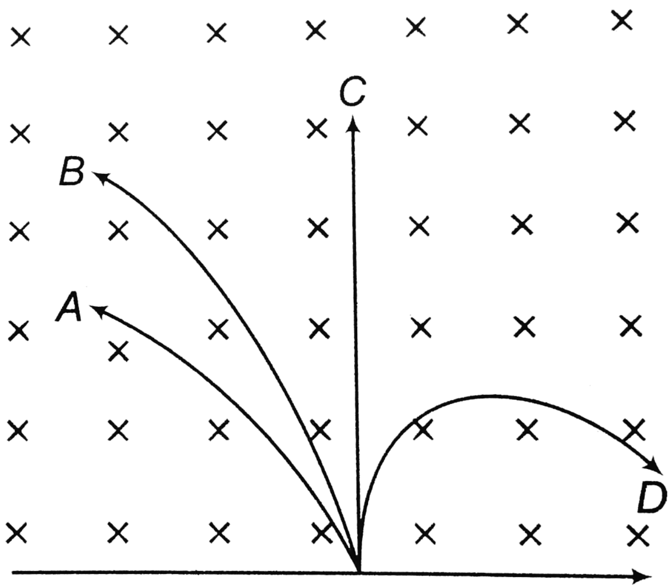
8. Find the charges on different particles.



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9. Assertion : From the relation $C = \frac{q}{V}$ We can say that, if more charge q is given to a conductor, its capacitance should increase.

Reason : Ratio $\frac{q}{V}$ will remain constant for a given conductor.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: D

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10. Assertion : A parallel plate capacitor is first charged and then distance between the plates is increased. In this process, electric field between the plates remains the same, while potential difference gets increased.

Reason: $E=\frac{q}{A\varepsilon_0}$ and $V=q\frac{d}{A\varepsilon_0}$ Since q, remain same, E will remain same while V will increase.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: A

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11. Assertion : When an uncharged capacitor is charged by a battery only 50% of the energy supplied is stored in the capacitor.

Reason : Rest 50% is lost.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: A::B

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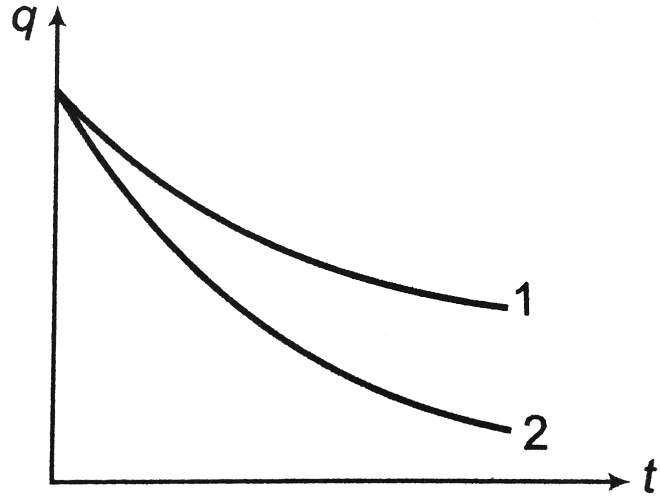
12. Assertion: Discharging graphs of two C.R. circuits having the same value of C is shown in figure. From the graph we can say that $\tau_{C_1} > \tau_{C_2}$



Reason: $R_1 > R_2$

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: A::B

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13. Assertion : In series combination, charges on two capacitors are always equal.

Reason : If charges are same, the total potential difference applied across two capacitors will be distributed in inverse ratio of capacities.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: D

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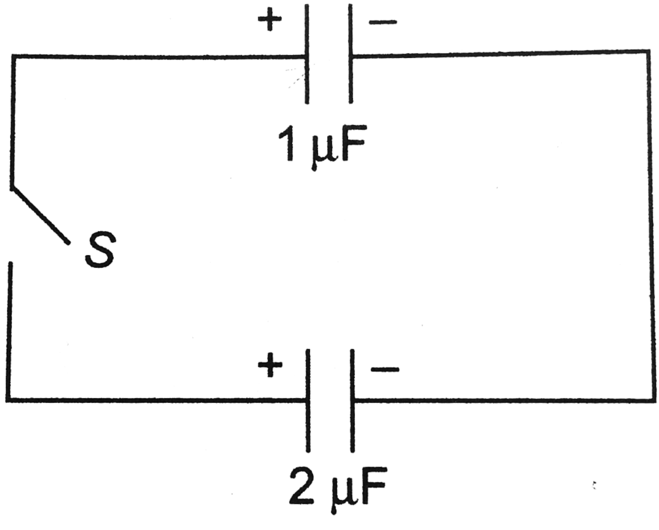
14. Assertion : Two capacitors are charged from the same battery nd then connected as shown. A current will flow i ntil clock direction as soon as switch is closed.



Reason: In steady state charges on two capacitors are in the ratio 1:2.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: D

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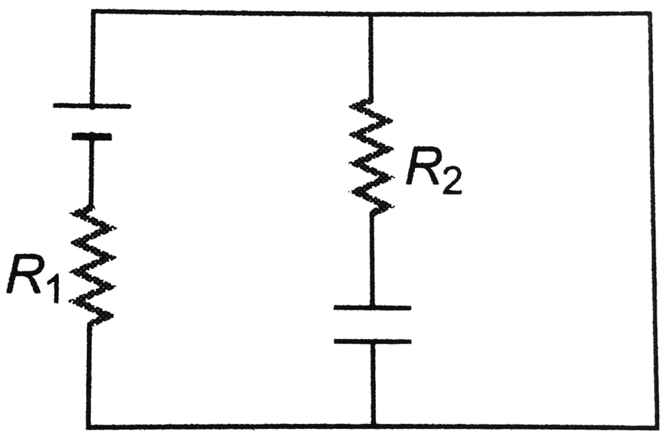
15. Assertion: In the circuit shown in figure no charge will stored in the capacitor.



Reason: Current through R_2 will be zero.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: B

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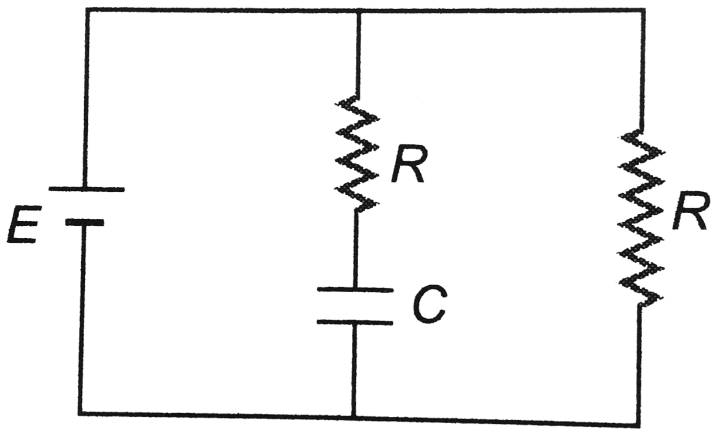
16. Assertion: In the circuit in figure, time constant of charging of capacitor is s$\frac{CR}{2}$



Reason: In the absence of capcitor in the circuit, two resistors are in parallel with the battery.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: D

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17. Assertion: Two capacitors are connected in series with a battery. Energy stored across them is in inverse ratio of their capacity.

Reason: $U = \frac{1}{2}qV$ or $U \propto qV$

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: B

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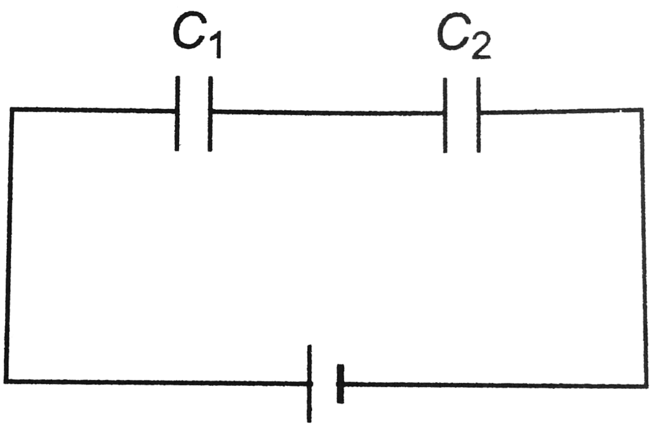
18. Assertion: In the circuit shown in figure with a dielectric slab is inserted in C_2, the potential difference across C_2 will decrease.



Reason: By inserting the slab a current will flow in the circuit in clockwise direction.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: B

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19. The separation between the plates of a charged parallel-plate capacitor is increased. The force between the plates

A. increases

B. decreases

C. remains same

D. first increases then decreases

Answer: C

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20. If the plates of a capacitor are joined together by as conducting wire, then its capacitance

A. reamains unchanged

B. decreases

C. become zero

D. becomes infinite

Answer: D

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21. Two metal spheres of radii a and b are connected by a thin wire. Their separation is very large compared to their dimensions. The capacitance of this system is

A. $4\pi\varepsilon_0(ab)$

B. $2\pi\varepsilon_0(a+b)$

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

D. $4\pi\varepsilon_0\left(\frac{a^2+b^2}{2}\right)$

Answer: C

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

A. zero

B. $(n-1)V$

C. nV

D. n^2V

Answer: C

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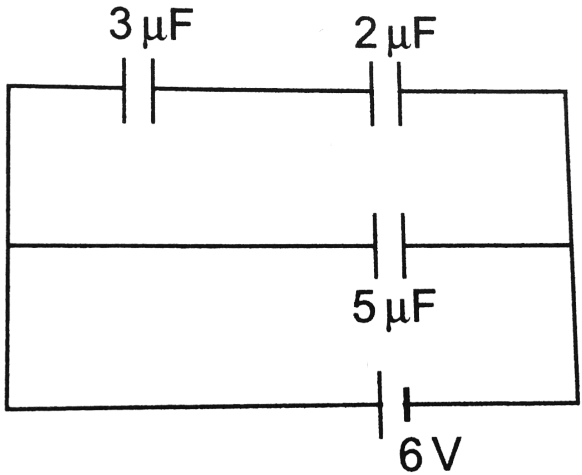
23. In the circuit shown in figure, the ratio of charge on $5\mu F$ and $2\mu F$ capacitor is



A. $\frac{5}{4}$

B. $\frac{5}{3}$

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

D. none of these

Answer: D

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24. In Millikan's oil drop experiment an oil drop of radius r and change Q is held in equilibrium between the plates of a charged parallel plate capacitor when the potential change is V. To keep a drop radius $2r$ and with a change $2Q$ is equilibriu between the plates the potential difference V ' required is:

A. V

B. $2V$

C. $4V$

D. $8V$

Answer: C

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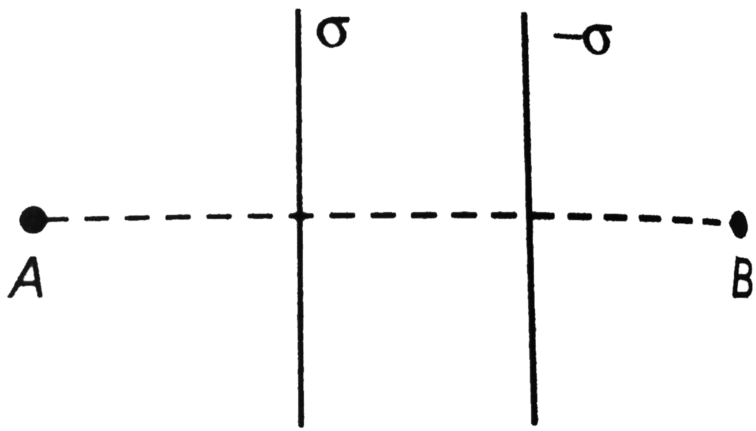
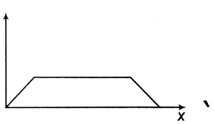
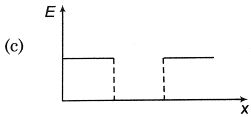
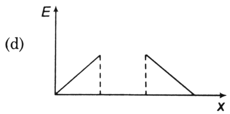
25. Two large parallel sheets charged uniformly with surfasce charge density σ and $-\sigma$ are located as shown in the figure. Which one of the following graphs shows the variation of electric field along a line perpendicular to the sheets as one moves from A to B ?



A. (a)


B. (b)


C.  `

D.  `

Answer: B

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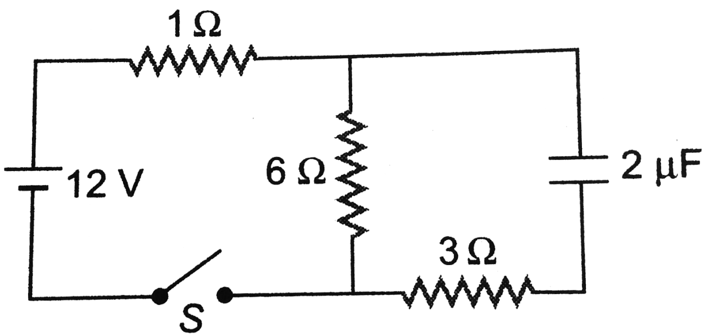
26. When the switch is closed, the initial current through the 1Ω resistor is



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A. $2A$

B. $4A$

C. $3A$

D. 6

Answer: B

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27. A capacitor of capacitance C carrying charge Q is connected to a source of emf E. Finally, the charge on capacitor would be

A. Q

B. $Q + CE$

C. CE

D. none of these

Answer: C

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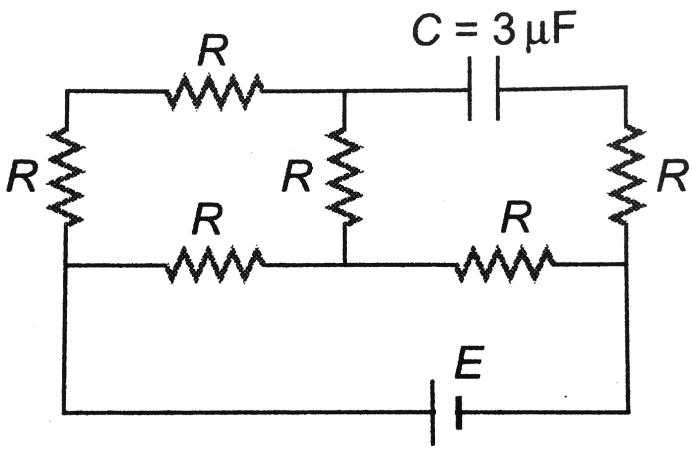
28. In the circuit the potential difference across the capacitor is $10V$. Each resistance is of 3Ω The cell is ideal. The emf of the cell is



A. $14V$

B. $16V$

C. $18V$

D. $24V$

Answer: A

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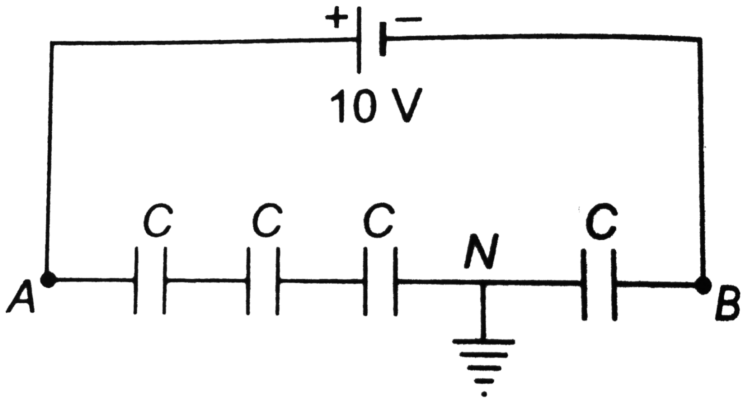
29. Four identical capacitors are connected in series with a $10V$ battery as shown in the figure. The point N is earthed. The potentials of points A and B are



A. $10V, 0V$

B. $7.5V, \ -2.5V$

C. $5V, \ -5V$

D. $7.5V, 2.5V$

Answer: B

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30. A capacitor of capacity $2\mu F$ is charged to $100V$. What is the heat generated when this capacitor is connected in parallel to an another capacitor of same capacity?

A. $2.5mJ$

B. $5.0mJ$

C. $10mJ$

D. $4mJ$

Answer: B

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31. A charged capacitor is discharged through a resistance. The time constant of the circuit is η. Then the value of time constant for the power dissipated through the resistance will be

A. η

B. 2η

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

D. zero

Answer: C

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32. A capacitor is charged by a cell of emf E the charging battery is then removed. If an identical capacitor is now inserted in the circuit in parallel with the previous capacitor, the potential difference across the new capacitor is

A. $2E$

B. E

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

D. zero

Answer: C

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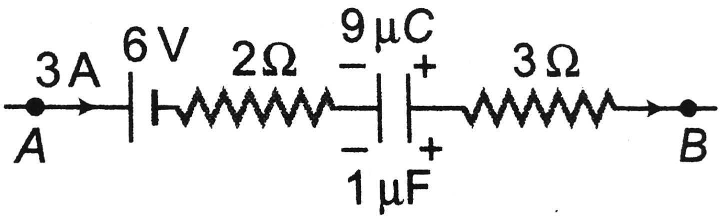
33. The potential differece $V_A - V_B$ between points A and B for the circuit segment shown in figure at the given instant is



A. $12V$

B. $-12V$

C. $6V$

D. $-6V$

Answer: A

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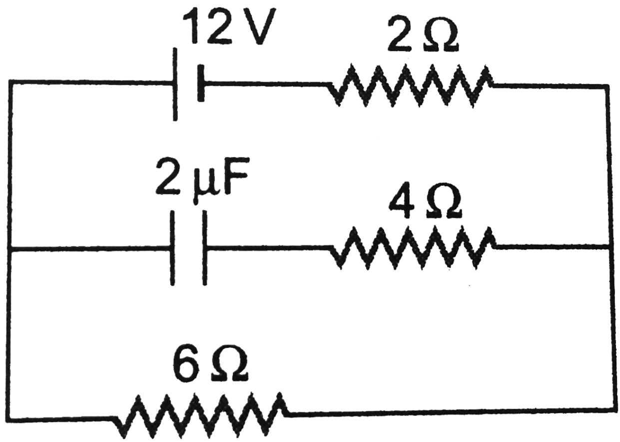
34. For the circuit arrangement shown in figure, in the steady state condition charge on the capacitor is



A. $12\mu C$

B. $14\mu C$

C. $2\mu C$

D. $18\mu C$

Answer: D

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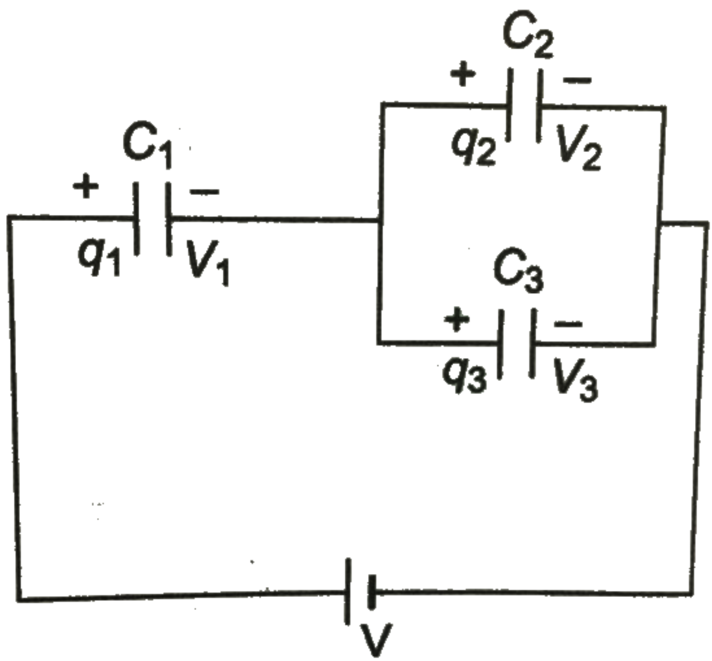
35. In the circuit as shown in figure if all the symbols have their usual meanings, then identify the correct statements,



A. $q_2 = q_3, V_2 = V_3$

B. $q_1 = q_2 + q_3, V_2 = V_3$

C. $q_1 = q_2 = q_3, V = V_1 + V_2 + V_3$

D. $q_1 + q_2 + q_3 = 0, , V_2 = V_3 = V - V - 1$

Answer: B

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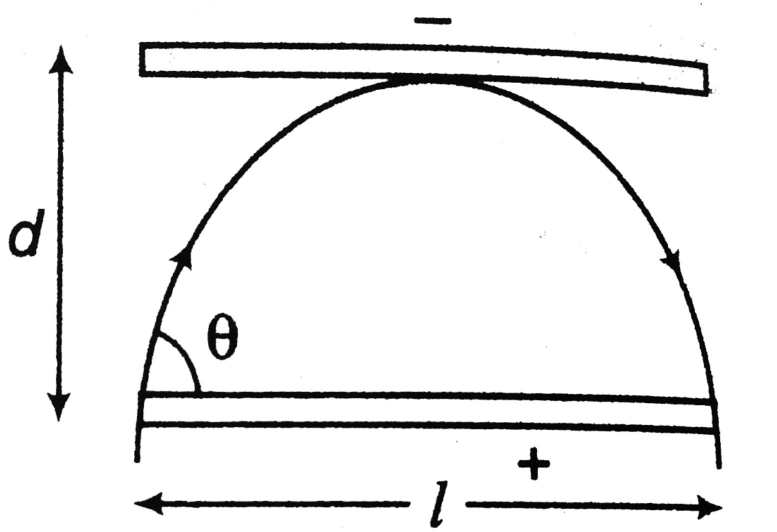
36. An electron enters the region between the plates of a parallel plate capacitor at an angle θ to the plates. The plate width is l, the plate separation is d. The electron follows the path shown just missing the upper plate.

Neglect gravity. Then,



A. $\tan\theta = 2\frac{d}{l}$

B. $\tan\theta = 4\frac{d}{l}$

C. $\tan\theta = 8\frac{d}{l}$

D. The data given is insufficient to find a relation between d, l and θ

Answer: B

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37. An infinite sheet of charge has a surfaces charge density of $10^{-7}\frac{C}{m^2}$. The separation between two equipotential surfce whose potentials differ by $5V$ is

A. $0.64cm$

B. $0.88mm$

C. $0.32cm$

D. $5 \times 10^{-7}m$

Answer: B

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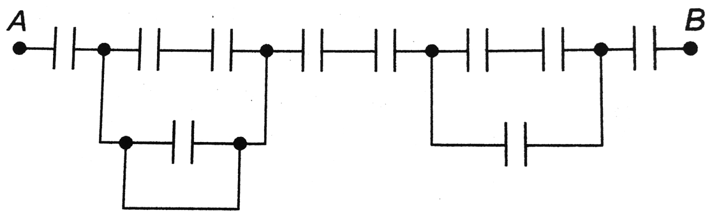
38. Find the equivalent capacitance across A and B for the arrangement shown in figure. All the capacitors are of capacitance C



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

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

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

D. none of these

Answer: A

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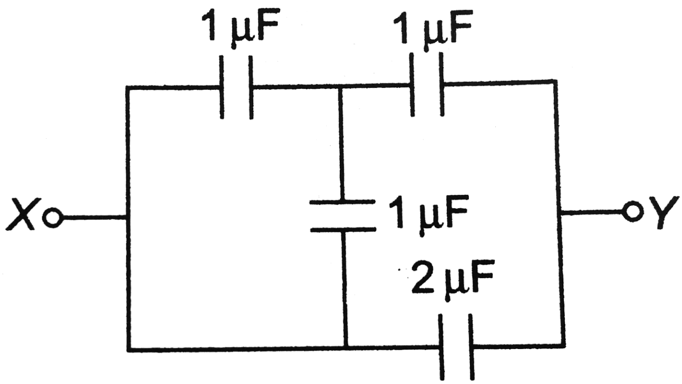
39. The equivalent capacitance between X and Y is



A. $\frac{5}{6}\mu F$

B. $\frac{7}{6}\mu F$

C. $\frac{8}{3}\mu F$

D. $1\mu F$

Answer: C

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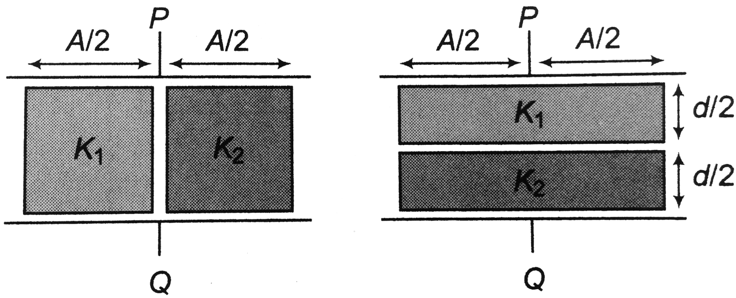
40. In the arrangement shown in figure dielectric constant $K_1 = 2$ and $K_2 = 3$. If the capacitance across P and Q are C_1 and C_2 respectively, then C_1 / C_2 wil be (the gaps shown are negligible)



A. $1:1$

B. $2:3$

C. $9:5$

D. $25:24$

Answer: D

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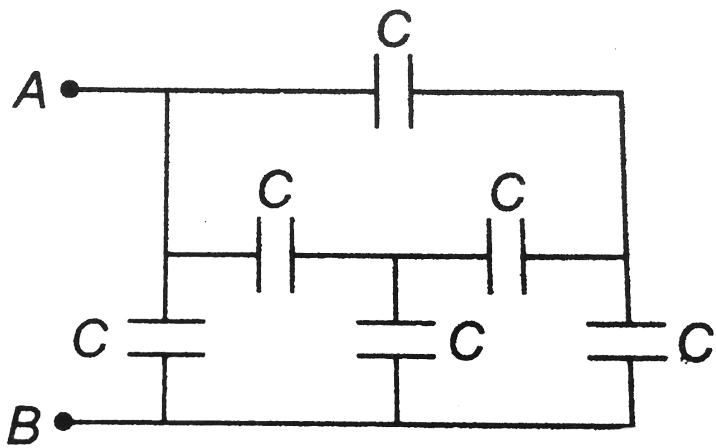
41. Six equal capacitors each of capacitance C are connected as shown in the figure. The equivalent capacitance between points A and B is



A. $1.5C$

B. C

C. $2C$

D. $0.5C$

Answer: C

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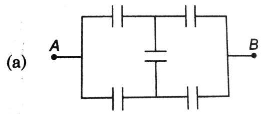
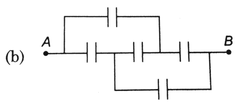
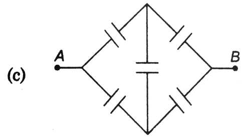
42. Four ways of making a network of five capacitor of the same value are shown in four choices. Three out of four are identical. The one which is different is

A. 

B. 

C. 

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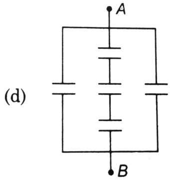
D. 

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Answer: D

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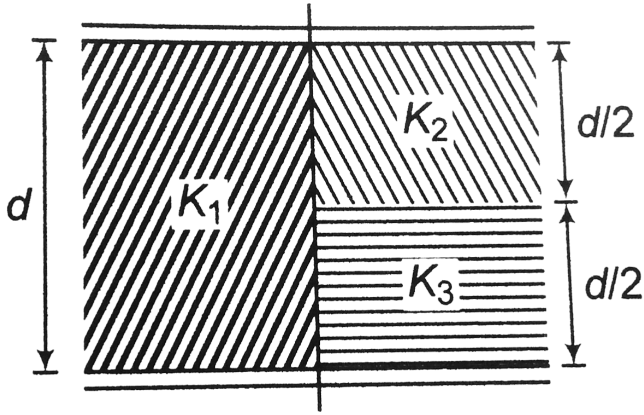
43. The equivalent capacitance of the arrangement shown in figure, if A is the area of each plate is



A. $C = \dfrac{\varepsilon_0 A}{d}\left[\dfrac{K_1}{2} + \dfrac{K_2 + K_3}{K_2 K_3}\right]$

B. $C = \dfrac{\varepsilon_0 A}{d}\left[\dfrac{K_1}{2} + \dfrac{K_2 K_3}{K_2 + K_3}\right]$

C. $C = \dfrac{\varepsilon_0 A}{2d}\left[K_1 + \dfrac{K_2 + K_3}{K_2 + K_3}\right]$

D. $C = \dfrac{\varepsilon_0 A}{d}\left[K_1 + \dfrac{K_2 K_3}{K_2 + K_3}\right]$

Answer: B

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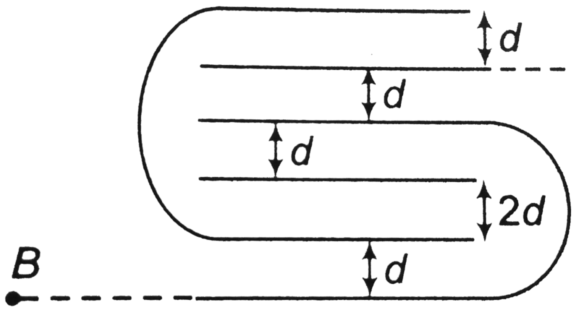
44. Find equivalent capacitance between points A and B.

[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. $7\mu F$

B. $11\mu F$

C. $12\mu F$

D. $15\mu F$

Answer: B

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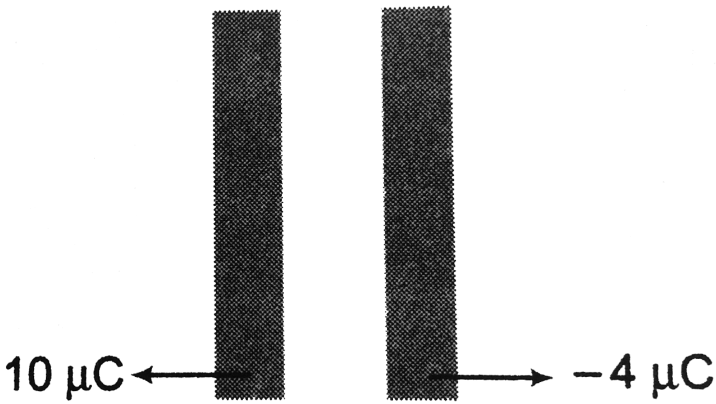
45. Two metallic plates are kept parallel to one another and charges are given to them as shown in figure. Find the charge on all the four faces.



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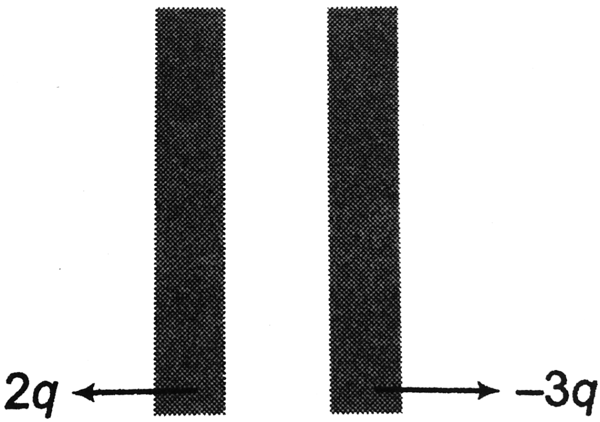
46. Charges $2q$ and $-3q$ are given to two identical metal plates of area of cross section A. the distance between the plates is d. Find the capacitance and potential difference between the plates.



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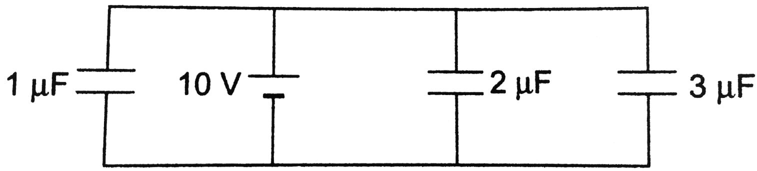
47. Find the charged stored in all the capacitors



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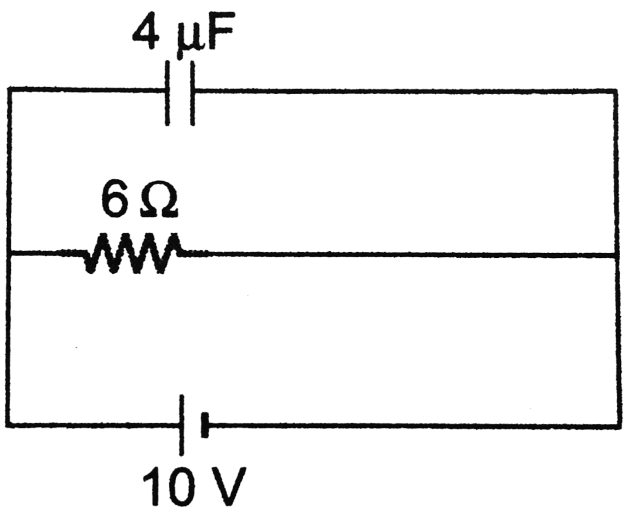
48. Find the charge stored in the capacitor.



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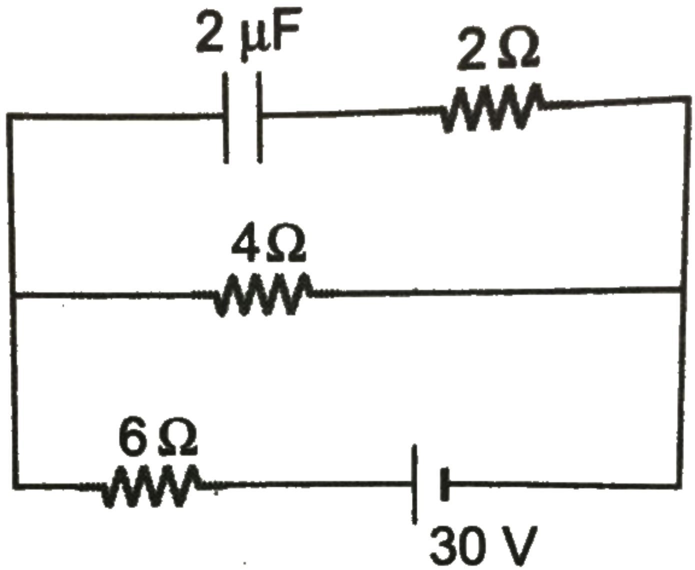
49. Find the charge stored in the capacitor.



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50. 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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51. 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 the capacity of second capacitor.

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52. An Uncharged capacitor C is connected to a battery through a resistance R. Show that by the time the capacitor gets fully charged, the energy dissipated in R is the same as the energy stored in C.

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53. How many time constants will elapse before the current in a charging $R-C$ circuit drops to half of its initial value?

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54. A capacitor of capacitance C is given a charge q0. At time $t=0$ it is connected to an uncharged capacitor of equal capacitance through a resistance R. Find the charge on the first capacitor and the second capacitor as a function of time t. Also plot the corresponding q-t graphs.

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

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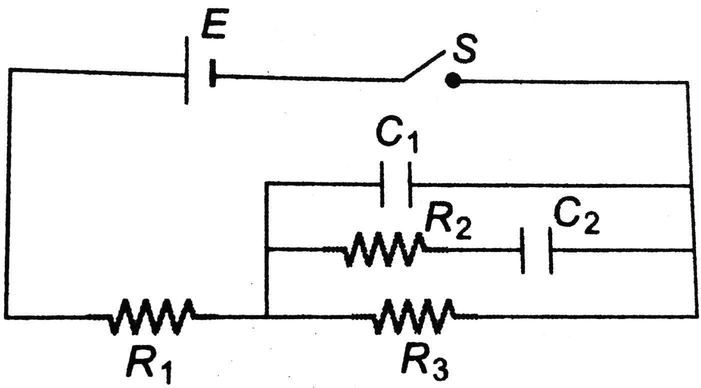
56. Determine the current through the battery in the circuit shown in figure.



(a) immediately after the switch S is closed

(b) after a long time.

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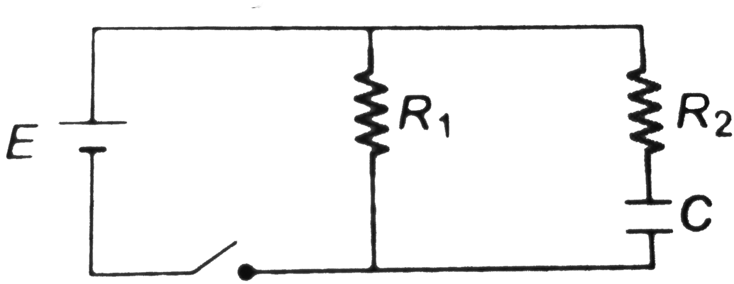
57. For the circuit shown in figure, find

(a) the initial current through each resistor

(b) steady state current through each resistor

(c) final energy stored in the capacitor

(d) time constant of the circuit when switch is opened.



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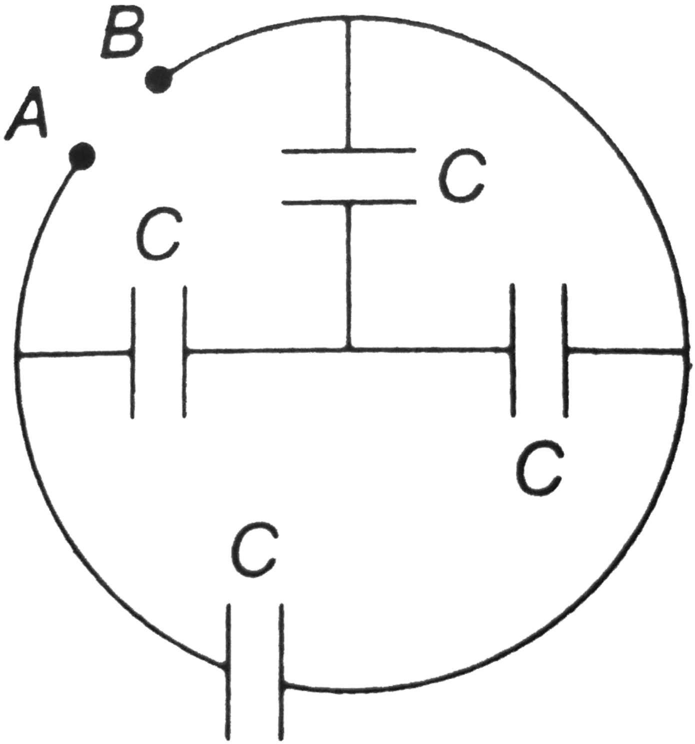
58. Find equivalent capacitance between points A and B,



(a)

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59. A $4.00\mu F$ capacitor and a $6.00\mu F$ capacitor are connected in parallel across a $660V$ supply line

(a) Find the charge on each capacitor and the voltage across each.

(b) The charged capacitors are disconnected from the line and from each other, and reconnected to each other with terminals of unlike sign together. Find the final charge on each and the voltage across each.

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60. The plates of a parallel plate capacitor have an area of $90cm^2$ each and are separated by $2mm$. The capacitor is charged by connecting it to a $400V$ supply. Then the energy density of the energy stored in Jm^{-3} in the capacitor is take $\varepsilon = 8.8 \times 10^{-10}$

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61. 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?

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62. Two condensers are in parallel and the energy of the combination is $0.1J$, when the difference. of potential between terminals is $2V$. With the same two condensers in series, the energy 1.6×10^{-2} J for the same difference of potential across the series combination. What are the capacities?

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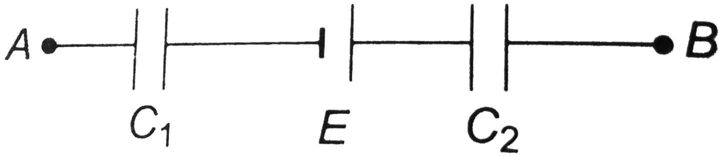
63. A circuit has section AB as shown in figure. The emf of the source equals $E = 10V$, the capacitor capacitances are equal to $C_1 = 1.0\mu F$ and $C_2 = 2.0\mu F$, and the potential difference $V_A - V_B = 5.0V$. Find the voltage across each capacitor.



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64. Several $10pF$ capacitors are given, each capable of withstanding $100V$. How would you construct :

(a) a unit possessing a capacitance of $2pF$ and capable of withstanding $500V$?

(b) a unit possessing a capacitance of $20pF$ and capable of withstanding $300V$?

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65. 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 $2pF$ 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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66. A $10.0\mu F$ parallel-plate capacitor with circular plates is connected to a $12.0V$ battery.

(a) What is the charge on each plate?

(b) How much charge would be on the plates if their separation were doubled while the capacitor remained connected to the battery?

(c) How much charge would be on the plates if the capacitor were connected to the $12.0V$ batter Y after the radius of each plate was doubled without changing their separation?

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67. A $450\mu F$ capacitor is charged to $295V$. Then, a wire is connected between the plates. How many joule of thermal energy are produced as the capacitor discharges if all of the energy that was stored goes into heating the wire?

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68. The plates of a parallel-plate capacitor in vacuum are $5.00mm$ apart and $2.00m^2$ in area. A potential difference of $10, 000V$ is applied across the capacitor. Compute

(a) the capacitance

(b) the charge on each plate, and

(c) the magnitude of the electric field in the space between them.

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69. Three capacitors having capacitances of $8.4\mu F, 8.4\mu F$ and $4.2\mu F$ are connected in series across a 36 potential difference.

(a) What is the charge on $4.2\mu F$ capacitor?

(b) What is the total energy stored in all three capacitors?

(c) The capacitors are disconnected from the potential difference without allowing them to discharge. They are then reconnected in parallel with each other, with the positively charged plates connected together. What is the voltage across each capacitor in the parallel combination?

(d) What is the total energy now stored in the capacitors?

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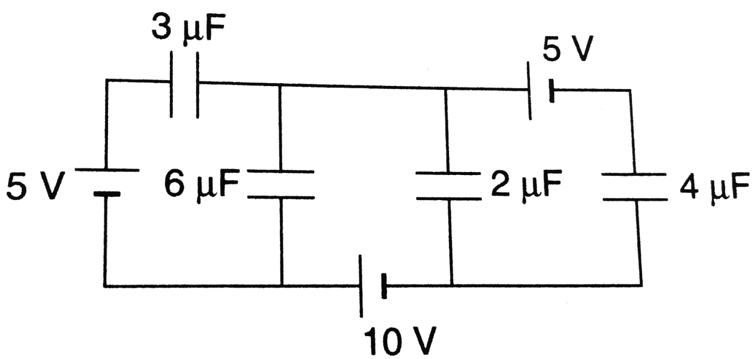
70. Find the charges on $6\mu F$ and $4\mu F$ capacitors



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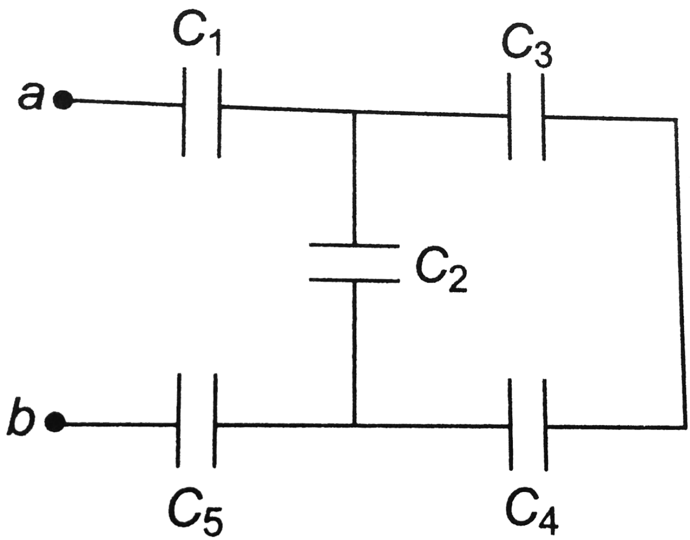
71. In figure $C_1 = C_5 = 8.4 \mu F$ and $C_2 = C_3 = C_4 = 4.2 \mu F$.The applied potential is $V_{ab} = 220V$



(a) What is the equivalent capacitance of the network between points a and b?

(b) Calculate the charge on each capacitor and the potential difference across each capacitor.

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72. 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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73. A capacitor of capacitance $C_1 = 1.0\mu F$ charged upto a voltage $V = 110V$ is connected in parallel to the terminals of a circuit consisting of two uncharged capacitors connected in series and possessing the capacitance $C_2 = 2.0\mu F$ and $C_3 = 3.0\mu F$. What charge will flow through the connecting wires?

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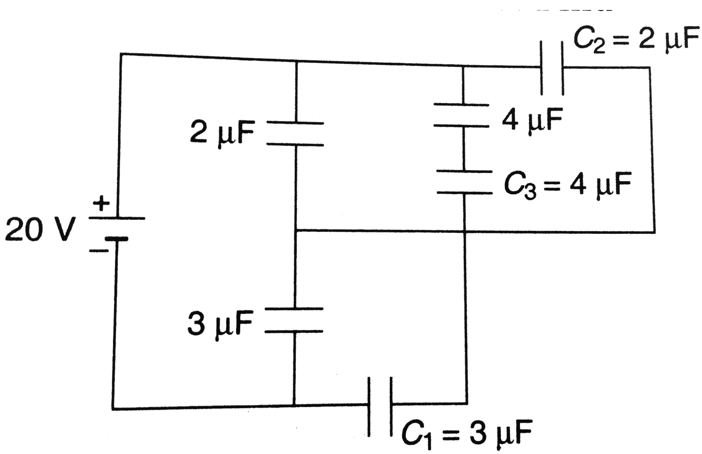
74. In figure the battery has a potential difference of $20V$. Find



(a) the equivalent capacitance of all the capacitors across the battery and

(b) the charge stored on that, equivalent capacitance. Find the charge on

(c) capacitor 1,

(d) capacitor 2, and

(e) capacitor 3.

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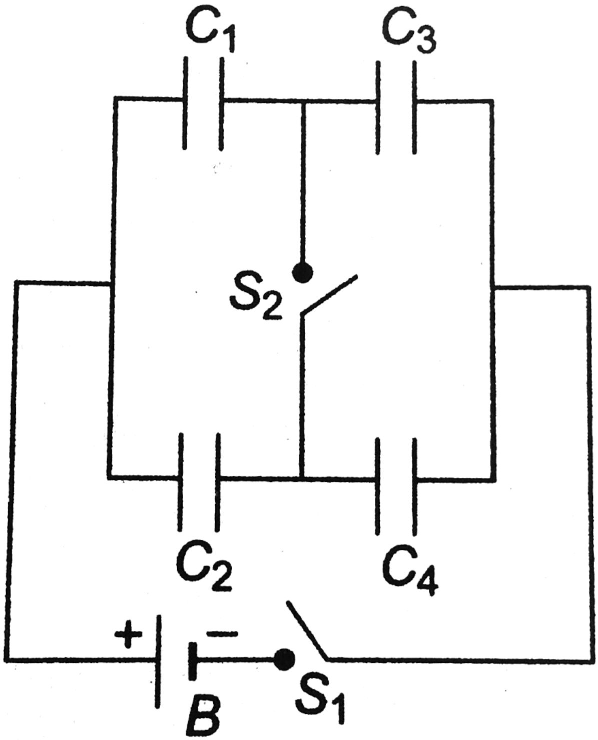
75. In figure, battery B supplies $12V$. Find the charge on each capacitor



(a) first when only switch S1 is closed and

(b) later when S2 is also closed.

(Take $C_1 = 1.0\mu F, C_2 = 2.0\mu F, C_3 = 3.0\mu F$ and $C_4 = 4.0\mu F$)

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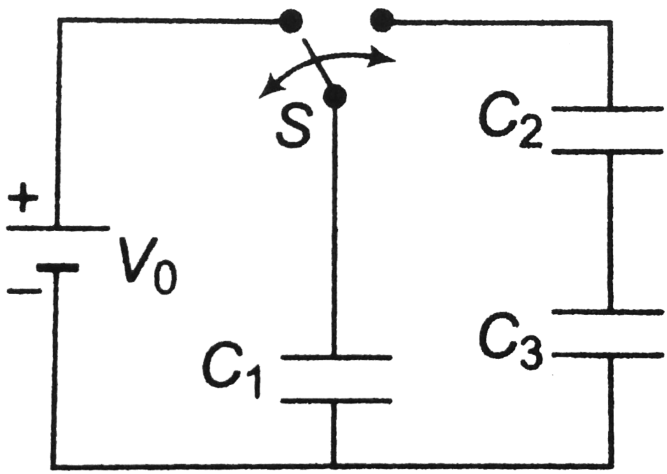
76. When switch S is thrown to the left in figure, the plates of capacitor 1 acquire a potential difference V_0. Capacitors 2 and 3 are initially uncharged. The switch is now thrown to the right. What are the final charges q_1, q_2 and q_3 on the capacitors?



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77. A parallel-plate capacitor has plates of area A and separation d and is charged to a potential difference V. The charging battery is then disconnected, and the plates are pulled apart until their separation is $2d$. Derive expression in terms of A, d and V for

(a) the new potential difference

(b) the initial and final stored energies, U_i and U_f and

(c) the work required to increase the separation of plates from d to $2d$.

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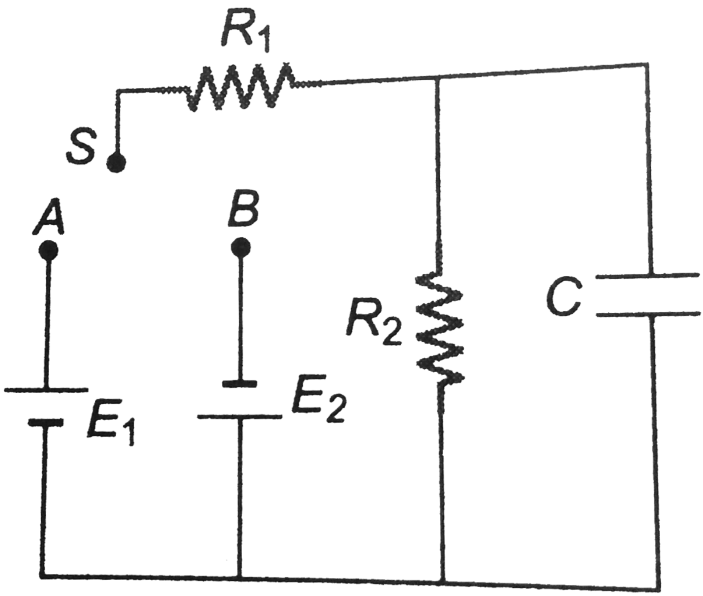
78. In the circuit shown in figure $E_1, E_2 = 20V, R_1 = R_2 = 10k\Omega$ and $C = 1\mu F$. Find the current through R_1, R_2 and C when



(a) S has been kept connected to A for a long time.

(b) The switch is suddenly shifted to B.

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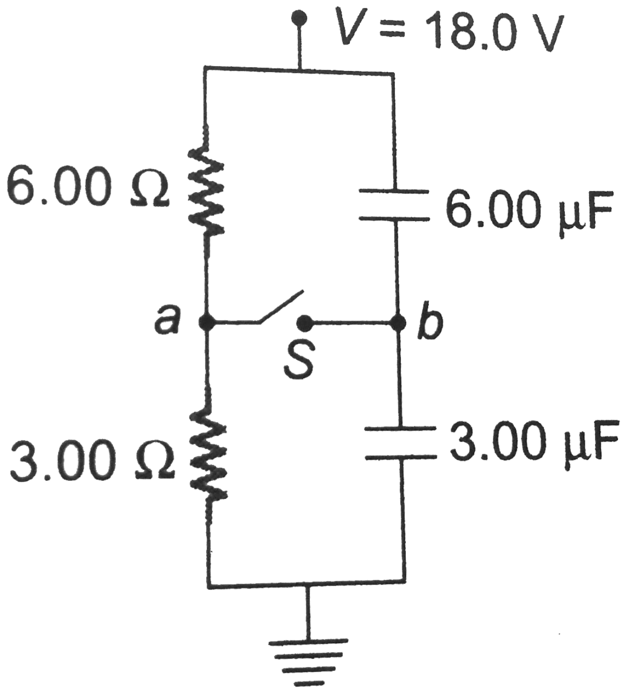


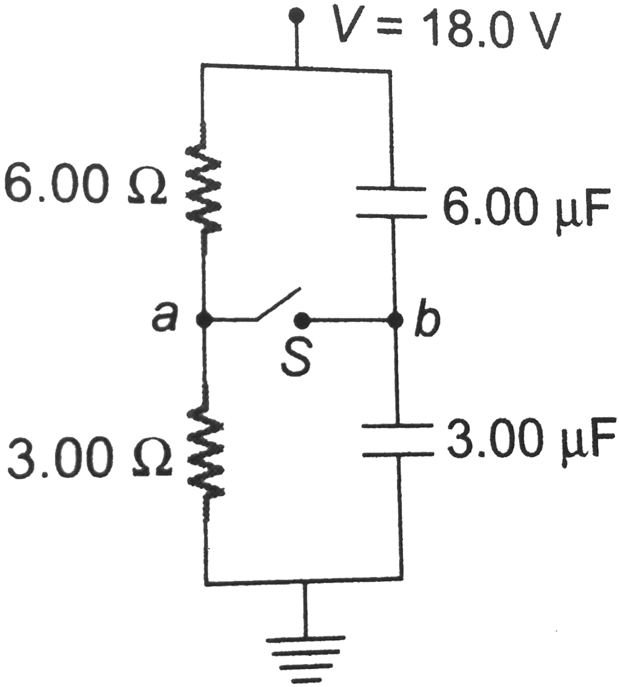
79.

(a) What is the potential of point a with respect to point b in figure, when switch S is open?

(b) Which point, a or b, is at the higher potential?

(c) What is the final potential of point b with respect to ground when switch S is closed?

(d) How much charge flows through switch S when it is closed?



80.

(a) What is the potential of point a with respect to point b in figure, when switch S is open?

(b) Which point, a or b, is at the higher potential?

(c) What is the final potential of point b with respect to ground when switch S is closed?

(d) How much charge flows through switch S when it is closed?

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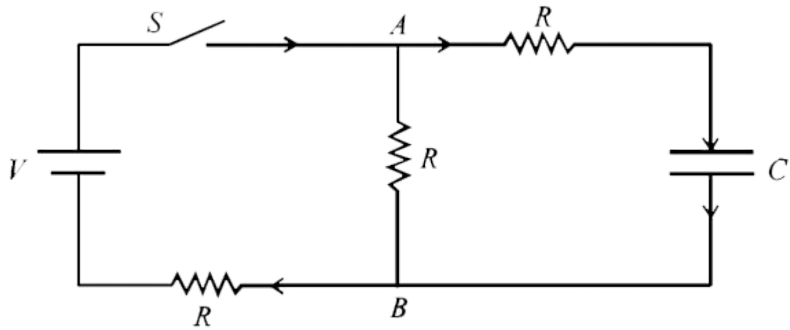
81. In the circuit shown in Figure, the battery is an ideal one, with emf V. The capacitor is initially uncharged. The switch S is closed at time t = 0 .

(a) Find the charge Q on the capacitor at time t.

(b) Find the current in AB at time t. What is its liniting value as $t \rightarrow \infty$:



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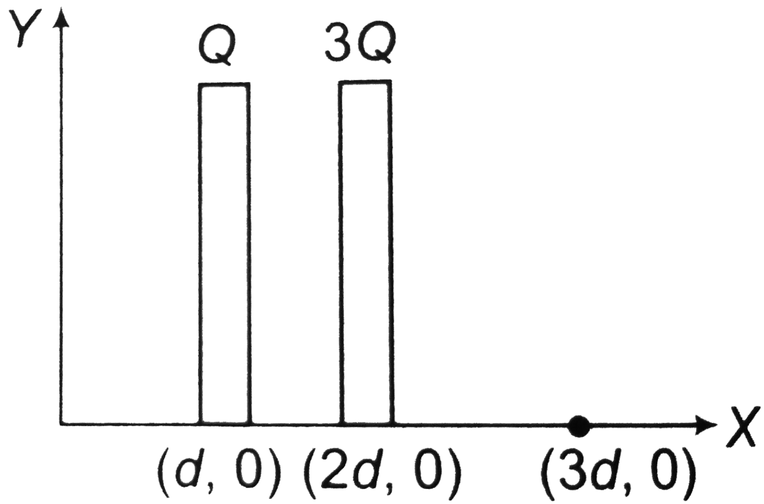
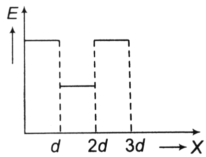
82. Two very large thin conducting plates having same cross sectional area are placed as shown in figure. They are carrying chaerges Q and $3Q$, respectivley. The variation of electric field as as function at x(for $x=0$ to $x=3d$)

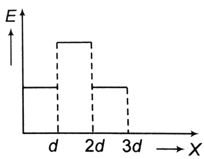
will be best represented as by



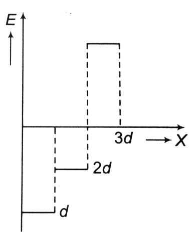
A. (a)

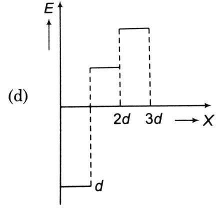


B. (b)



C. (c)



D. 

Answer: C

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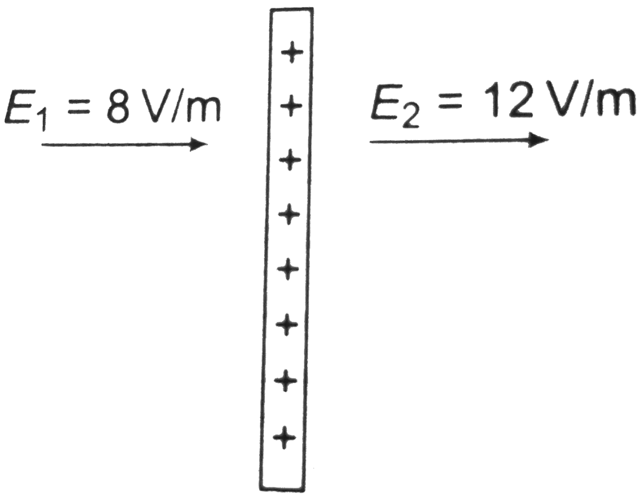
83. The electric field on two sides of a thin sheet of charge is shown in the figure. The charge density on the sheet is



A. $2\varepsilon_0$

B. $4\varepsilon_0$

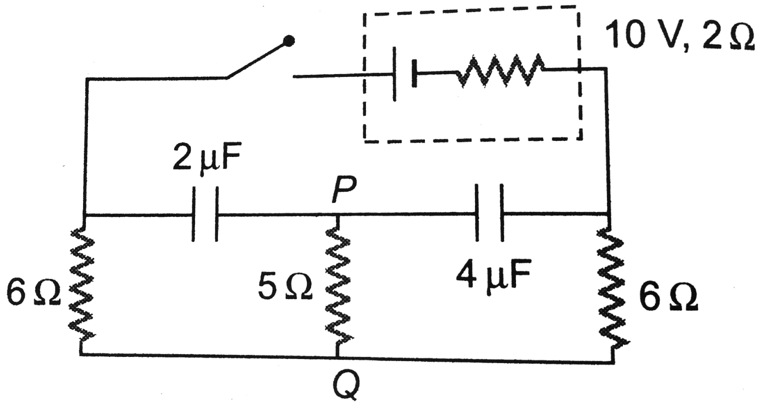
C. $10\varepsilon_0$

D. zero

Answer: B

Watch Video Solution

84. In the circuit shown in figure, the capacitors are initially uncharged. The current through resistor PQ just after closing the switch is



A. $2A$ from P to Q

B. $2A$ from Q to P

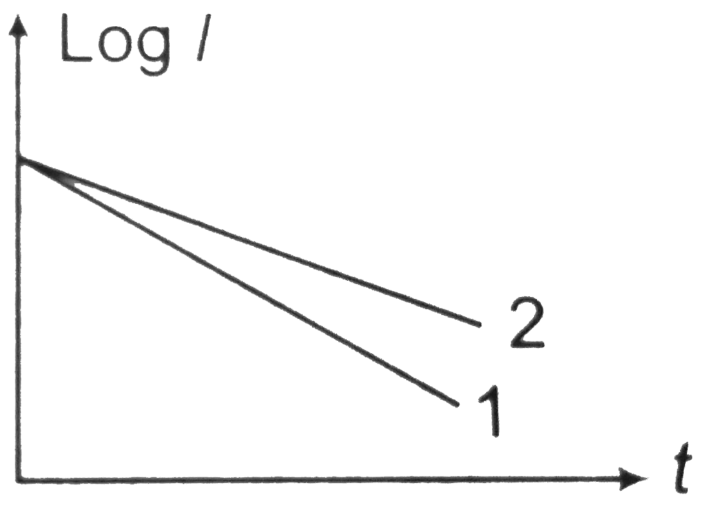
C. $6A$ from P to Q

D. zero

Answer: D

Watch Video Solution

85. A graph between current and time during charging of a capacitor by a battery in series with a resistor is shown. The graphs are drawn for two circutis. R_1, R_2, C_1, C_2 and V_1, V_2 are the values of resistance, capacitance and EMF of the cell in the two circuits. If only two parameters (out of resistance, capacitance, EMF) are different in the two circuits. What may be the correct options (s) ?



A. $V_1 = V_2, R_1 > R_2, C_1 > C_2$

B. $V_1 > V_2, R_1 > R_2, C_1 = C_2$

C. $V_1 < V_2, R_1 < R_2, C_1 = C_2$

D. $V_1 > V_2, R_1 = R_2, C_1 < C_2$

Answer: C

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86. A capacitor of capacitance C is charge by a battery of emf E and internal resistance r. A resistasnce 2r is also connet in sereis with the capacitor. The amount of heat liberated inside the battery by the time capacitor is 50% charged is

A. $\frac{3}{8}E^2C$

B. $\frac{E^2C}{6}$

C. $\frac{E^2C}{12}$

D. $\frac{E^2C}{24}$

Answer: D

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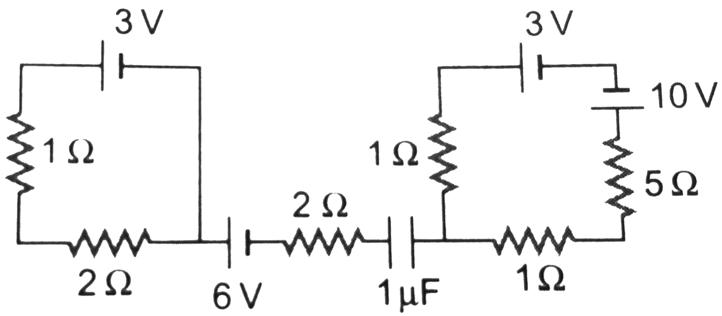
87. For the circuit shown in the figure determine the charge on capacitor in steady state.



A. $4\mu C$

B. $6\mu C$

C. $1\mu C$

D. zero

Answer: D

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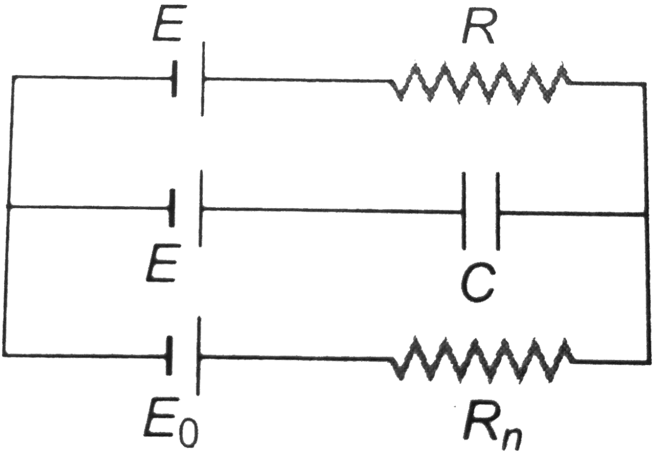
88. For the circuit shown in the figure, find the charge stored on capacitor in steady state.



A. $\dfrac{RC}{R+R_0}E$

B. $\dfrac{RC}{R_0}E-E_0$

C. zero

D. $\dfrac{RC}{R+R_0}(E-E_0)$

Answer: D

Watch Video Solution

89. 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 capacity of the system will increase

B. the new capacity of the system will decrease

C. the new capacity of the system will remain same

D. data insufficient

Answer: B

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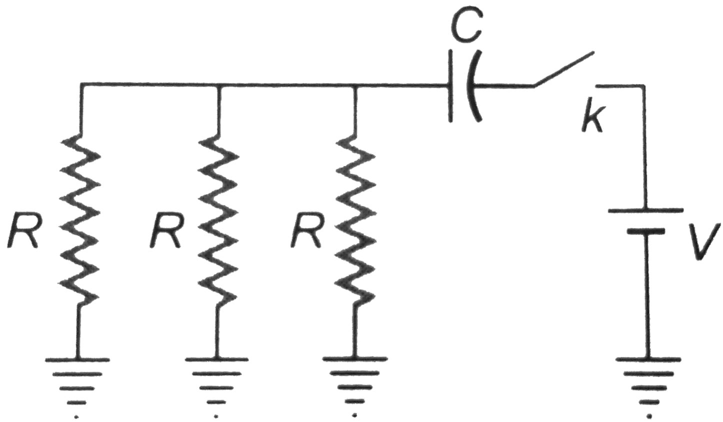
90. The switch shown n the figure is closed at $t=0$. The charge on the capacitor as a function of time is given by



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

B. $3CV\left(1-e^{-\frac{t}{RC}}\right)$

C. $CV\left(1-e^{\frac{-3t}{RC}}\right)$

D. $CV\left(1-e^{-\frac{t}{3RC}}\right)$

Answer: C

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91. A $2\mu F$ capacitor C_1 is charge to a voltage 100 V and a $4\mu F$ capacitor C_2 is charged to a voltage 50 V. The capacitors are then connected in parallel What is the loss of energy due to parallel connection?

A. $1.7J$

B. $0.17J$

C. $1.7 \times 10^{-2}J$

D. $1.7 \times 10^{-3}J$

Answer: D

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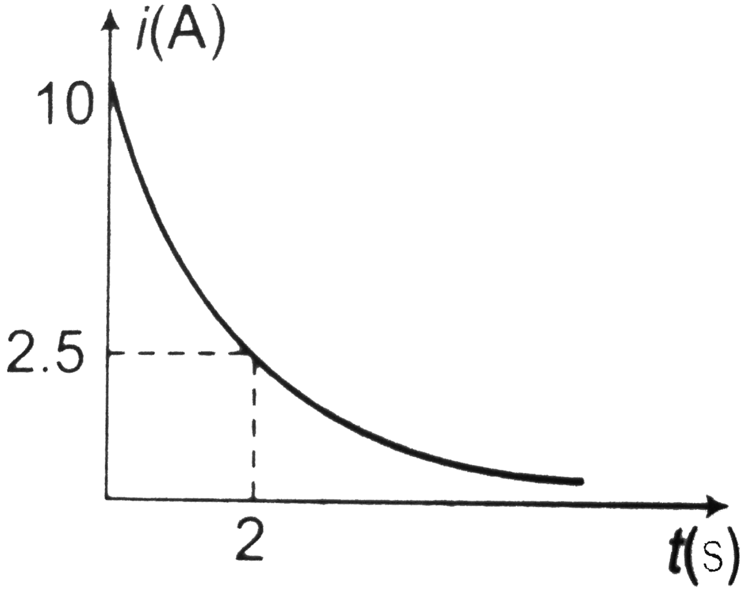
92. The figure shows a graph of the current in a charging circuit of a capacitor through a resistor of resistance 10Ω.



A. the initial potential difference across the capacitor is $100V$

B. The capacitor of the capcitor is $\frac{1}{10\ln 2}F$

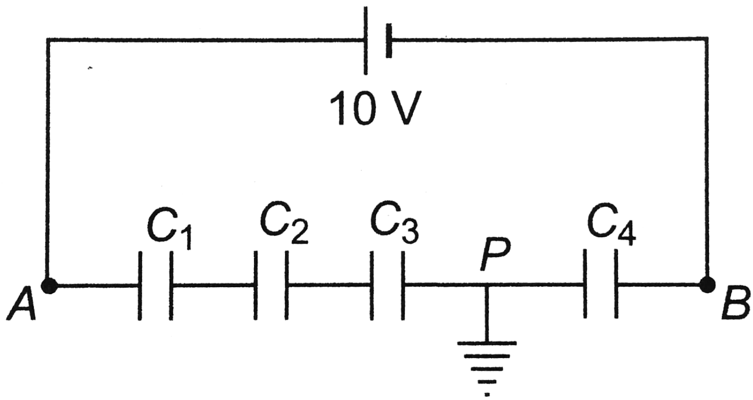
C. the total heat produced in the circuit will be $\left(\frac{500}{\ln 2}\right)J$

D. All of the above

Answer: D

Watch Video Solution

93. Four capacitors are connected inseries a battery of emf $10V$ as shown in the figure. The point P is earthed. The potential of point A is equal in magnitude to potetial of points B but opposite in sign is



A. $C_1 + C_2 + C_3 = C_4$

B. $\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} = \frac{1}{C_4}$

C. $\frac{C_1C_2C_3}{C_1^2 + C_2^2 + C_3^2} = C_4$

D. its is never possible

Answer: B

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94. 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. $\frac{25CV^2}{3}$

Answer: D

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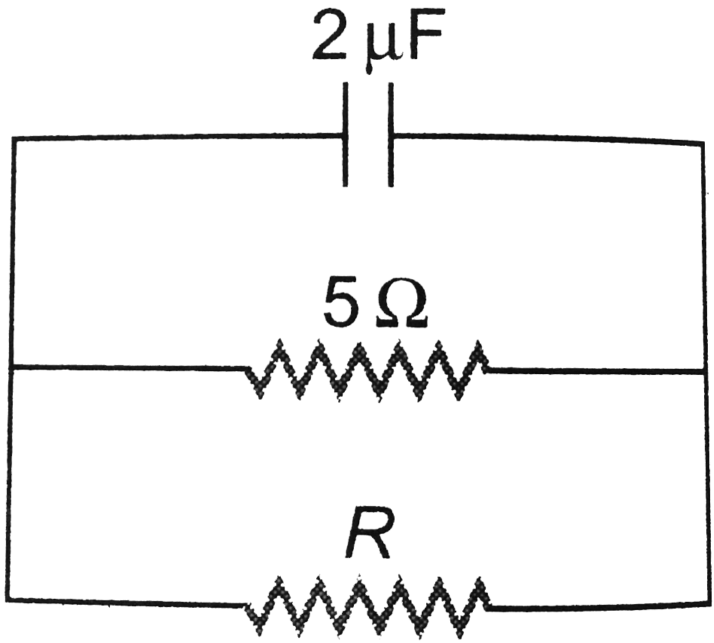
95. A capacitor of capacitance $2\mu F$ is charged to a potential difference of $5V$. Now, the charging battery is disconected and the capacitor is connected in parallel to a resistor of 5Ω and another unknown resistor of resistance R as shown in figure. If the total heat produced in 5Ω resistance is $10\mu J$ then the unknown resistance R is equal to



A. 10Ω

B. 15Ω

C. $\frac{10}{3}\Omega$

D. 7.5Ω

Answer: C

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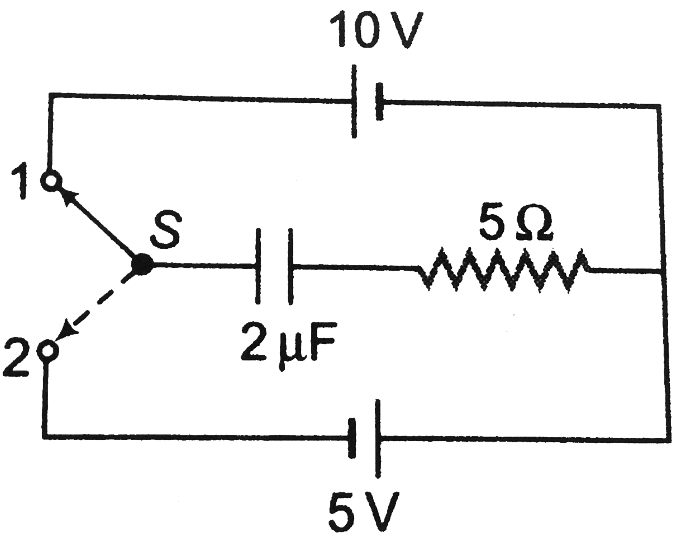
96. In the circuit shown in figure switch S is thrown to position 1 at $t = 0$. when the current in the resistort is $1A$, it is shifted to position 2. the total heat generated in the circuit after shifting to position 2 is



A. zero

B. $625\mu J$

C. $100\mu J$

D. none of these

Answer: C

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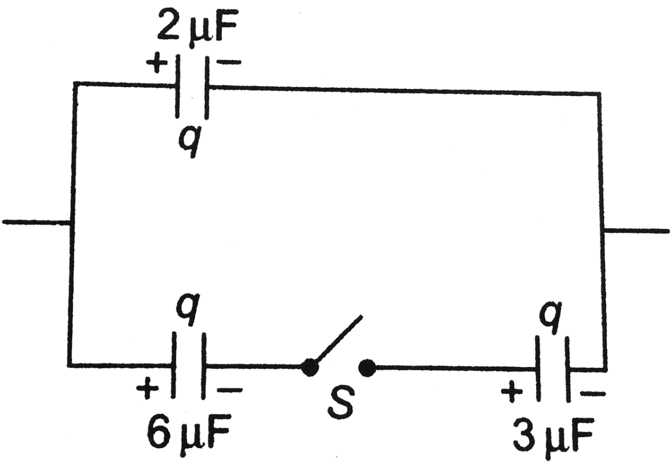
97. The flow of charge through switch S if it is closed is



A. zero

B. $\frac{q}{4}$

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

D. $\frac{q}{3}$

Answer: A

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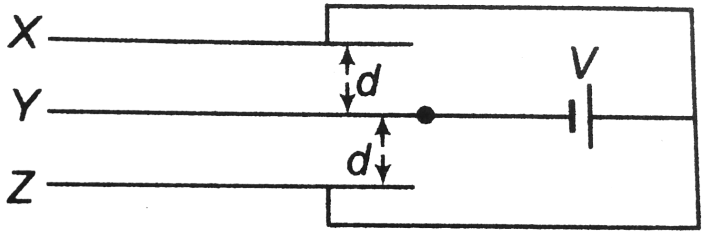
98. Consider the arrangement of three plates X, Y and Z each of the area A and separatioin d. The energy sotred when the plates are fully charged is



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

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

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

D. $3\varepsilon A \frac{V^2}{d}$

Answer: B

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99. Consider a capacitor charging circuit. Let Q_1 be the charge given to the capacitor in time interval of $20ms$ and Q_2 be the charge given in the next time interval of $20ms$. Let 10μC charge be deposited in a time interval t_1 and the next $10\mu C$ charges is deposited in the next time interval t_2. Then

A. $Q_1 > Q_2, t_1 > t_2$

B. $Q_1 > Q_2, t_1 < t_2$

C. $Q_1 < Q_2, t_1 > t_2$

D. $Q_1 < Q_2, t_1 < t_2$

Answer: B

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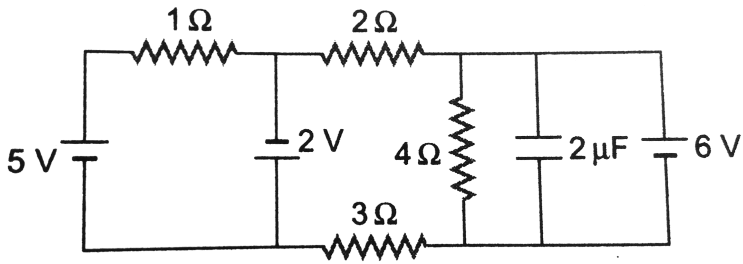
100. The current in 1Ω resistance and charge stored in the capacitor are



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

B. $7A,\ 12\mu C$

C. $4,\ 12\mu C$

D. $7A,\ 6\mu C$

Answer: B

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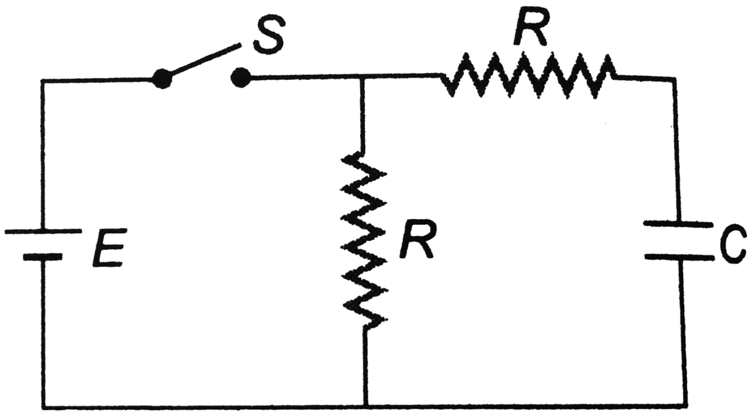
101. A capacitor C is connected to two equal resistances as shown in the figure. Consider the following statemets



i. At the time of charging of capacitor time constant of the circuit is CR

ii. At the time of discharging of the capacitor the time constant of the circuit is CR

iii. At the time of discharging of the capacitor the time constant of the circuit is $2CR$

iv At the time of charging of the capacitor the time constant of the circuit is $2CR$

A. statements i and ii only are correct

B. statements ii and iii only are correct

C. statements iii and iv only are correct

D. statements i and iii only are correct

Answer: C

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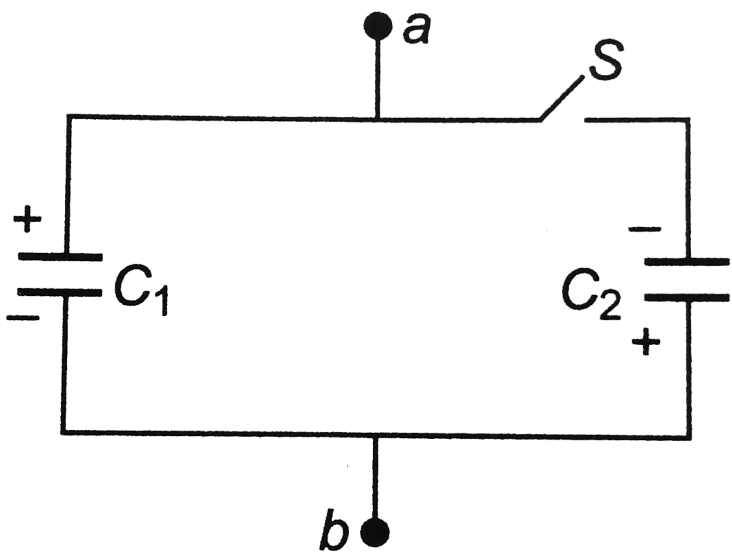
102. Two capacitors $C_1 = 1\mu F$ and $C_2 = 3\mu F$ each are charged to a potential difference of $100V$ but with opposite polarity as shown in the figure. When the switch S is closed, the new potential difference between the points a and b is



A. $200V$

B. $100V$

C. $50V$

D. $25V$

Answer: C

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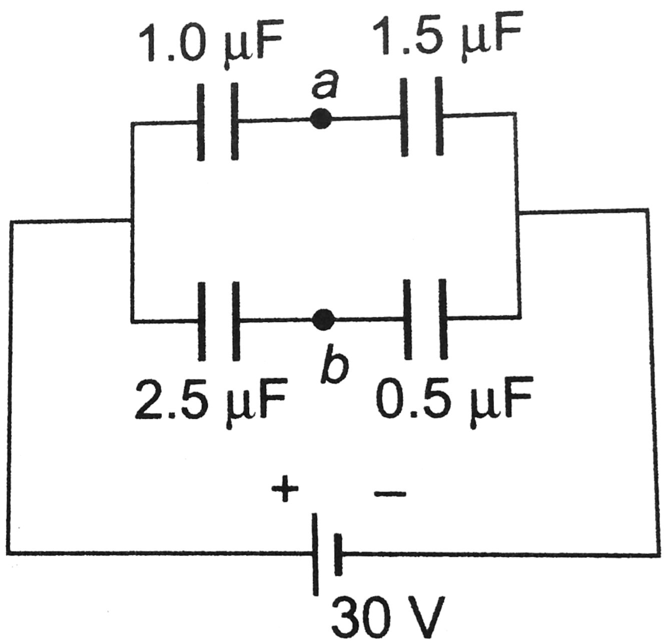
103. Four capacitors are connected as shown in figuere to a $30V$ battery. The potential difference between points a and b



A. $5V$

B. $9V$

C. $10V$

D. $13V$

Answer: D

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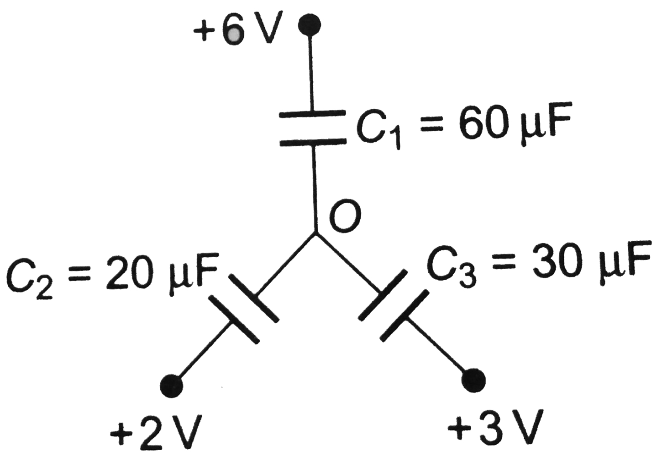
104. Three uncharged capacitors of capacitance C_1, C_2 and C_3 are connected to one another as shown in figure. The potential at O will be



A. $3V$

B. $\frac{49}{11}V$

C. $4V$

D. $\frac{3}{11}V$

Answer: B

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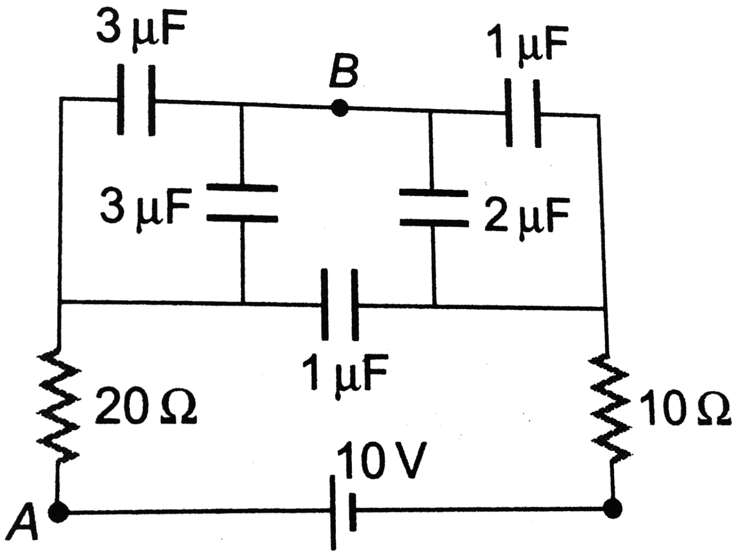
105. In the circuit shown in figure potential difference between the points A and B in the steady state is



A. zero

B. $6V$

C. $4V$

D. $\frac{10}{3}V$

Answer: D

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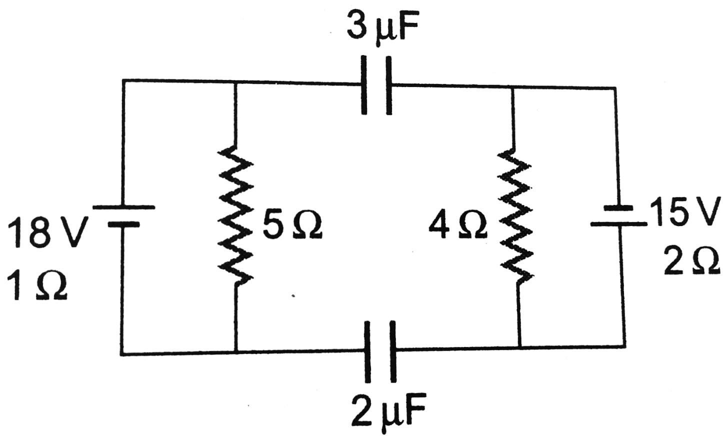
106. Two cellls, two resistance and two capacitors are connected as shown in figure. The charge on $2\mu F$ capacitors is



A. $30\mu C$

B. $20\mu C$

C. $25\mu C$

D. $48\mu C$

Answer: A

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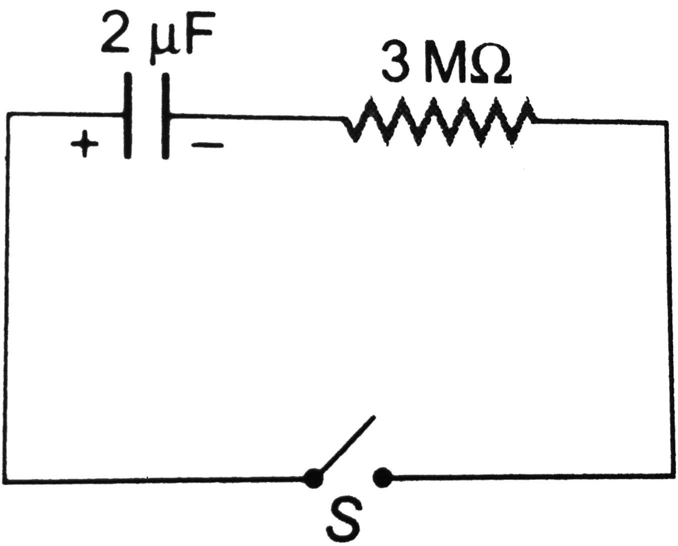
107. In the circuit shown in figure, the capacitor is charged with a cell of $5V$.If the switch is closed at $t = 0$, then at $t = 12s$, charge on the capacitor is



A. $(0.37)10\mu C$

B. $(0.37)^{210}\mu C$

C. $(0.63)10\mu C$

D. $(0.63)^{210}\mu C$

Answer: B

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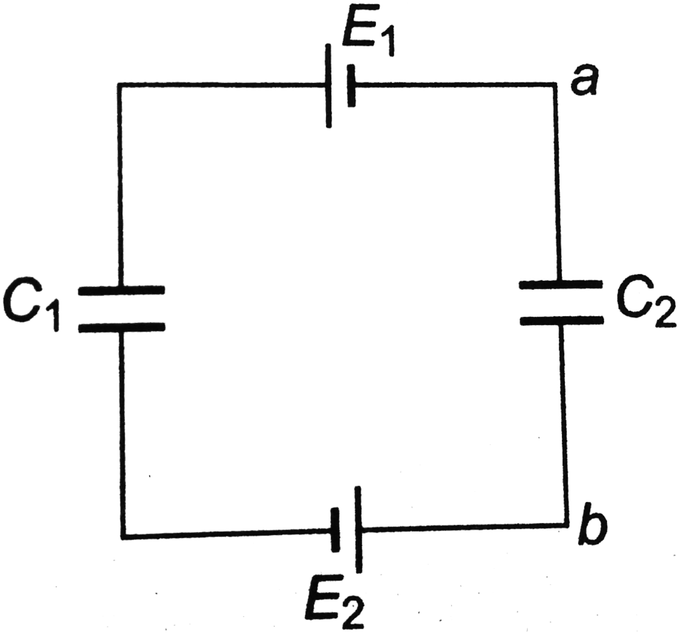
108. The potential difference between points a and b of circuits shown in figure is



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

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

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

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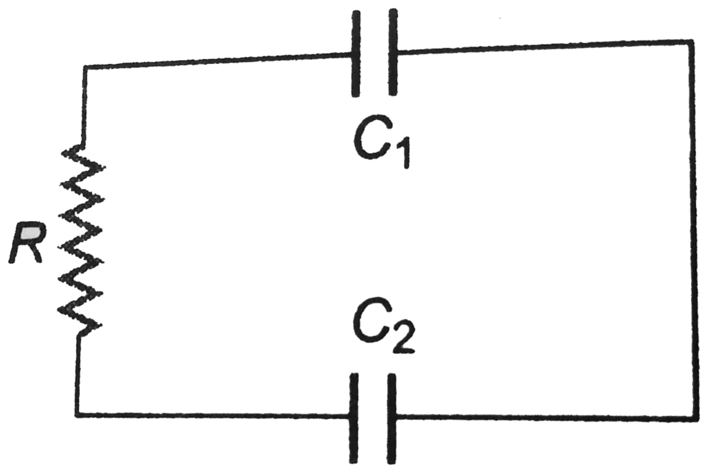
109. A capacitors C_1 is charged to a potential V and connected to another capacitor in seris with a resistor R as shown. It is observed that heat H_1 is dissipated across resistance R, tilll the circuit reaches steady state. Same process is repeated using resistance of $2R$. If H_2 is heat dissipated in this case then



A. $\dfrac{H_2}{H_1} = 1$

B. $\frac{H_2}{H_1} = 4$

C. $\frac{H_2}{H_1} = \frac{1}{4}$

D. $\frac{H_2}{H_1} = 2$

Answer: A

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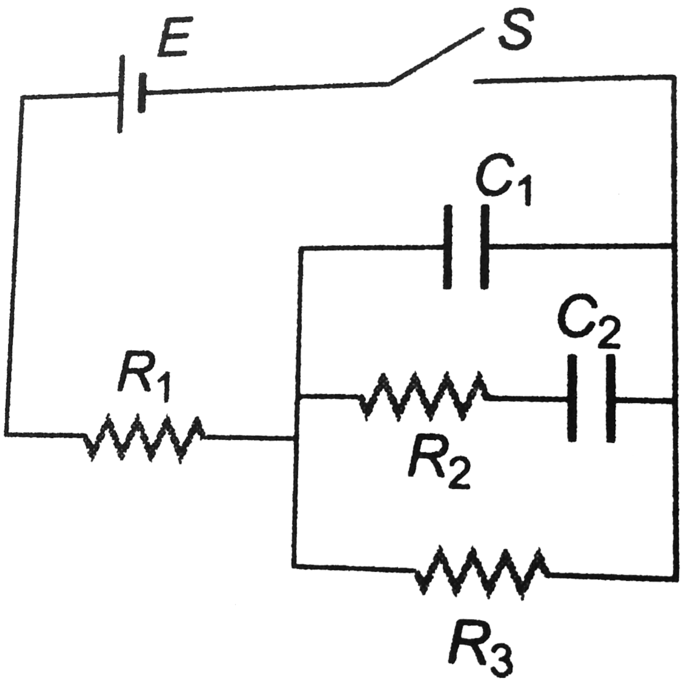
110. In the circuit diagram the current through the battery immediately after the switch S is closed is



A. zero

B. $\frac{E}{R_1}$

C. $\frac{E}{R_1 + R_2}$

D. $\frac{E}{R_1} + \frac{R_2 R_3}{R_2 + R_3}$

Answer: B

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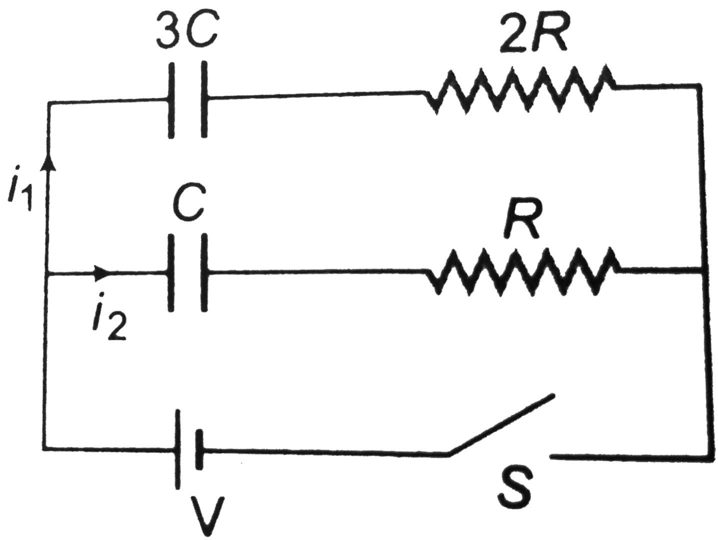
111. In the circuit shown switch S is closed at $t = 0$. Let i_1 and i_2 be the current at any finite time t then the ratio $\frac{i_1}{i_2}$



A. is constant

B. increases with line

C. decrease with time

D. first increases then decreases

Answer: B

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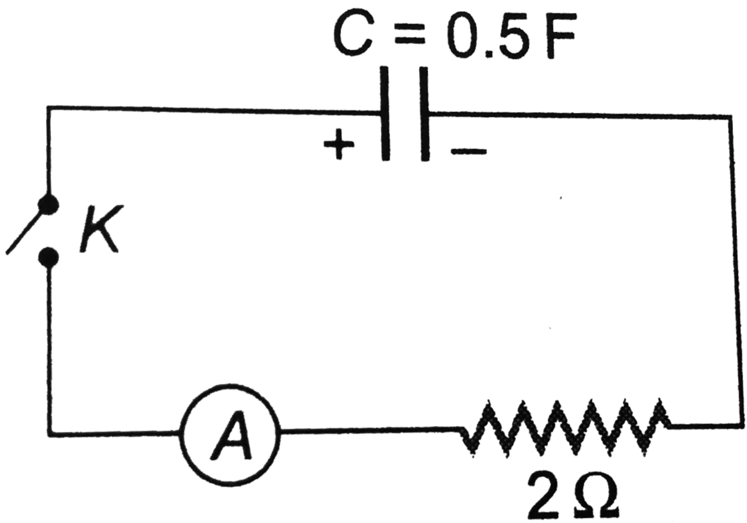
112. A charged capacitor is allowed to dischare through a resistor by closing the key at the instant $t = 0$. At the instant $t = (\ln 4)\mu s$, the reading of the ammeter falls half the initial vaslue. The resistance of the ammeter is equal to



A. 0.5Ω

B. 1Ω

C. 2Ω

D. 4Ω

Answer: C

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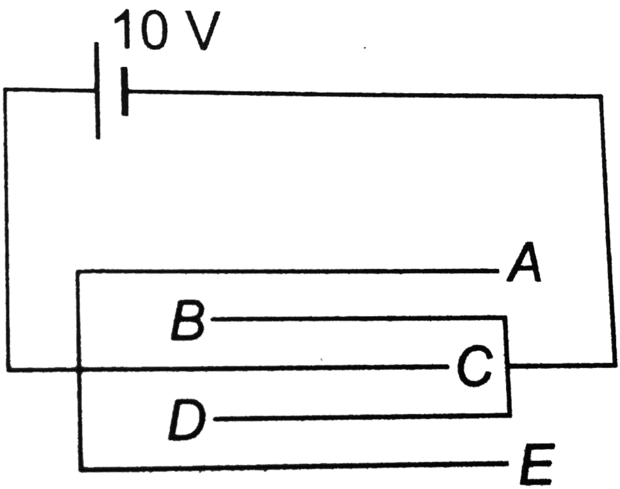
113. Five identical capacitor plates are arranged such that they make four capacitors each of $2 \mu F$. The plates are connected to a source of emf $10 V$. The charge on plate C is



A. $+20 \mu C$

B. $+40 \mu C$

C. $+60 \mu C$

D. $+80\mu C$

Answer: B

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

A. V

B. $V + \frac{Q}{C}$

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

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

Answer: C

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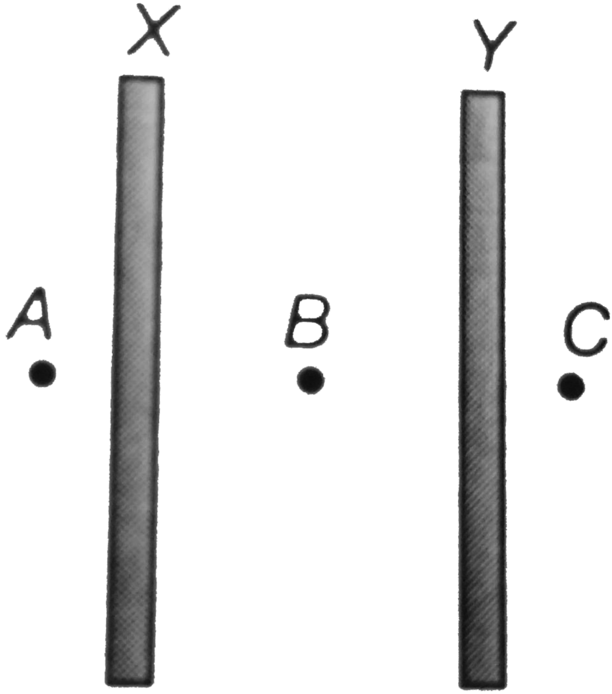
115. X and Y are large, parallel conducting plates close to each other. Each face has an area A. X is given a charge Q. Y is without any charge. Points A, B and C are as shown in the figure.



A. The field at B is $\frac{Q}{2\varepsilon A}$

B. The field at B is $\frac{Q}{\varepsilon_0 A}$

C. The fiels at A, B and C are of the same magnitude

D. The fieds at A and C are of the same magnitude, but

in opposite directions

Answer: A::C::D

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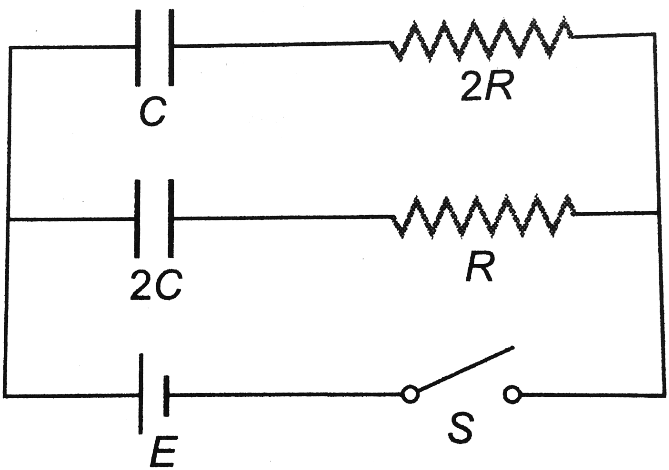
116. In the circuit shown in the figure, switch S is closed at time $t = 0$. Select the correct statements.



A. Rate of increase of charge is same in both the capacitors

B. Ratio of charge stored in capacitors C and $2C$ at any time t would be $1:2$

C. Time constants of both the capacitors are equal

D. Steady state chares on capacitors C and $2C$ are in the ratio of $1:2$

Answer: B::C::D

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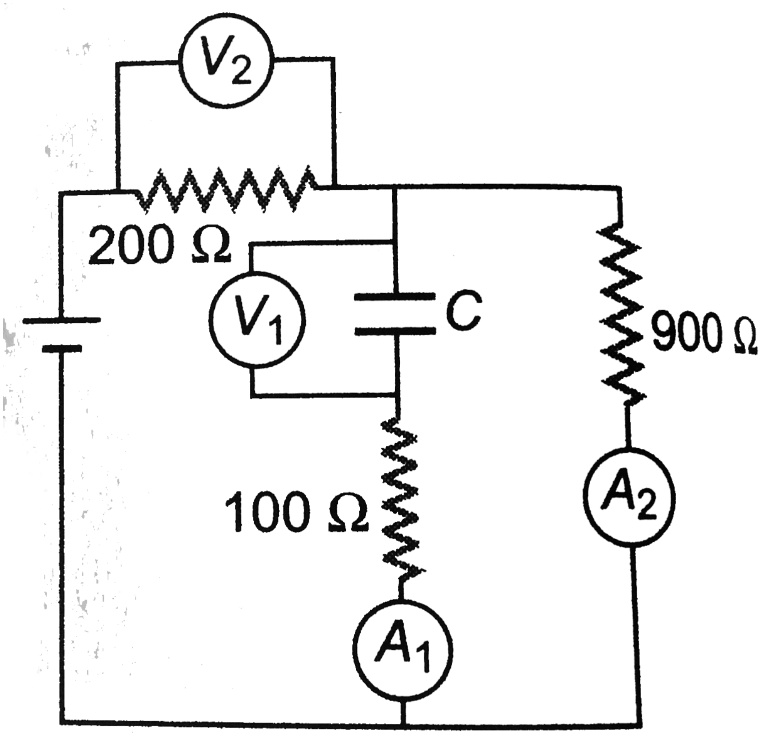
117. An electrical circuit is shown in the given figure. The resistance of each voltmeter is infinite and ech ammeter is

100Ω. The charge on the cpacitor of $100 \mu F$ in steady staste is $4 mC$. Chose correct statement(s) regarding the given circuit.



A. Reading of voltmeter $V_2 is 16$

B. Reading of ammeter A_1 is zero and A_2 is $\frac{1}{25} A$

C. Reading of voltmeter V_1 is $40V$

D. Emf of the ideal cell is $66V$

Answer: B::C::D

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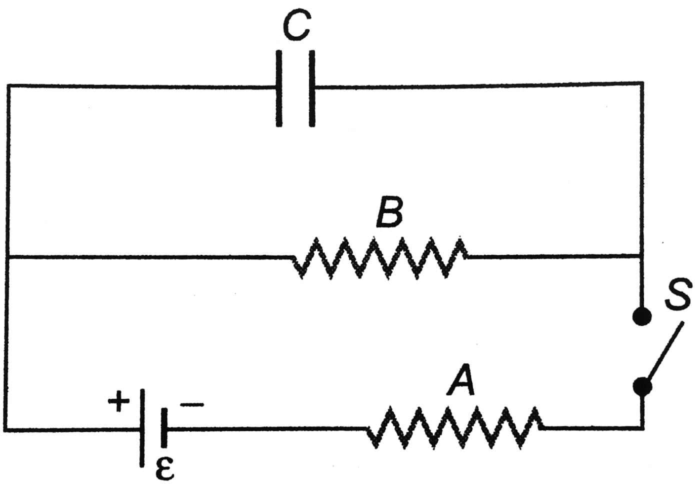
118. In the circuit shown, A and B are equal resistances. When S is closed, the capcitor Ccharges from the cell of emf epsilon and reaches a steady state.



A. During charging, more heat is produced in A than in B

B. In stedy state heat is produced at the same rate in A and B

C. In the steady state, energy stored in C is $\frac{1}{4}C\varepsilon^2$

D. In the steady state energy stored in C is $\frac{1}{8}C\varepsilon^2$

Answer: A::B::D

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119. A parallel plate capacitor is charged from a cell and then isolated from it. The separation between the plates is now increased

A. The force of attraction between the plates will decrease

B. The field in the region between the plates will not change

C. The energy stored in the capacitor will increase

D. The potential difference between the plates will decrease

Answer: B::C

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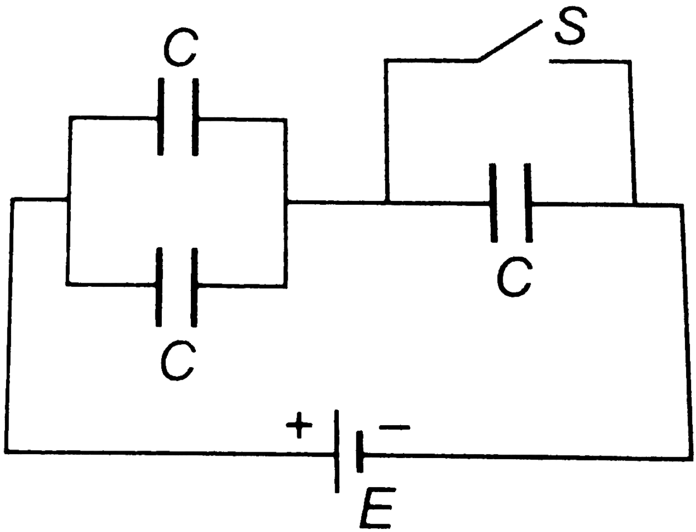
120. In the circuit shown each capacitor has a capcitance C. The emf of the celll is E. If the switch S is closed then



A. Positive charge wil flow out of the positive terminal

of the cell

B. Positive charge will enter the positive terminal of the

cell

C. the amount of the charge flowing through the cell

will be $\frac{1}{3}$ CE

D. the amount of charge flowing through the cell is $\left(\frac{4}{3}\right)CE$

Answer: A::D

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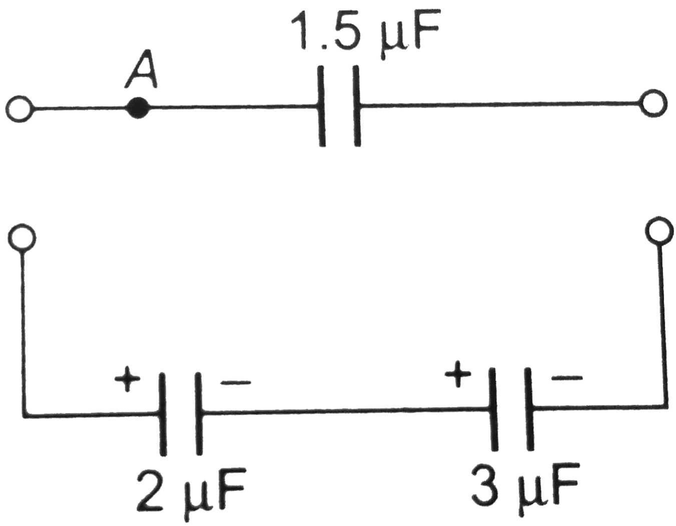
121. Two capacitors of $2\mu F$ and $3\mu F$ are charged to $150V$ and $120V$, respectively. The plates of capacitor are connected as shown in the figure. An uncharged capacitor of capacity $1.5\mu F$ falls to the free end of the wire. Then



A. chargeg on $1.5\mu F$ capacitor is $180\mu F$

B. charge on $2\mu F$capacitor is $120\mu F$

C. positive chasrge 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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122. A parallel plate capacitor is charged and then the battery is disconnected. When the plates of the capacitor are brought closer, then

A. energy stored in the capacitor decreases

B. the potential differences between the plates decreases

C. the capacitance increases

D. the electric field between the plates decreases

Answer: A::B::C

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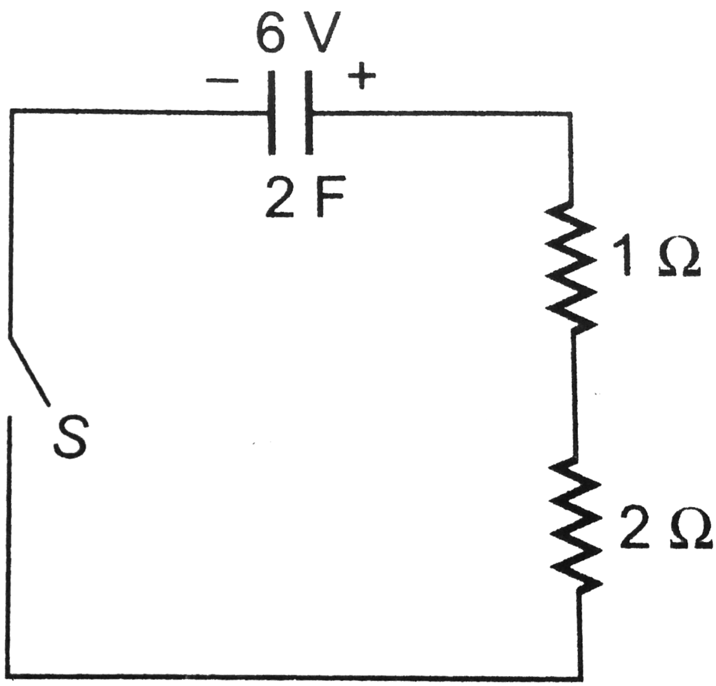
123. A capacitor of $2F$ (practically not possible to have a capacity of $2F$) is charged by a battery of $6v$. The battery is removed and circuit is made as shown. Switch is closed at time $t=0$. Choose the correct options.



A. At time $t=0$ current in the circuirt is $2A$

B. At time $t = (6 \ln 2)$second, potential difference across capacitor is $3V$

C. At time $t = (6 \ln 2)$ second potential difference across 1Ω resistance is $1V$

D. At time $t = (6 \ln 2)$ second, potential difference across 2Ω resistance is $2V$

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

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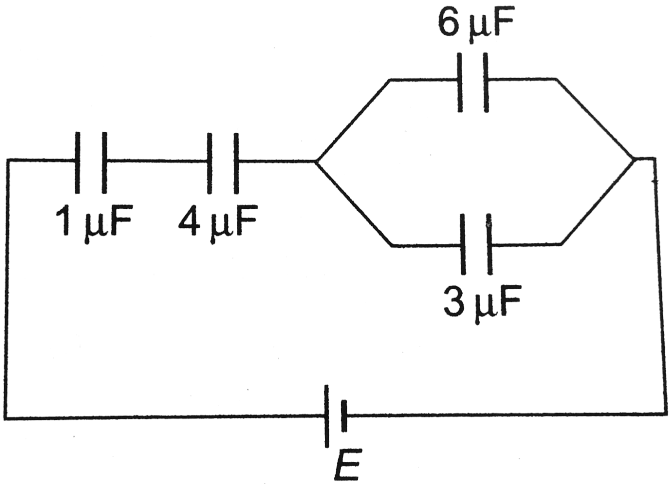
124. given that potential differene across $1\mu F$ capacitor is $10V$. Then,



A. potential difference across $4\mu F$ capacitor is $40V$

B. potential difference acros $4\mu F$ capacitor is $2.5V$

C. potential diference across $3\mu F$e capacitor is $5V$

D. value of E is $50V$

Answer: B

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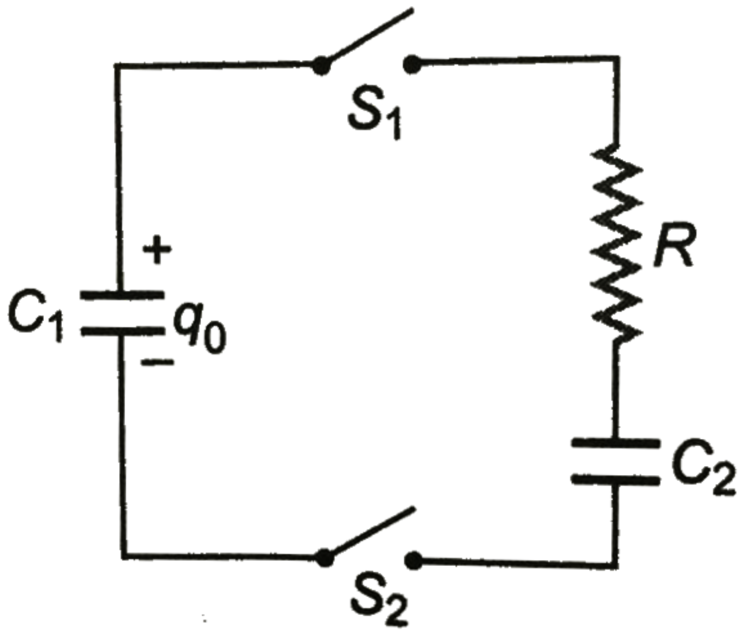
125. The capacitor C_1 in the figure shown initially carries a charge q_0. When the switches S_1 and S_2 are closed,capacitor C_1 is connected in series to a resistor R and a second capacitor C_2 which is initially uncharged.



find the charge flown through wires as a function of time is

where $C = \dfrac{C_1 C_2}{C_1 + C_2}$

A. $q_0 e^{-\frac{t}{RC}} + \dfrac{C}{C_2} q_0$

B. $\frac{q_0 C}{C_1} x \left[1 - e^{-\frac{t}{RC}}\right]$

C. $q_0 \frac{C}{C_1} e^{-\frac{t}{CR}}$

D. $q_0 e^{-\frac{t}{RC}}$

Answer: B

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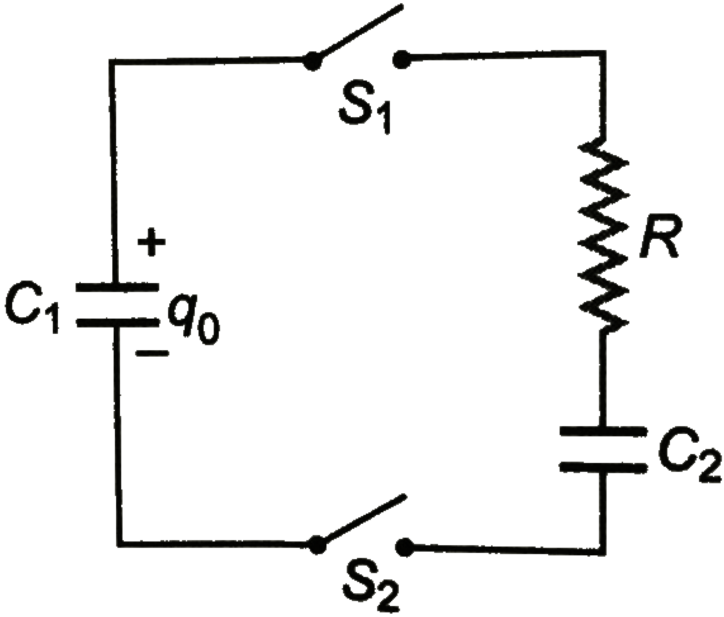
126. The capacitor C_1 in the figure shown initially carries a charge q_0. When the switches S_1 and S_2 are closed,capacitor C_1 is connected in series to a resistor R and a second capacitor C_2 which is initially uncharged.



the total heat dissipated in the circuit during the discharging process of C_1 is

A. $\frac{q_0^2}{2C_1^2} \times C$

B. $\frac{q_0^2}{2C}$

C. $\frac{q_0^2 C_2}{2C_1^2}$

D. $\frac{q_0^2}{2C_1 C_2}$

Answer: A

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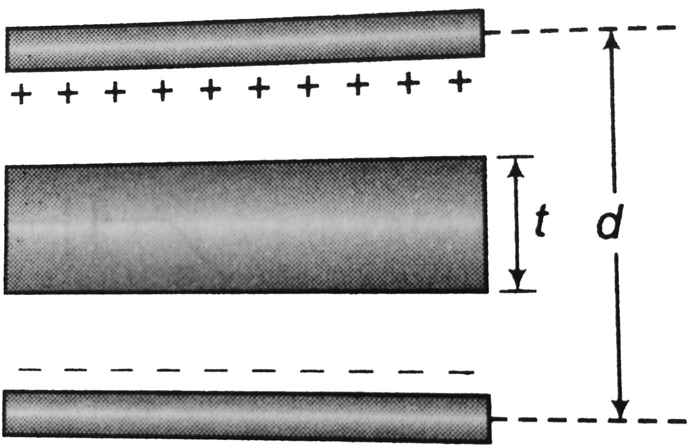
127. Figure shows a parallel plate capacitor with plate area A and plate separation d. A potential difference is being applied between the plates. The battery is then disconnected and a dielectric slab of dieletric constant K is placed in between the plates of the capacitor as shown.



The electric field in the gaps between the plates and the electric slab will be

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

B. $\frac{V}{d}$

C. $\frac{KV}{d}$

D. $\frac{V}{d-t}$

Answer: B

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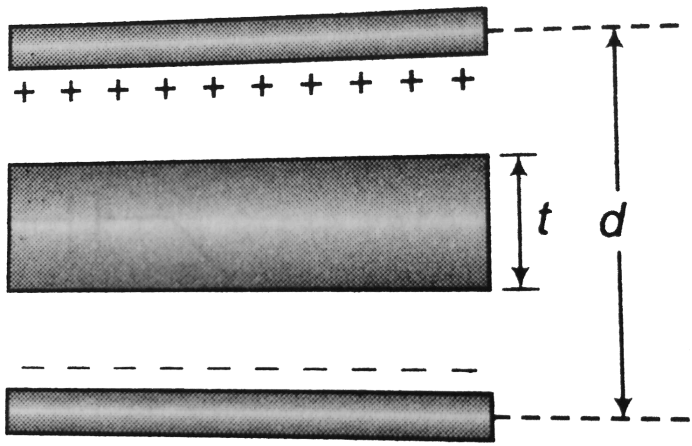
128. Figue shows a parallel plate capacitor with plate area A and plate separation d. A potential difference is being applied between the plates. The battery is then disconnected and a dielectric slab of dieletric constant K is placed in between the plates of the capacitor as shown.



The electric field in the dielectric slab is

A. $\frac{V}{Kd}$

B. $\frac{KV}{d}$

C. $\frac{V}{d}$

D. $\frac{KV}{t}$

Answer: A

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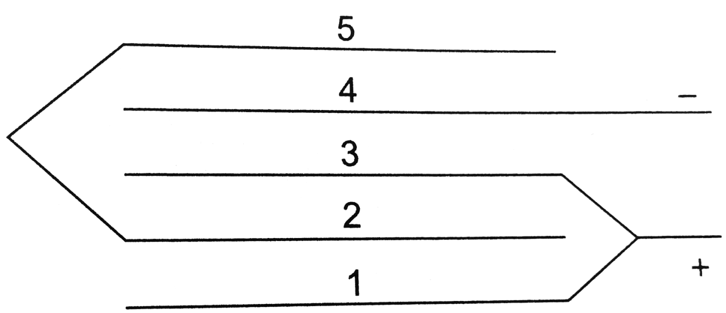
129. Five identical conducting plates, $1, 2, 3, 4$ and 5 are fixed parallel pltes equidistant from each other (see figure). A conductor connects plates 2 and 5 while another conductor joins 1 and 3. The junction of 1 and 3 and the plate 4 are connected to a source of constant emf V_0. Find



(a) the effective capacity of the system between the terminals of source.

(b) the charges on the plates 3 and 5. Given, $d =$ distance between any two successive plates and $A =$ area of either face of each plate.

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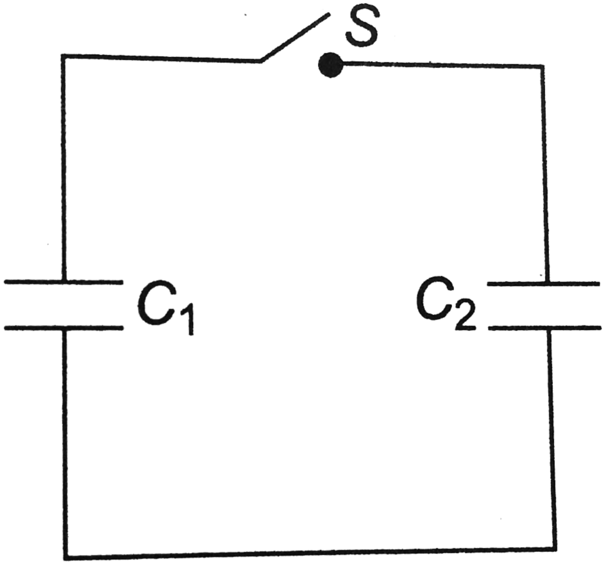
130. A $8uF$ capacitor C_1 is charged to $V_0 = 120V$. The charging battery is then removed and the capacitor is connected in parallel to an uncharged $+4\mu F$ capacitor C_2

.



(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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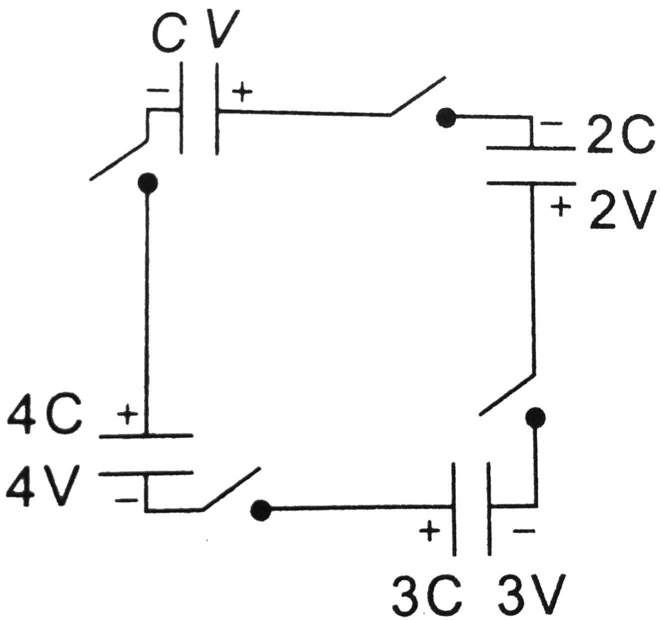
131. Condensers with capacities$C, 2C, 3C$ and $4C$ are charged to the voltage, $V, 2V, 3V$ and $4V$ correspondingly. The circuit is closed. Find the voltage on all condensers in the equilibrium.



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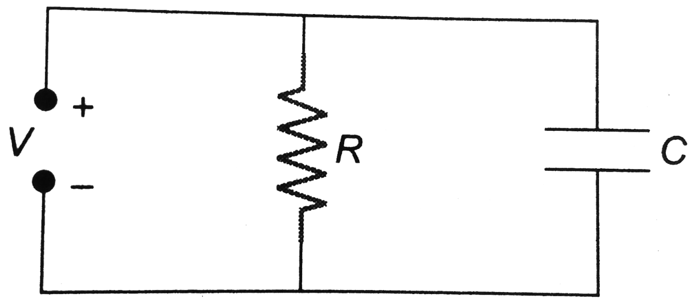
132. In the circuit shown, a time varying voltage $V = 2000t$ volt is applied where t is in second. At time $t5ms$, determine the Current through the resistor $R = 4\Omega$ and through the capacitor $C300\mu F$



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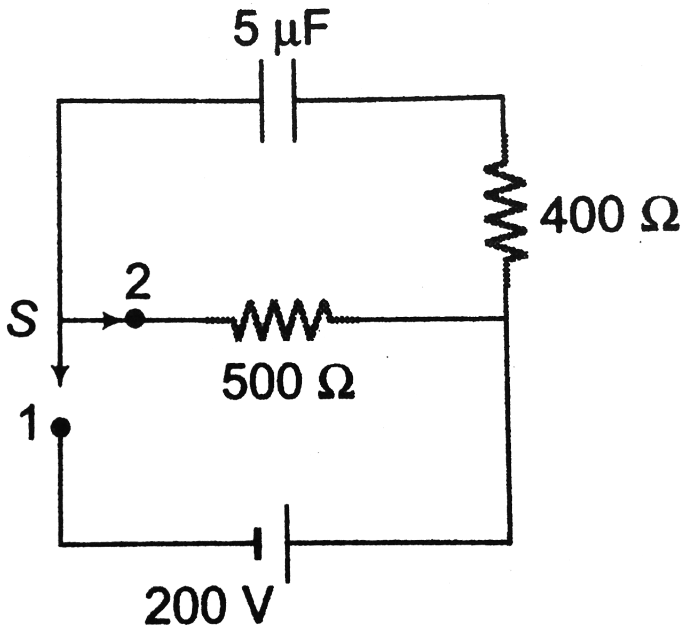
133. A capacitor of capacitance $5\mu F$ is connected to a source of constant emf of $200V$,Then switch was shifted to contact 2 from contact 1. Find the amount of heat generated in the 400Ω resistance.



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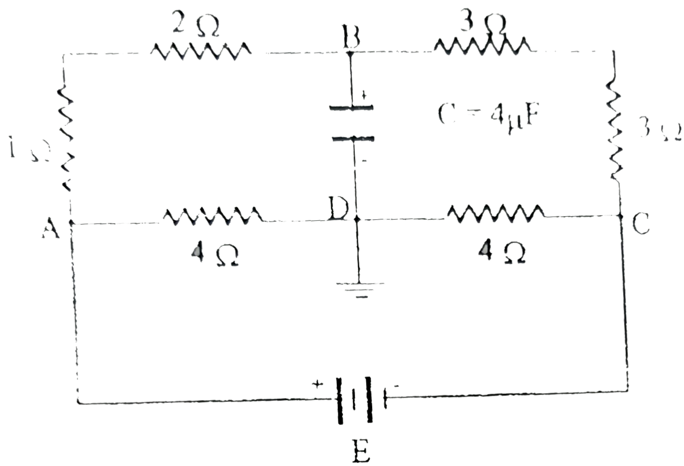
134. Analyse the given circuit in the steady state condition.

Charge on the capacitor is $q_0 = 16 \mu C$. If the e.m.f. of the battery is $6k$ then find the value of k.



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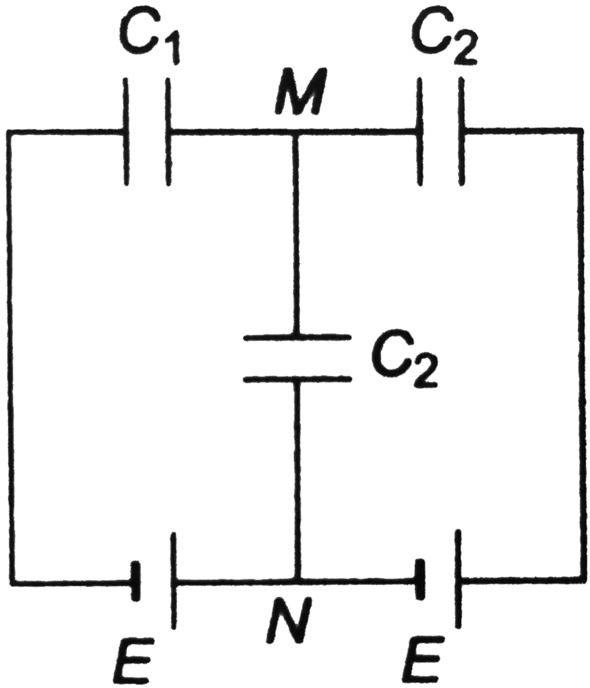
135. Find the potential difference between points M and N of the system shown in figure, if the emf is equal to

$E = 110V$ and the capacitance ratio $\frac{C_1}{C_2} is 2.$



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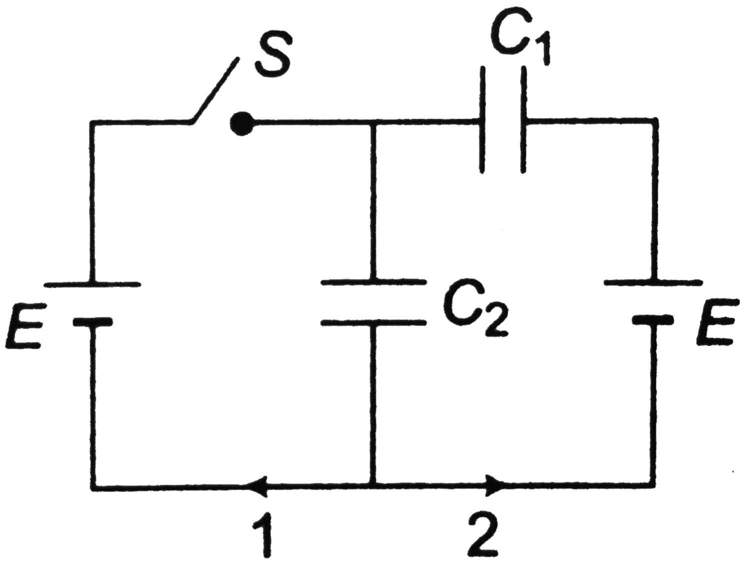
136. In the given circuit diagram, find the charges which flow through directions 1 and 2 when switch S is closed.



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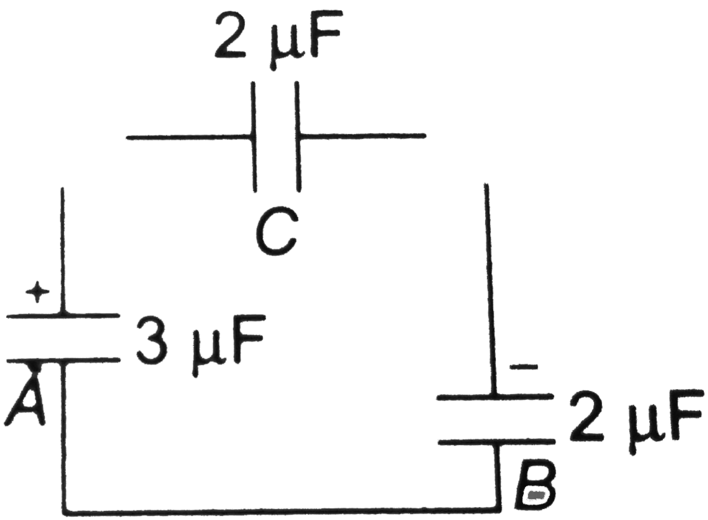
137. Two capacitors A and B with capacities $3\mu F$ and $2\mu F$ are charged to a potential difference of $100V$ and $180V$, respectively. The plates of the capacitors are connected as show in figure with one wire of each capacitor free. The upper plate of A is positive and that of B is negastive. An 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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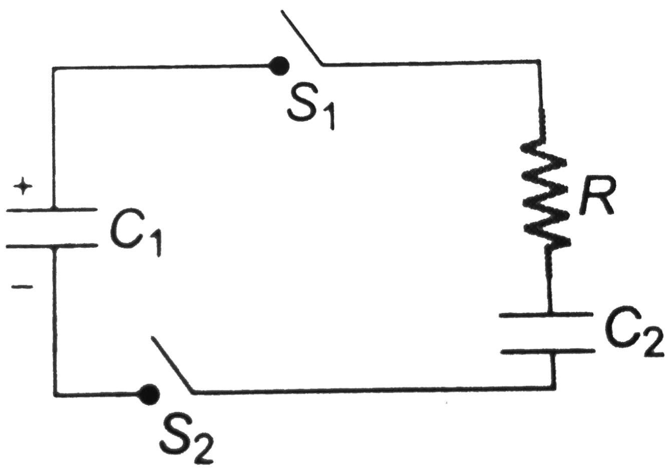
138. The capacitor C_1 in the figure initially carries a charge q_0. When the i switch S_1 and S_2 are closed, capacitor C_1 is connected to a resistor R and a second capacitor C_2, which initially does not carry any charge.

(a) Find the charges deposited on the capacitors in steady state and the current through R as a function of time.

(b) What is heat lost in the resistor after a long time of closing the switch?



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139. A leaky parallel plate capacitor is filled completely with a material having dielectric constant $K = 5$ and electrical conductivity $\sigma = 7.4 \times 10^{-12} \Omega^{-1} m^{-1}$. If the charge on the capacitor at the instant $t = 0$ is $q_0 = 8.55 \mu C$, then calculate the leakage current at the instant $t = 12s$.

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140. 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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141. A spherical capacitor has the inner sphere of radius $2cm$ and the outerone of $4cm$. If the inner sphere is earthed and the outer one is charged with a charge of $2\mu C$ and isolated. Calculate ltbr. (a) the potential to which the outer sphere is raised.

(b) the charge retained on the outer surface of the outer sphere.

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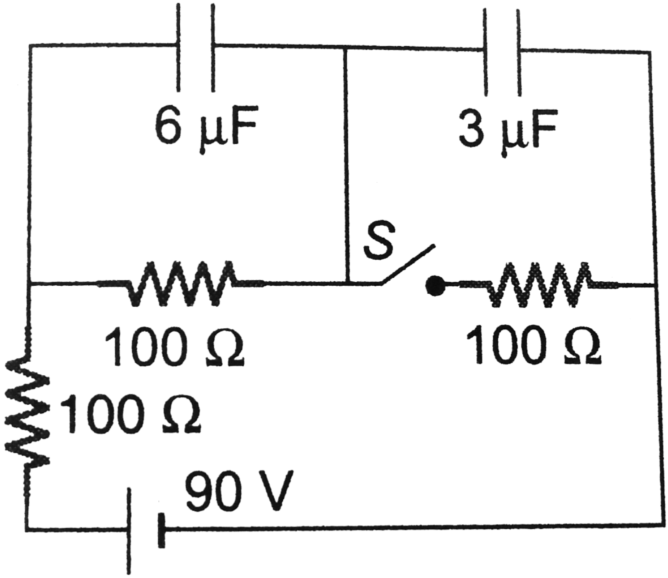
142. Calculate the charge on each capacitor and the potential difference across it in the circuits shown in figure for the cases :



(a)

(i) switch S is closed and

(ii) switch S is open.

(iii) In. figure (b), what is the potential of point A when S is open?

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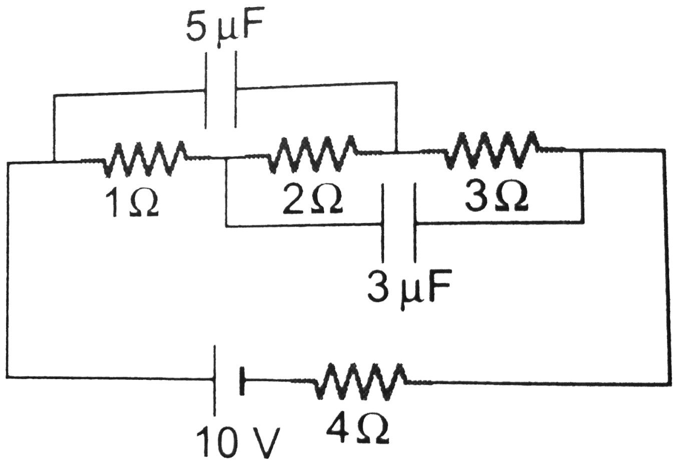
143. In the shown network, find the charges on capacitors of capacitances $5\mu F$ and $3\mu F$, in steady state.



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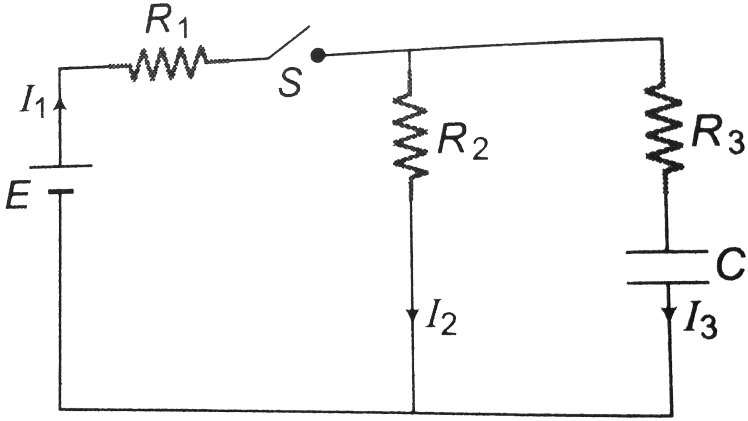
144. In the circuit shown, $E = 18kV, C = 10\mu F, R_1 = 4M\Omega, R_2 = 6M\Omega, R_3 = 3M\Omega$ with C completely uncharged, switch S is suddenly closed (at $t = 0$).

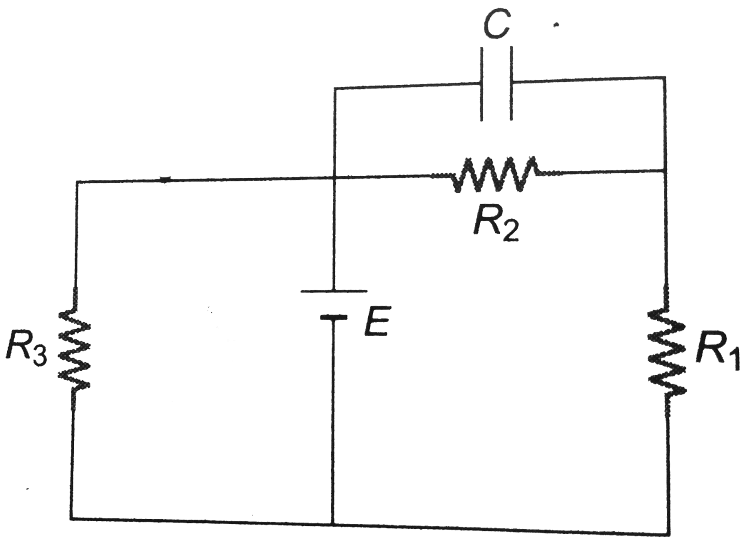


(a) Determine the current through each resistor for $t = 0$ and $t = \infty$

(b) What are the values of V_2 (potential difference across R_2) at $t = 0$ and $t = \infty$. ?

(c) Plot a graph of the potential difference V_2 versus t and determine the instantaneous value of V_2.

145. The charge on the capacitor is initially zero. Find the charge on the capacitor as a function of time t. All resistors are of equal value R.



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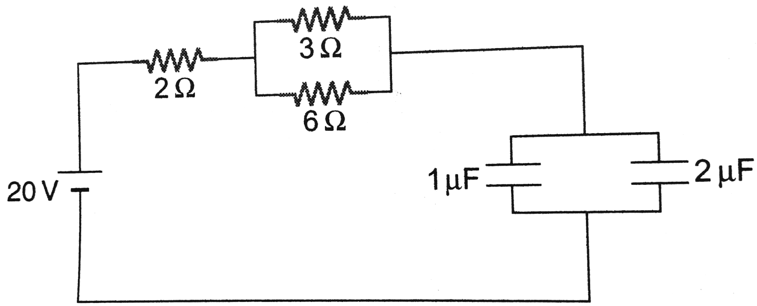
146. The capacitors are initially uncharged. In a certain time the capacitor of capacitance $2\mu F$ gets a charge of

$20\mu C$. In that time interval find the heat produced by each resistor individually.



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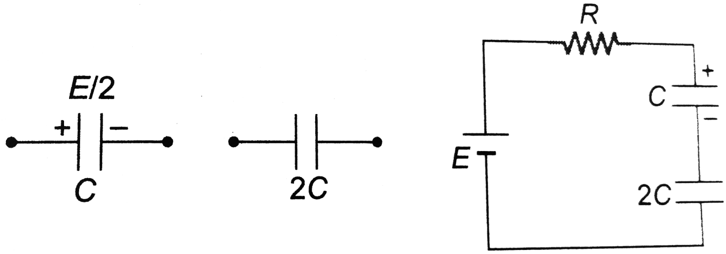
147. A capacitor of capacitance C has potential difference $\frac{E}{2}$ and another capacitor of capacitance 2C is uncharged. They are joined to form a closed circuit as shown in the figure.



a. Find the current in the circuit at t =0.

b. Find the charge on C as a function of time.

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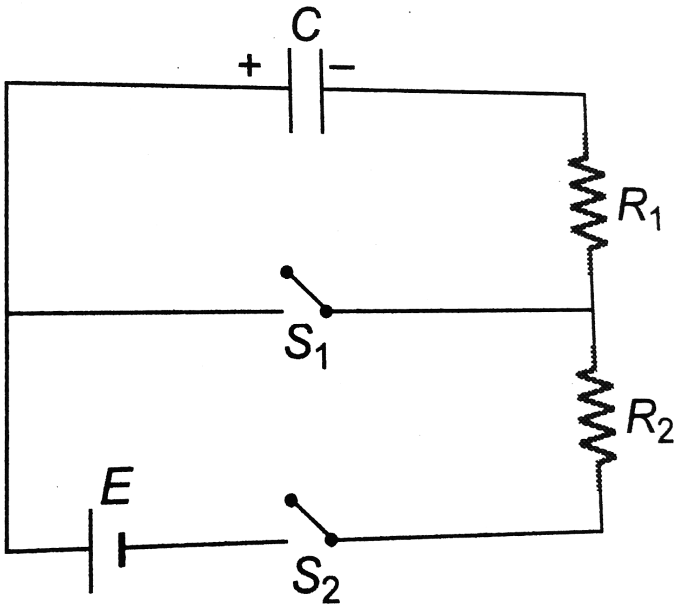
148. The capacitor shown in figure has been charged to a potential difference of V volt, so that it carries a charge CV with both the switches S_1 and S_2 remaining open. Switch S_1 is closed at $t=0$. At $t=R_1C$ switch S_1 is opened and S_2 is closed. Find the charge on the capacitor at $t = 2R - 1C + R_2C$.



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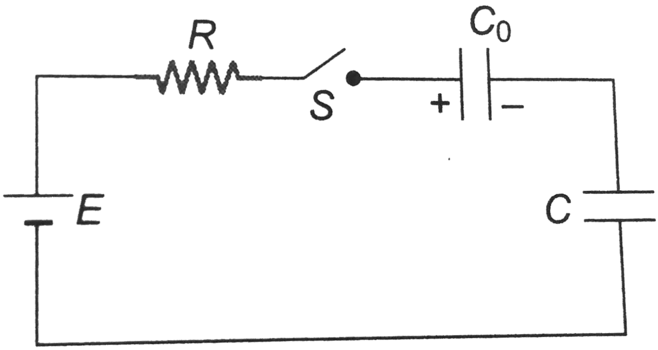
149. The switch S is closed at $t = 0$. the capacitor C is uncharged but C_0 has a charge $Q_0 = 2\mu C$ at $t = 0$. If $= 100Ommega$, $C = 2\mu F$, $C_0 = 2\mu F, E = 4V$.

Calculate $i(t)$ in the circuit.



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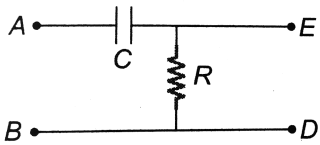
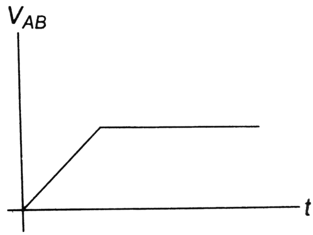
150. A time varying voltage is applied to the clamps A and B such that voltage across the capacitor plates is as shown in the figure. Plot the time dependence of voltage across the terminals of the esistance E and D.





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151. In the above problem if given graph is between V_{AB} and time. Then plot graph between V_{ED} and time.

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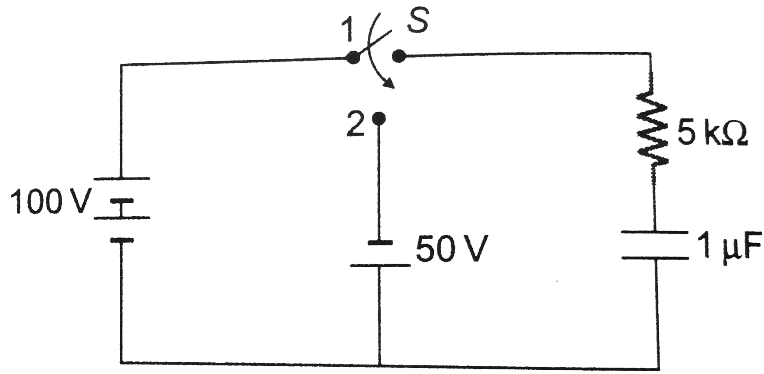
152. Initially, the switch is in position 1 for a long time. At $t = 0$, the switch is Obtain expressions for V_C and V_R for

$t > 0$



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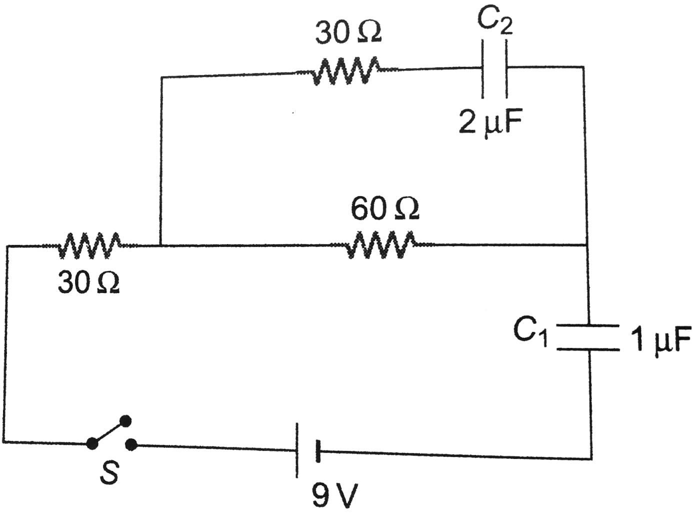
153. For the arrangement shown in the figure, the switch is closed at $t = 0$. C_2 is initially uncharged while C_1 has a charge of $2\mu C$



(a) Find the current comingn out of the battery just after the switch is closed.

(b) Find the charge on the capacitors in the steady state condition.

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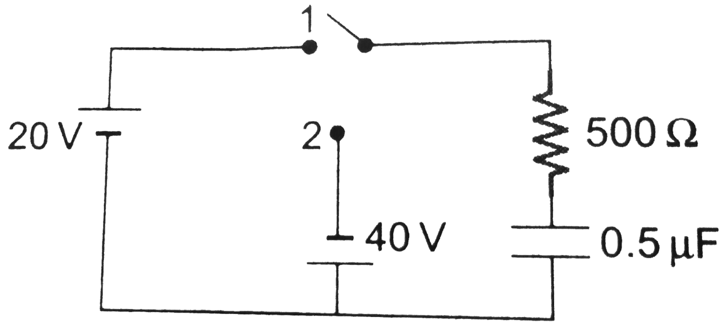
154. In the given circuit the switch ils closed in the positin 1 at $t = 0$ and then moved to 2 after $250 \mu s$. Derive and expression for current as a functioin of time for $t > 0$.

Also plot the variation of current with time.



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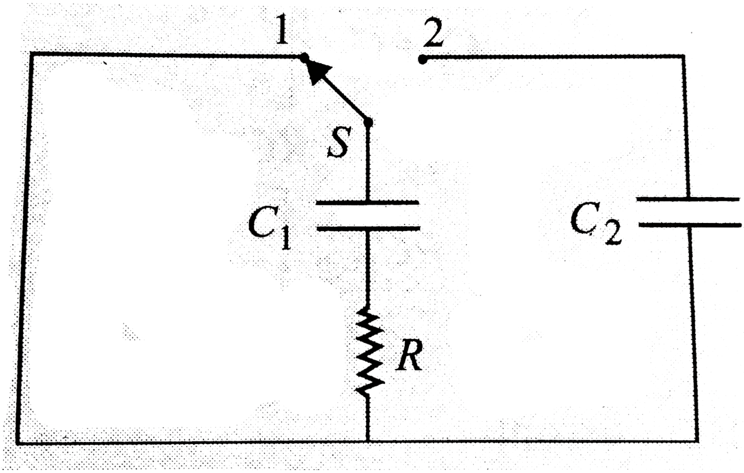
155. A charged capacitor C_1 is discharged through a resistance R by putting switch S in position 1 of the circuit as shown in fig.5.201. When the discharge current reduces to i_0, the switch is suddenly shifted to position 2. Calculate the amount of heat liberated in resistor R starting form this instant. Also calculate current I through the circuit as a function of time.



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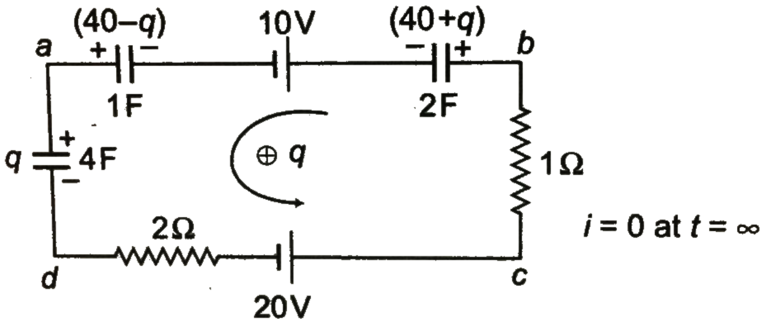
Objective Type

1. In the circuit shown as potential difference of $60V$ is appliled across AB. The potential difference between the

points M and N is



A. $10V$

B. $15V$

C. $20V$

D. $30V$

Answer: D

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