Revise Most Important Questions to Crack NEET 2020

Q-1 - 18254600

Calculate amount of charge flow, when a conducting sphere of radius R and carrying a charge Q, is joined to an uncharged conducting sphere of radius 2R.

(A) $\frac{Q}{4}$

(B) $\frac{Q}{3}$

(C) $\frac{Q}{2}$

(D) $\frac{2Q}{3}$

CORRECT ANSWER: D

SOLUTION:

Capacitance of first sphere, $C_1 = 4\pi\varepsilon_0 R)$

Capacitance of second sphere $C_2 = 4\pi\varepsilon_0(2R) = 2C_1$

Then, when they are in constant with the common

potential between them

$$= V = \frac{Q}{C_1 + C_2}$$

Charge on

$$C_2 = C_2 V = \frac{QC_2}{C_1 + C_2}$$

$$= \frac{2}{3}Q$$

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Q-2 - 13657165

A potential difference of 500 V is applied across a paralle plate capacitor. The separation between the plates is $2 \times 10^{-3} m$. The plates of the capacitor are vertical. An electron is projected vertically upwards between the plates with a velocity of $10^5 m/a$ and it moves undeflected between the plates. The magnetic field acting perpendicular to the electric field has magnitude of

(A) $0 \quad Wb/m^2$

(B) $5/2 \quad Wb/m^2$

(C) $10^{-6} \quad Wb/m^2$

(D) $10^5 \quad Wb/m^2$

CORRECT ANSWER: B

SOLUTION:

$$e\vec{V} \times \vec{B} = e\vec{B}$$

$$\Rightarrow VB = E \quad B - \frac{E}{V}$$

Also 500 Volt $= E(2 \times 10^{-3} m)$.

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Q-3 - 11964513

A parallel plate condenser has a unifrom electric field $E(V / m)$ in the space between the plates. If the distance between the plates is $d(m)$ and area of each plate is $A\left(m^2\right)$ the energy (joule) stored in the condenser is

(A) $\frac{1}{2}\varepsilon_0 E^2$

(B) $\varepsilon_0 EAd$

(C) $\frac{1}{2}\varepsilon_0 E^2 Ad$

(D) $E^2 Ad \mid \varepsilon_0$

CORRECT ANSWER: C

SOLUTION:

The energy stored in the capacitor

$$U = \frac{1}{2}CV^2$$

$$U = \frac{1}{2}\left(\frac{A\varepsilon_0}{d}\right)(Ed)^2 \left(\because C = \frac{A\varepsilon_0}{d} \text{ and } V = Ed\right)$$

$$U = \frac{1}{2}\varepsilon_0 E^2 Ad$$

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Q-4 - 14797059

The false statement are, on increasing the distance between the plates of a parallel plate condenser,

(1) The electric field intensity between the plates will decrease

(2) The electric field intensity between the plates will increase

(3) The P. D. between the plates will decrease

(4)The electric field intensity between the plates will remain unchanged

(A) 1, 2 and 3 are incorrect

(B) 1 and 2 are correct

(C) 2 and 4 are correct

(D) 1 and 3 are correct

CORRECT ANSWER: A

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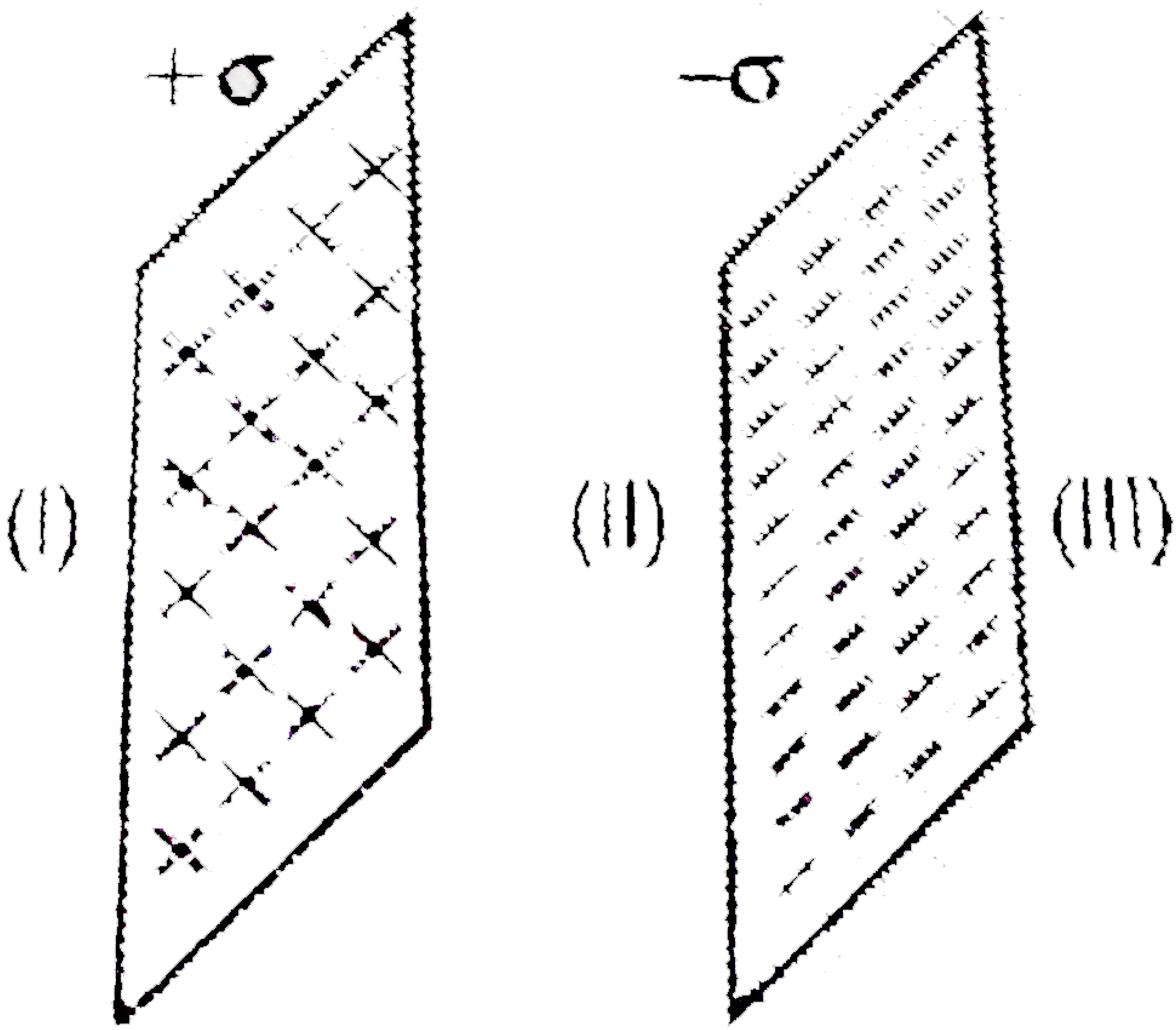
Q-5 - 18254601

Find the electric field in region II as shown in figure.



(A) zero

(B) $\dfrac{\sigma}{4\pi\varepsilon_0}$

(C) $\dfrac{\sigma}{\varepsilon_0}$

(D) Infinite

CORRECT ANSWER: C

SOLUTION:

N//a

Q-6 - 11964524

A parallel plate air capacitor has capcity C distance of separtion between plates is d and potential difference V is applied between the plates force of attraction between the plates of the parallel plate air capacitor is

(A) $\dfrac{C^2V^2}{2d^2}$

(B) $\dfrac{C^2V^2}{2d}$

(C) $\dfrac{CV^2}{2d}$

(D) $\dfrac{CV^2}{d}$

CORRECT ANSWER: C

SOLUTION:

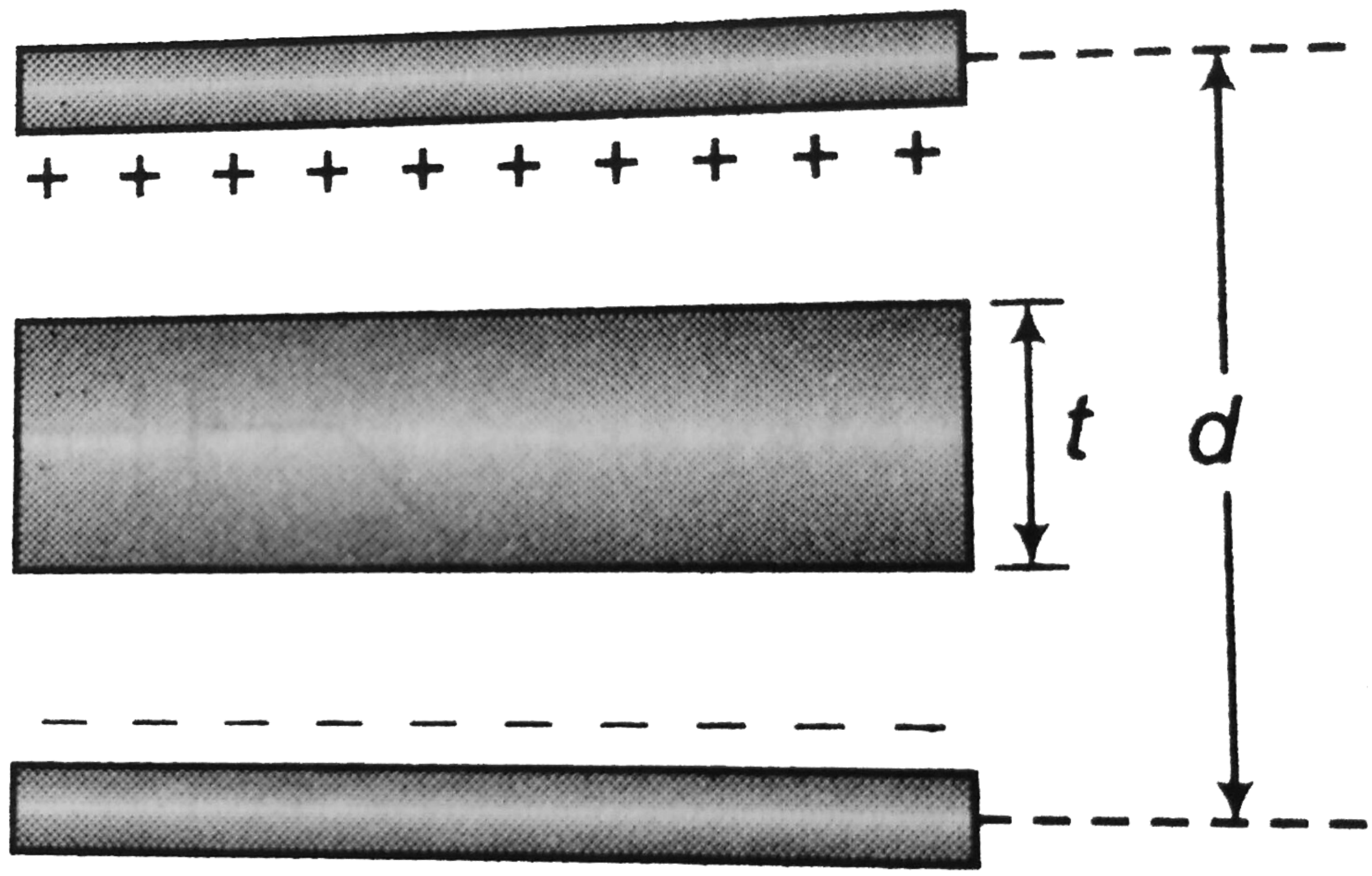
$$F = \frac{Q^2}{2\varepsilon_0 A}$$

$\therefore Q = CV$ and $C = \dfrac{\varepsilon_0 A}{d} \Rightarrow \varepsilon_A = Cd$

So $F = \dfrac{C^2V^2}{2Cd} = \dfrac{CV^2}{2d}$

Q-7 - 10967337

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) $\dfrac{V}{d-t}$

CORRECT ANSWER: B

SOLUTION:

$$E_{air} = E_0 = \frac{V}{d}$$

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Q-8 - 11964271

A parallel plate condenser is immersed in an oil of dielectric constant 2. The field between the plates is

(A) increased proportional to 2

(B) decreased proportional to $\dfrac{1}{2}$

(C) increased proportional to $\sqrt{2}$

(D) decreased proportional to $\dfrac{1}{\sqrt{2}}$

CORRECT ANSWER: B

SOLUTION:

$$E_{medium} = \frac{E_{air}}{K} = \frac{E}{2}$$

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Q-9 - 10967269

A $5.80\mu F$ parallel-plate air capacitor has a plate separation of $5.00mm$ and is charged to a potential difference of $400V$. Calculate the energy density in the region between the plates, in $\frac{J}{m^3}$

SOLUTION:

$$u = \frac{1}{2}\varepsilon_0 E^2$$

$$= \frac{1}{2}\varepsilon_0\left(\frac{V}{d}\right)^2$$

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Q-10 - 18254604

The 90 pF capacitor is connected to a 12 V battery. How many electrons a transferred from one plate to another?

(A) 1.1×10^9

(B) 6.7×10^9

(C) 4×10^{19}

(D) 5×10^{19}

CORRECT ANSWER: B

SOLUTION:

N//a

Q-11 - 11309046

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

CORRECT ANSWER: 4

SOLUTION:

(4) Initial energy : $E = \frac{1}{2}C_0V_0^2$

(i) $E_1 = 2E$, Because charge remains the same and the capacitance becomes half.

(ii) $E_2 = \frac{E}{2}$, because potential trmains the same and the capacitance becomes half. SoE_(1)/E_(2)=4`.

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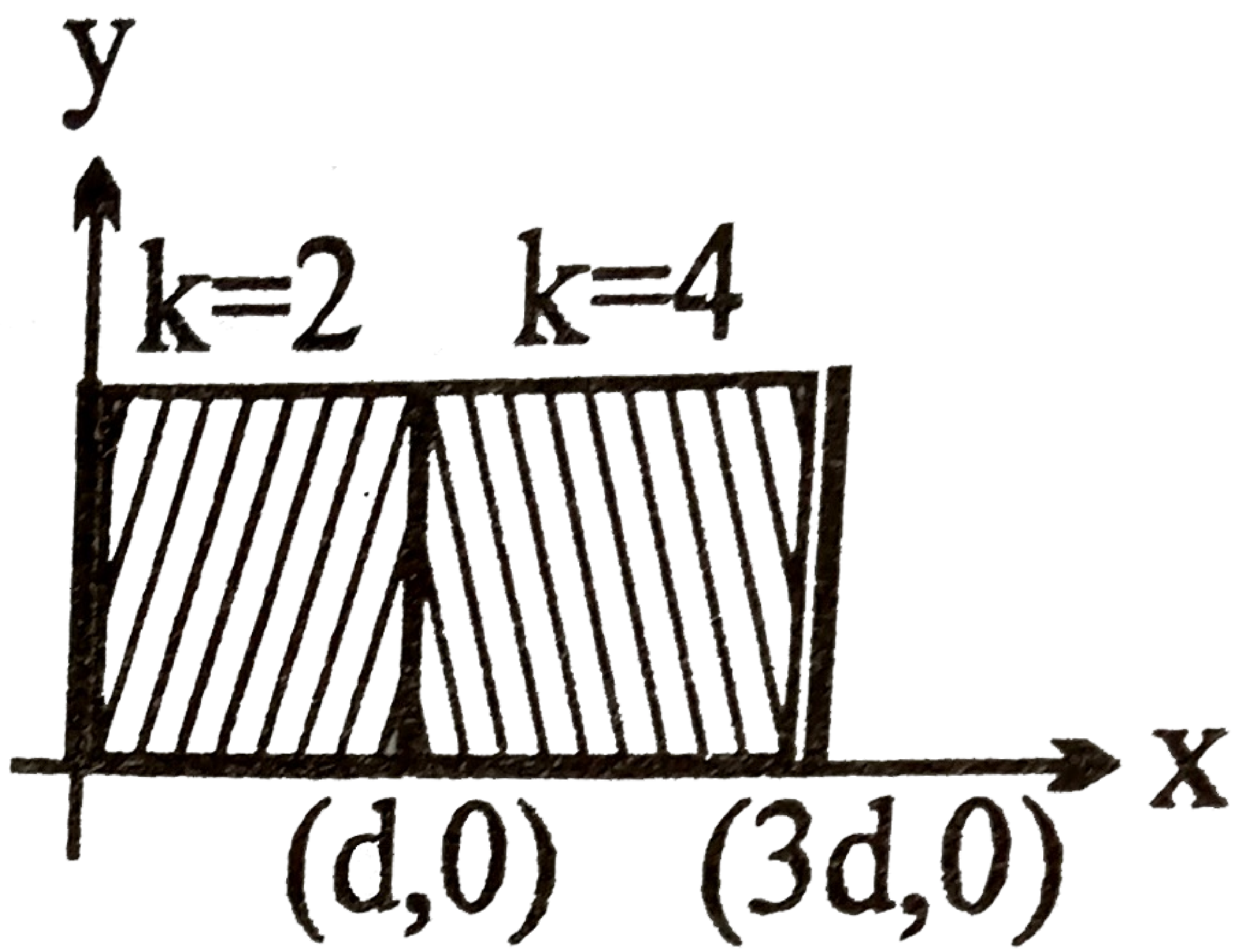
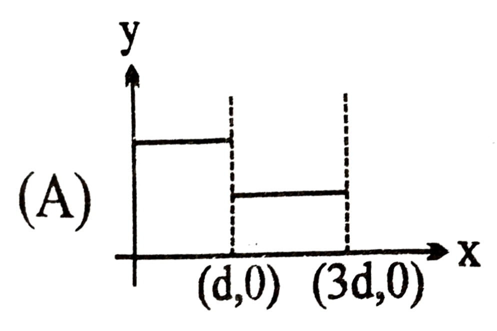
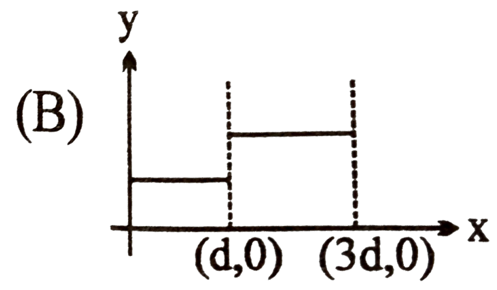
Q-12 - 12228588

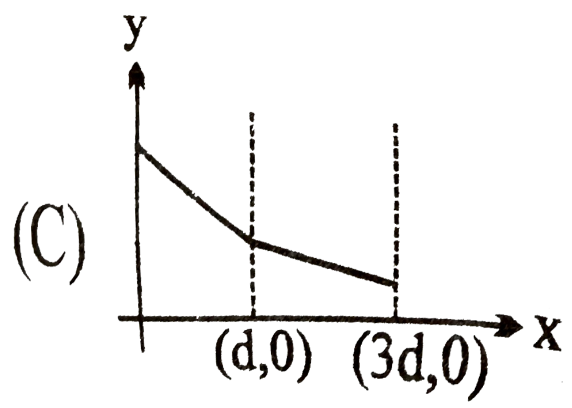
A parallel plate capacitor has two layers of dielectric as shown in figure. This capacitor is connected across a battery. The graph which shows the variation of electric field (E) and distance (X) from left plate.

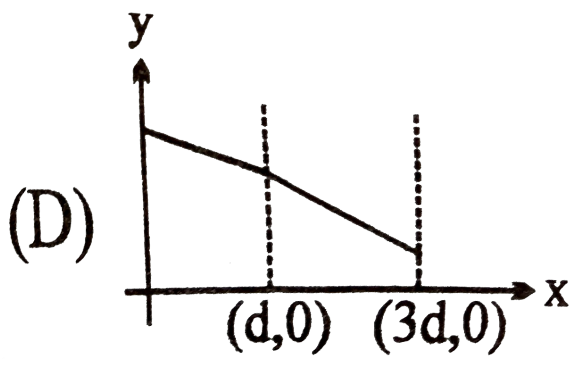


(A)



(B) 

(C) 

(D) 

CORRECT ANSWER: A

SOLUTION:

Field in dielectric is $\frac{E}{K}$ when E is the filed in air.

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Q-13 - 11309861

Statement I: When air between the plates of a parallel plate condenser is replaced by an insulating dielectric medium, its capacity decreases.

Statement II: Electric field intensity between the plates with dielectric in between is reduced.

(A) Statement I is true, Statement II is True, Statement II is a correct explanation for statement I.

(B) Statement I is true, Statement II is True, Statement II is Not a correct explanation for statement I.

(C) Statement I is True, Statement II is False.

(D) Statement I is False, Statement II is True.

CORRECT ANSWER: D

SOLUTION:

Capacitance increase and electric field decreaes.

Q-14 - 14797057

A parallel plate capacitor of plate area A and plates separation distance d is charged by applying a potential V_0 between the plates. The dielectric constant of the medium between the plates is K. What is the uniform electric field E between the plates of the capacitor ?

(A) $E = \in_0 \dfrac{CV_0}{KA}$

(B) $E = \dfrac{V_0}{Kd}$

(C) $E = \dfrac{V_0}{KA}$

(D) $E = \dfrac{KV_0 d}{\in_0 A}$

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Q-15 - 18254610

A parallel plate capacitor is connected to a battery of constant emf.

Let the electric field at a given point between the plate be E_0, when there is no medium between the plates. The new electric field at the point, If a medium of dielectric constant A is intoduced between them, is

(A) $\frac{E_0}{4}$

(B) $\frac{E_0}{2}$

(C) E_0

(D) $4E_0$

CORRECT ANSWER: C

SOLUTION:

N//a

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Q-16 - 11308944

A parallel plate capacitor is connected across a battery. Now, keeping the battery connected, a dielectric slab is inserted between the plates. In the process,

(A) no work done

(B) work is done by the battery and the stored energy increases.

(C) work is done by the external agent, and the stored energy decteases. It

(D) work is done by the battery as well as the external agent, but the stored energy done not charge.

CORRECT ANSWER: B

SOLUTION:

Extra charge will flow through battery, so work is done by battery. External agent will do negative work.

Q-17 - 18254615

A capacitor of capacitance C is charged to a potential difference V_0. The charged battery is disconnected and the capacitor is connected to a capacitor of unknown capacitance C_x. The potential difference across the combination is V. The value of C_x should be

(A) $\frac{C(V_0 - V)}{V}$

(B) $\frac{C(V - V_0)}{V}$

(C) $\frac{CV}{V_0}$

(D) $\frac{CV_0}{V}$

CORRECT ANSWER: A

SOLUTION:

The initial charge on first capacitor is $Q = CV_0$

After connection, voltages of both capacitors become

same, i.e. V

$\therefore Q = q_1$
$+ q_2$ or $CV_0 = CV$
$+ C_x V$

$$V = \frac{CV_0}{C + C_x} \therefore C_x$$
$$= \frac{C(V_0 - V)}{V}$$

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Q-18 - 10967324

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

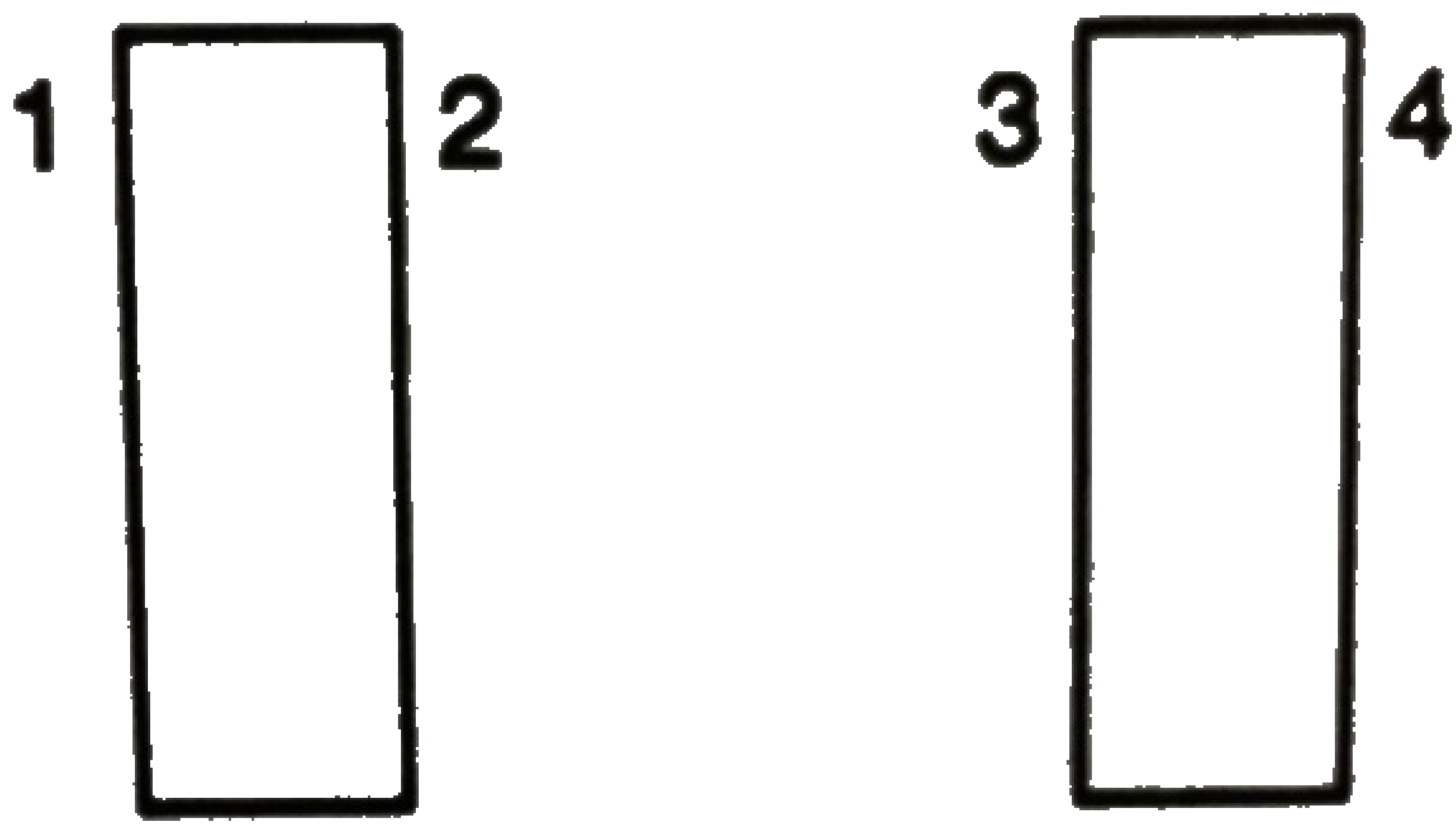
(B) $V + \dfrac{Q}{C}$

(C) $V + \dfrac{Q}{2C}$

(D) $V - \dfrac{Q}{C}$ if $Q < CV$

CORRECT ANSWER: C

SOLUTION:



$$q_1 = q_4 = \frac{q_{\text{total}}}{2}$$
$$= \frac{CV - CV + Q}{2}$$
$$= \frac{Q}{2}$$

$$q_2 = (Q + CV) - \frac{Q}{2}$$
$$= \left(\frac{Q}{2} + CV\right)$$

$$q_3 = -q_2 =$$
$$-\left(\frac{Q}{2} + CV\right)$$

Electric field between two plates and hence the potentiall difference is due to q_2 and q_3 only.

$$PD = \frac{q_2}{C} = V + \frac{Q}{2C}$$

Q-19 - 13079478

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

(A) $q_0 = 40\mu C$

(B) $V_0 = 60V$

(C) $V_0 = 80V$

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

(A) A,C are correct

(B) A,B are correct

(C) B,D are correct

(D) C,D are correct

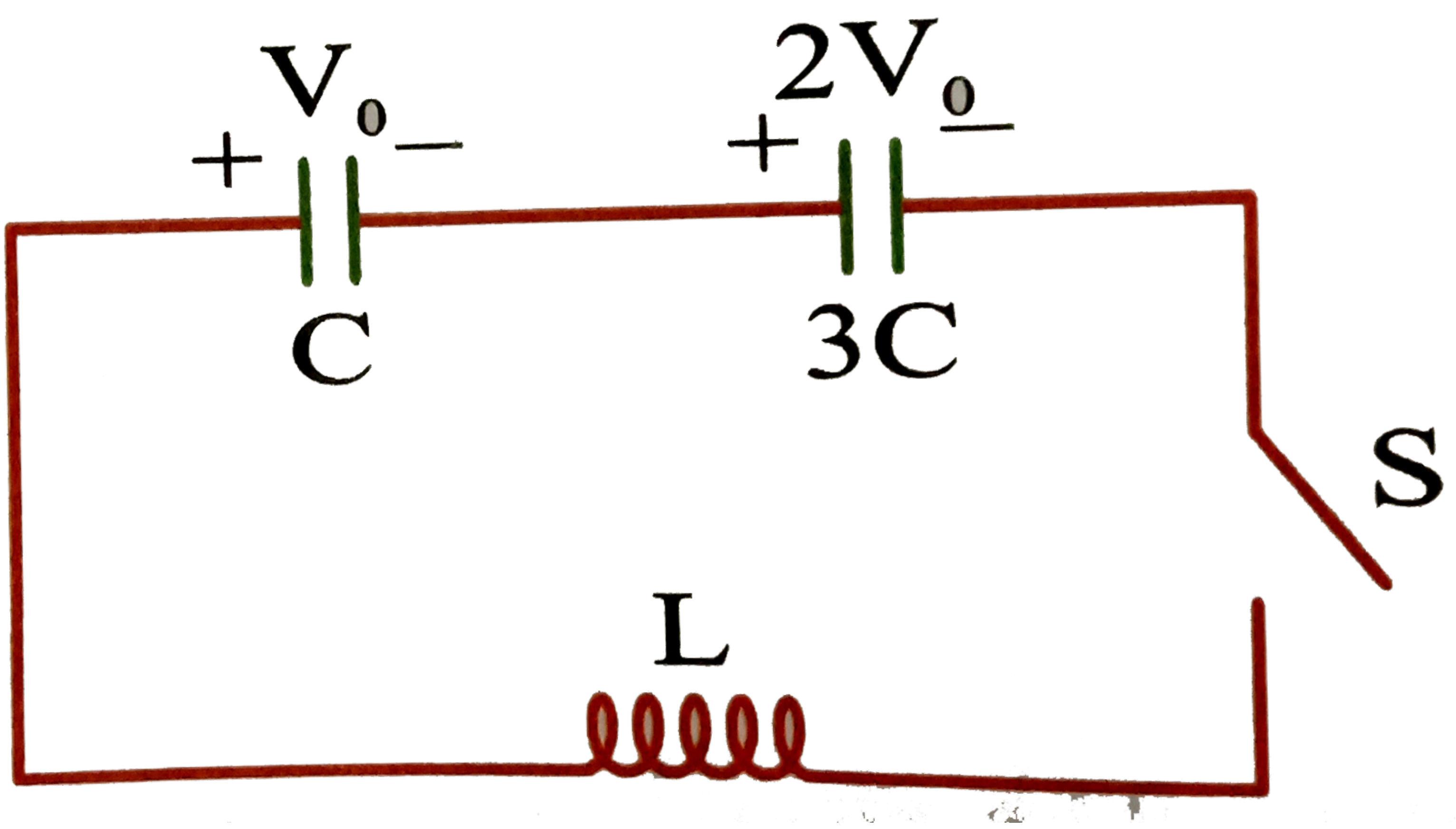
CORRECT ANSWER: D

SOLUTION:

$$Q = \left(\frac{C_1 C_2}{C_1 + C_2}\right)V.$$

Q-20 - 13657640

Two capacitors of capacitance C and $3C$ are charged to potential difference V_0 and $2V_0$ respectively, and connected to an inductor of inductance L as shown in figure. Initially the current in the inductor is zero. Now, the switch S is closed.



Potential difference across capacitor of capacitance C when the current in the cirucit is maximum is

(A) $\frac{V_0}{4}$

(B) $\frac{3V_0}{4}$

(C) $\frac{5V_0}{4}$

(D) $\frac{7V_0}{4}$

CORRECT ANSWER: C

SOLUTION:

When current is maximum $\frac{dI}{dt} = 0$

e.m.f of across $L = 0$ so potential difference across the capacitor will be same.

From the law of conservation of charge on plate 2 and 3.

$3CV + CV = 6CV_0$

$- CV_0 \Rightarrow V = \frac{5}{4}V_0$

Q-21 - 11968542

A small signal voltage $V(t) = V_0 \sin \omega t$ is applied across an ideal capacitor C:

(A) Current $I(t)$, lags voltage $V(t)$ by 90°

(B) Over a full cycle the capacitor C does not consume any energy from the voltage source.

(C) Current $I(t)$ is in phase with voltage $V(t)$

(D) Current $I(t)$ leads voltage $V(t)$ by 180°

CORRECT ANSWER: B

SOLUTION:

Power $= V_{rms} . I_{rms} \cos \phi$

$as \cos \theta = 0$(Because $\phi = 90$)

$\therefore$ Power consumed $= 0$ (in one complete cycle)

Q-22 - 12296825

The distance between the plates fo a parallel plate capacitor is d. A metal plate of thickness $d/2$ is placed between the plates, what will be the new capacity ?

SOLUTION:

As electrons field inside the metal plate is zero, d becomes $d/2$. Hencr C becomes twice (from $C = \in_0 A/d$).

Q-23 - 11309012

Each plate of a parallel plate air capacitor has area $S = 5 \times 10^{-3} m^2$ and the distance between the plates is

$d = 8.80mm$. Plate A has positive charge $q_1 = +10^{-10}C$, and plate B has charge $q_2 = +2 \times 10^{-10}C$. A battery of emf $E = 10V$ has its positive terminal connected to plate A and the negative terminal to plate B. (Given $\varepsilon_0 = 8.8 \times 10^{12}Nm^2C^{-2}$).

Energy supplied by the battery is.

(A) $10^{-9}J$

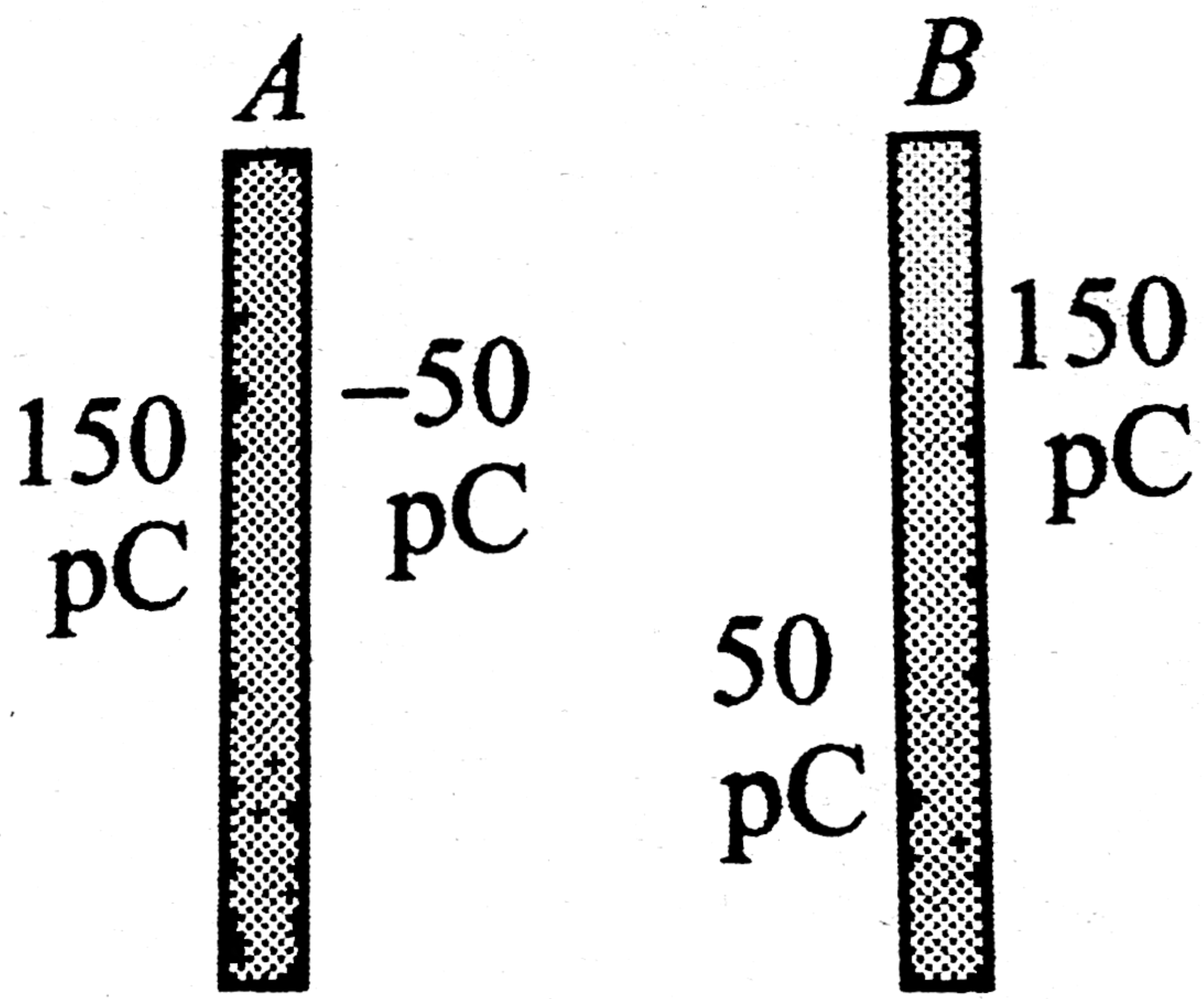
(B) $5 \times 10^9 J$

(C) $50 \times 10^{-9}J$

(D) $25 \times 10^{-9}J$

CORRECT ANSWER: A

SOLUTION:



(i)

$$C = \frac{\varepsilon_0 A}{d}$$

$$= \frac{8.8 \times 10^{-12} \times 5 \times 10^{-3}}{8.8 \times 10^{-3}}$$

$$= 5 \times 10^{-12} F$$

Charge on the plate after connection with the battery is

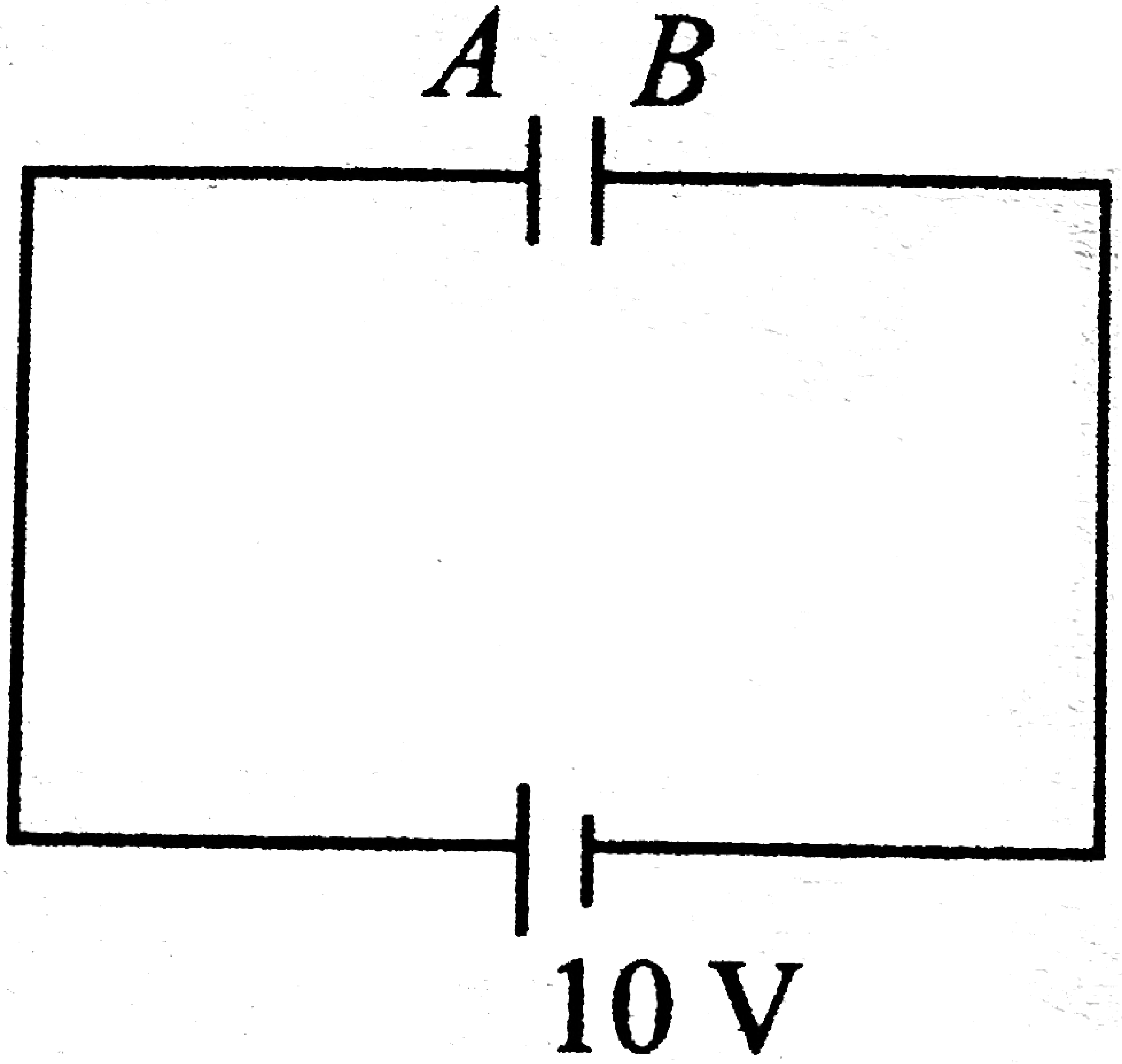


Fig. S4.90

$q = CV = 5 \times 10^{-12}$
$\times 10 = 50pC$

Charge supplied by the battery is

$\Delta q = (50 + 50)pC$
$= 100pC$

Energy supplied by the battery is

(ii)

$$U_{\text{battery}} = \Delta q V = 100 \times 10 = 1000 pJ$$

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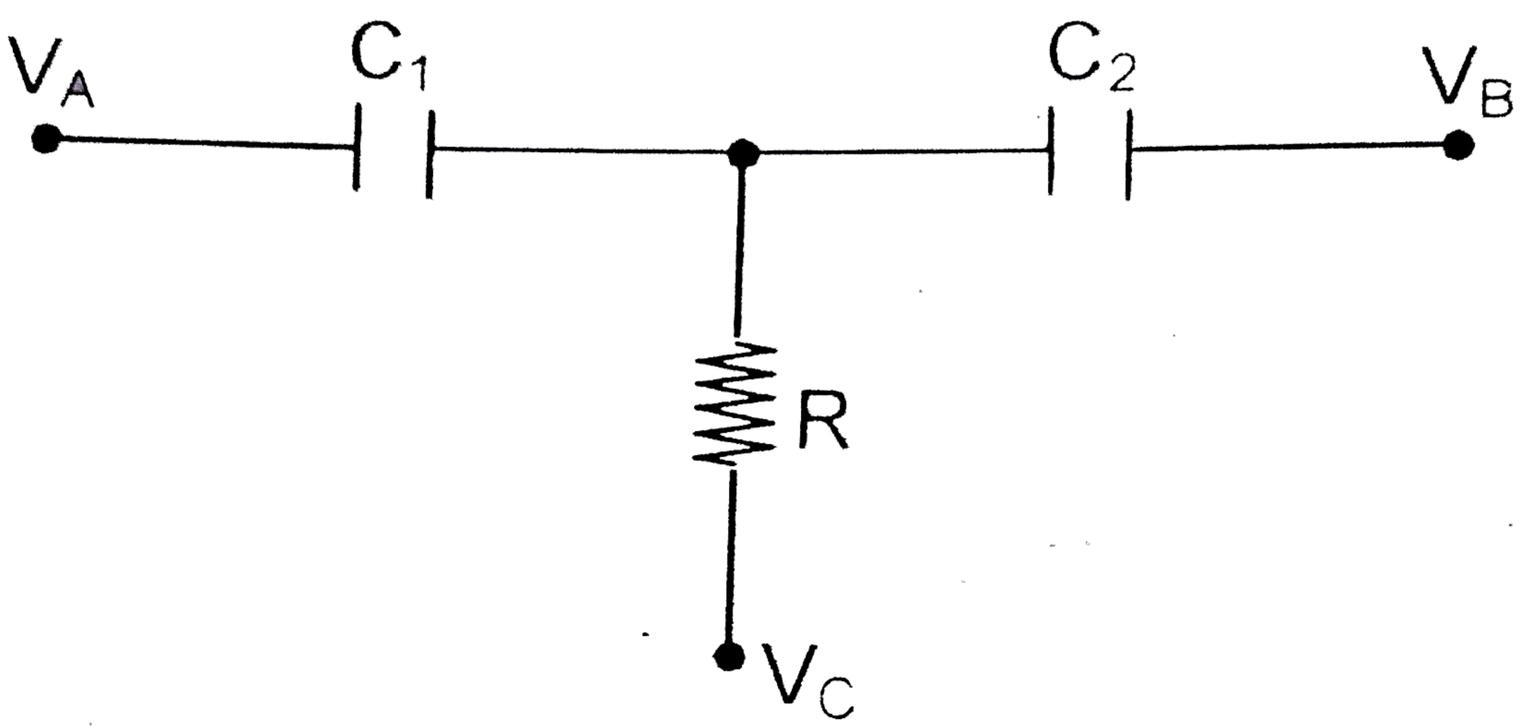
Q-24 - 14278063

For given circuit charge on capacitor C, and C_2 in steady state will be equal to



(A)

$C_1(V_A - V_c)$,

$(V_c - V_B)$

respectively

(B)
$C_1(V_A - V_B)$,
$C_2(V_A - V_B)$
respectively

(C) $(C_1 + C_2)(V_A - V_B)$ on each capacitor

(D) $\left(\frac{C_1 C_2}{C_1 + C_2}\right)(V_A - V_B)$ on each capacitor

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CORRECT ANSWER: A

SOLUTION:

No current will flow through the resistance at steady state.

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Q-25 - 10059701

Two capacitors C_1 and C_2 are charged to 120V and 200V respectively. It is found that connecting them together the potential on each one can be made zero. Then

(A) (a) $5C_1 = 3C_2$

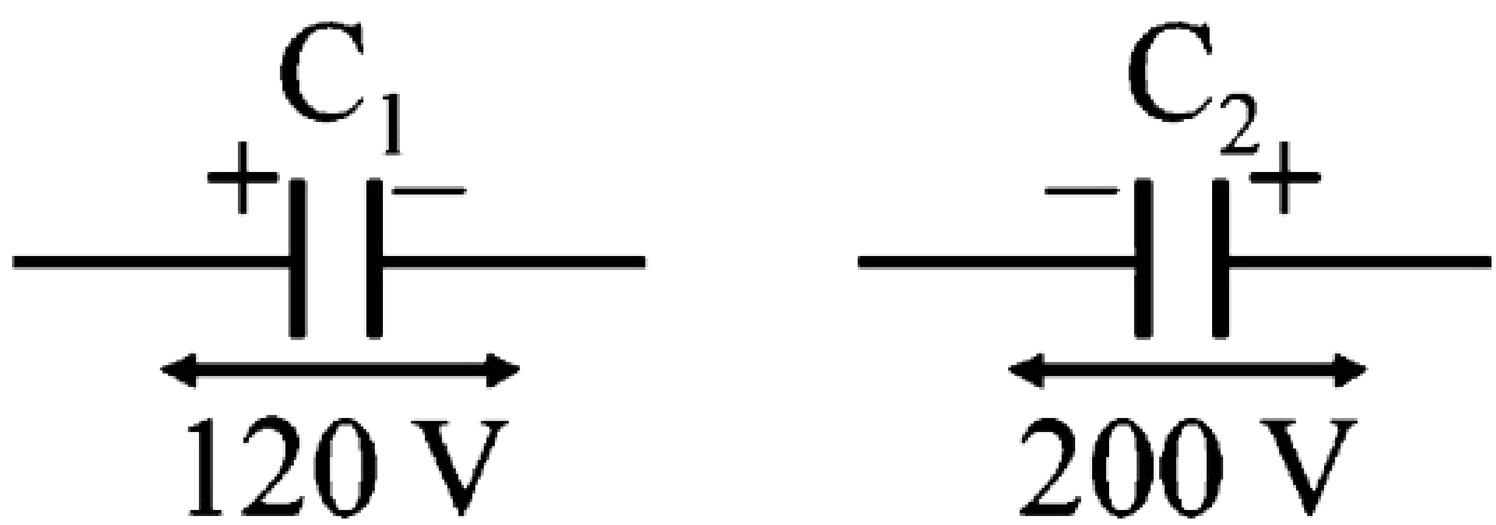
(B) (b) $3C_1 = 5C_2$

(C) (c) $3C_1 + 5C_2 = 0$

(D) (d) $9C_1 = 4C_2$

CORRECT ANSWER: B

SOLUTION:



For potential to be made zero, after connection

$$120C_1 = 200C_2\left[\because C = \frac{q}{v}\right]$$

$$\Rightarrow 3C_1 = 5C_2$$

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Q-26 - 15157869

03DSKE3Step 1Step 11Step

III115KGSA485JESTE2KT3PEBL8B7N2 CMESSM2AMS c5

UOSInput :K6 MEUS

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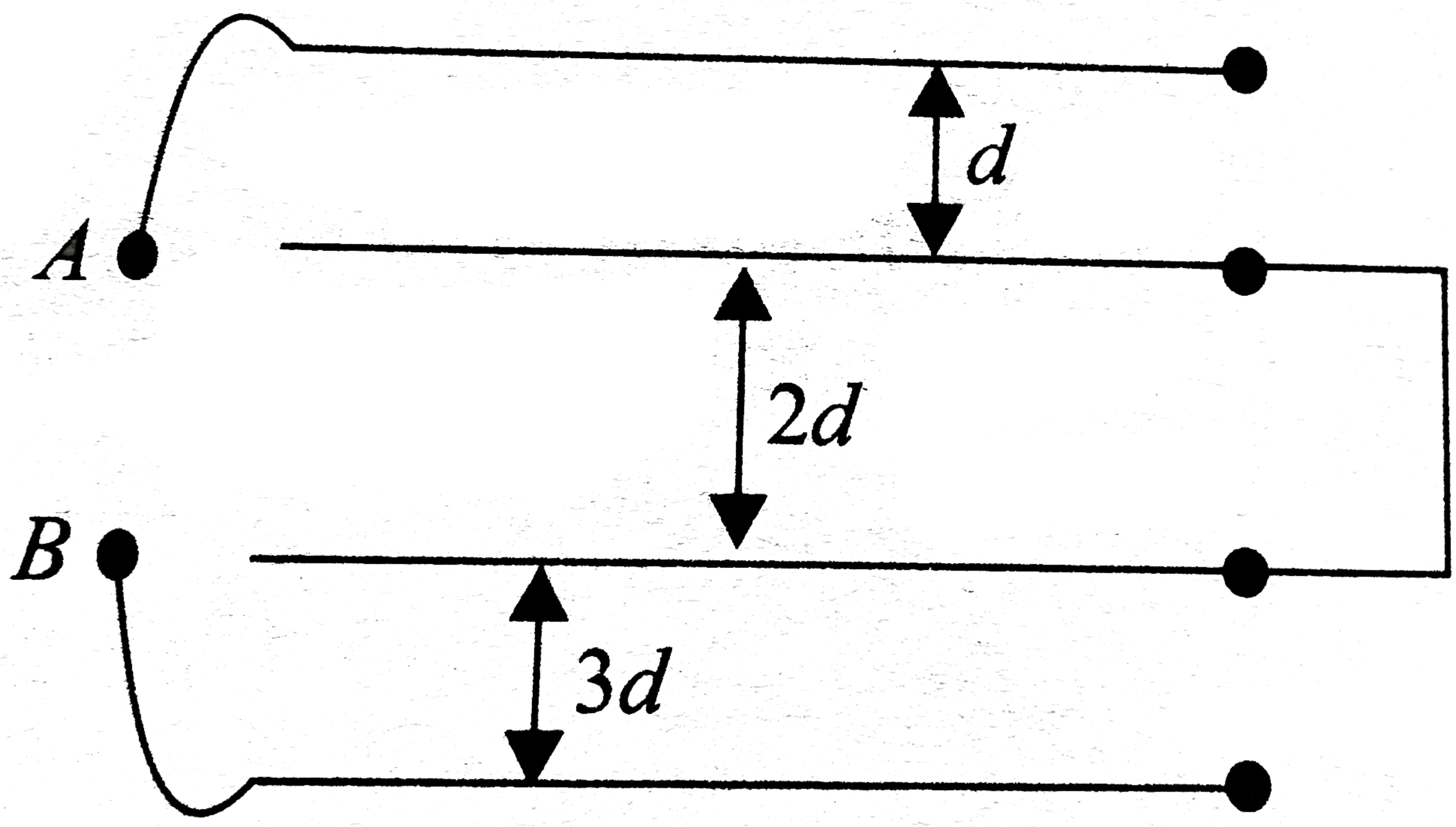
Q-27 - 11308914

If the area of each plate is A and then successive separations are d, $2d$ and $3d$, then find the equivalent capacitance across A and B.



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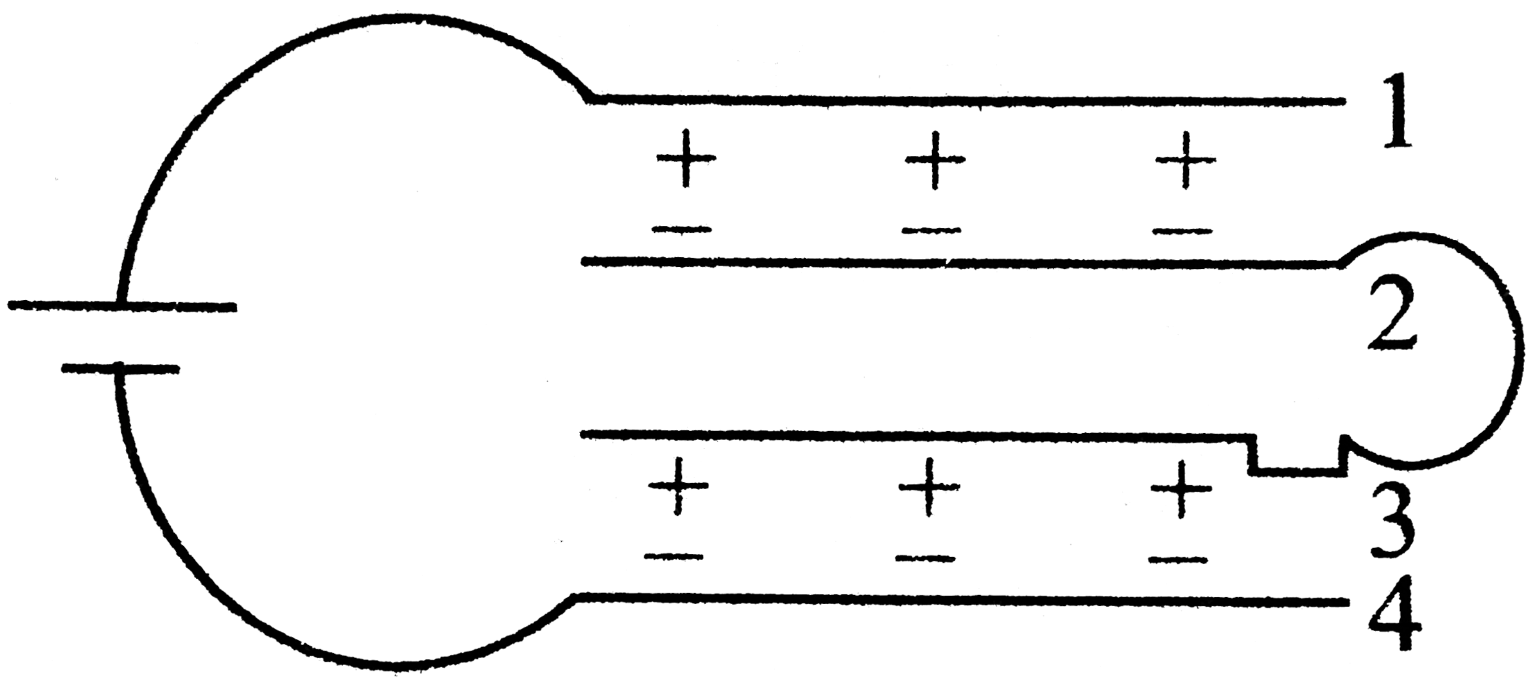
CORRECT ANSWER: $\dfrac{EPSILON_0 A}{4D}$

SOLUTION:



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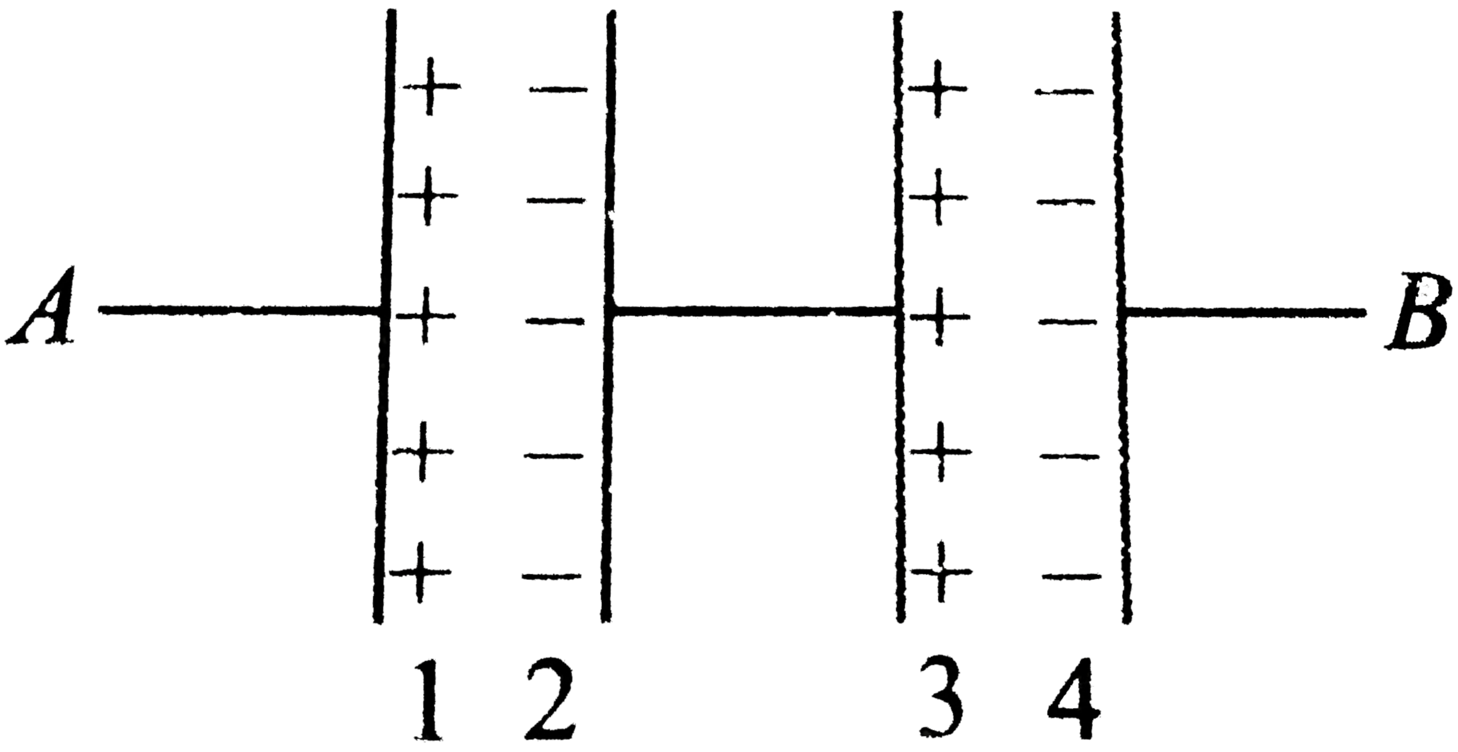
Plates can be rearranged as shown in

plates 1 and 2 and plates 3 and 4 form two capacitors, which are in series between A and B plates 2 and 3 do not form any capacitor as they at the same potential.



$$C_{eq} = \frac{C_1 C_2}{C_1 + C_2}$$

$$= \frac{\left(\varepsilon_0 \frac{A}{d}\right) \times \left(\frac{\varepsilon_0 A}{3} d\right)}{\frac{\varepsilon_0 A}{d} + \frac{\varepsilon_0 A}{3d}}$$

$$= \frac{\varepsilon_0}{4d}$$

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Q-28 - 13156733

A capacitor is charged and then made to discharged through a resistance. The time constant is τ. In what time will the potential difference across the capacitor decreases by 10 % ?

(A) $\tau 1n(0.1)$

(B) $\tau 1n(0.9)$

(C) $\tau 1n\frac{10}{9}$

(D) $\tau 1n\frac{11}{10}$

CORRECT ANSWER: C

SOLUTION:

$q = q_0 e^{-t/\tau}$

$V_C - \frac{q}{C} = \frac{q_0}{C} e^{-t/\tau}$

$\frac{9}{10}\frac{q_0}{C} = \frac{q_0}{C} e^{-t/\tau}$

$e^{t/\tau} = 10/9 \Rightarrow t$

$= \tau 1n(10/9)$

.

Q-29 - 17244511

An electrical heater and a capacitor are joined in series across a $220V$, $50Hz$, AC supply. The potential difference across the heater is $90V$. The potential difference across the capacitor will be about:

(A) $200V$

(B) $130V$

(C) $110V$

(D) $90V$

CORRECT ANSWER: A

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Q-30 - 11308940

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

CORRECT ANSWER: A

SOLUTION:

As battery is disconnected, so charge will remain the same. It is given that final potential is the same. So final capacitance should be equal to initial capacitance, i.e.

$$\frac{\varepsilon_0 A}{d} = \frac{\varepsilon_0 A}{(1.6 + d) - t(1 - 1/K)}$$

or $K = 5$.

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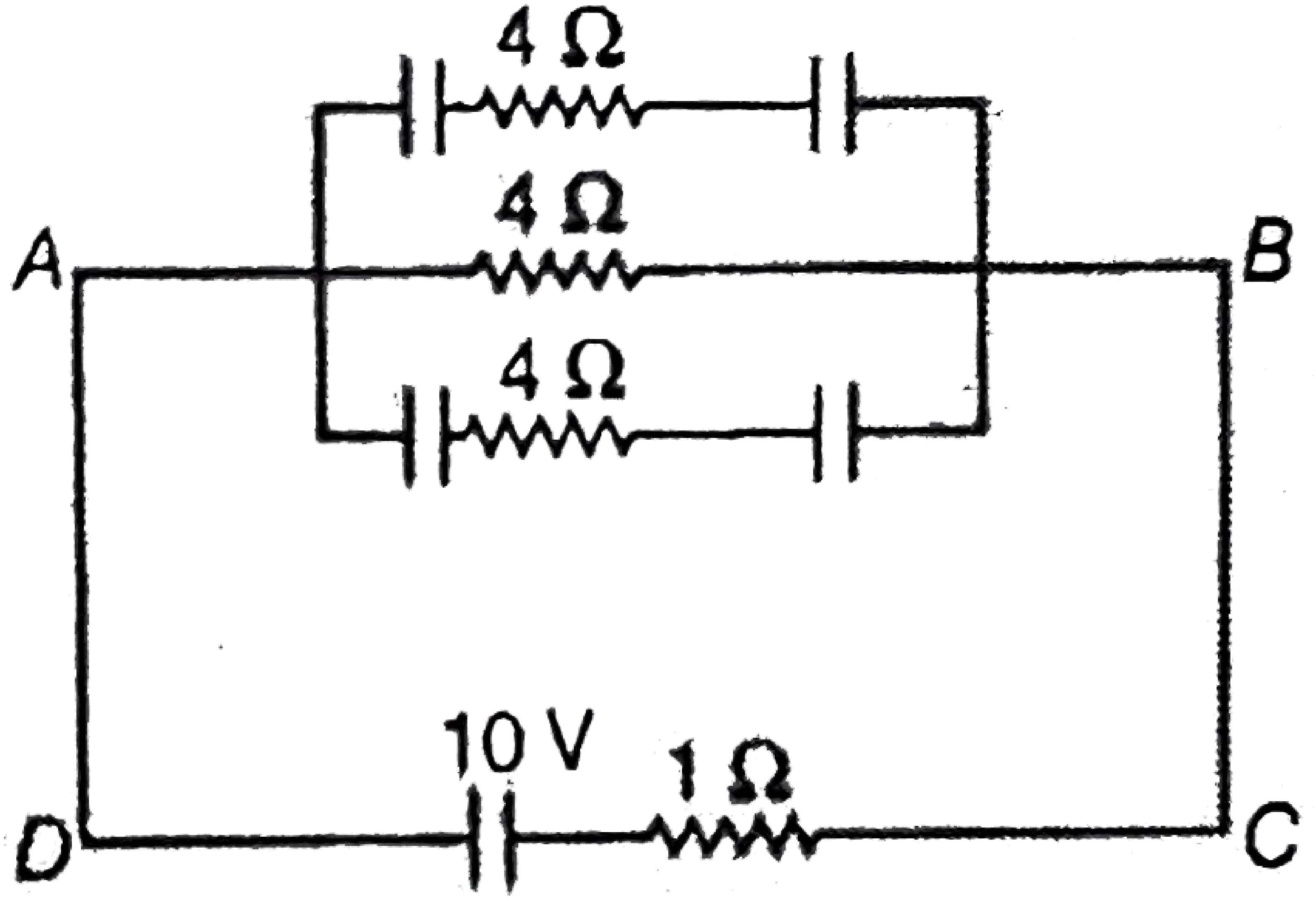
Q-31 - 19037581

In the given circuit (as shown in figure), each capacitor has a capacity of $3\mu F$. What will be the net charge on each capacitor ?



(A) $48 \mu C$

(B) $24 \mu C$

(C) $12 \mu C$

(D) None of these

CORRECT ANSWER: C

SOLUTION:

Net resistance between ABCD is

$R = 4 + 1 = 5 \Omega$

$$\therefore Current \quad I = \frac{V}{R}$$

$$= \frac{10}{5} = 2A$$

Potential difference across A and B

$1 \times 4 = 2 \times 4 = 8V$ therefore Two capcitors of $3\mu F$

each are in series

therefore Potential difference across each capacitor

$$= \frac{8}{2} = 4V$$

Charge on each capacitor,

$$q = CV = 3 \times 4$$

$$= 12\mu C$$

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Q-32 - 17817296

A parallel plate capacitor is connecyed to a battery of emf V volts as shown. Now a slab of dielectric constant $k = 2$ is inserted between the plates of capacitor without disconnecting the battery. The electric field between the plates of capacitor after inserting the slab is $E = \dfrac{PV}{2d}$. Find the value of P.

CORRECT ANSWER: 2

Q-33 - 11309710

A parallel plate capacitor of capacitance $10\mu F$ is connected across a battery of emf 5 mV. Now, the space between the plates of the capacitors is filled with a deielectric material of dielectric constant K=5. Then, the charge that will flow through the battery till equilibrium is reached is

(A) $250\mu C$

(B) $250nC$

(C) $200nC$

(D) $200\mu C$

CORRECT ANSWER: C

SOLUTION:

The charge on capacitor before dielectric is

$q_1 = CV = 50$
$\times 10^{-9} C$

Final charge on capacitor after dielectric is
$q_2 = (KC)V = 5 \times 50$
$\times 10^{-9}$

$= 250 \times 10^{-9} C$

Charge flow from battery
$\triangle q = q_2 - q_1$
$= 200 nC$

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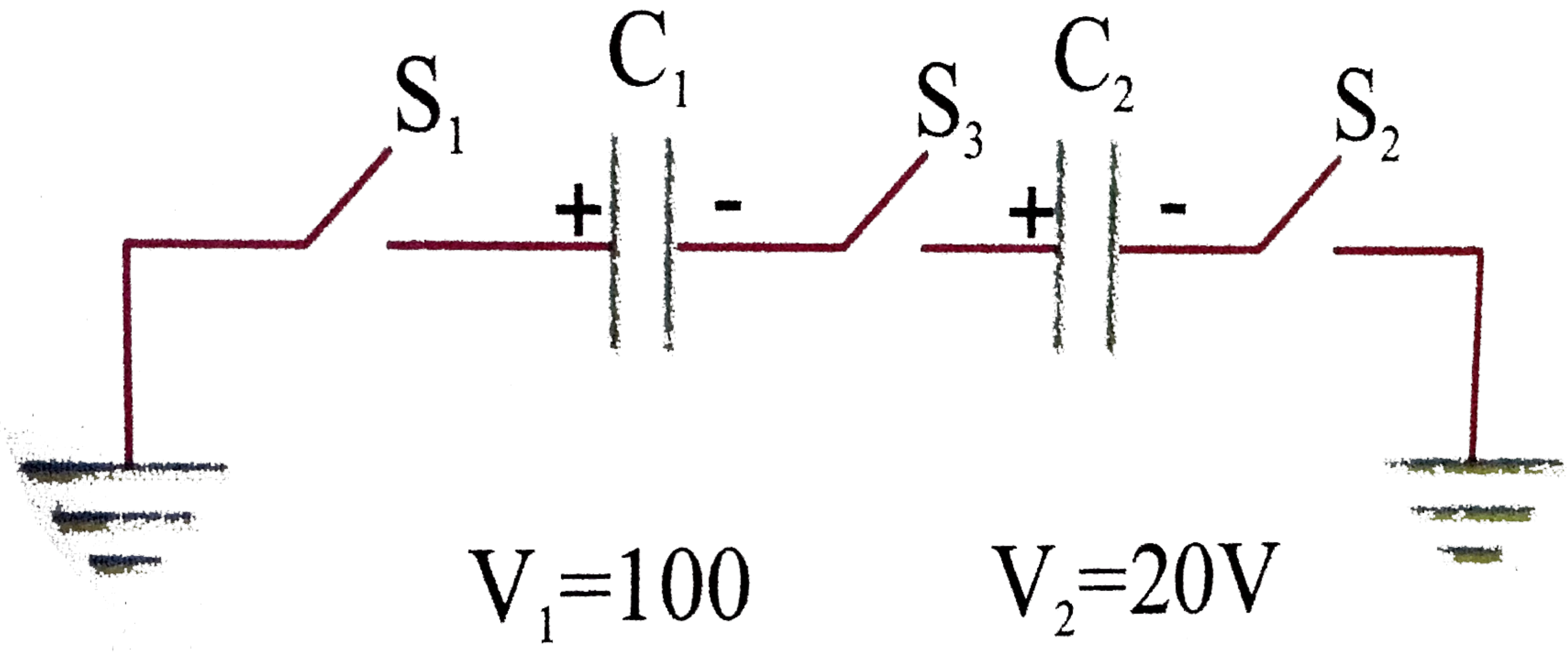
Q-34 - 13079376

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

is



.

SOLUTION:

When S_1, S_2 and S_3 are closed, both the capacitors are in parallel with unlike charged plates together. So, they attain a common potential.

Before closing the switches,

Charge on C_1 is

$$q_1 = 100 \times 1$$
$$= 100\mu C$$

Charge on C_2 is $q_2 = 20 \times 2 = 40\mu C$

After closing the switches

Common potential

$$V = \frac{q_1 - q_2}{C_1 + C_2}$$
$$= \frac{100 - 40}{3} = 20V$$

Now final charges

$$q_1^1 = C_1 V = 1 \times 20$$
$$= 20\mu C$$

$$q_2^1 = C_2 V = 2 \times 20$$
$$= 40\mu C$$

The charge that flows through S_1 is

$$\Delta q = 100 - 20$$
$$= 80\mu C$$

.

Q-35 - 12296752

An ebomiote rod (K = 3), 6 mm thick is introduced between the plates of a parallel plate capacitor of plate area $4 \times 10^{-2} m^2$ and plate separation 0.01m. Find the capacitance.

SOLUTION:

Here,

$$t = 6mm = 6 \times 10^{-3} m$$

$$A = 4 \times 10^{-2} m^2, d = 0.01m, K = 3$$

$$C = \frac{\in_0 A}{d - 1\left(1 - \frac{1}{K}\right)}$$

$$= \frac{8.85 \times 10^{-12} \times 4 \times 10^{-2}}{0.01 - 6 \times 10^{-3}}$$

$$= 59 \times 10^{-12} F$$

$$= 59pF$$

Q-36 - 17960602

Two capacitors of equal capacitance when connected in series hae net capacitance C_1 and when connected in parallel have net capacitance C_2 what is the value of C_1 / C_2?

CORRECT ANSWER: $C_1 / C_2 = 1/4$

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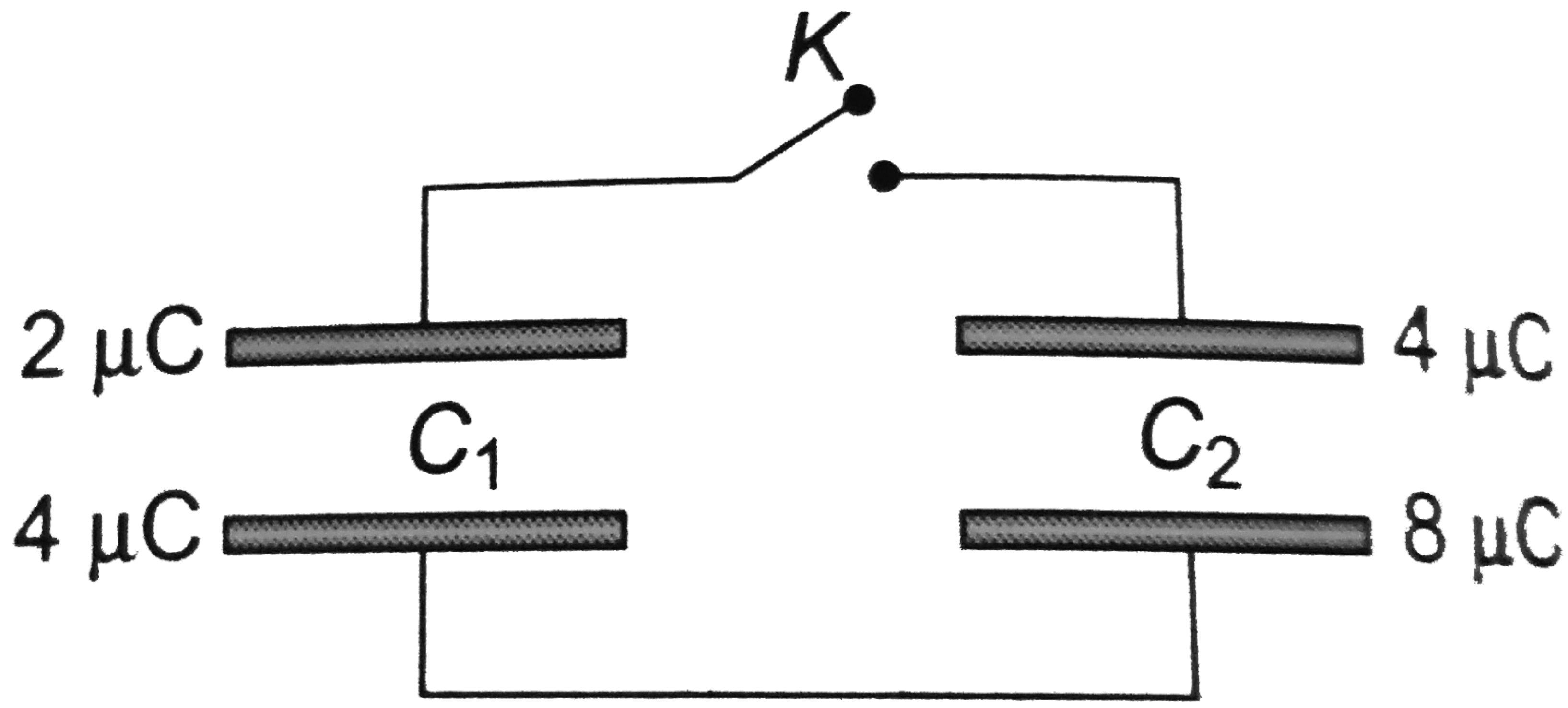
Q-37 - 11964486

Assertion: Charges are given to plates of two plane parallel plate capacitors C_1 and C_2 (such that $C_2 = 2C_1$) as shown in figure. Then the key K is pressed to complate the circuit. Finally the net charge on upper plate and net charge on lower plate of capacitor C_1 is positive.



Reason: In a parallel plate capacitor both plates always carry equal and opposite charge.

(A) If both assertion and reason are true and reson is the correct explanation of assertion.

(B) If both assertion and reason are true but reason is not the correct explanation of assertion.

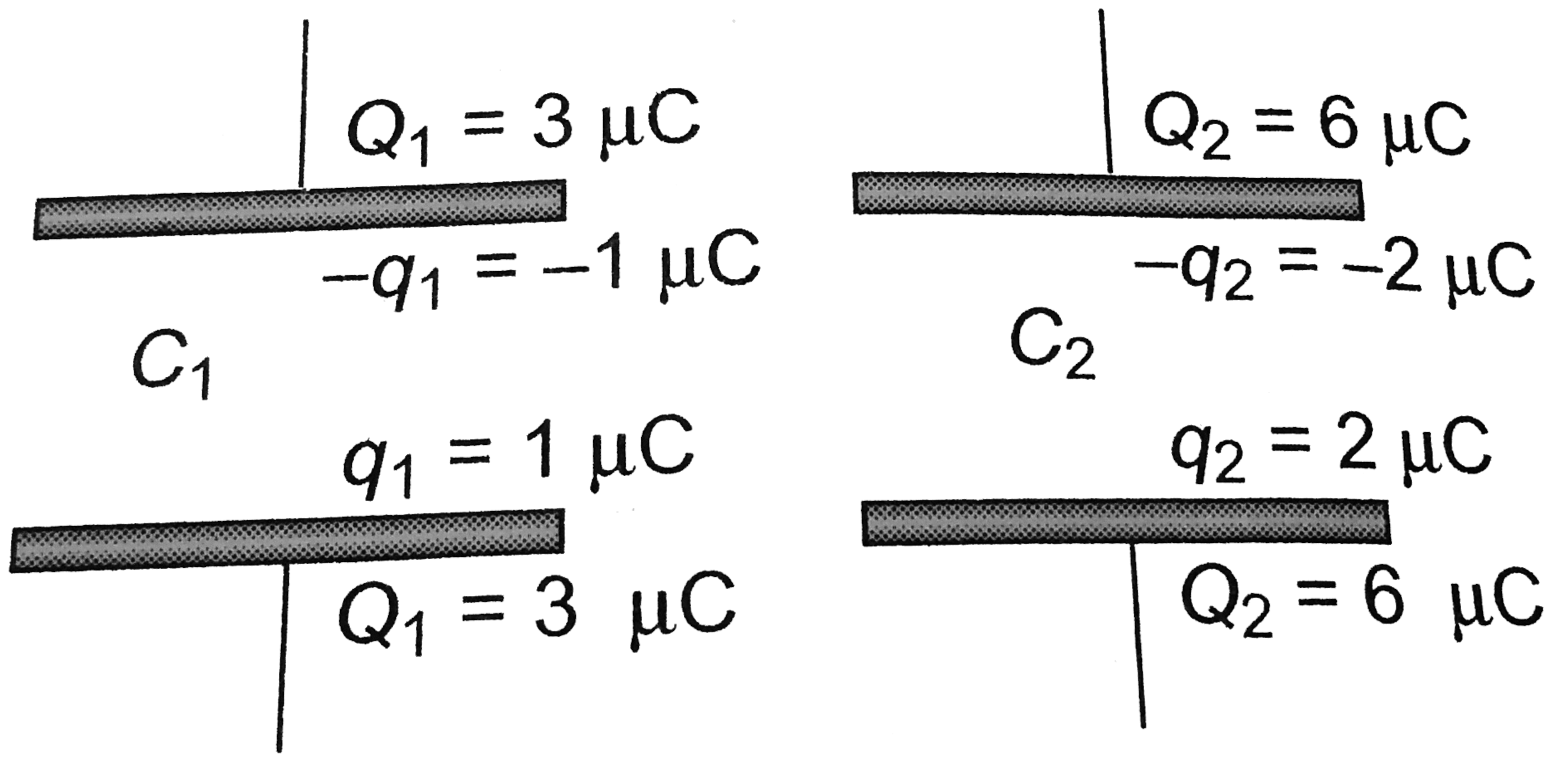
(C) If assertion is true but reason is false.

(D) If assertion and reason both are false.

CORRECT ANSWER: C

SOLUTION:

In isolated condition the charge distribution on each surface of capacitor C_1 and C_2 is



The $p.\ d.$ across first capacitor is $\dfrac{q_1}{C_1} = \dfrac{1\mu F}{C_1}$

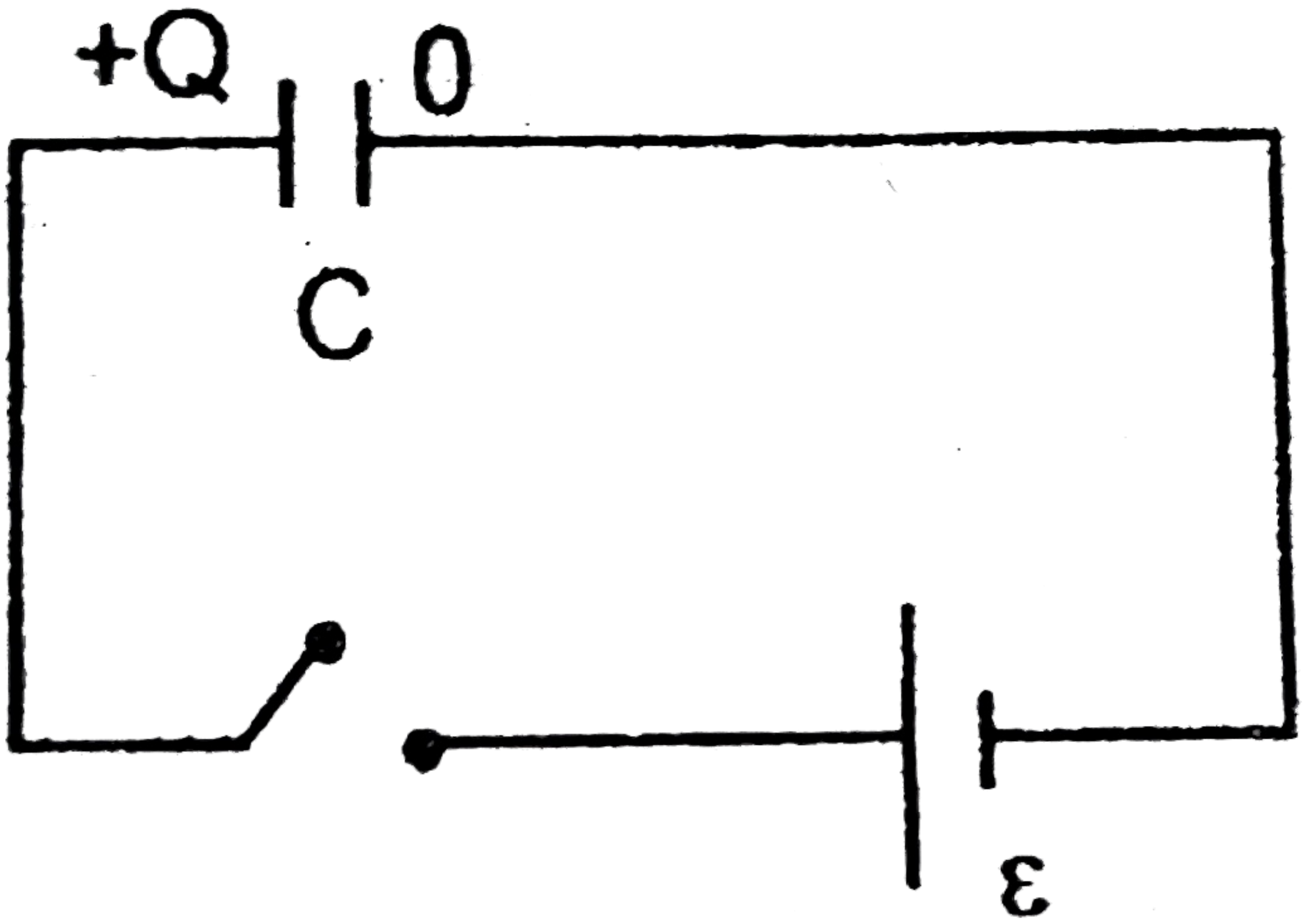
The $p.\ d$ across second capacitor is $\dfrac{q_2}{C_2} = \dfrac{2\mu F}{C_2}$

Hence potential difference across both the capacitors is same (hence $C_2 = 2C_1$). therefore on connecting both capacitors, charges, charge does not flow from one capacitor to other. Therefore net charge on upper and lower plates of C_1 is positive.

Hence Assertion is true and Reason is false.

Q-38 - 16112570

The left plate of the capacitor shown in the figure above carries a charge $+Q$ while the right plate is uncharged at $t = 0$. The total charge on the right plate after closing the switch will be:



(A) $\frac{Q}{2} + C\varepsilon$

(B) $\frac{Q}{2} - C\varepsilon$

(C) $-\frac{Q}{2}$

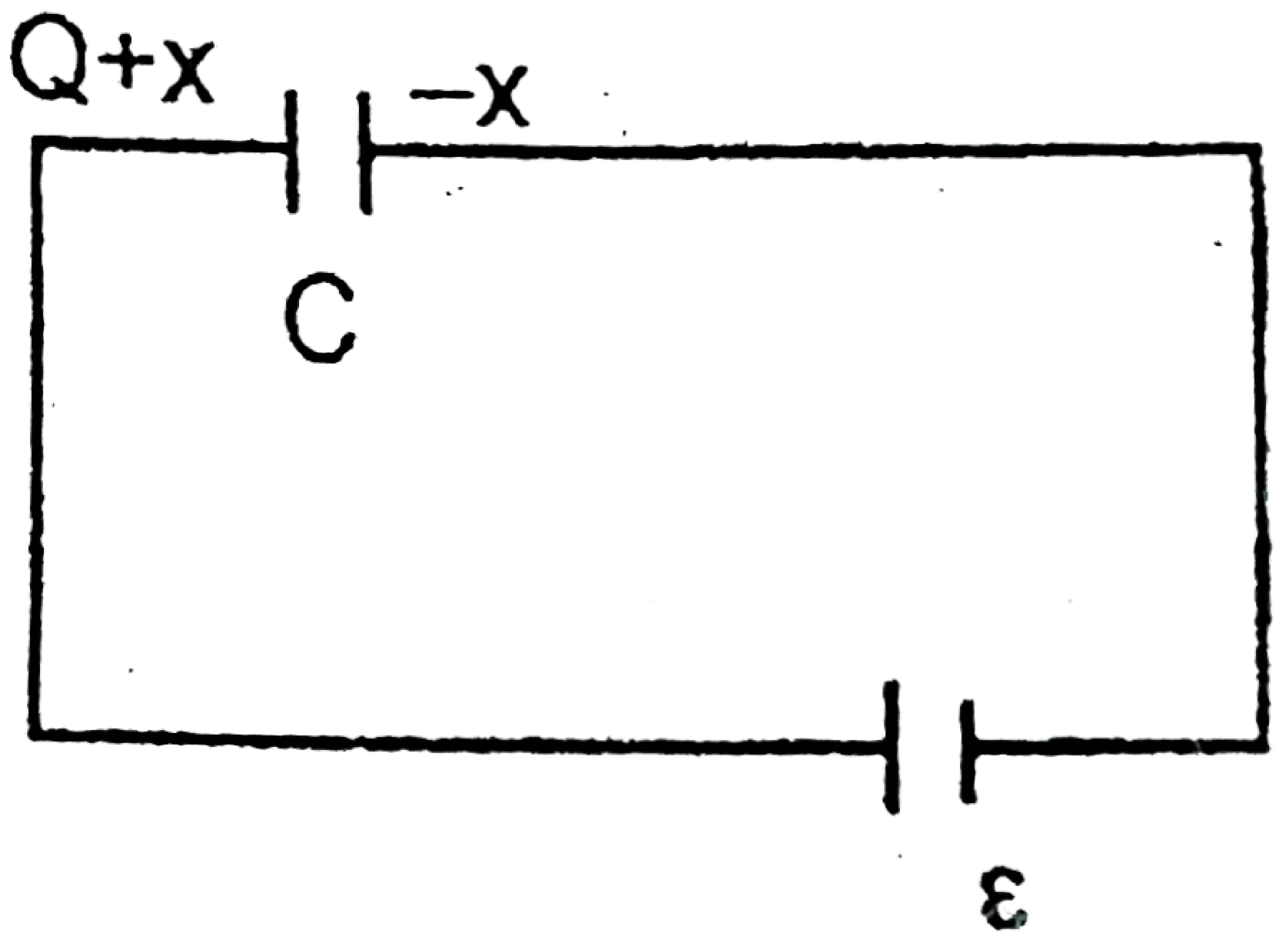
(D) $-C\varepsilon$

CORRECT ANSWER: B

SOLUTION:

Electric field between the capacitor plates

$$\frac{\sigma_1}{2\varepsilon_0}+\frac{(-\sigma_2)}{2\varepsilon_0}$$



$$E=\frac{Q+x}{2A\varepsilon_0}+\frac{x}{2A\varepsilon_0}$$
$$=\frac{1}{2A\varepsilon_0}[Q+2x]$$

$\Rightarrow$ Potential different

$$Ed = \frac{d}{2As\varepsilon_0}[Q+2x]$$
$$= \varepsilon$$

$$\Rightarrow \varepsilon = \frac{Q+2x}{2C} =$$
$$-x = \frac{Q}{2} - C\varepsilon$$

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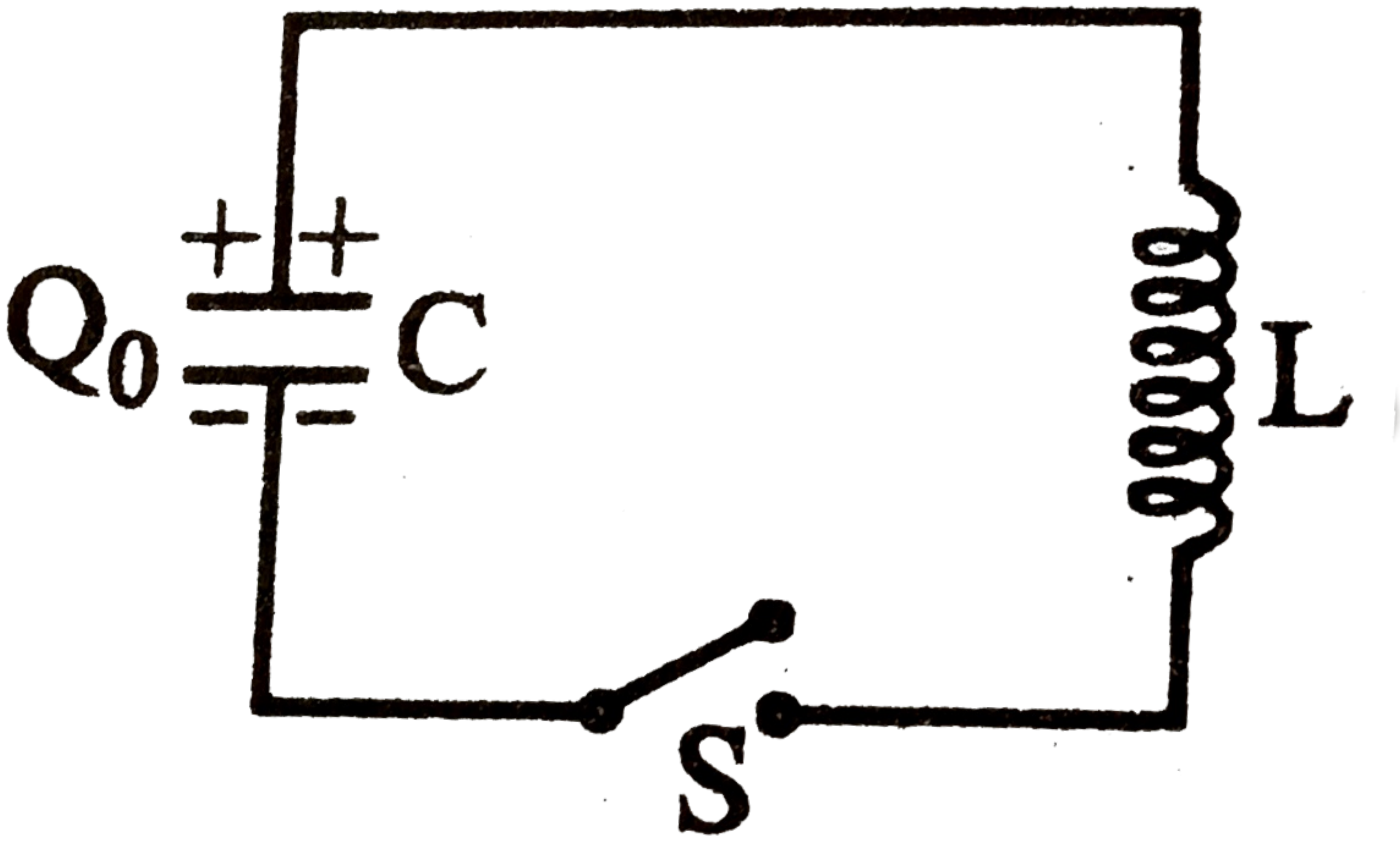
Q-39 - 12229368

A capacitor C with a charge Q_0 is connected across an inductor through a switch S. If at t=0, the switch is closed, then find the instantaneous charge q on the upper plate of capacitor.

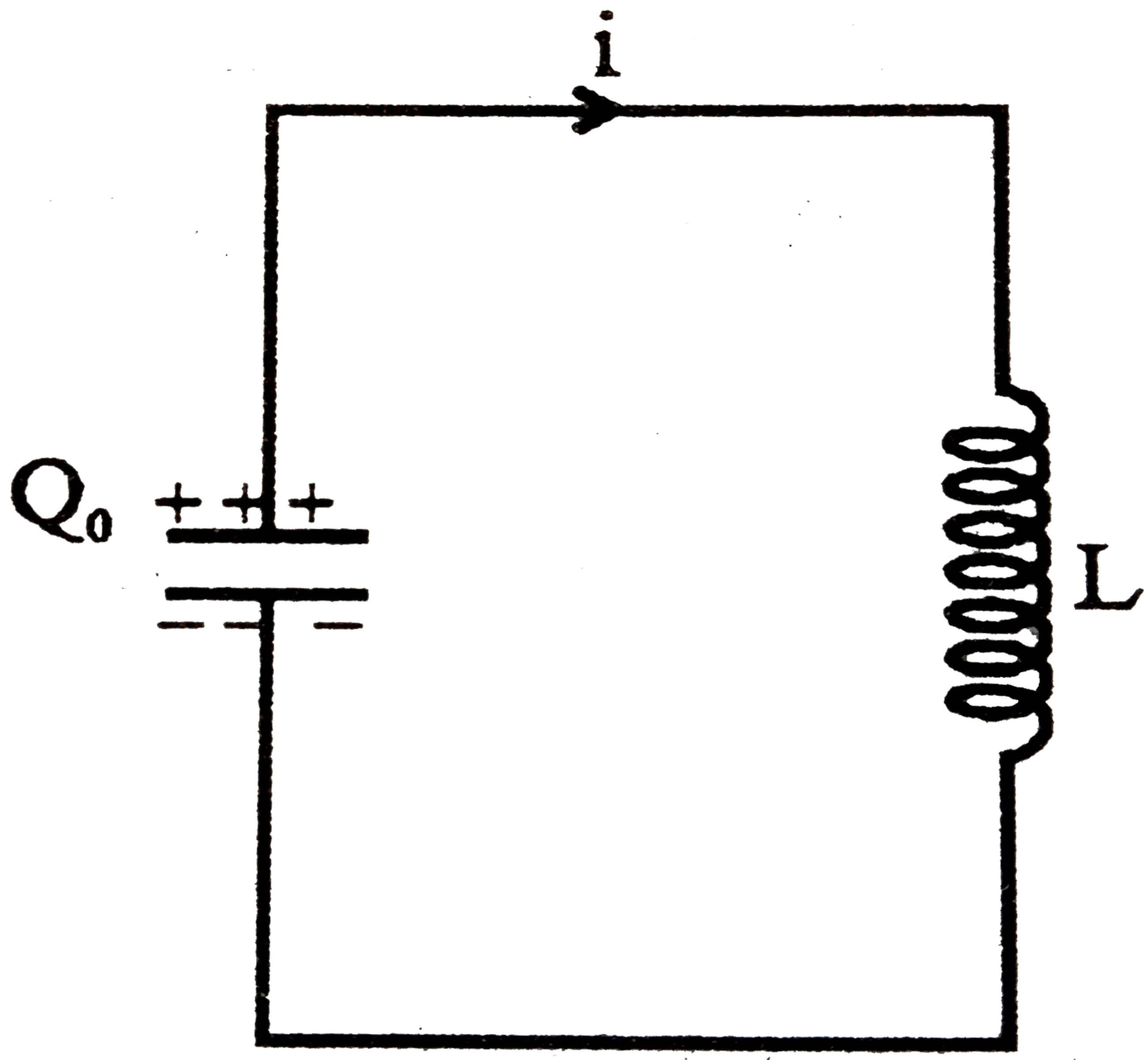


CORRECT ANSWER:

$$Q = Q_0 SIN \left(SQRT\left(\frac{1}{LC}\right) T + P\frac{I}{2} \right)$$

SOLUTION:

Applying loop law



$$\frac{q}{C} - L\left(-\frac{di}{dt}\right) = 0$$

$$\frac{q}{C} + L\frac{d^2q}{dt^2} = 0$$

$$\frac{d^2q}{dt^2} + \frac{1}{LC}q = 0$$

This is a equation of SHM so $\omega = \frac{1}{\sqrt{LC}}$

charge will oscillate and at $t = 0, q = Q_0$ so

$q = Q_0 \cos(\omega t)$

$= Q_0 \cos\left(\frac{t}{\sqrt{LC}}\right)$

$$= Q_0 \sin\left(\frac{t}{\sqrt{LC}} + \frac{\pi}{2}\right)$$

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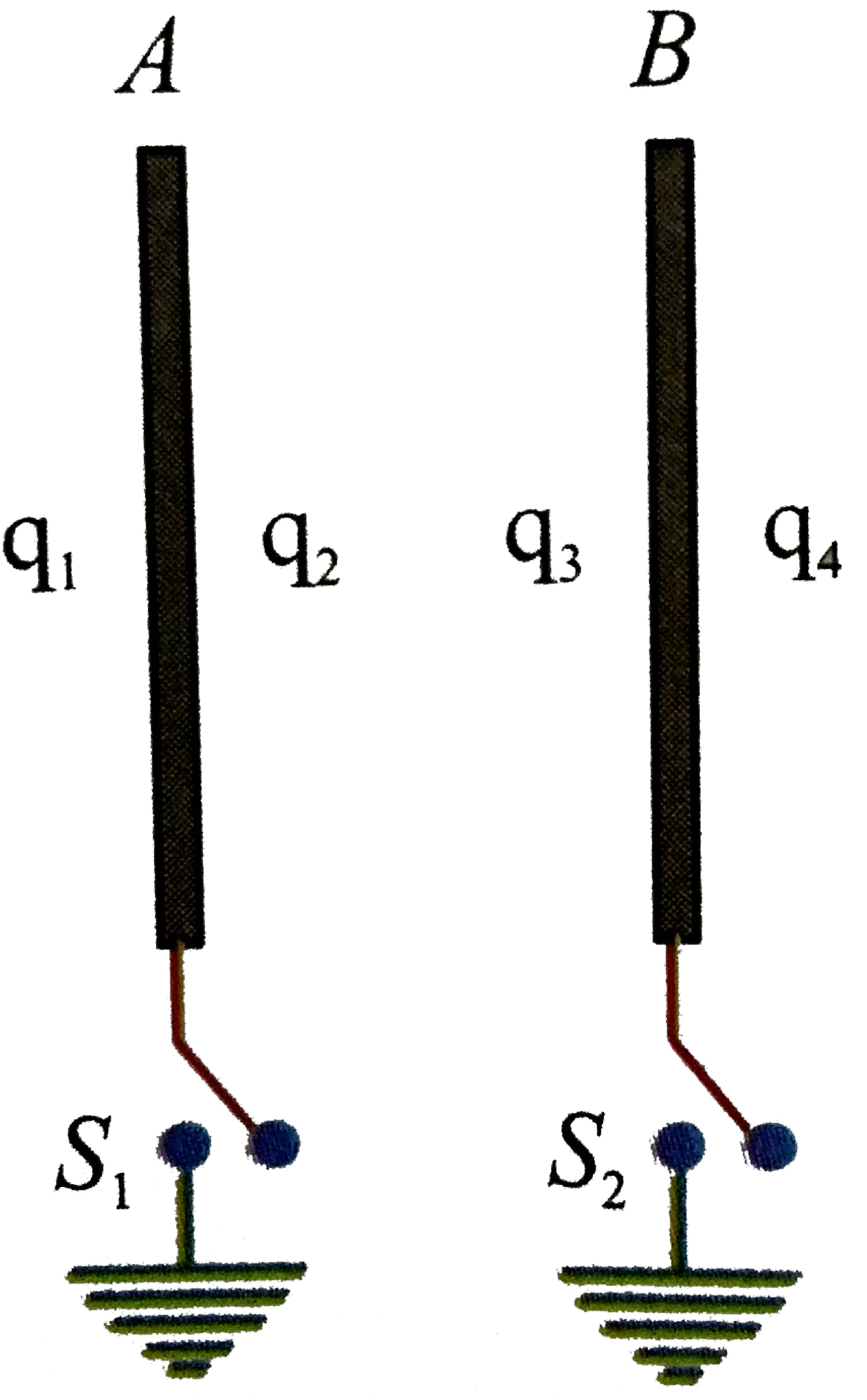
Q-40 - 13079571

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



When only switch S_1 is closed , then

(A) $q_1 = 10 \mu C$

(B) $q_2 = -60\mu C$

(C) $q_3 = 50\mu C$

(D) $q_4 = 10\mu C$

CORRECT ANSWER: B

SOLUTION:

When S_1 is closed, $q_1 = 0$ and $q_2 = -60\mu c$ so that

$$V_A = 0$$
$$q_0 = 0 q_2 = -60\mu C q_3 = 60\mu C q_4 = 0$$

.

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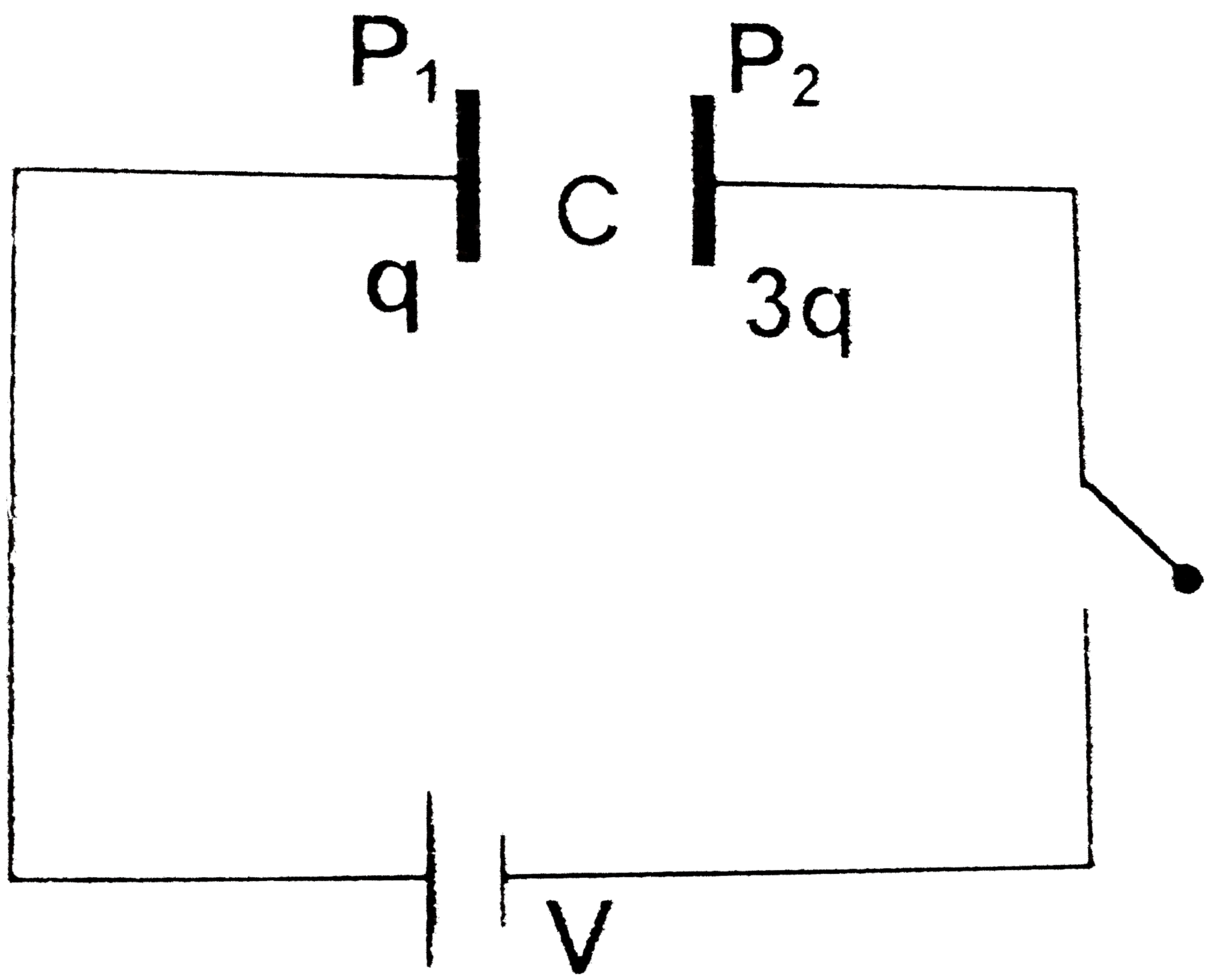
Q-41 - 14278106

A capacitor of capacity C having charge q and $3q$, on the plate P_1 and P_2 respectively as shoen in figure. Now switch 'S' is closed, find the work done by the battery. (take $q = CV$)



(A) qV

(B) $2qV$

(C) $3qV$

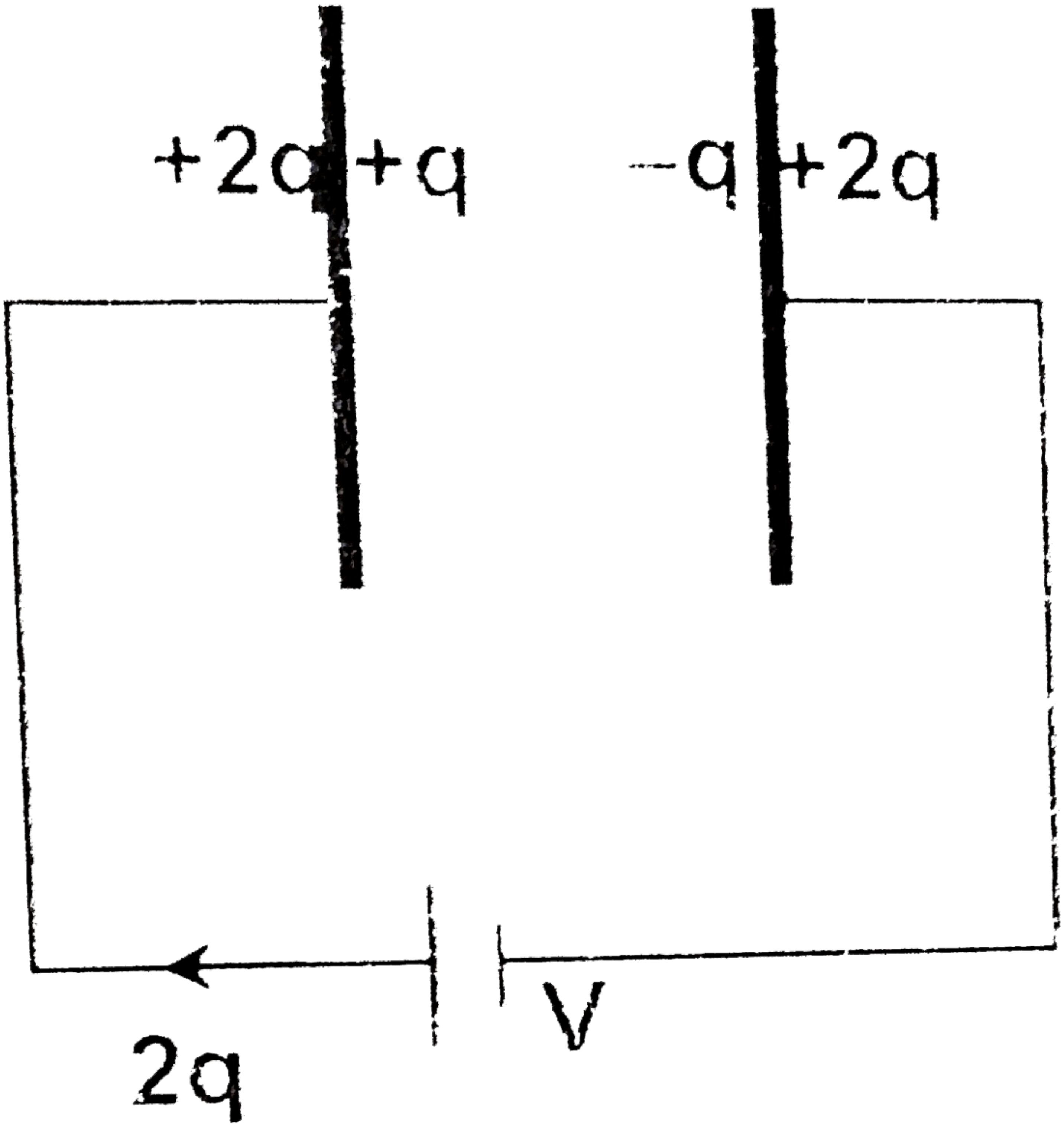
(D) $4qV$

CORRECT ANSWER: B

SOLUTION:

The distribution of charge on the plate of capacitor.

$W_B = 2qV$



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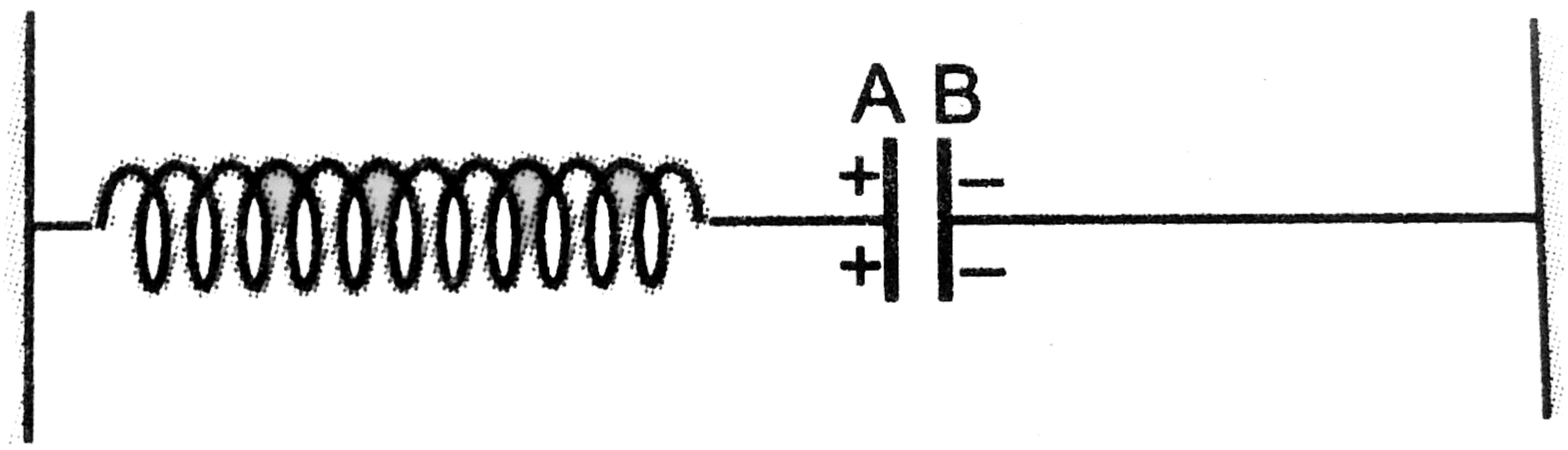
Q-42 - 12296921

Plate A of parallel plate air filled capacitor is connected to a spring having force constant k and plate B is fixed. They are held on a frictionless table top as shown in Fig. If charge $+q$ is placed on plate A and a charge $-q$ on plate A and a charge $-q$ on plate B, by how much does the spring expand ?



SOLUTION:

In a capacitor, plates carry equal and opposite charges. Therefore, there is a force of attraction between the plates.

In a parallel plate capacitor, energy stored,

$$U = \frac{1}{2}\frac{q^2}{C} \text{ and } C$$

$$= \frac{\epsilon_0 A}{x}$$

$$\therefore U = \frac{q^2 x}{2 \in_0 A}$$

As the electric field is conservation, therefore,

As the electric field is conservative , therefore,

$$F = -\frac{dU}{dx} =$$

$$-\frac{d}{dx}\left(\frac{q^2 x}{2 \in_0 A}\right) =$$

$$-\frac{q^2}{2 \in_0 A}$$

Negative sign imples that force is attractive. If k is force constant of the spring and it expands through a distance x, then $-F = kx$

or

$$x = -\frac{F}{k}$$

$$= \frac{q^2}{2 \in_0 Ak}$$

Q-43 - 11309011

Each plate of a parallel plate air capacitor has area $S = 5 \times 10^{-3} m^2$ and the distance between the plates is $d = 8.80 mm$.Plate A has positive charge $q_1 = +10^{-10} C$, and plate B has charge $q_2 = +2 \times 10^{-10} C$. A battery of emf $E = 10V$ has its positive terminal connected to plate A and the negative terminal to plate B. (Given $\varepsilon_0 = 8.8 \times^{12} Nm^2 C^{-2}$). Charge supplied by time the battery is .

(A) $120 pC$

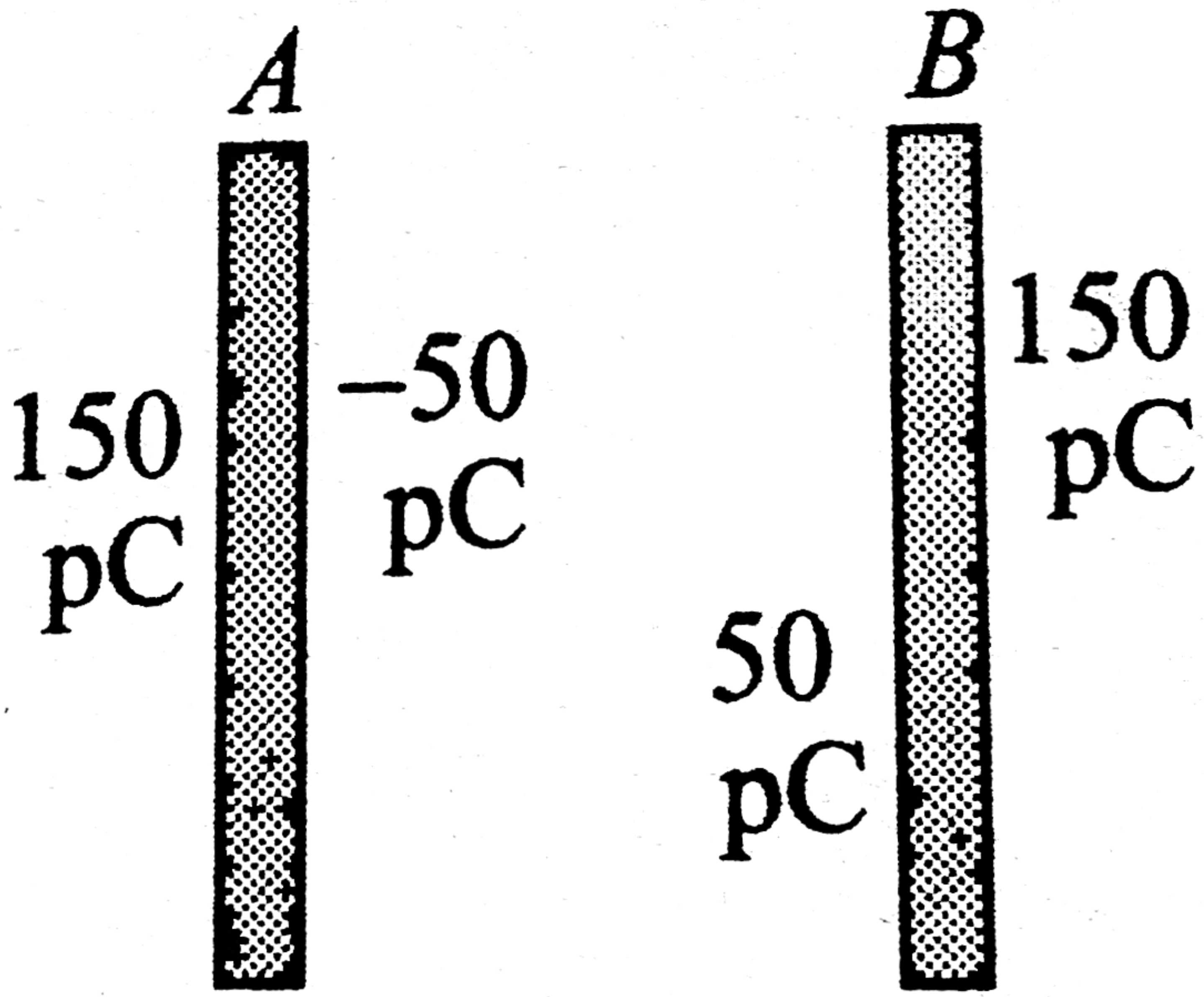
(B) $100 pC$

(C) $60 pC$

(D) $50 pC$

CORRECT ANSWER: B

SOLUTION:



(i)

$$C=\frac{\varepsilon_0 A}{d}$$

$$=\frac{8.8\times10^{-12}\times5\times10^{-3}}{8.8\times10^{-3}}$$

$$=5\times10^{-12}F$$

Charge on the plate after connection with the battery is

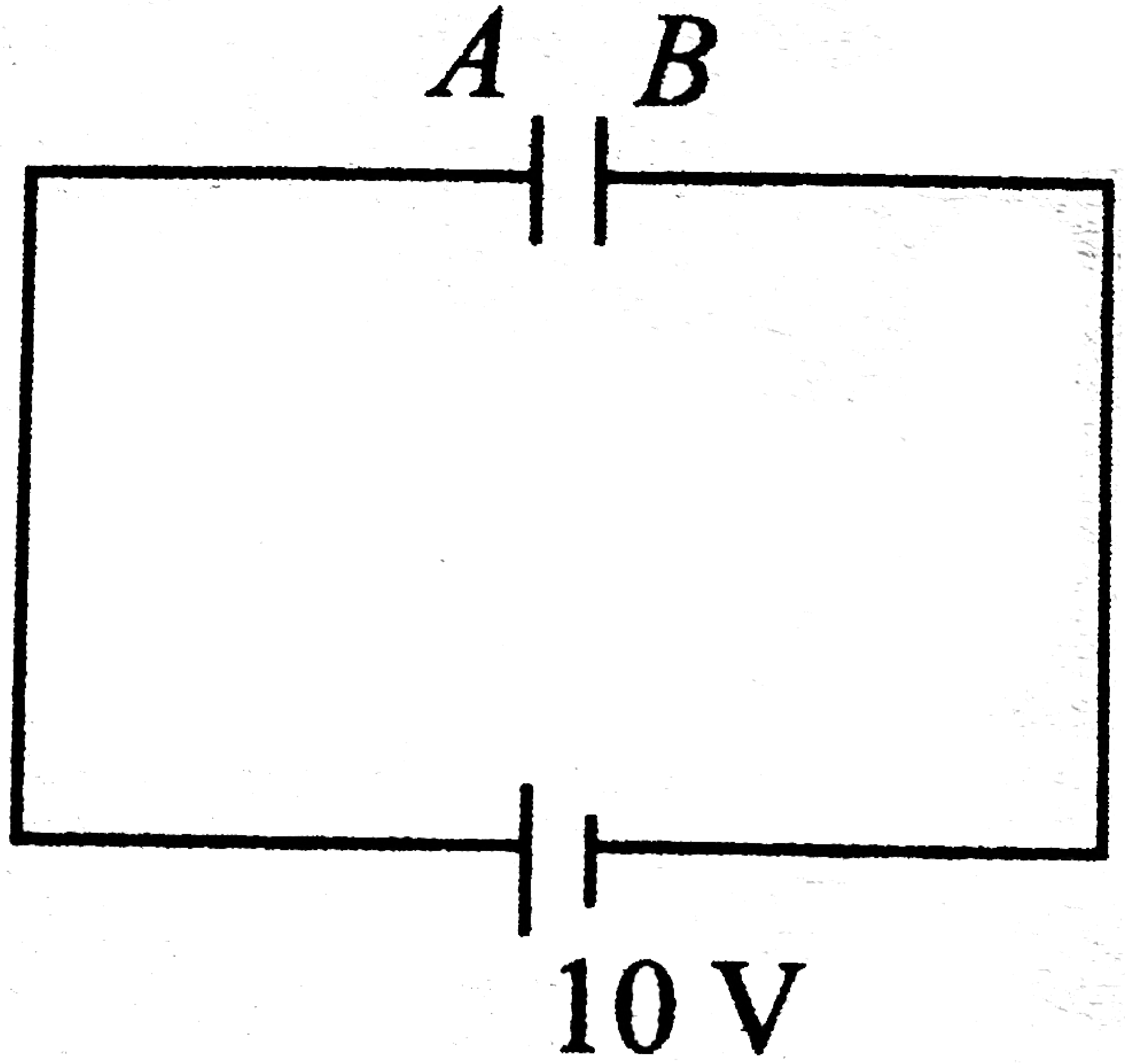


Fig. S4.90

$q = CV = 5 \times 10^{-12}$
$\times 10 = 50 pC$

Charge supplied by the battery is

$\Delta q = (50 + 50) pC$
$= 100 pC$

Energy supplied by the battery is

(ii)

$$U_{\text{battery}} = \Delta qV = 100$$

$$\times 10 = 1000 pJ$$

.

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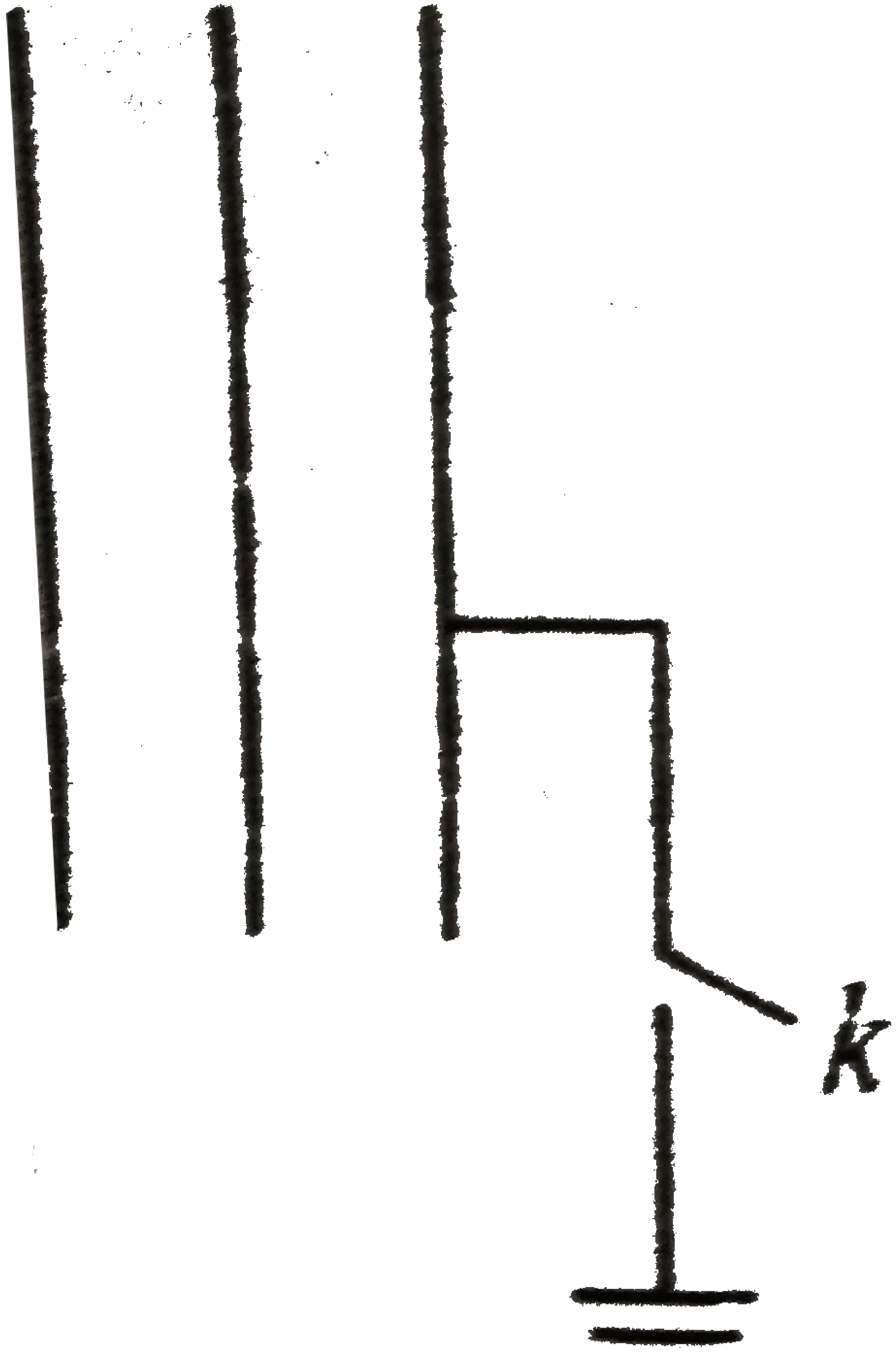
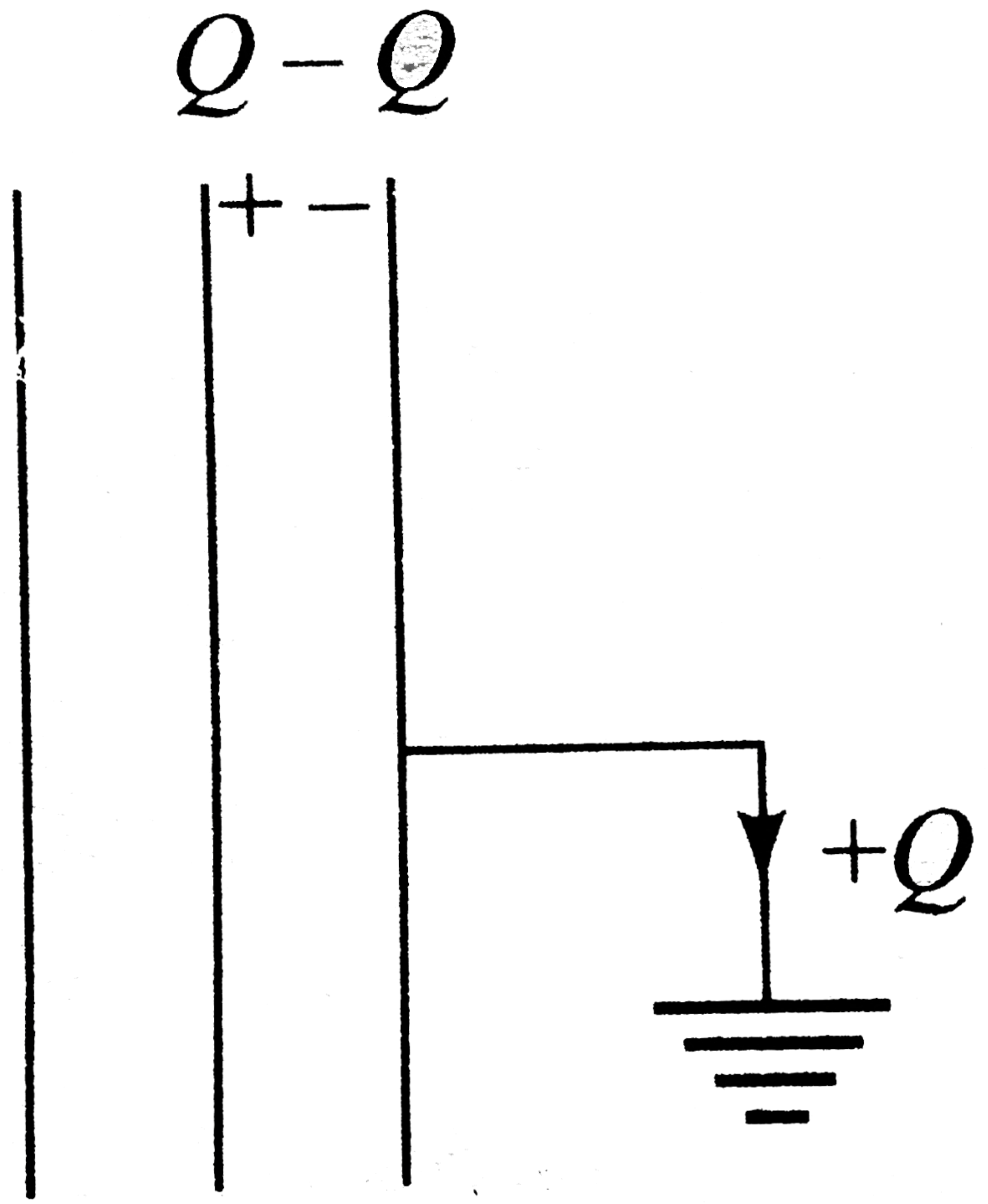
Q-44 - 11308867

Three identical large metallic plates are placed parallel to each other at a very small separation as shown in. The central plate is give a charge Q. What amount of charge will flow to earth when the key is pressid?



SOLUTION:

On connecting with earth, the charge on central plate will shift ot its right face. $-Q$ charge will be induced on the induced on the left face of the earthed plate. Thus, $+Q$ charge will flow to the earth.



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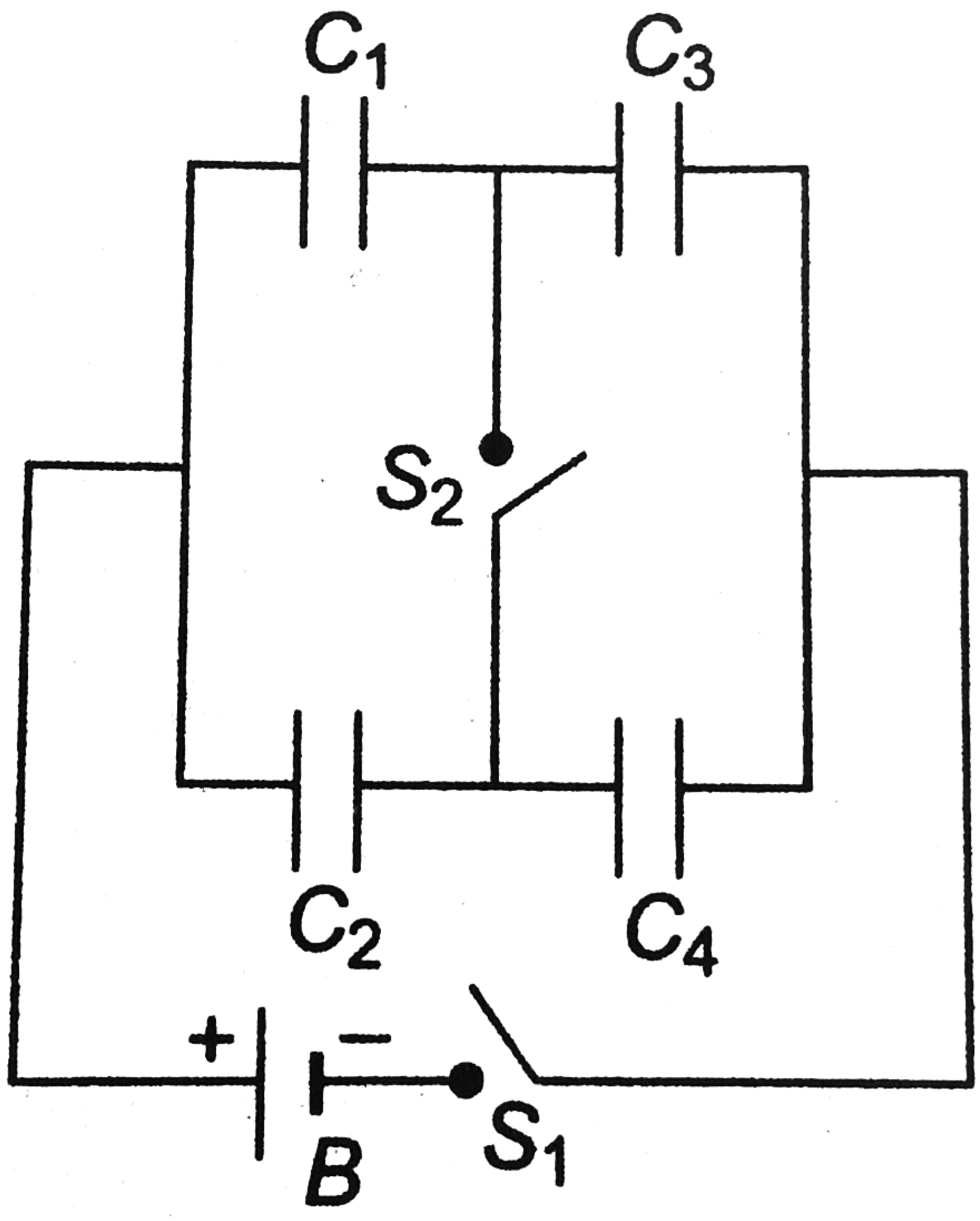
Q-45 - 10967285

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

$C_1 = 1.0\mu F, C_2 = 2.0\mu F,$

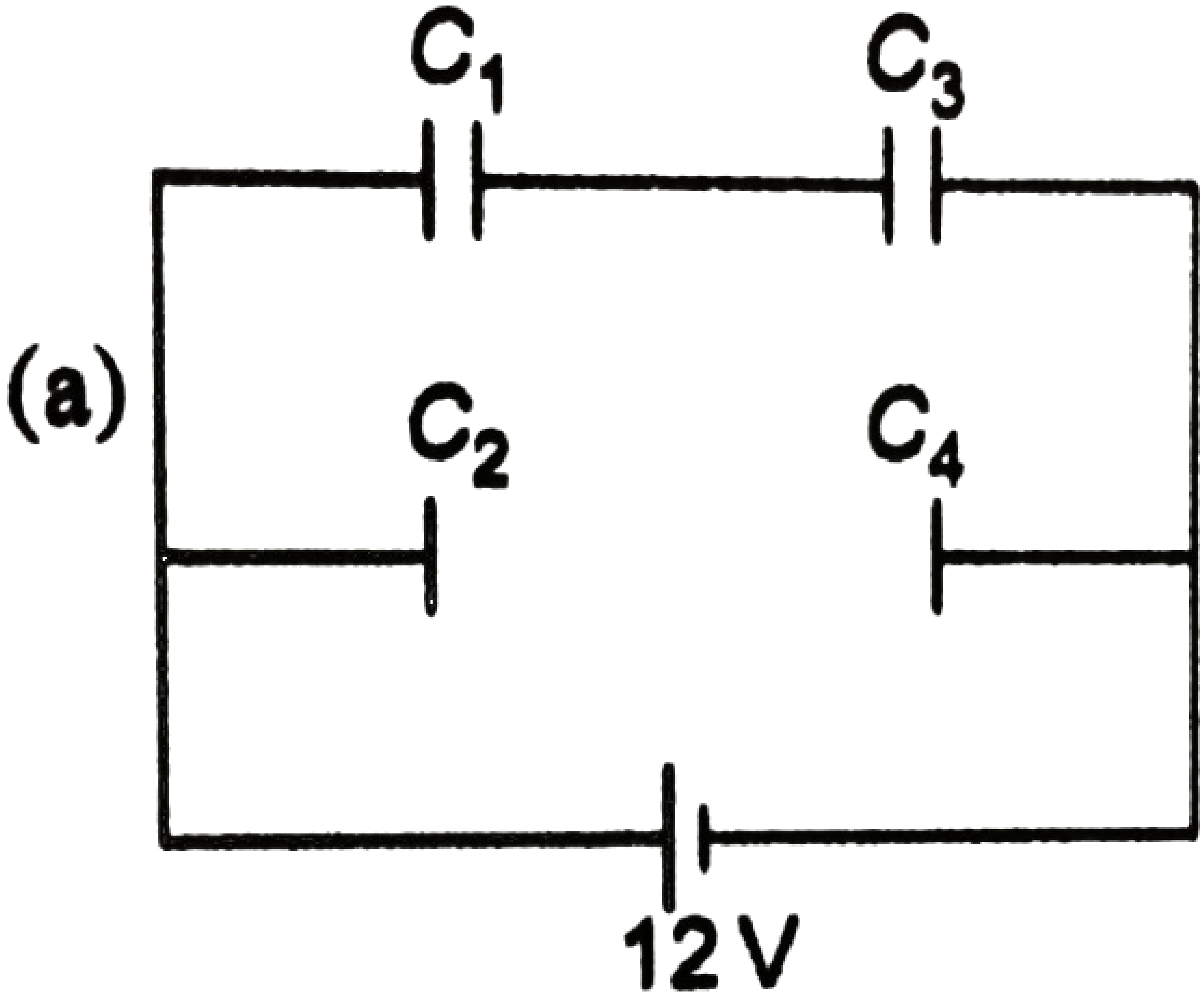
$C_3 = 3.0\mu F$

and $C_4 = 4.0\mu F$)

CORRECT ANSWER: A::C::D

SOLUTION:

a.



$$C_{13} = \frac{1 \times 3}{1+3} = \frac{3}{4}\mu F$$

$$C_{24} = \frac{2x4}{2+4} = \frac{4}{3}\mu F$$

$$V_{C_1C_3} = V_{C_2C_3} = 12V$$

$$\therefore q_1 = q_3$$

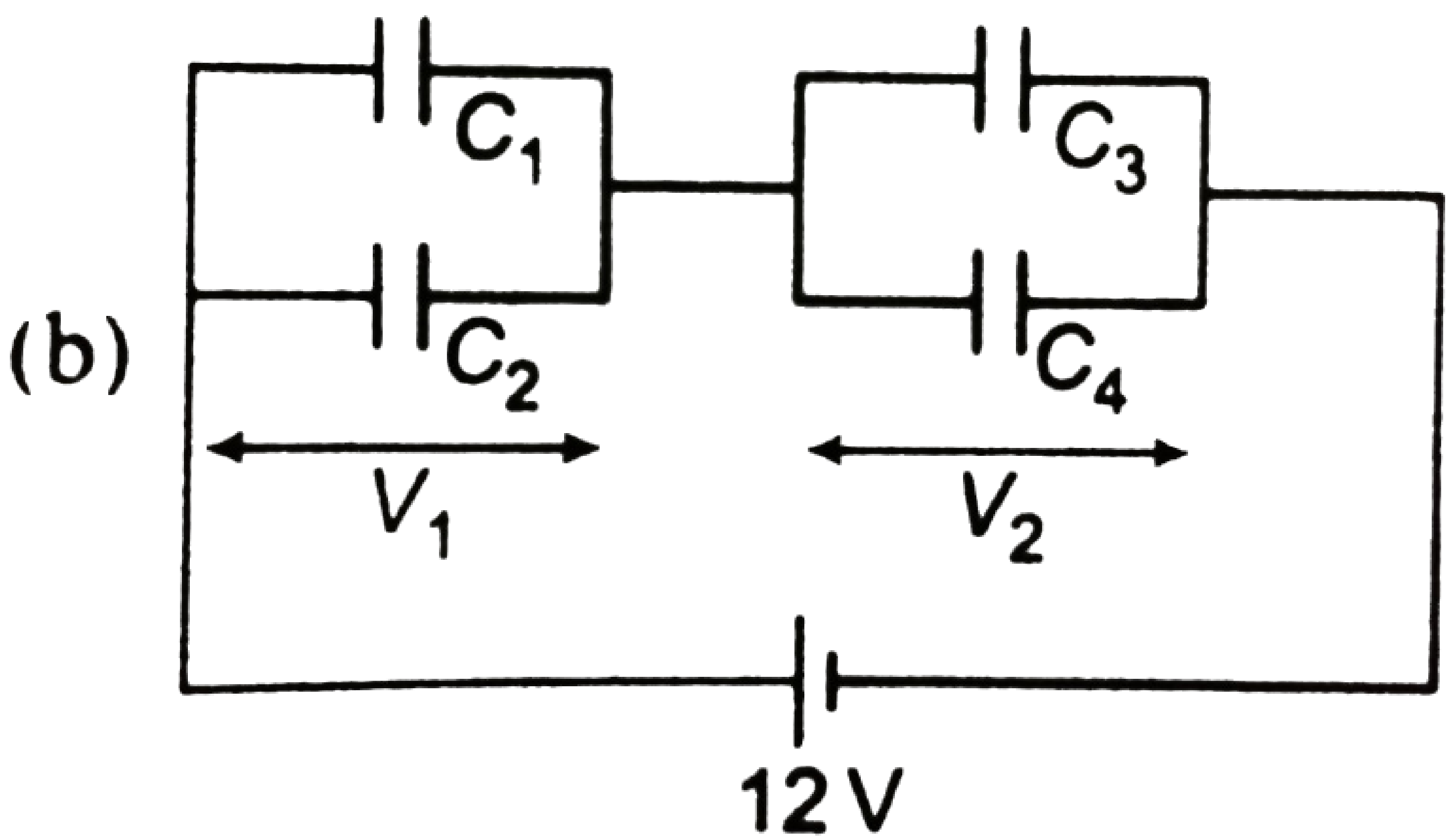
$$= (C_{13})\left(V_{C_1C_3} = \frac{3}{4}\right.$$

$$\left.\times 12\right) = 9\mu C$$

$$q_2 = q_4 = (C_{24})\left(V_{C_2C_4}\right.$$

$$\left.= \frac{4}{3} \times 12\right) = 16\mu C$$

b.



$$C_{12} = \frac{1 \times 2}{1 + 2} = \frac{2}{3}\mu F$$

$$C_{34} = \frac{3 \times 4}{3+4}$$
$$= \frac{12}{7}\mu F$$

$$\frac{V_1}{V_2} = \frac{C_{34}}{C_{12}} = \frac{\frac{12}{7}}{\frac{2}{3}}$$
$$= \frac{18}{7}$$

$$\therefore V_1 = \left(\frac{18}{25}\right)(12)$$
$$= 8.64V$$

V_2=12-8.64=3.36V`

now, we can apply q=CV for finding charge on different capacitors.

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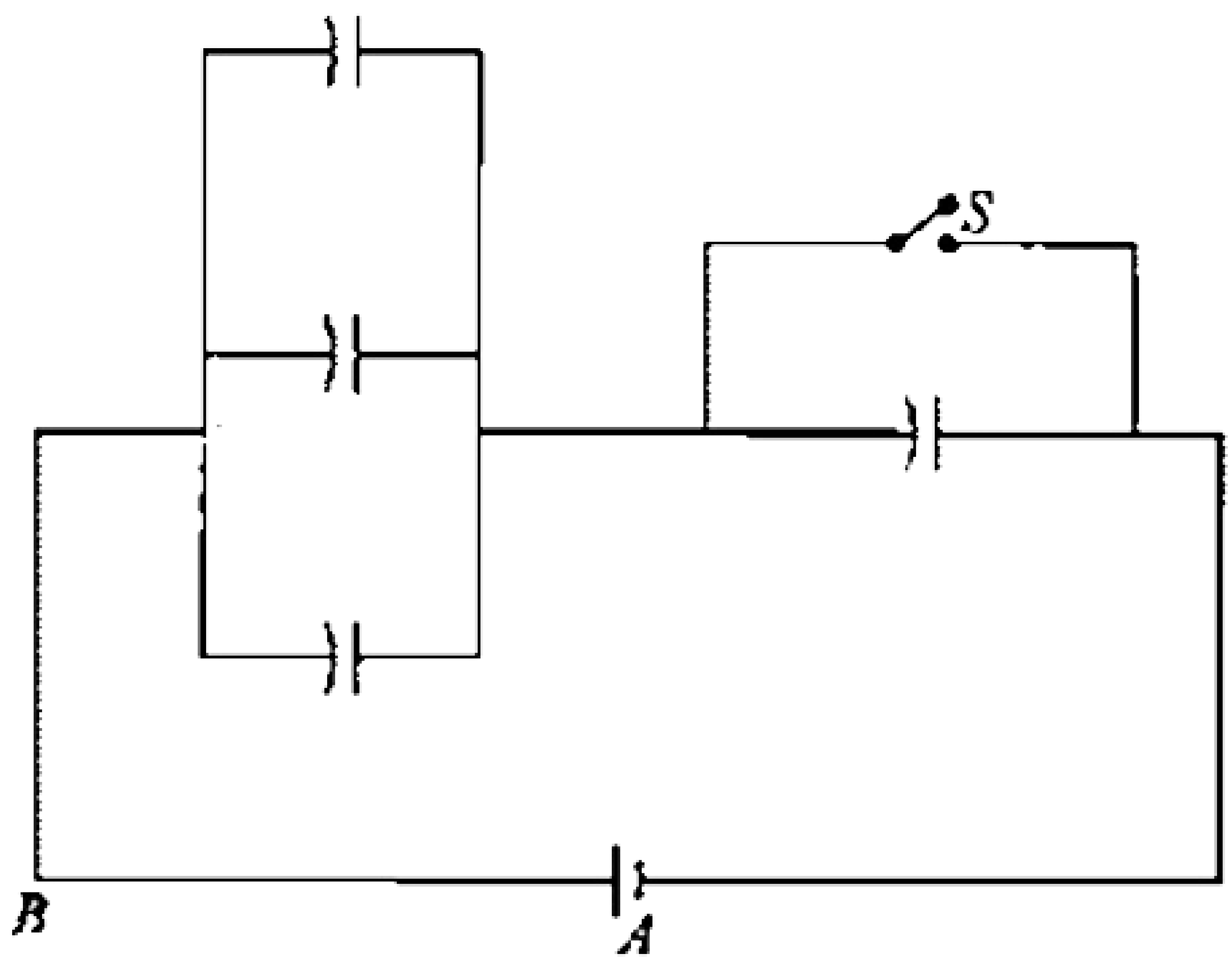
Q-46 - 16537117

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) $4500\mu C$

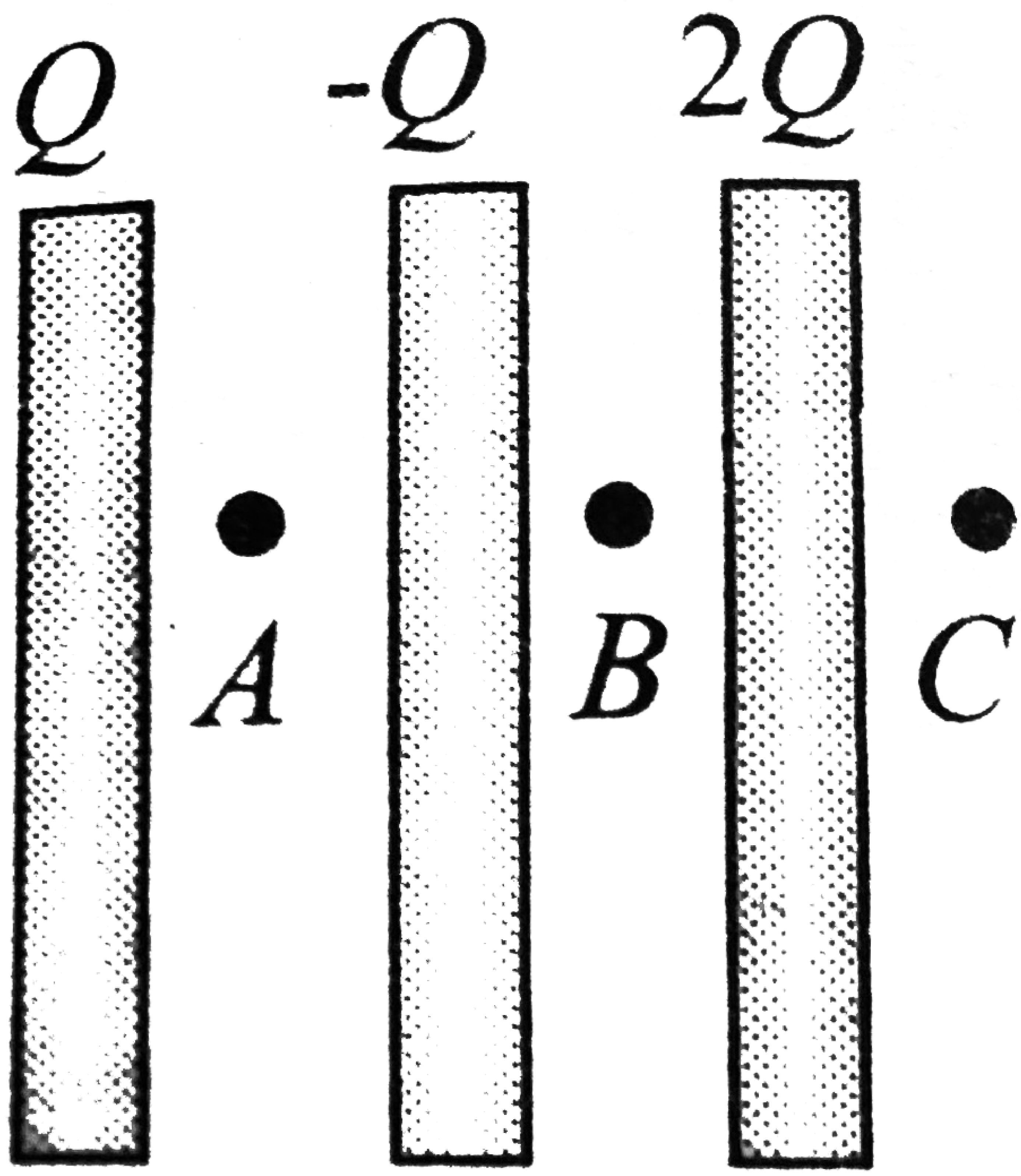
(C) $3000\mu C$

(D) $4000\mu C$

CORRECT ANSWER: B

Q-47 - 11308527

Three large identical conducting parallel plates carrying charge $+Q, \ -Q, \ \text{and} \ +2Q$, respectively, are placed as shown in figure. If $E_A, E_b, \ \text{and} \ E_C$ refer to the magnitudes of the electric field at points A, B, and C, respectively. Then



(A) $E_A > E_B > E_C$

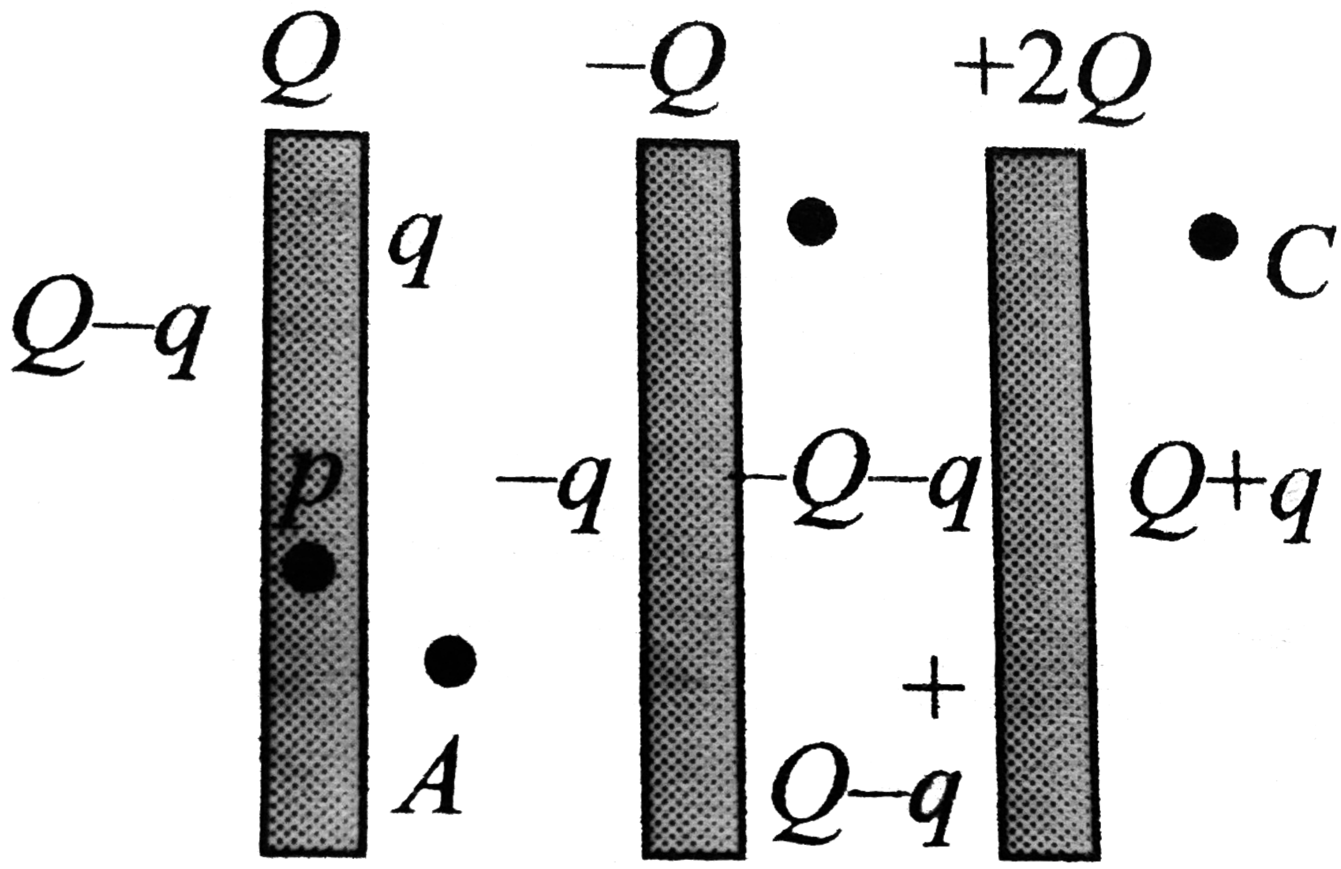
(B) $E_A = E_B > E_C$

(C) $E_A = 0$ and $E_B > E_C$

(D) $E_A = 0$ and $E_B = E_C$

CORRECT ANSWER: D

SOLUTION:

d. 

$E_P = 0$ (since it is a point inside conductor)

or

$$K\left[\frac{Q-q}{2\varepsilon_0} - \frac{1}{2\varepsilon_0}\right.$$

$$+ \frac{q}{2\varepsilon_0} + \frac{Q-q}{2\varepsilon_0}$$

$$\left.- \frac{Q+q}{2\varepsilon_0} - \frac{Q-q}{2\varepsilon_0}\right]$$

= 0

or $q = 0$

Clearly $= E_A = 0$

$$E_B = -\frac{2KQ}{2\varepsilon_0}$$

$$-\frac{KQ}{\varepsilon_0}$$

$$E_C = \frac{2KQ}{2\varepsilon_0} = \frac{KQ}{\varepsilon_0}$$

In magnitude, $E_B = E_C$

Q-48 - 11964309

If the distance between the plates of parallel plate capacitor is halved and the dielectric constant of dielectric is doubled, then its capacity will

(A) increase by 16 times

(B) increase by 4 times

(C) increase by 2 times

(D) remain the same

CORRECT ANSWER: B

SOLUTION:

$$C = \frac{K\varepsilon_0 A}{d} \propto \frac{K}{d}$$

Hence,

$$\frac{C_1}{C_2} = \frac{K_1}{K_2} \times \frac{d_2}{d_1}$$

$$= \frac{K}{2K} \times \frac{d/2}{d} = \frac{1}{4}$$

Therefore, $C_2 = 4C_1$

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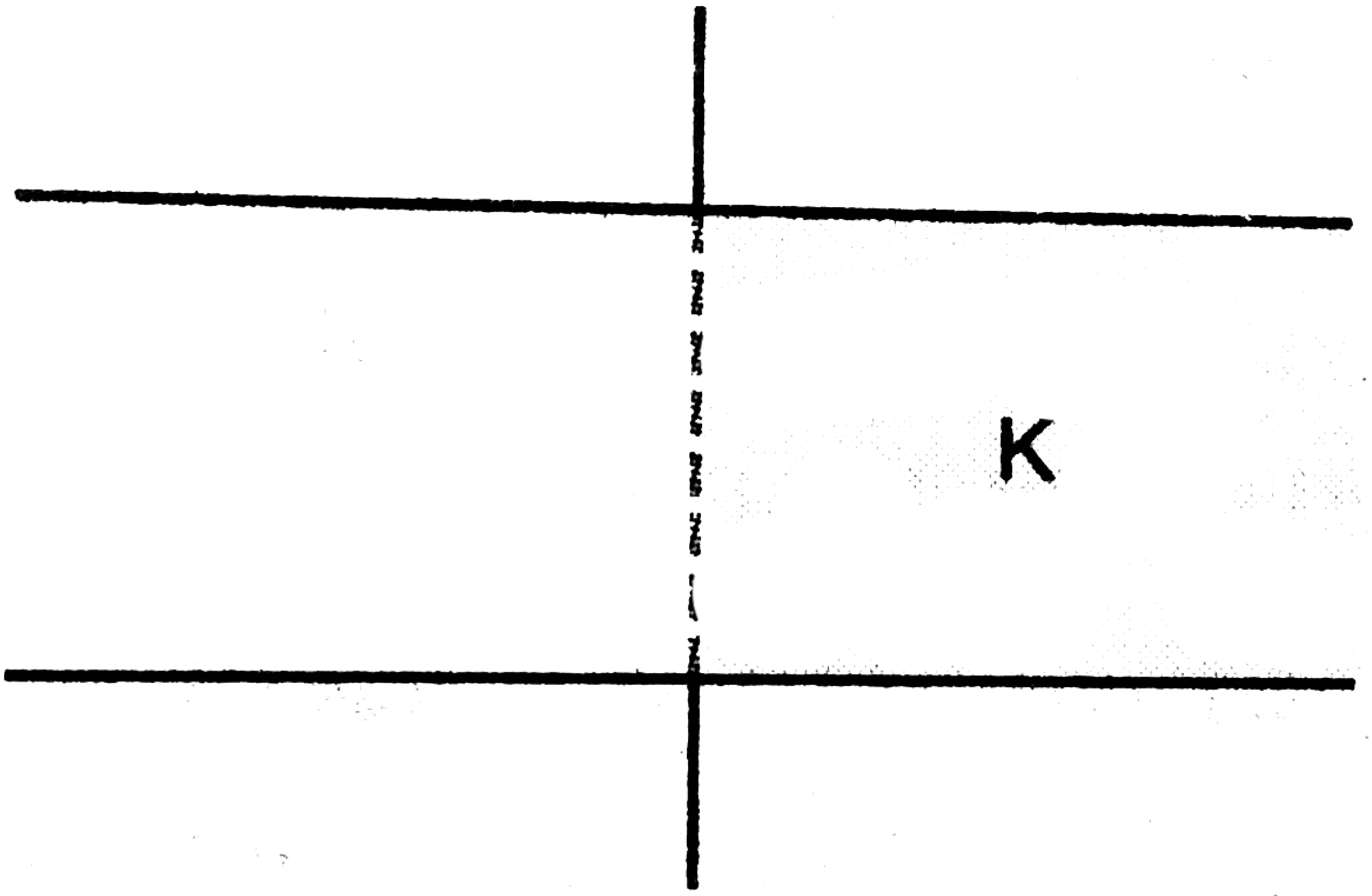
Q-49 - 12296786

As shown in Fig, a dielectric material of dielectric constant K is insered in half portan between plates of parallel plate capacitor. If its initial capacitance is C, what is the new capacitance ?



SOLUTION:

The new arrangement is equivalent to two capacitors connected in parallel.

$$C_1 = \frac{\in_0 A/2}{d} C_2$$

$$= \frac{K \in_0 A/2}{d}$$

$$C_P = C_1 + C_2$$

$$= \frac{\in_0 A}{2d} + \frac{K \in_0 A}{2d}$$

$$= \frac{\in_0 A}{2d}(K+1)$$

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

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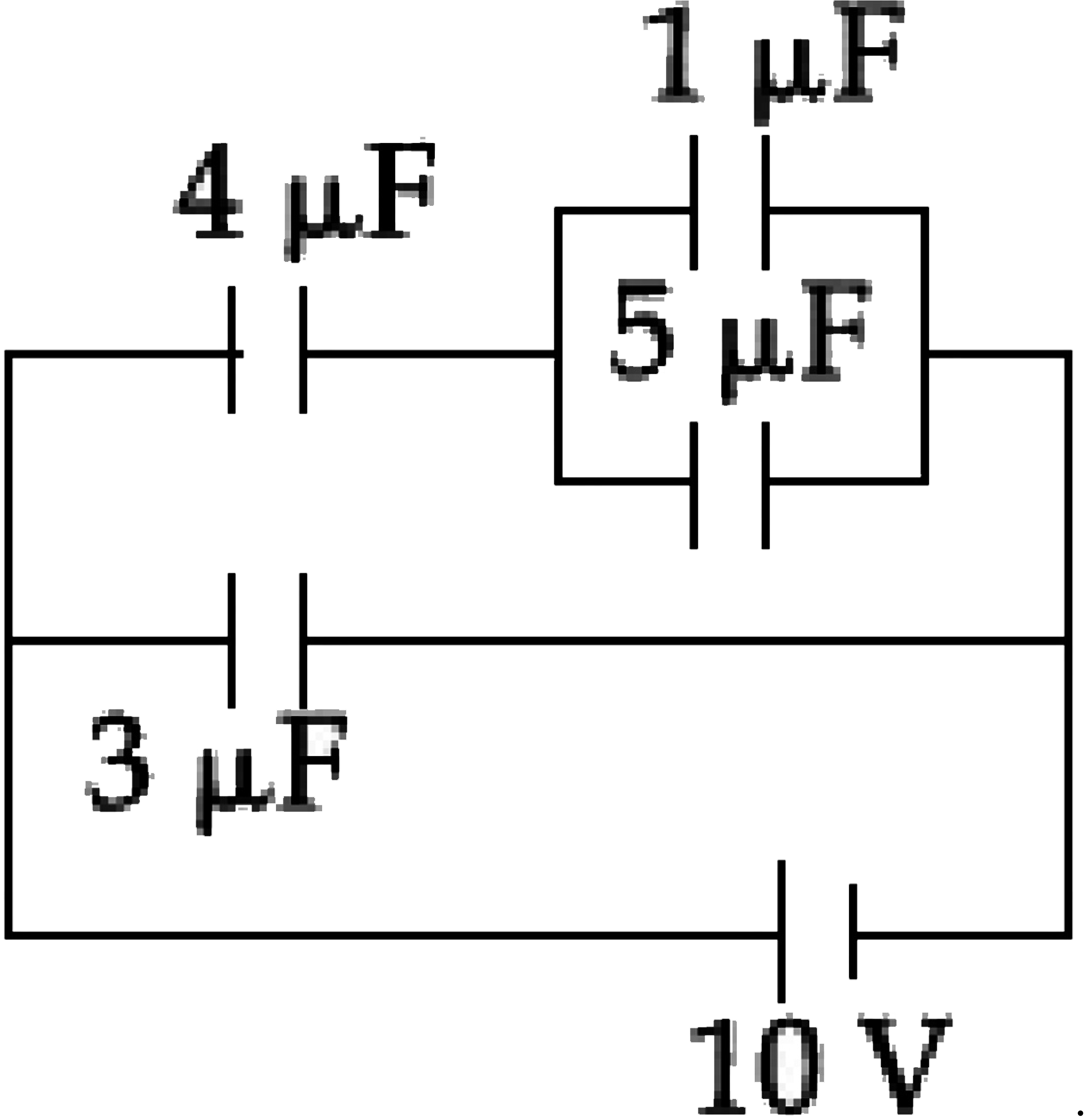
Q-50 - 9717083

In the given circuit, the charge on $4\mu F$ capacitor will be :



(A) $5.4 \mu C$

(B) $9.6 \mu C$

(C) $13.4 \mu C$

(D) $24 \mu C$

CORRECT ANSWER: A

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Q-51 - 12012786

220 V, Hz is connected across a capacitor of $5\mu F$. Calculate the effective current.

SOLUTION:

Here,

$$E_V = 220V, v$$
$$= 50Hz, C = 5$$
$$\times 10^{-6} F$$

$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi v C}$$
$$= \frac{1}{2\pi \times 50 \times 5 \times 10^{-6}}$$
$$= \frac{10^6}{500\pi} ohm$$

$$I_v = \frac{E_v}{X_C}$$
$$= \frac{220 \times 500\pi}{10^6}$$
$$= 0.11 \times 3.14A$$
$$= 0.375A$$

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Q-52 - 12297392

A slab of materail of dielectric constant K has the same area as the plates of a parallel plate capacitor but has thickness $d/2$, where d is the separation between the plates. Find the expression for the capacitance when the slab is inserted between the plates.

CORRECT ANSWER: $\frac{2K}{K+1}C_0$

SOLUTION:

Without dielectric, $E_0 = \frac{V_0}{d}$

$$V = E_0 \frac{d}{2} + E.\frac{d}{2}$$
$$= E_0 \frac{d}{2} + \frac{E_0}{K}\frac{d}{2}$$

$$= \frac{E_0 d}{2}\frac{(K+1)}{K}$$
$$= \frac{V_0(K+1)}{2K}$$

$$C = \frac{q_0}{V_0}$$
$$= \frac{2kq_0}{V_0(K+1)}$$
$$= \frac{2K}{K+1}C_0$$

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Q-53 - 11964583

Two identical parallel plate capacitors are connected in series to a battery of $100V$. A dielectric slab of dielectric constant 4.0 is inserted between the plates of second capacitor. The potential difference across the capacitors will now be respectively

(A) $50V, 50V$

(B) $80V, 20V$

(C) $20V, 80V$

(D) $75V, 25V$

CORRECT ANSWER: B

SOLUTION:

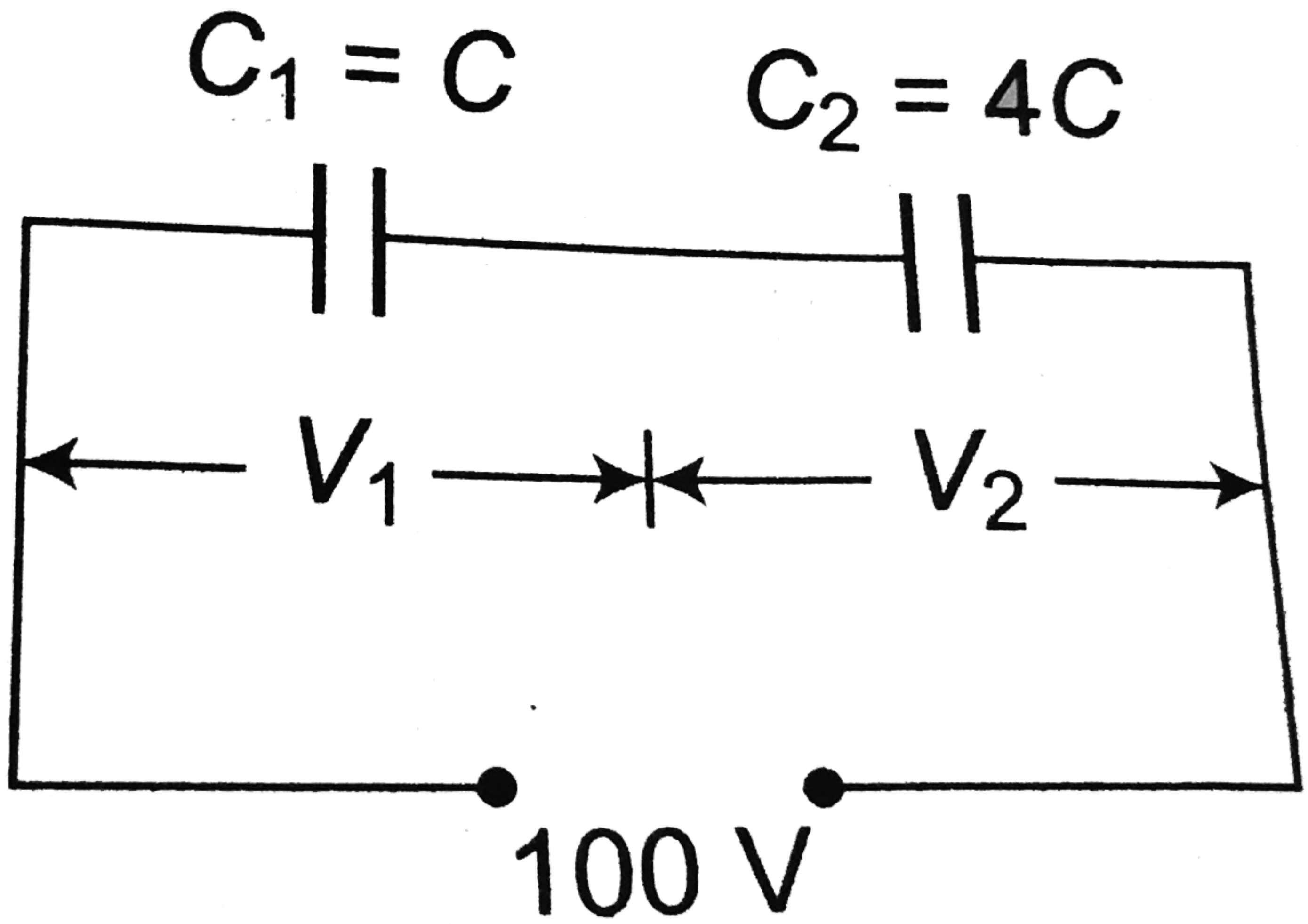
$$C_{eq} = \frac{C \times 4C}{(C + 4C)}$$
$$= \frac{4C}{5}$$

$$Q = C_{eq}.V = \frac{4C}{5}$$
$$\times 100 = 80C$$

Hence

$$V_1 = \frac{Q}{C_1} = \frac{80C}{C_1}$$
$$= 80V$$

and $V_2 = \dfrac{80C}{4C} = 20C$



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Q-54 - 17817296

A parallel plate capacitor is connecyed to a battery of emf V volts as shown. Now a slab of dielectric constant $k = 2$ is inserted between the plates of capacitor without disconnecting the battery. The electric field between the plates of capacitor after inserting the slab is $E = \frac{PV}{2d}$. Find the value of P.

CORRECT ANSWER: 2

Q-55 - 13079472

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

(A) $33.3\ \%$

(B) $66.7\ \%$

(C) 0.5

(D) 0.75

CORRECT ANSWER: B

SOLUTION:

$$C_0 = \frac{\varepsilon_0 A}{d}, C$$

$$= \frac{\epsilon_0\ A}{d - t(1 - 1/k)}$$

$$\Delta C\,\% = \frac{C - C_0}{C_0} \times 100\,\%$$

.

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Q-56 - 11964276

Between the plates of a parallel plate condenser, a plate of thickness t_1 and dielectric constant k_1 is placed. In the rest of the space, there is another plate of thickness t_2 and dielectric constant k_2. The potential difference across the condenser will be

(A) $\frac{Q}{A\varepsilon_0}\left(\frac{t_1}{k_1} + \frac{t_2}{k_2}\right)$

(B) $\frac{\varepsilon_0 Q}{A}\left(\frac{t_1}{k_1} + \frac{t_2}{k_2}\right)$

(C) $\frac{Q}{A\varepsilon_0}\left(\frac{k_1}{t_1} + \frac{k_2}{t_2}\right)$

(D) $\frac{\varepsilon_0 Q}{A}(k_1 t_1 + k_2 t_2)$

CORRECT ANSWER: A

SOLUTION:

Potential difference across the condenser

$$V = V_1 + V_2 = E_1 t_1 + E_2 t_2 = \frac{\sigma}{K_1 \varepsilon_0} + \frac{\sigma}{K_2 \varepsilon_0} t_2$$

$$\Rightarrow V = \frac{\sigma}{\varepsilon_0}\left(\frac{t_1}{K_1} + \frac{t_2}{K_2}\right) = \frac{Q}{A\varepsilon_0}\left(\frac{t_1}{K_1} + \frac{t_2}{K_2}\right)$$

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Q-57 - 10059686

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) (a) zero

(B) (b) $\frac{1}{2}(K-1)CV^2$

(C) (c) $\frac{CV^2(K-1)}{K}$

(D) (d) $(K-1)CV^2$

CORRECT ANSWER: A

SOLUTION:

The potential energy of a charged capacitor before removing the dielectric slat is $U=\frac{Q^2}{2C}$.

The potential energy of the capacitor when the dielectric slat is first removed and the reinserted in the gap between the plates is $U = \dfrac{Q^2}{2C}$

There is no change in potential energy, therefore work done is zero.

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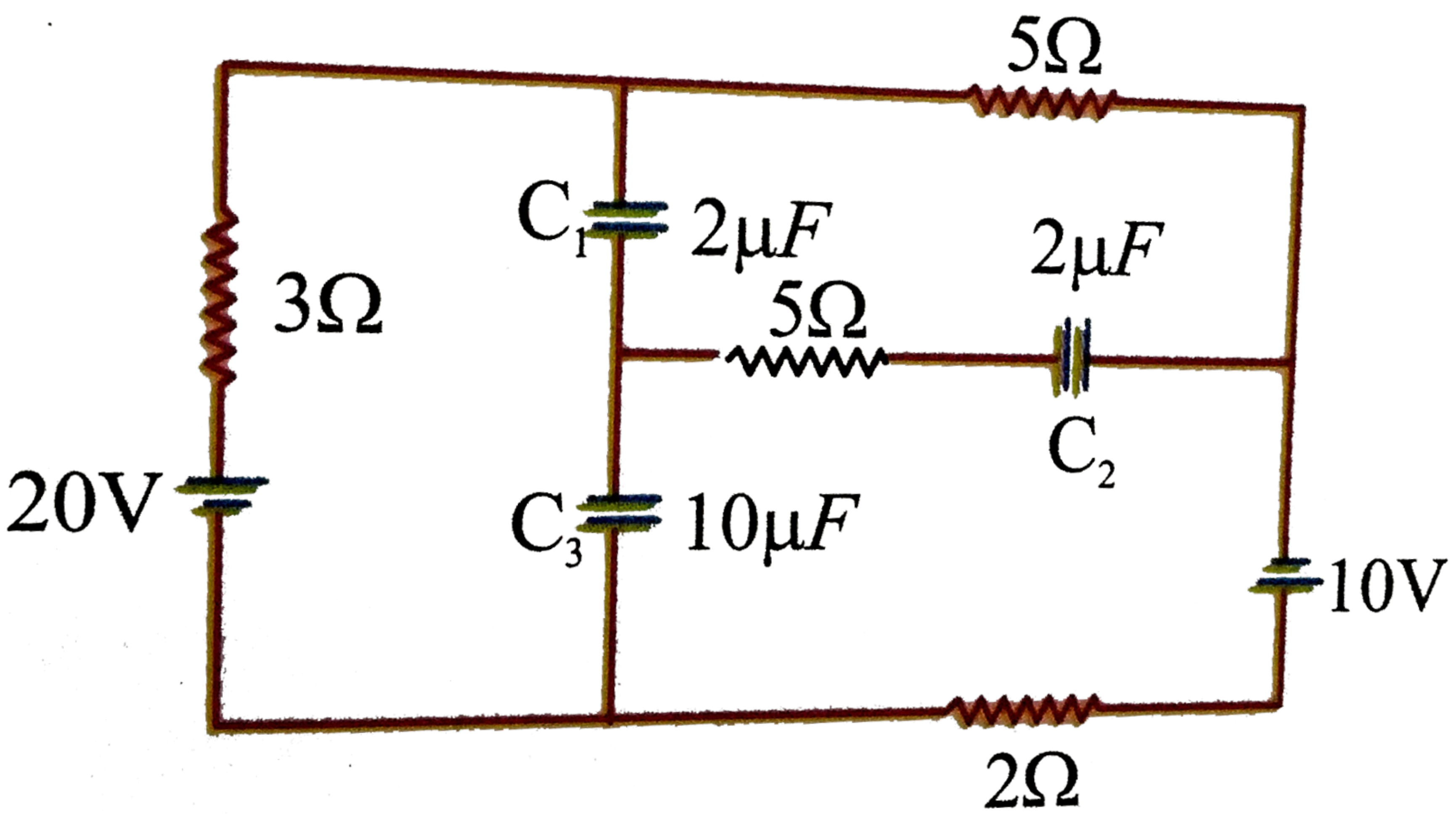
Q-58 - 13079576

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



CORRECT ANSWER: 1

SOLUTION:

Use the concept of CR-circuit.

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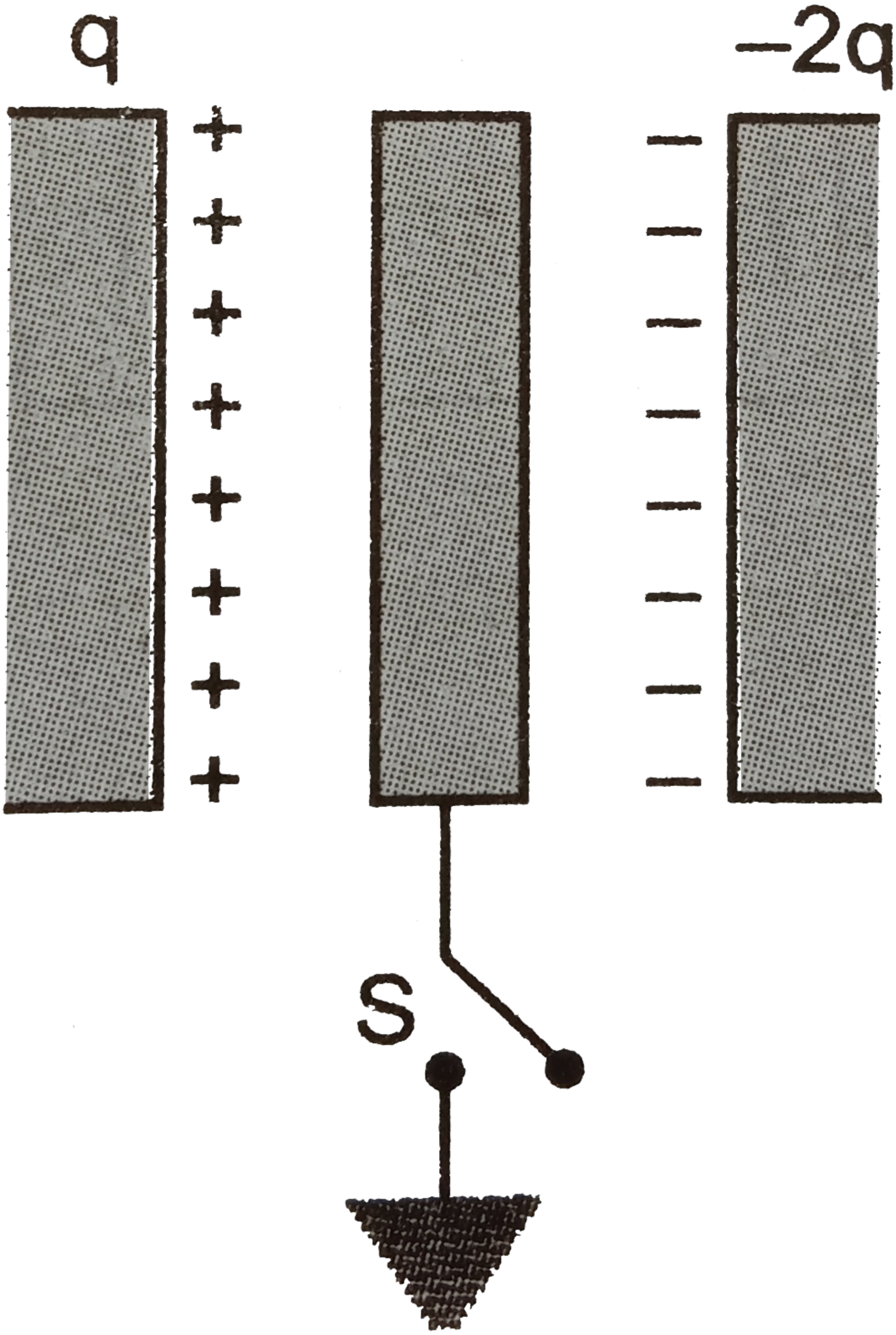
Q-59 - 12297518

The metal plate on the left in Fig, carries a charge $+q$. The metal plate on the right has a charge of $-2q$. What charge will flow through S when it is closed if the central plate is initially neutral ?



(A) zero

(B) $-q$

(C) $+q$

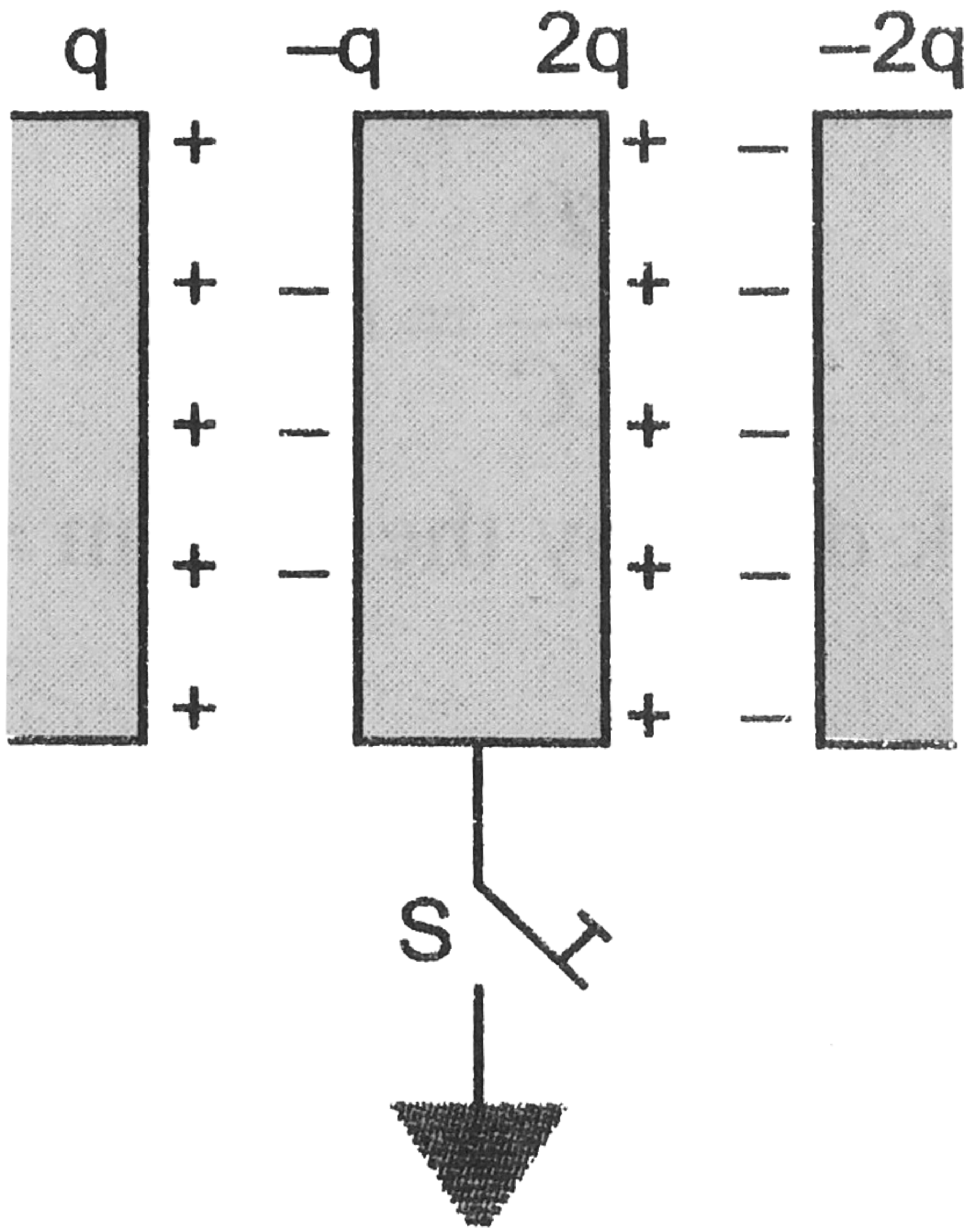
(D) $-2q$

CORRECT ANSWER: C

SOLUTION:

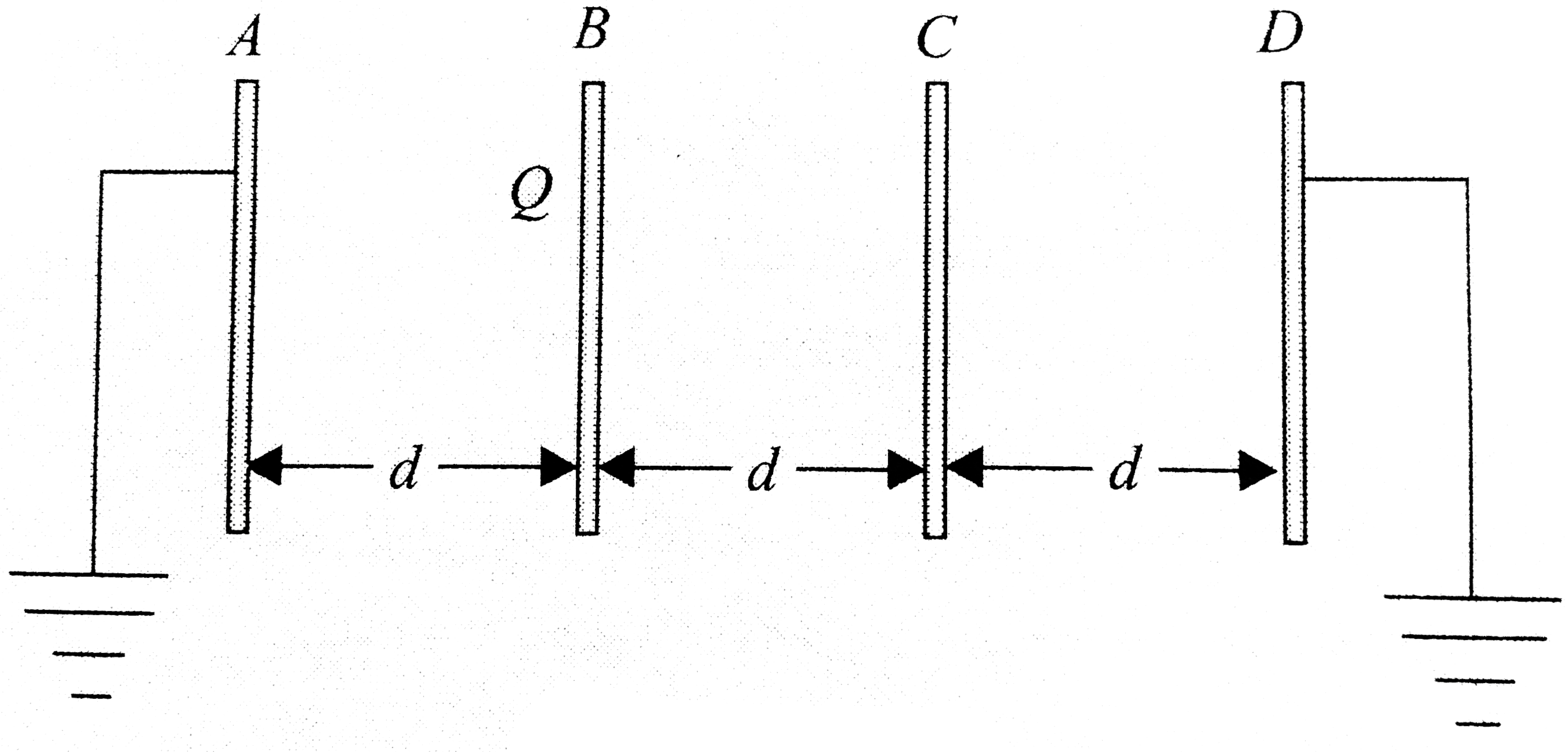
In Fig, $-q$ charge is induced on left face and $+2q$ charge is induced on right face of central plate.

Therefore, when switch S is closed, charge that flows through S to earth $=(+2q-q)=+q$.



Q-60 - 11308899

Four parallel large plates separated by equal distance d are arranged as shown in. The area of the plates is S Find the potential differnce between plats B and C if plate B is given a charge Q.



SOLUTION:

Moving from plate A and D

$$0+\frac{(Q-x)}{C}-\frac{x}{c}$$

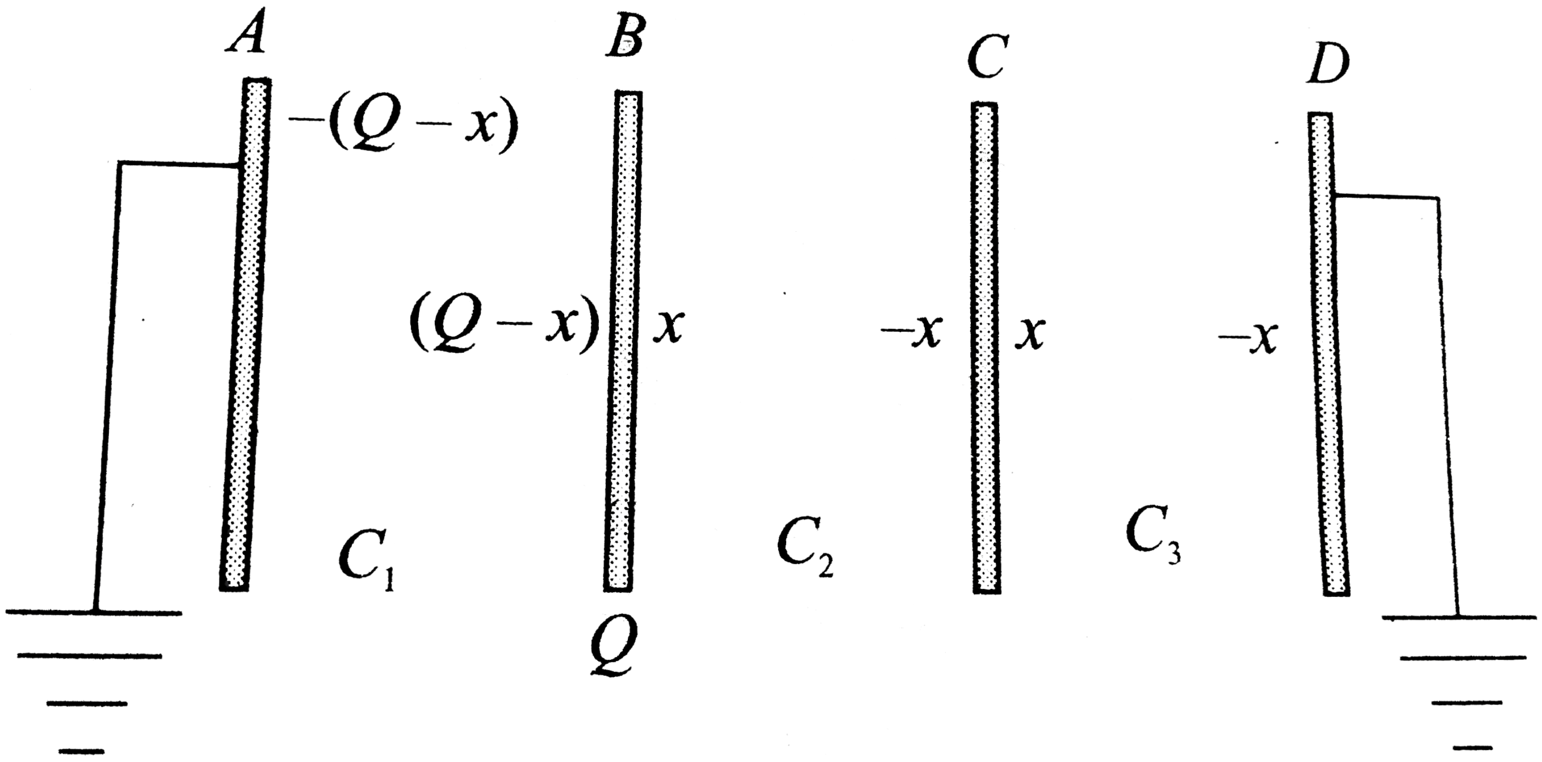
$$-\frac{x}{C}=0$$

x = (Q)/(3)

$Hence, potentiald$

$\Leftrightarrow erencebetween$

B and CV_(BC) =x/C=Q/(3C)=(Qd)/(3epsilon_(0)S)`



A
B
C
D
$-(Q-x)$
$(Q-x)$
x
$-x$
x
$-x$
C_1
C_2
C_3
Q