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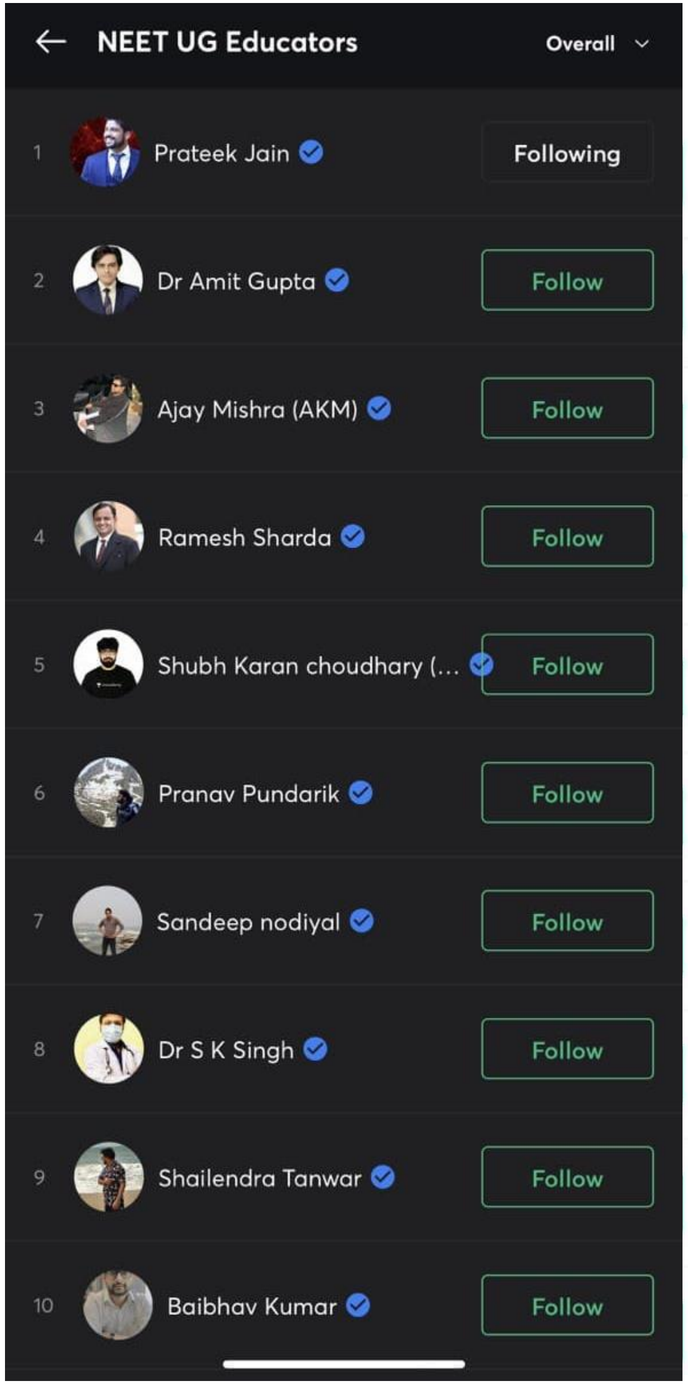

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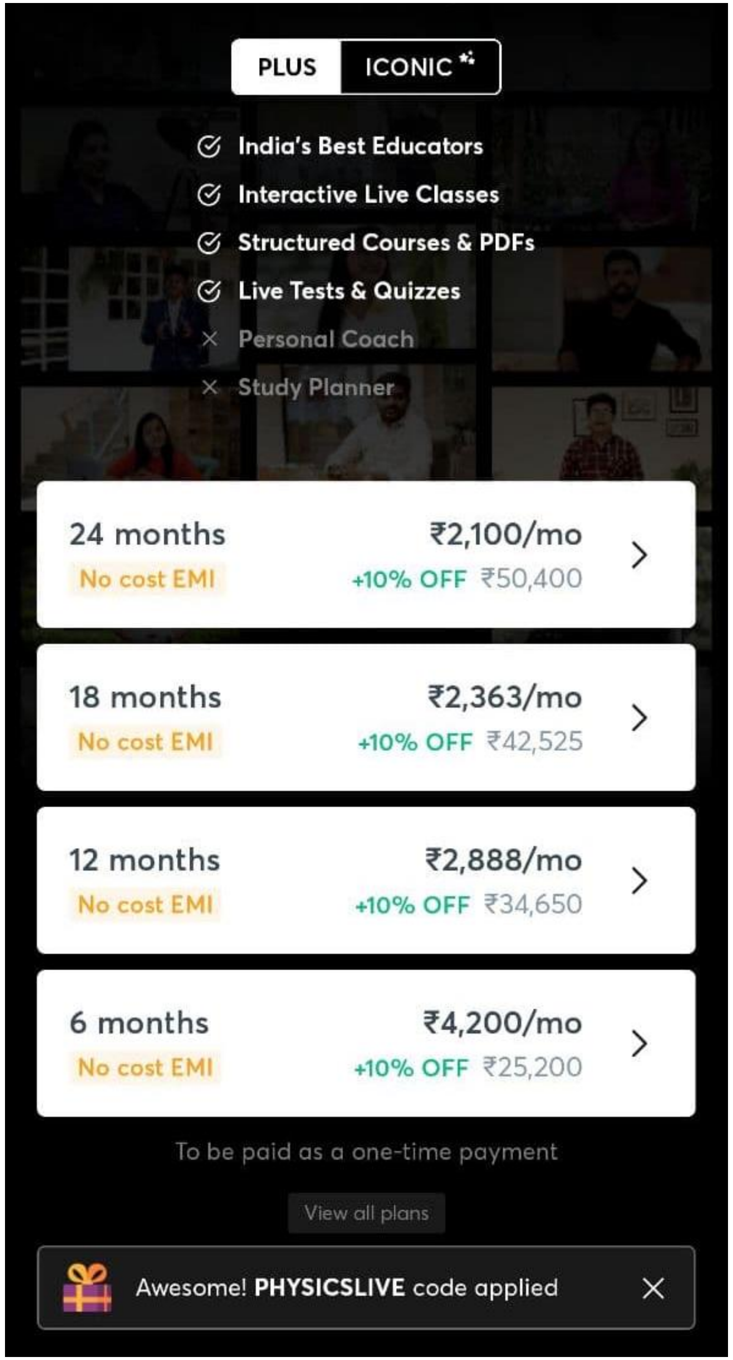

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NEET & AIIMS
Previous Years Questions

Topic - Capacitor

By Physicsaholics Team

What is the area of the plates of a 3 F parallel plate capacitor, if the separation between the plates is 5 mm?

(a) $9.281 \times 10^9\ m^2$
(b) $4.529 \times 10^9\ m^2$
(c) $1.694 \times 10^9\ m^2$
(d) $12.981 \times 10^9\ m^2$

$C = \varepsilon_0 A / d$

AIIMS *(1998)*

Ans. (c)

$$C = \frac{A\epsilon_0}{d} \Rightarrow A = \frac{Cd}{\epsilon_0}$$

$$A = \frac{3 \times 5 \times 10^{-3}}{8.85 \times 10^{-12}} = \frac{15}{8.85} \times 10^{9}\ m^2$$

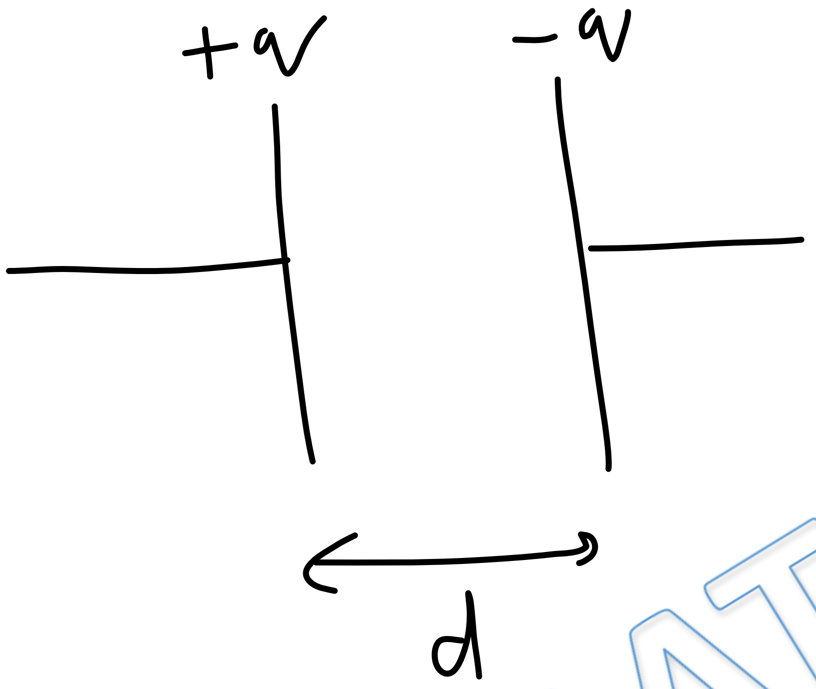
$$= 1.694 \times 10^{9}\ m^2$$

Ans (c)

A parallel plate air capacitor is charged to a potential difference of V volts. After disconnecting the charging battery the distance between the plates of the capacitor is increased using an insulating handle. As a result the potential difference between the plates *[CBSE AIPMT 2006]*

(a) decreases
(b) does not change
(c) becomes zero
(d) increases

Ans. (d)



On increasing d, q remains Constant.

$$V = \frac{q}{C} = \frac{q\,d}{A\epsilon_0} \Rightarrow$$ V increases on increasing d.

Ans (d)

The diameter of the plate of a parallel plate condenser is 6 cm. If its capacity is equal to that of a sphere of diameter 200 cm, the separation between the plates of the condenser is

(a) 4.5×10^{-4} m (b) 2.25×10^{-4} m

(c) 6.75×10^{-4} m (d) 9×10^{-4} m **AIIMS**

(2014)

Ans. (b)

Capacitance of Parallel plate Capacitor

= ,, ,, sphere

$$\Rightarrow \frac{A\epsilon_0}{d} = 4\pi\epsilon_0 r \Rightarrow d = \frac{A}{4\pi r}$$

$$\Rightarrow d = \frac{\pi\left(\frac{6}{2}\times10^{-2}\right)^2}{4\pi\times\left(2/2\right)} = \frac{9\times10^{-4}}{4}\,m$$

$$= 2.25\times10^{-4}\,m$$

Ans (b)

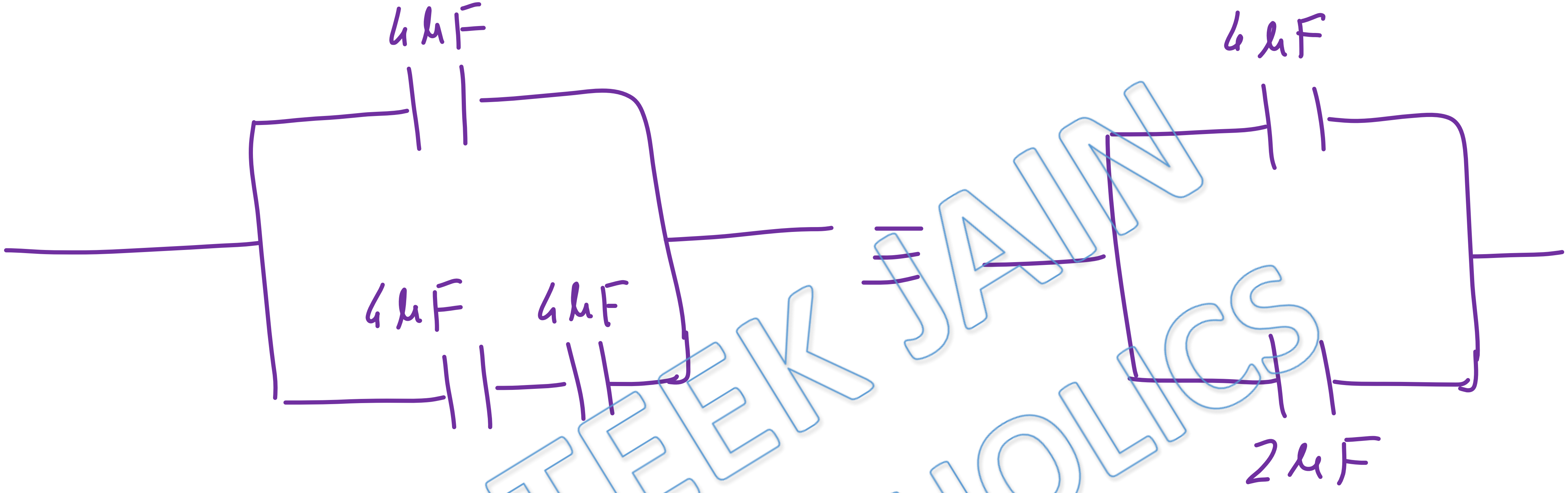
PYQs on Following Subtopic:

Combination of Capacitors

Three capacitors each of capacity 4 μF are to be connected in such a way that the effective capacitance is 6 μF. This can be done by *[CBSE AIPMT 2003]*

(a) connecting two in series and one in parallel
(b) connecting two in parallel and one in series
(c) connecting all of them in series
(d) connecting all of them in parallel

Ans. (a)



$C_{eff} = 4\mu F + 2\mu F = 6\mu F$

Ans (a)

Given a number of capacitors labelled as 8 μF, 250 V. Find the minimum number of capacitors needed to get an arrangement equivalent to 16 μF, 1000 V is Series / Parallel

(a) 4 (b) 16

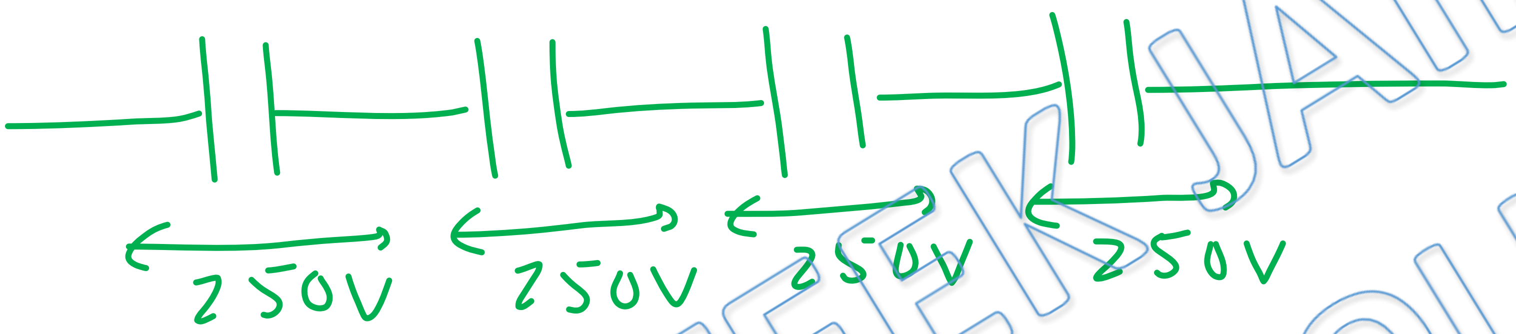
(c) 32 (d) 64

AIIMS

(2000)

Ans. (c)

Add Capacitors in series to get 1000V breakdown Voltage.



$C_{eq} = \frac{8\mu F}{4} = 2\mu F$

add 8 such branches in parallel to get 16 μF Capacitance.

$\Rightarrow$ total no of Capacitors required $= 4 \times 8 = 32$

Ans (c)

Seven capacitors each of capacitance 2 μF are to be connected to obtain a capacitance of $\frac{10}{11}$ μF. Which of the following combination is possible?

(wrong)

(a) 5 in parallel, 2 in series

(b) 4 in parallel, 3 in series

(c) 3 in parallel, 4 in series

(d) 2 in parallel, 5 in series.

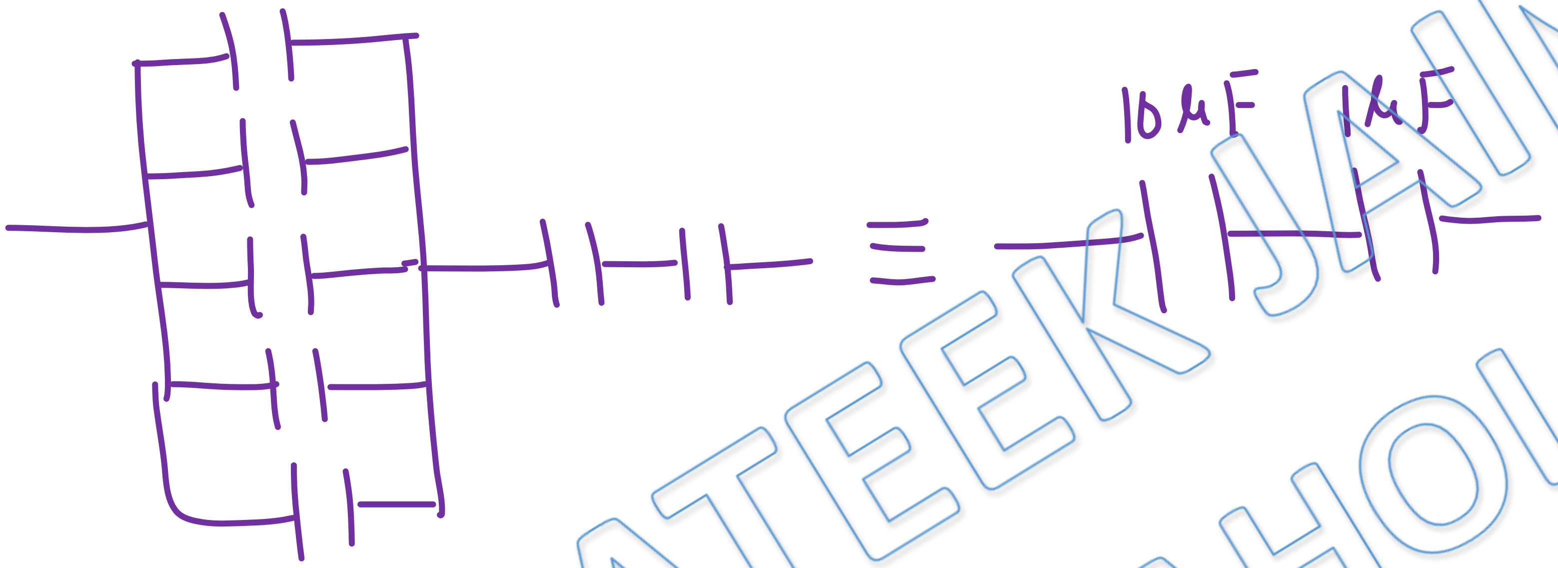
AIIMS (2000)

Ans. (a)

Two config. Possible for every option.

Effective of 7 Capacitors of 2 μF each $= \frac{10}{11}\,\mu F$

(a)



$\Rightarrow C_{eff} = \frac{10 \times 1}{10+1}\,\mu F$

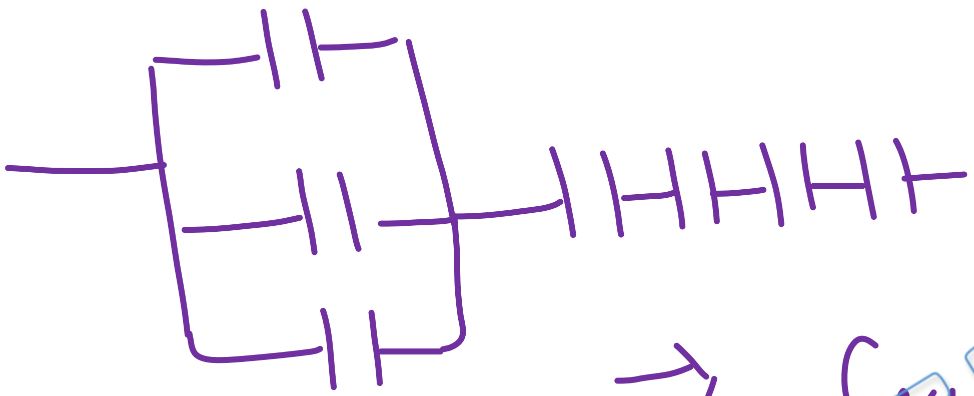
$= \frac{10}{11}\,\mu F$

(b)

$\Rightarrow C_{eff} = \frac{8 \times 2/3}{8 + 2/3}\,\mu F$

$= \frac{16}{26}\,\mu F = \frac{8}{13}\,\mu F$

(c)



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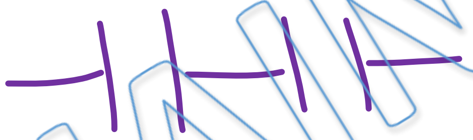
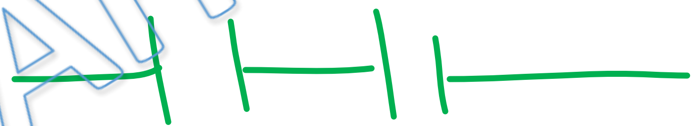


$$\Rightarrow C_{eff} = \frac{6 \times .5}{6.5}\,\mu F = \frac{6}{13}\,\mu F$$

(d)

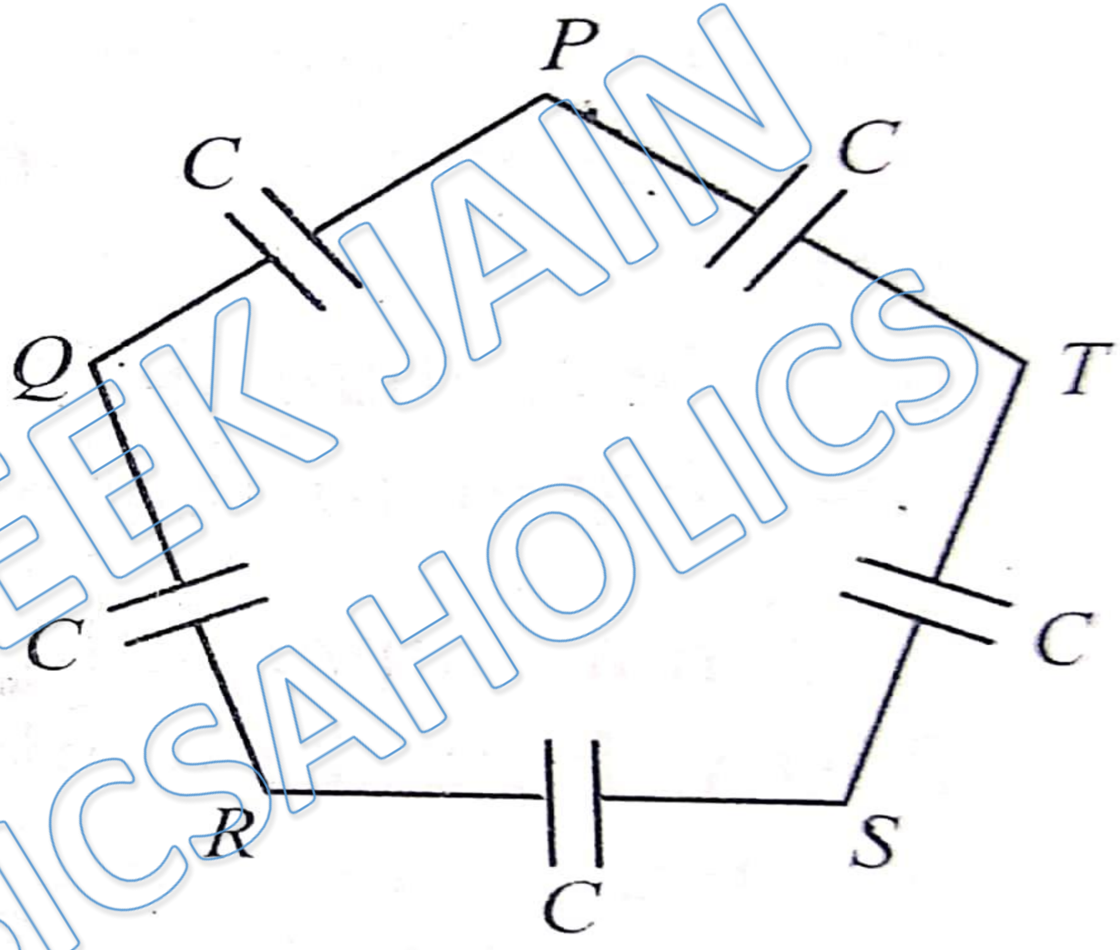
$\equiv$



$$C_{eff} = \frac{4 \times 2/5}{4 + 2/5} = \frac{8}{22}\,\mu F = \frac{4}{11}\,\mu F$$

Ans (a)

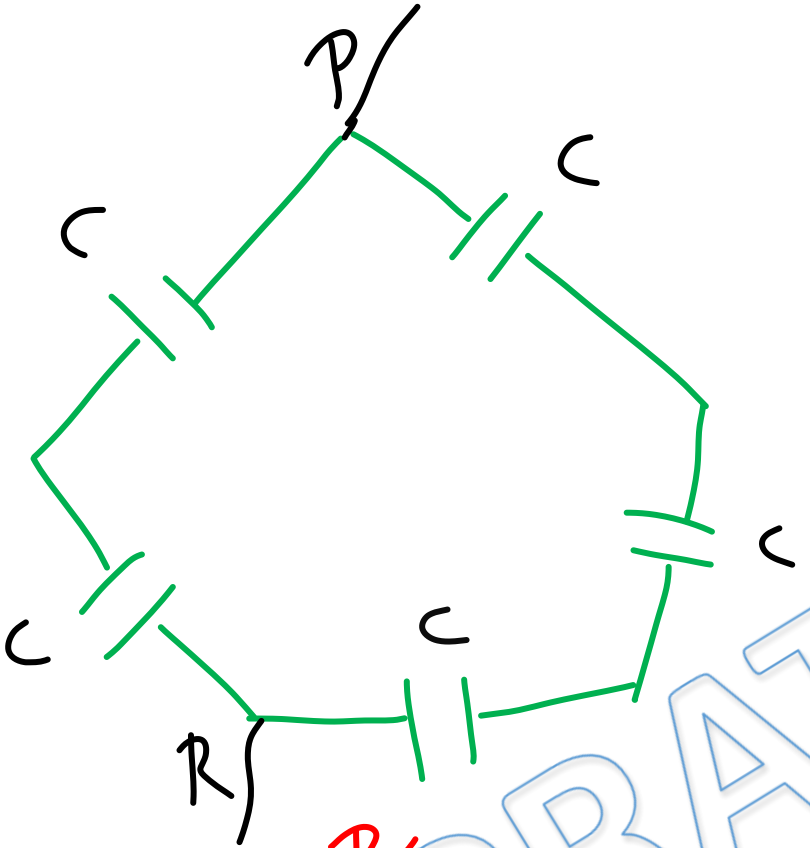
Five capacitors, each of capacitance value C are connected as shown in the figure. The ratio of capacitance between P and R, and the capacitance between P and Q if the battery is connected to P and R first and then P and Q

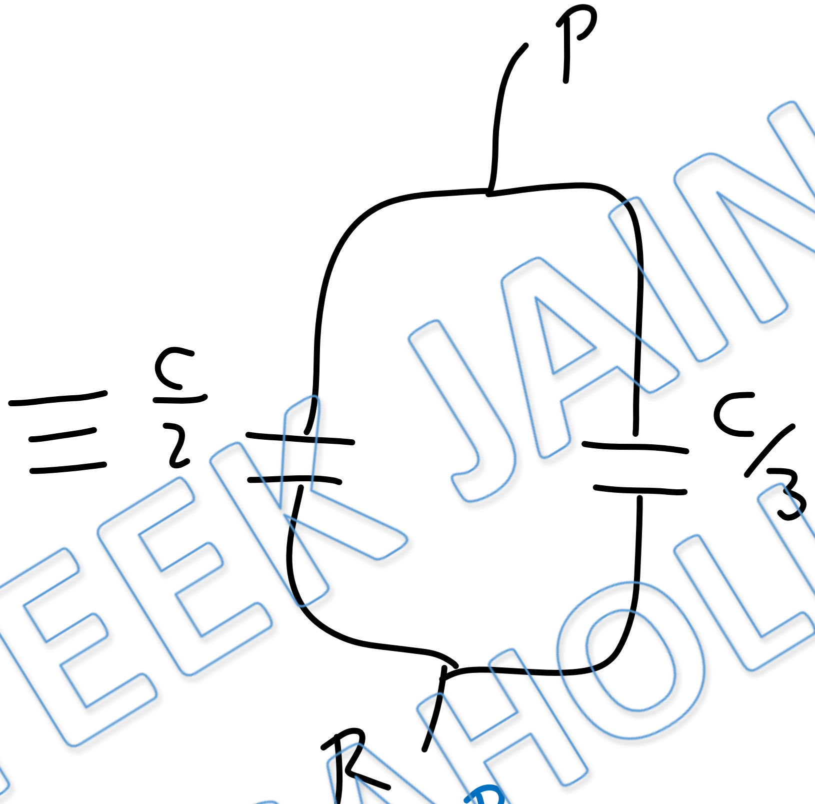


(a) 3 : 1
(b) 5 : 2
(c) 2 : 3
(d) 1 : 1

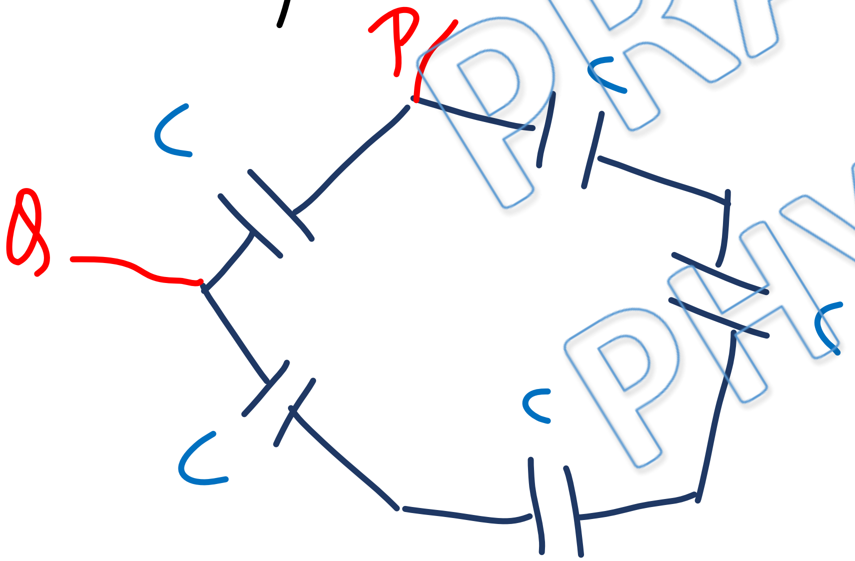
AIIMS (2006)

Ans. (c)





$$\Rightarrow C_{PR} = \frac{C}{2} + \frac{C}{3} = \frac{5C}{6}$$



$$C_{PQ} = C + \frac{C}{4} = \frac{5C}{4}$$

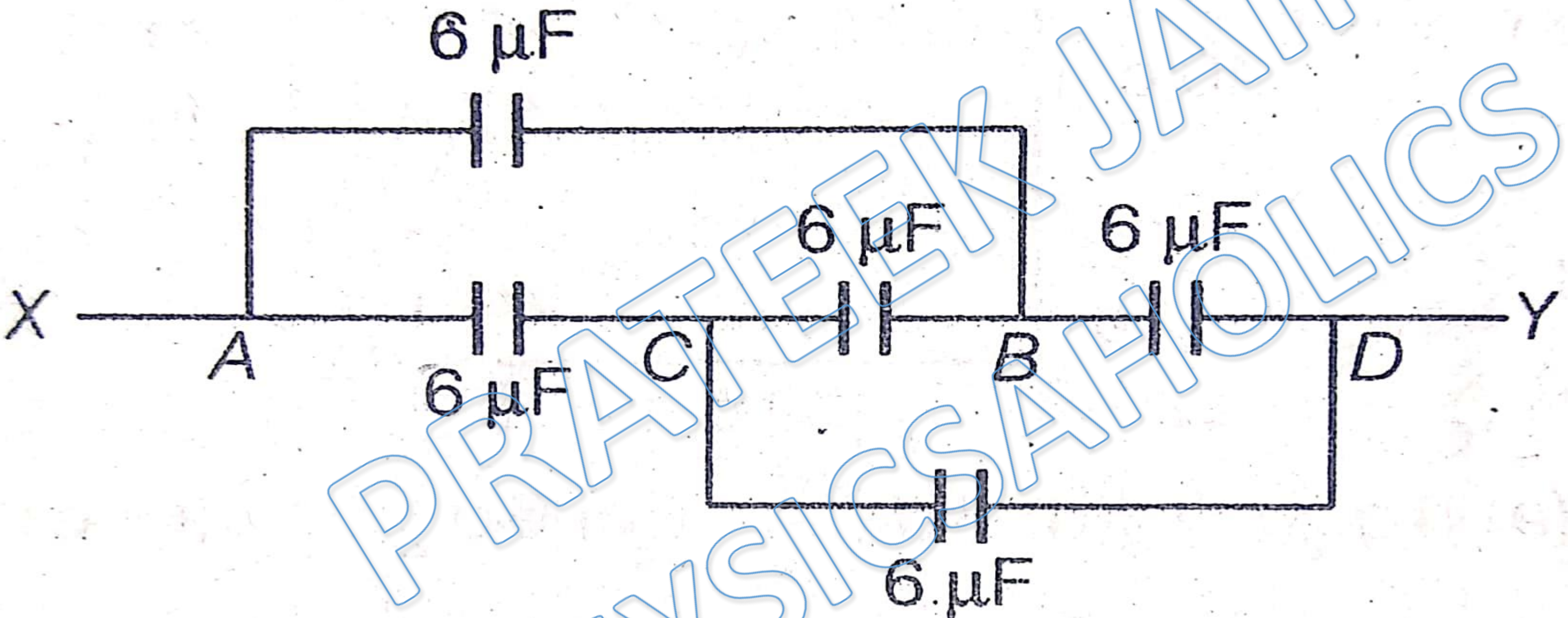
$$\frac{C_{PR}}{C_{PQ}} = \frac{5C/6}{5C/4} = \frac{4}{6} = \frac{2}{3}$$

Ans (c)

PYQs on Following Subtopic:

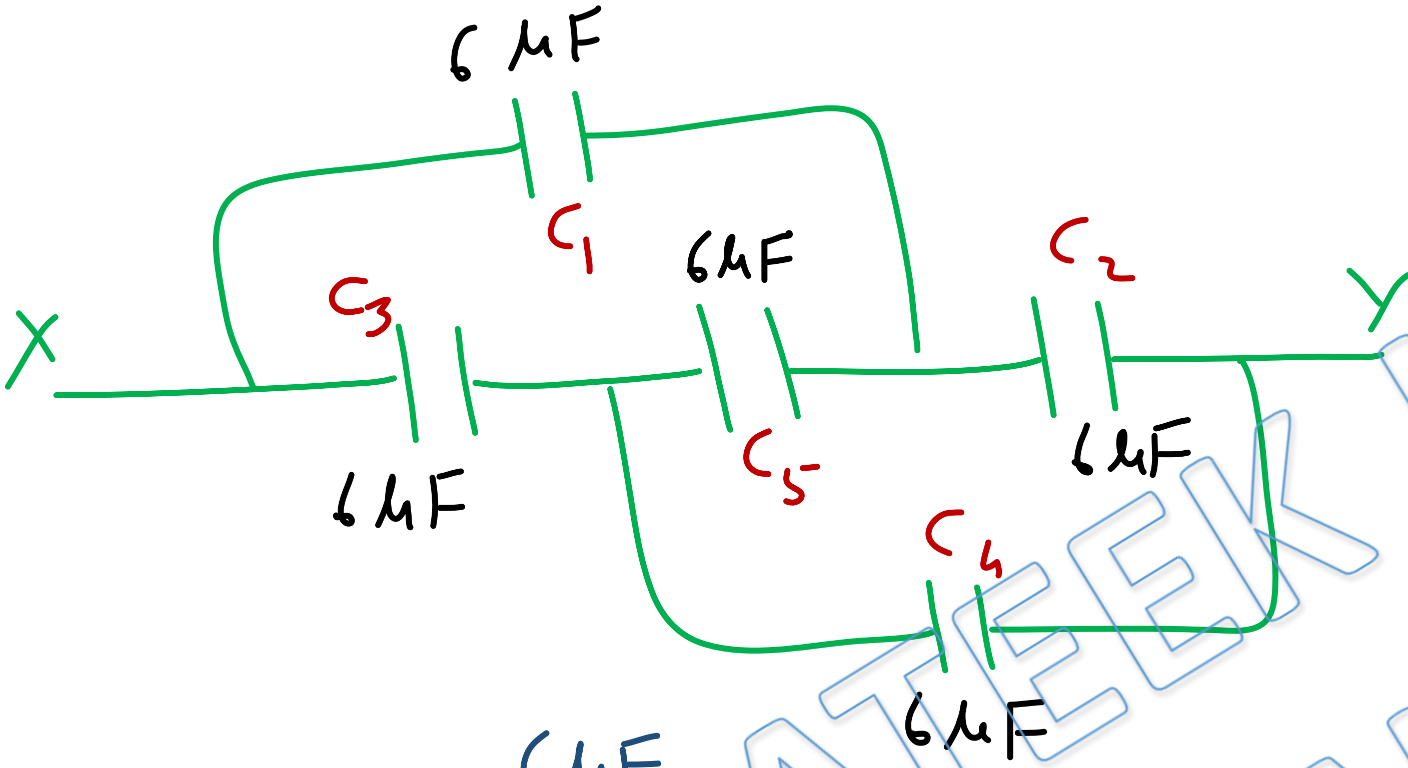
Wheatstone bridge of Capacitor

The effective capacitance between points X and Y of figure shown is [CBSE AIPMT 1999]



(a) 6 μF
(b) 12 μF
(c) 18 μF
(d) 24 μF

Ans. (a)

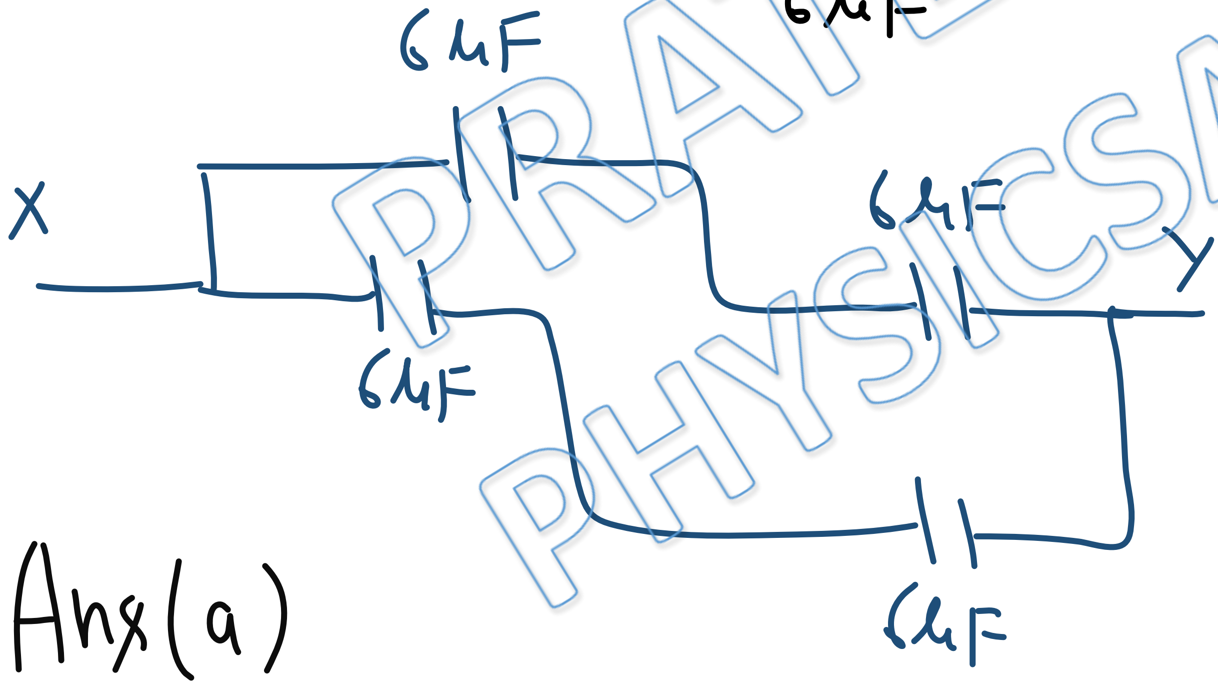


Here $\dfrac{C_1}{C_2} = \dfrac{C_3}{C_4} = \dfrac{6}{6} = \dfrac{1}{1}$

$\Rightarrow$ ballanced wheat stone bridge

$\Rightarrow$ C_5 is useless.

$\Rightarrow$



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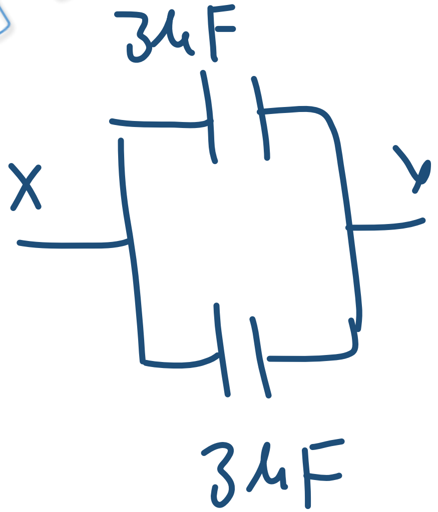
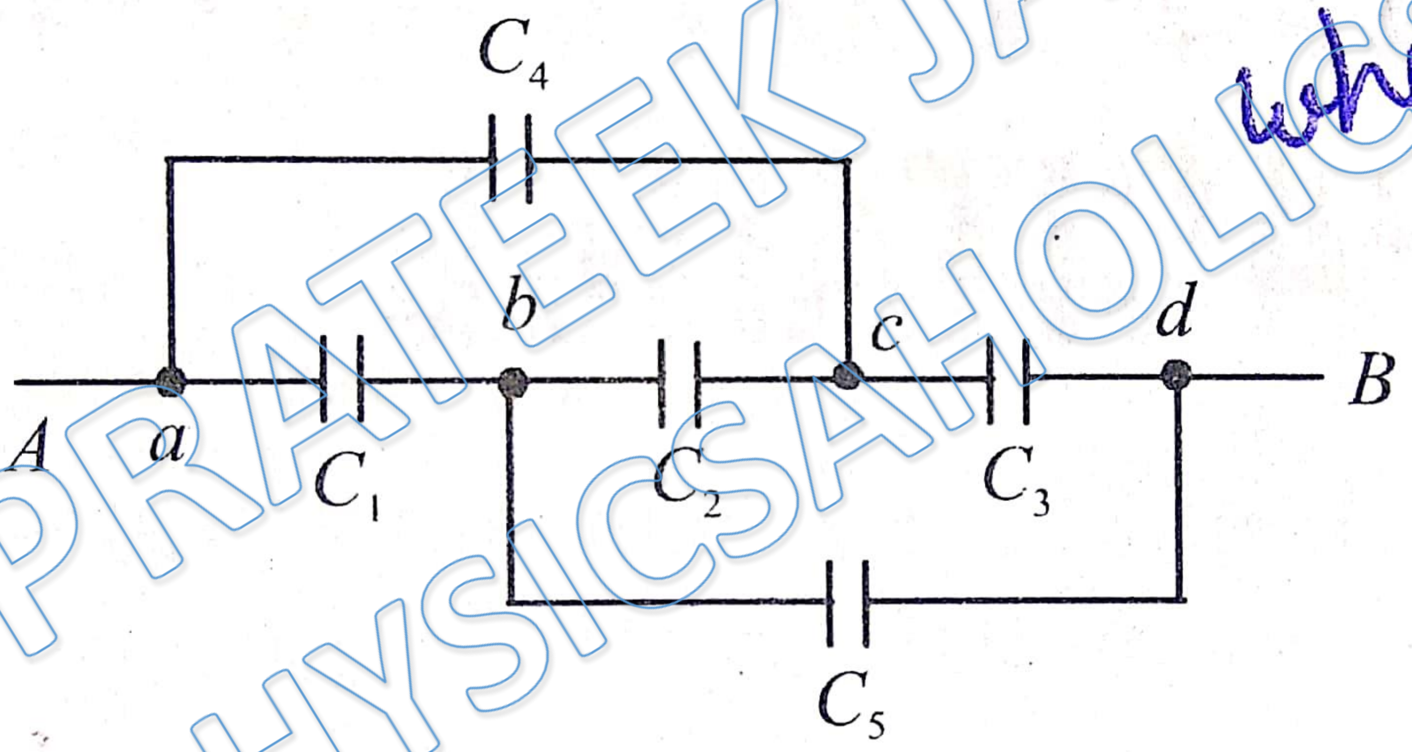


$\Rightarrow C_{eff} = 6\,\mu F$

Ans (a)

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

wheatstone



(a) 2 μF
(b) 6 μF
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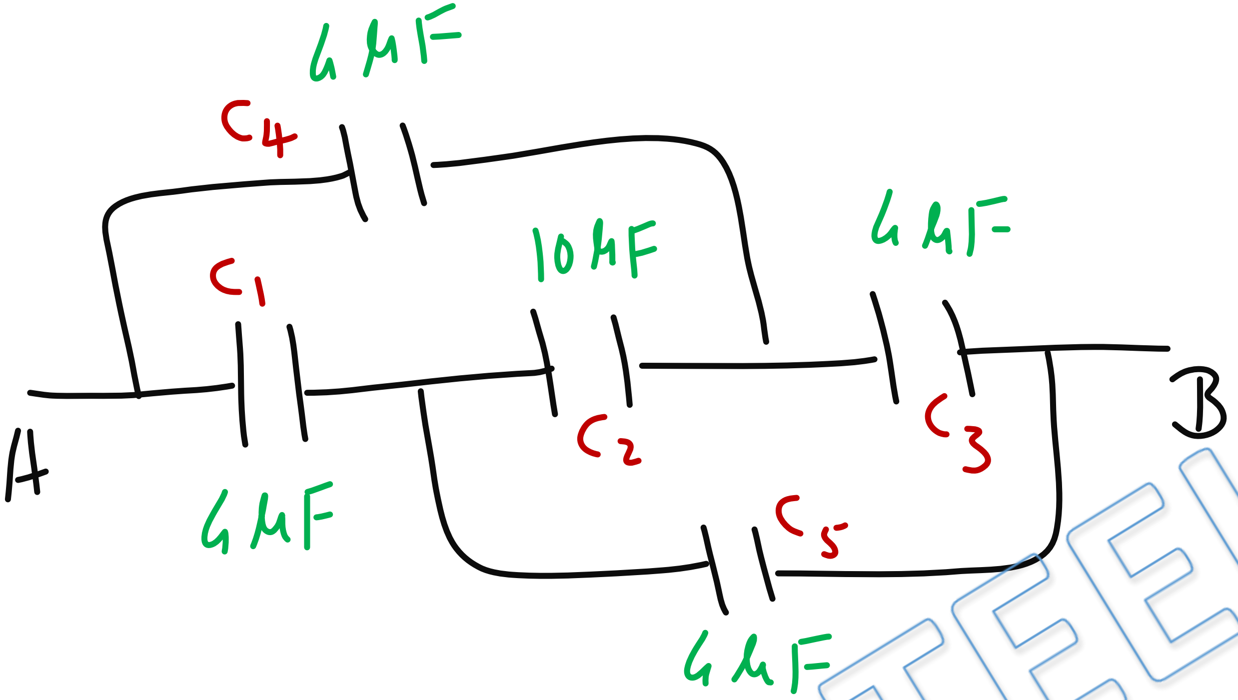
(c) 4 μF
(d) 8 μF
(2002)

tory

Ans. (c)

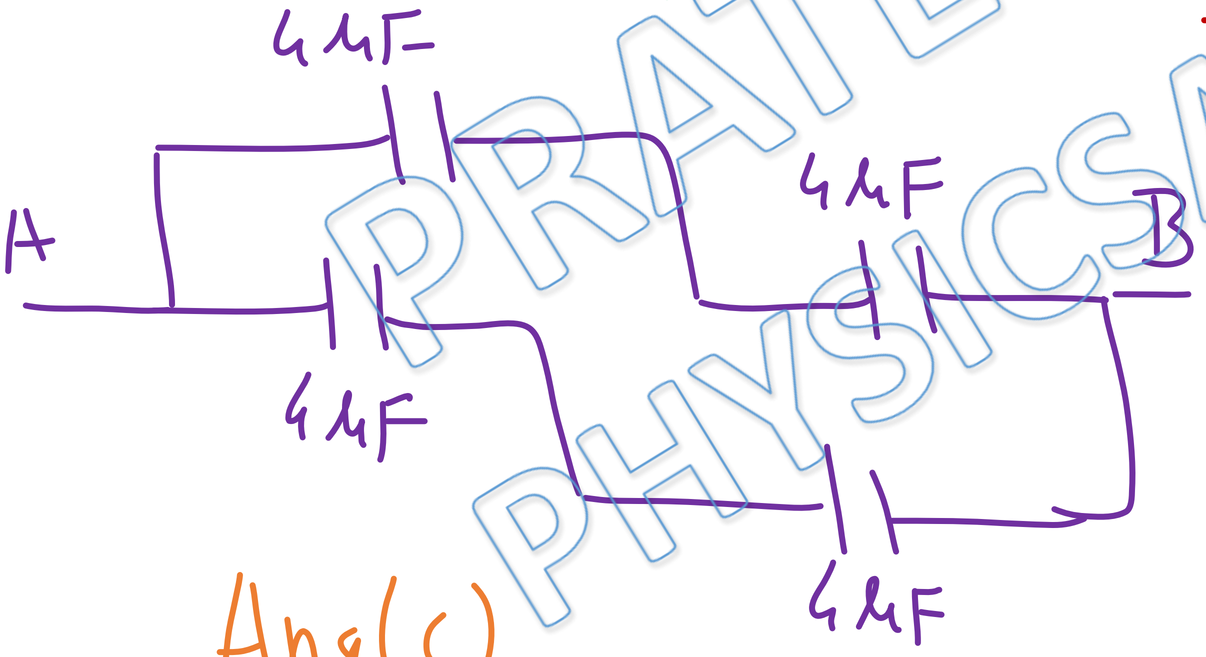


Here $\frac{C_4}{C_3} = \frac{C_1}{C_5} = 1$

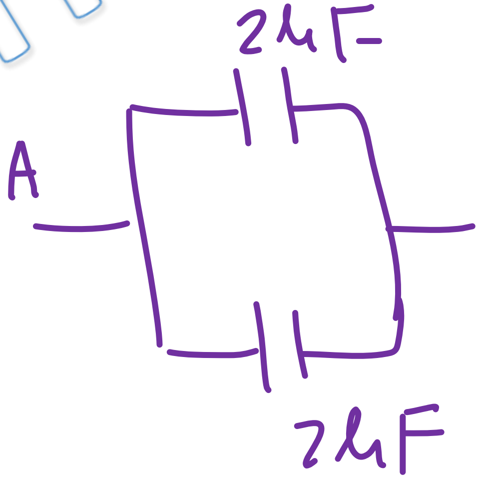
$\Rightarrow$ ballanced wheatstone bridge

$\Rightarrow C_2$ is useless

$\Rightarrow$



$\Rightarrow$



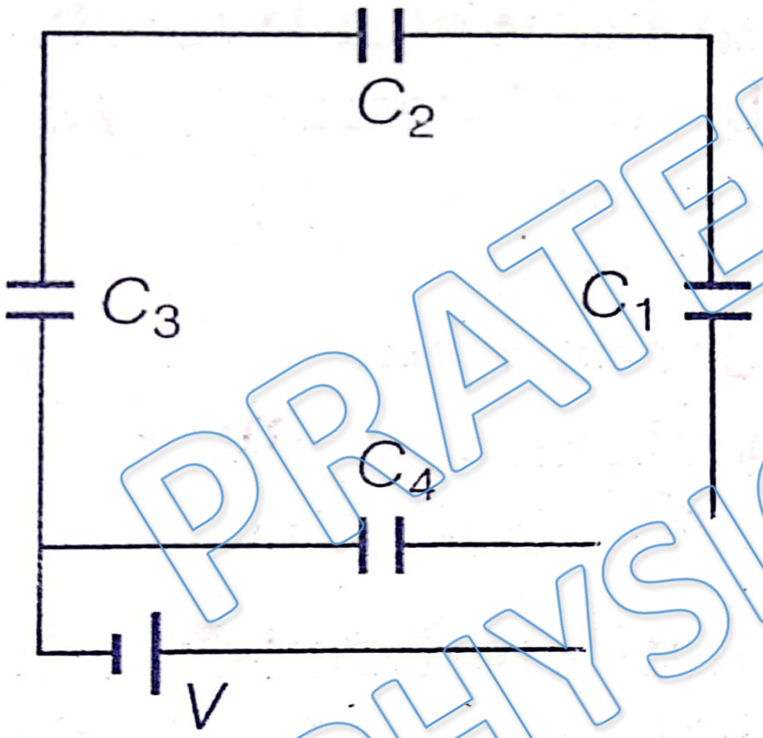
$\Rightarrow C_{eff} = 4\,\mu F$

Ans (c)

PYQs on Following Subtopic:

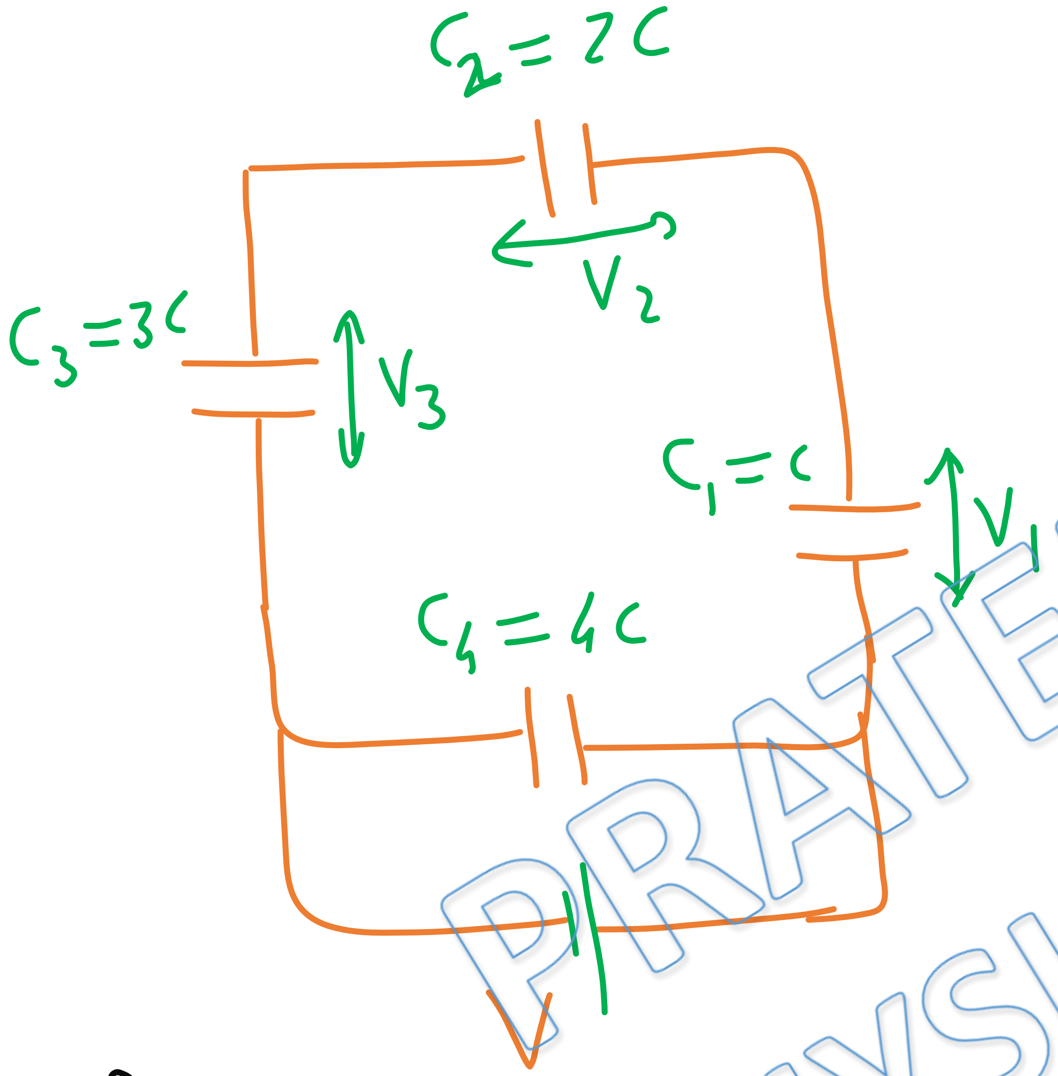
Capacitor Circuit

A network of four capacitors of capacity equal to $C_1 = C, C_2 = 2C, C_3 = 3C$ and $C_4 = 4C$ are connected to a battery as shown in the figure. The ratio of the charges on C_2 and C_4 is [CBSE AIPMT 2005]



(a) $\frac{22}{3}$ (b) $\frac{3}{22}$ (c) $\frac{7}{4}$ (d) $\frac{4}{7}$

Ans. (b)



C_1, C_2 & C_3 are in series

$$V_1 : V_2 : V_3 = \frac{1}{C} : \frac{1}{2C} : \frac{1}{3C}$$

$$= 6 : 3 : 2$$

$$\Rightarrow V_2 = \frac{3}{6+3+2} \times V = \frac{3V}{11}$$

$$\frac{\text{Charge on } C_2}{\text{,, \quad ,, } C_4} = \frac{2C \times 3V/11}{4C \times V} = \frac{3}{22}$$

Ans(b)

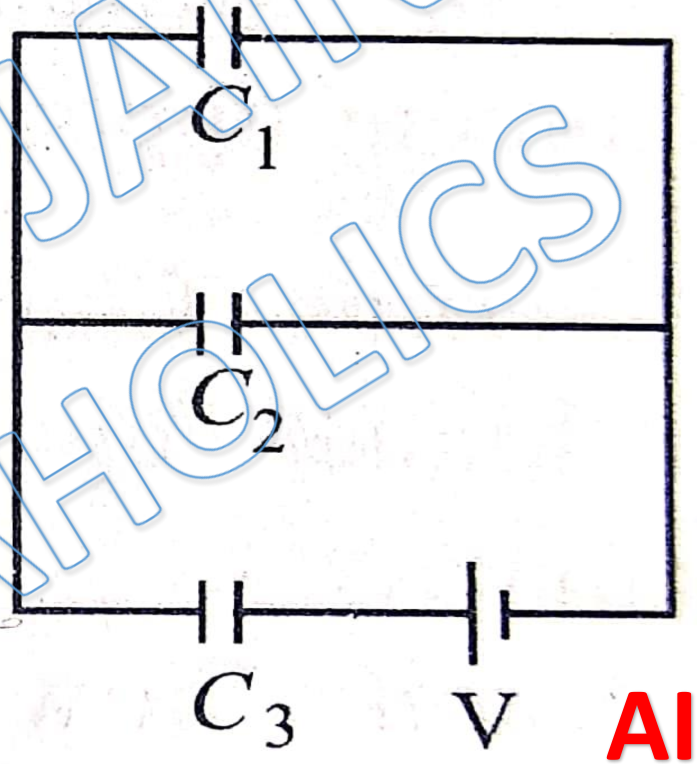
What would be the voltage across C_3?

(a) $\dfrac{(C_1+C_2)V}{C_1+C_2+C_3}$

(b) $\dfrac{C_1V}{C_1+C_2+C_3}$

(c) $\dfrac{C_2V}{C_2+C_2+C_3}$

(d) $\dfrac{C_3V}{C_1+C_2+C_3}$



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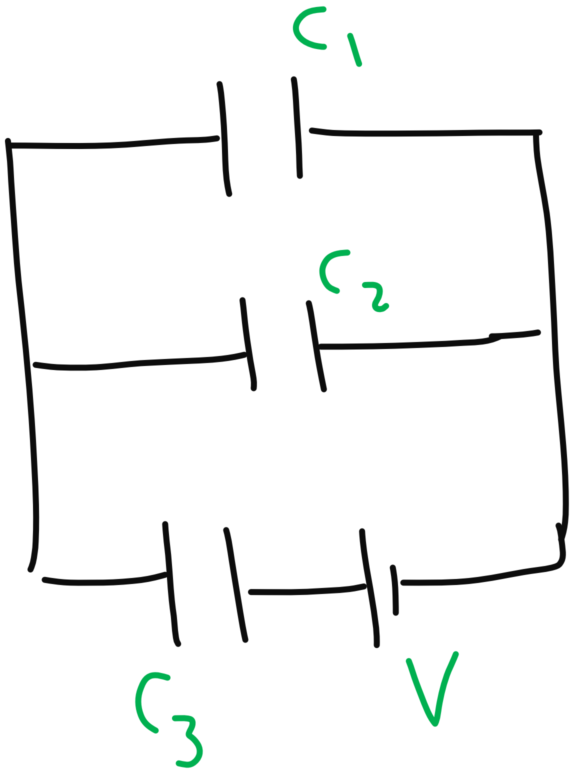
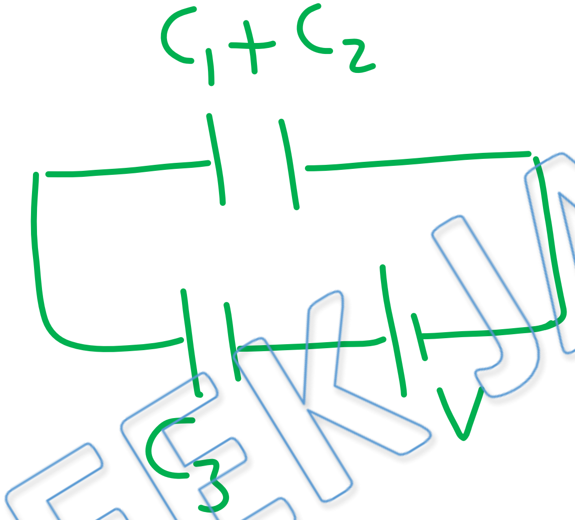
(2010)

Ans. (a)



$\equiv$



$$C_{eff} = \frac{(C_1+C_2)C_3}{C_1+C_2+C_3}$$

Charge on C_3 = Charge supplied by cell $= \dfrac{(C_1+C_2)C_3}{C_1+C_2+C_3}V$

Voltage across $C_3 = \dfrac{q_3}{C_3} = \dfrac{(C_1+C_2)V}{C_1+C_2+C_3}$

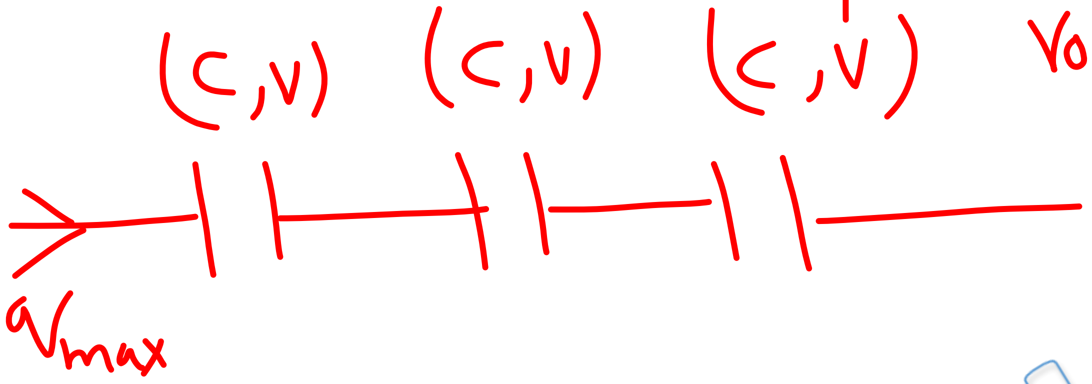
Ans(a)

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

(a) $\frac{C}{3}, \frac{V}{3}$ (b) $3C, \frac{V}{3}$

(c) $\frac{C}{3}, 3V$ (d) $3C, 3V$

Ans. (c)



$\rightarrow$ breakdown Voltage

each Capacitor Can hold maximum charge CV.

$\Rightarrow$ maximum charge on Combination = CV

$C_{eff} = C/3$

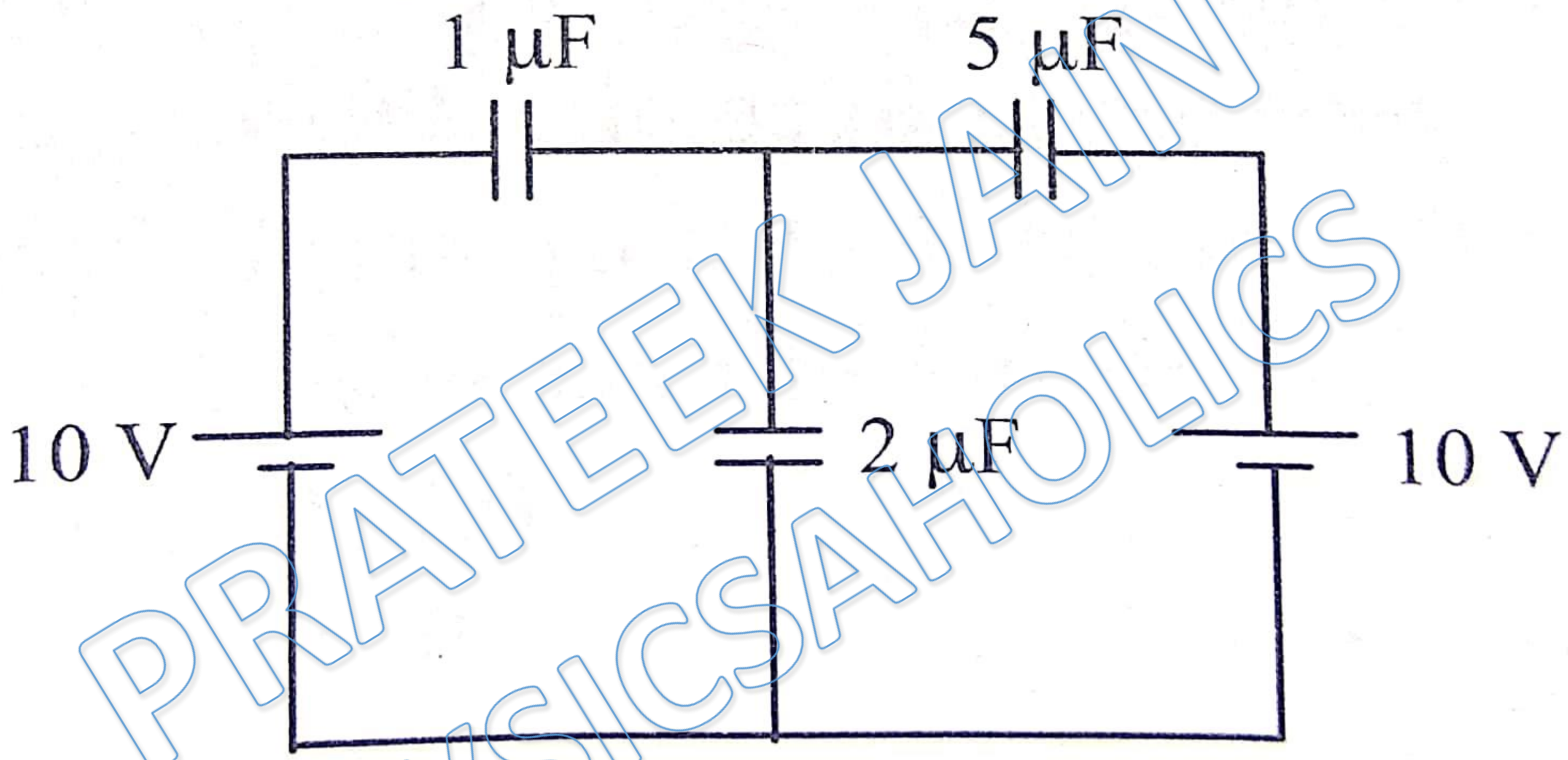
maximum voltage across combination $= \dfrac{q_{max}}{C_{eff}} = \dfrac{CV}{C/3} = 3V$

Ans (c)

PYQs on Following Subtopic:

Kirchhoff's First & Second (Loop) Law

Find the charge on 2μF.



(a) 18 μC
(b) 25 μC
(c) 15 μC
(d) 17 μC

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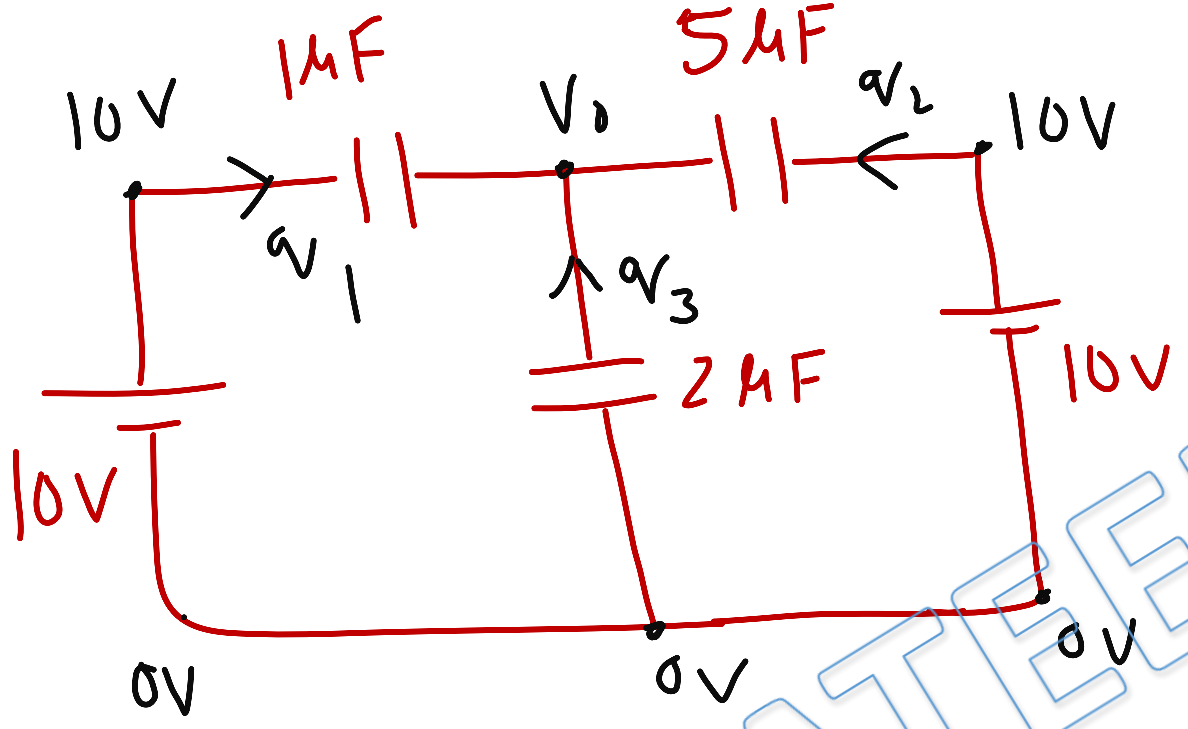
(2018)

Ans. (c)



$$q_1 + q_2 + q_3 = 0$$

$$\Rightarrow 1\mu(10 - V_0) + 5\mu(10 - V_0) + 2\mu(-V_0) = 0$$

$$\Rightarrow 10 - V_0 + 50 - 5V_0 - 2V_0 = 0$$

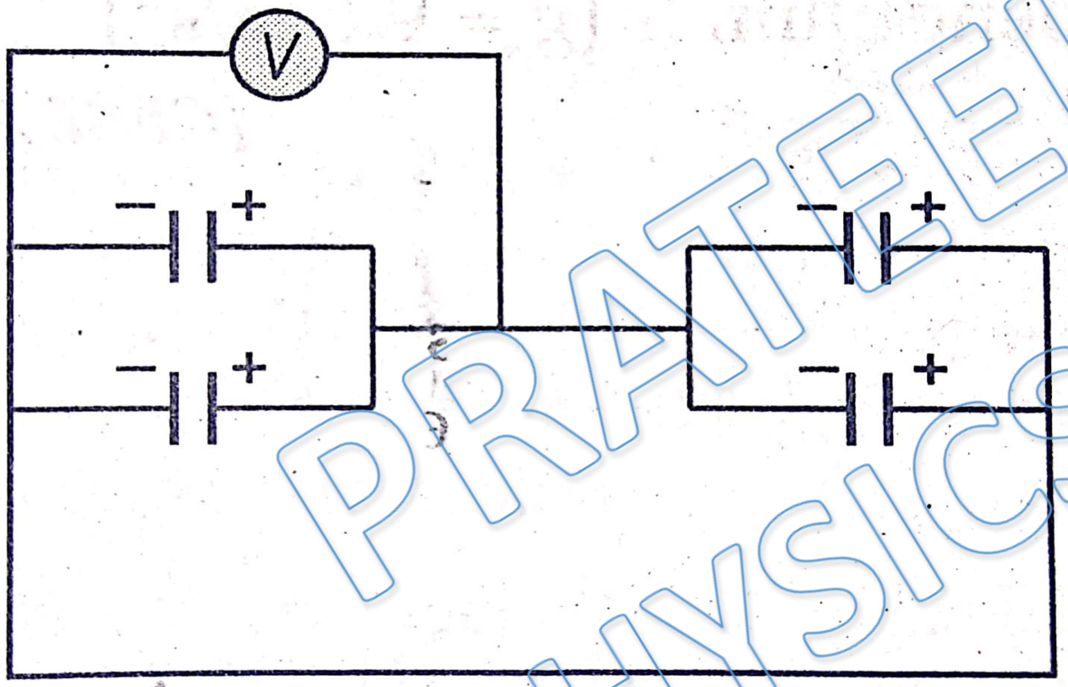
$$\Rightarrow 8V_0 = 60$$

$$V_0 = \frac{15}{2}\,V$$

Charge on $2\mu F = 2\mu \times \frac{15}{2} = 15\mu C$

Ans(c)

The four capacitors, each of 25 μF are connected as shown in figure. The DC voltmeter reads 200 V. The charge on each plate of capacitor is [CBSE AIPMT 1994]



wrong charge distribution.

(a) $\pm 2 \times 10^{-3}$ C
(b) $\pm 5 \times 10^{-3}$ C
(c) $\pm 2 \times 10^{-2}$ C
(d) $\pm 5 \times 10^{-2}$ C

Ans. (b)

Charge on each Capacitor

$$q = CV$$

$$= 25\mu \times 200$$

$$= 5000 \times 10^{-6}\ C$$

$$= 5 \times 10^{-3}\ C$$

Ans(b)

PYQs on Following Subtopic:

Parallel connection of charged capacitor with other charged or uncharged capacitor

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

[CBSE AIPMT 2002]

(a) $\dfrac{C_2V}{C_1+C_2}$

(b) $\dfrac{C_1V}{C_1+C_2}$

(c) $\left(1+\dfrac{C_2}{C_1}\right)V$

(d) $\left(1-\dfrac{C_2}{C_1}\right)V$

Ans. (b)

$$V = \frac{C_1 V_1 + C_2 V_2}{C_1 + C_2} = \frac{C_1 V}{C_1 + C_2}$$

Ans (b)

Assertion : Charge never flows from a condenser of higher capacity to the condenser of lower capacity.

Reason : Flow of charge between two bodies connected by a thin wire is determined by the charges on them. *(2018)*

AIIMS

Ans. (d)

flow of charge between two bodies is determined by their potentials.

Charge will flow from high Capacity Condenser to low capacity condenser. If high Capacity Condenser have high potential.

Assertion & reason both are wrong.

PYQs on Following Subtopic:

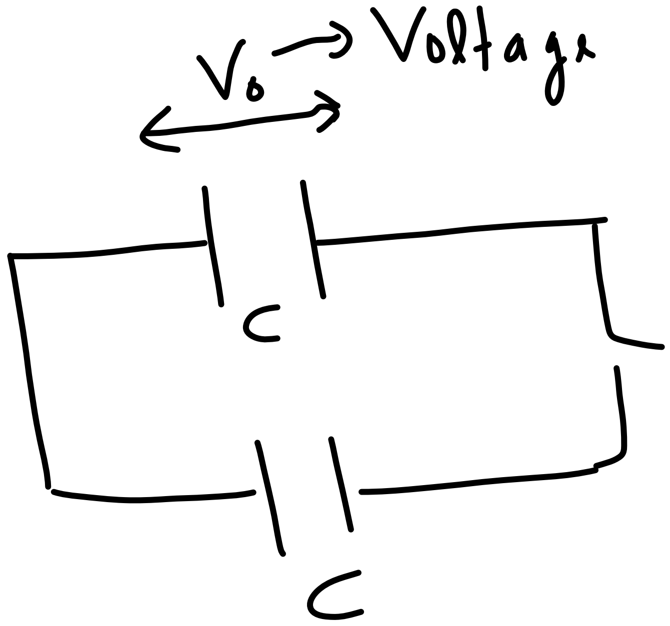
Energy stored in a charged capacitor in the form of Electric field

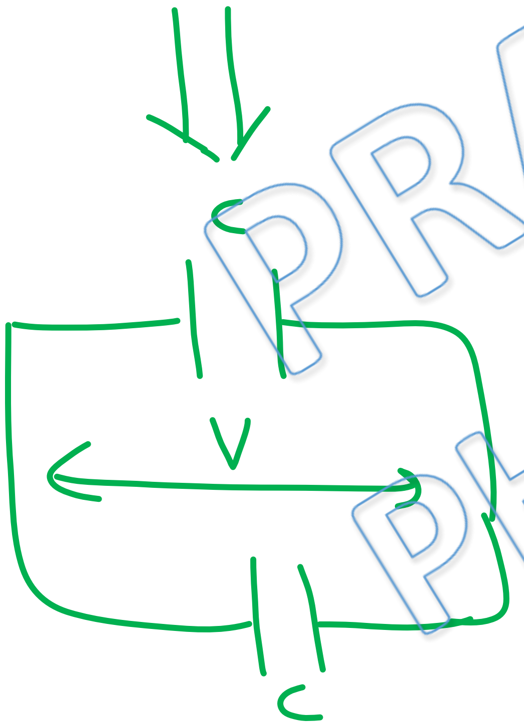
. A capacitor is charged by connecting a battery across its plates. It stores energy U. 8
Now the battery is disconnected and another identical capacitor is connected across it, then the energy stored by both capacitors of the system will be

[CBSE AIPMT 2000]

(a) U (b) $\frac{U}{2}$ (c) $2U$ (d) $\frac{3}{2}U$

Ans. (b)





energy stored in upper Capacitor $U = \frac{1}{2} C V_0^2$

Common voltage after closing switch

$$V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2} = \frac{CV_0}{C+C} = \frac{V_0}{2}$$

$$\text{final energy} = \frac{1}{2}CV^2 + \frac{1}{2}CV^2 = C\left(\frac{V_0}{2}\right)^2$$

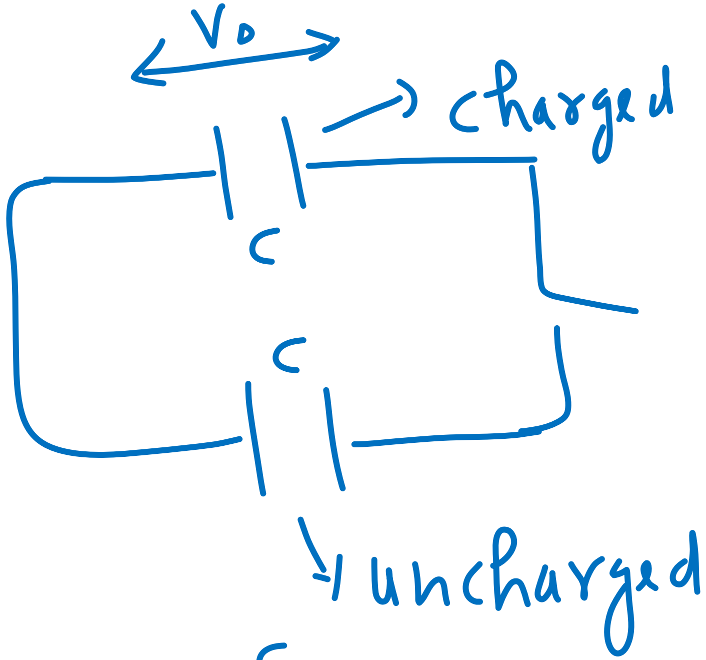
$$= \frac{1}{4}CV_0^2 = \frac{U}{2}$$

Ans(b)

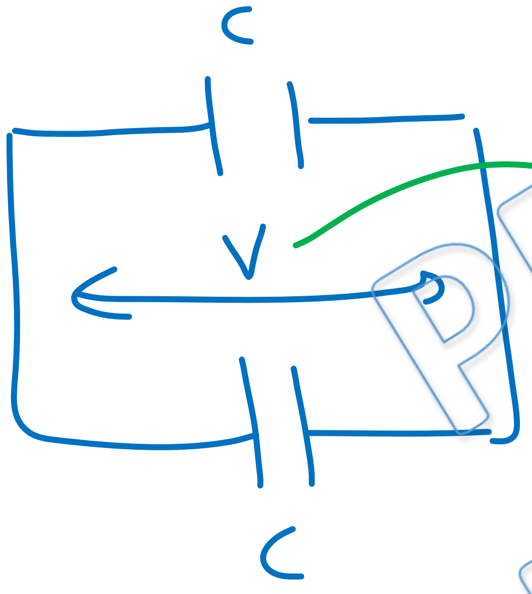
A capacitor is charged by a battery. The battery is removed and another identical uncharged capacitor is connected in parallel. The total electrostatic energy of resulting system [NEET 2017]

(a) increases by a factor of 4
(b) decreases by a factor of 2
(c) remains the same
(d) increases by a factor of 2

Ans. (b)



$$\Rightarrow U_i = \frac{1}{2} C V_0^2$$



Common Voltage $= \dfrac{C_1V_1 + C_2V_2}{C_1 + C_2} = \dfrac{CV_0}{2C} = \dfrac{V_0}{2}$

final energy of system $= \dfrac{1}{2}CV^2 \times 2 = \dfrac{CV_0^2}{4}$

$$= \frac{U_i}{2}$$

Ans(b)

If the potential of a capacitor having capacity 6 μF is increased from 10 V to 20 V, then increase in its energy will be

[CBSE AIPMT 1995]

(a) 4×10^{-4} J
(b) 4×10^{-14} J
(c) 9×10^{-4} J
(d) 12×10^{-6} J

Ans. (c)

$$\Delta U = \frac{1}{2} C \left(V_f^2 - V_i^2 \right)$$

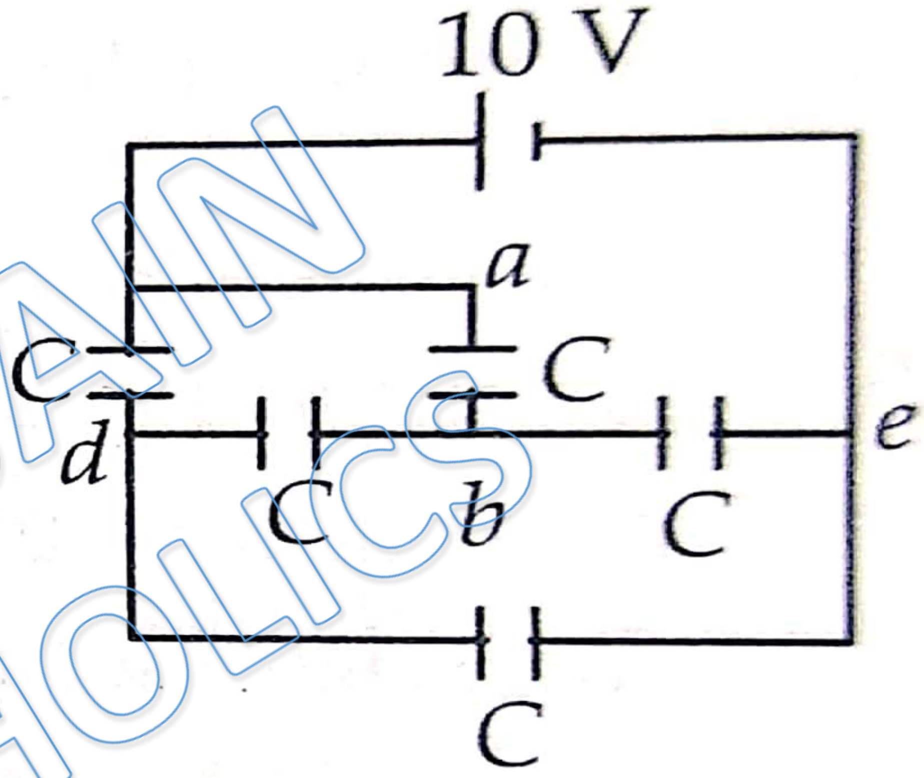
$$= \frac{1}{2} \times 6 \times 10^{-6} \left[400 - 100 \right]$$

$$= 900 \times 10^{-6} \text{ J}$$

$$= 9 \times 10^{-4} \text{ J}$$

Ans (c)

What is the energy stored in the capacitor between terminals a and b of the network shown in the figure? (Capacitance of each capacitor $C = 1\ \mu F$)

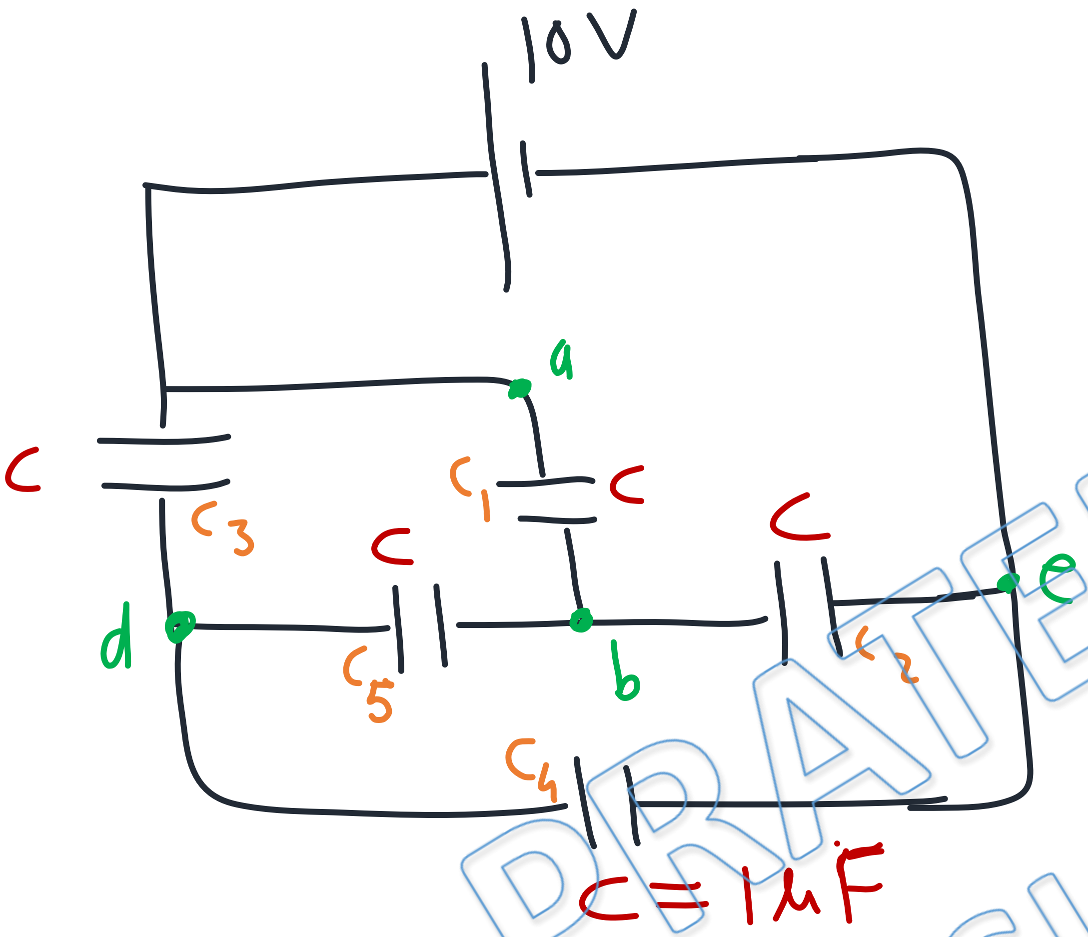


(a) 12.5 μJ (b) Zero

(c) 25 μJ (d) 50 μJ

AIIMS (2009)

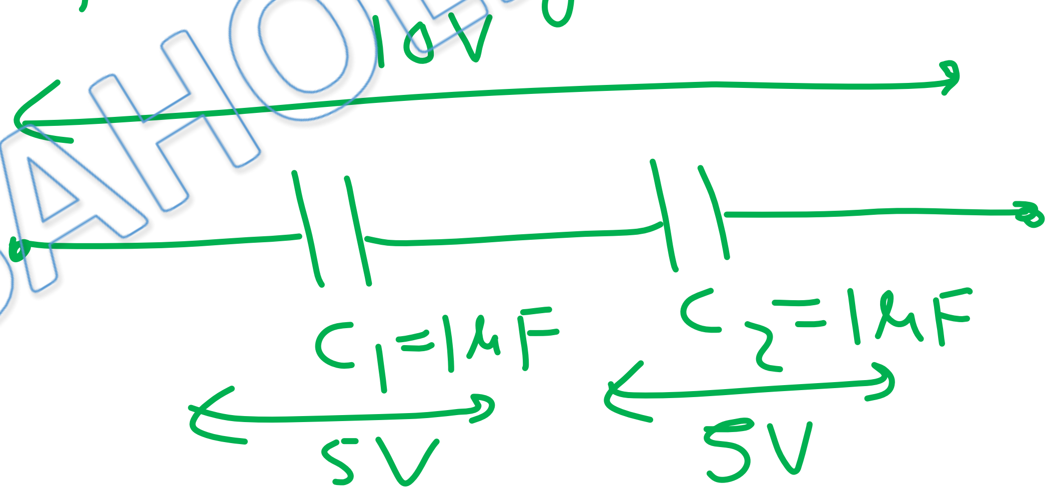
Ans. (a)



Here $\frac{C_1}{C_2} = \frac{C_3}{C_4} = 1$

$\Rightarrow$ It is a ballanced wheat stone bridge. C_5 is useless

after removing C_5



Voltage across C_1 is 5V.

Energy in $C_1 = \frac{1}{2} \times 1\mu \times 25 = 12.5\mu J$

Ans (a)

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

(a) $\frac{2C_1}{n_1 n_2}$

(b) $16\frac{n_2}{n_1}C_1$

(c) $2\frac{n_2}{n_1}C_1$

(d) $\frac{16C_1}{n_1 n_2}$

Ans. (d)

Effective Capacitance of Series Combination of n_1 Capacitors each of Capacitance C_1 $= \frac{C_1}{n}$

Energy stored in it $= \frac{1}{2}\left(\frac{C_1}{n_1}\right)(4V)^2 = \frac{8C_1V^2}{n_1}$

Effective capacitance of parallel Combination of n_2 Capacitors each of Capacitance C_2 $= n_2C_2$

Energy stored in it $= \frac{1}{2}(n_2C_2)V^2 = \frac{8C_1V^2}{n_1}$

$$\Rightarrow \quad C_2 = \frac{16C_1}{n_1n_2}$$

Ans(d)

A 40 μF capacitor in a defibrillator is charged to 3000 V. The energy stored in the capacitor is sent through the patient during a pulse of duration 2 ms. The power delivered to the patient is

(a) 45 kW (b) 90 kW **AIIMS**

(c) 180 kW (d) 360 kW *(2004)*

Ans. (b)

Energy stored in Capacitor $= \frac{1}{2} \times 40\mu \times (3000)^2$

$= 20 \times 9 = 180\,J$

Power $= \frac{\Delta U}{\Delta t} = \frac{180}{2 \times 10^{-3}} = 90000$ Watt

$= 90\,KW$

Ans (b)

A parallel plate condenser has a uniform electric field E (V/m) in the space between the plates. If the distance between the plates is d (m) and area of each plate is A(m^2), the energy (joule) stored in the condenser is [CBSE AIPMT 2011]

(a) $\frac{1}{2}\varepsilon_0 E^2$ (b) $\varepsilon_0 EAd$ (c) $\frac{1}{2}\varepsilon_0 E^2 Ad$ (d) $E^2 Ad / \varepsilon_0$

Ans. (c)

Energy density between plates of Parallel Plate Capacitor $= \frac{1}{2}\epsilon_0 E^2$

Volume of Capacitor $= Ad$

Energy stored between plates $= \frac{1}{2}\epsilon_0 E^2 Ad$

In a parallel plate capacitor, the distance between the plates is d and potential difference across plates is V. Energy stored per unit volume between the plates of capacitor is [CBSE AIPMT 2001]

(a) $\dfrac{Q^2}{2V^2}$ (b) $\dfrac{1}{2}\dfrac{\varepsilon_0 V^2}{d^2}$ (c) $\dfrac{1}{2}\dfrac{V^2}{\varepsilon_0 d^2}$ (d) $\dfrac{1}{2}\varepsilon_0\dfrac{V^2}{d}$

Ans. (b)

Energy stored per unit volume

$$= \frac{1}{2}\epsilon_0 E^2$$

$$= \frac{1}{2}\epsilon_0 \left(\frac{V}{d}\right)^2$$

; Since $V = Ed$ in Parallel plate Capacitor.

Ans (b)

Energy stored in between the plates of parallel plate capacitor of area A, separated by distance d is

(a) $\frac{1}{2}\varepsilon_0 E^2 Ad$ (b) $\frac{1}{2}\varepsilon_0 E^2 \frac{A}{d}$

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

AIIMS (2011)

Ans. (a)

Energy stored

= Energy density x volume

$= \frac{1}{2}\epsilon_0 E^2 A d$

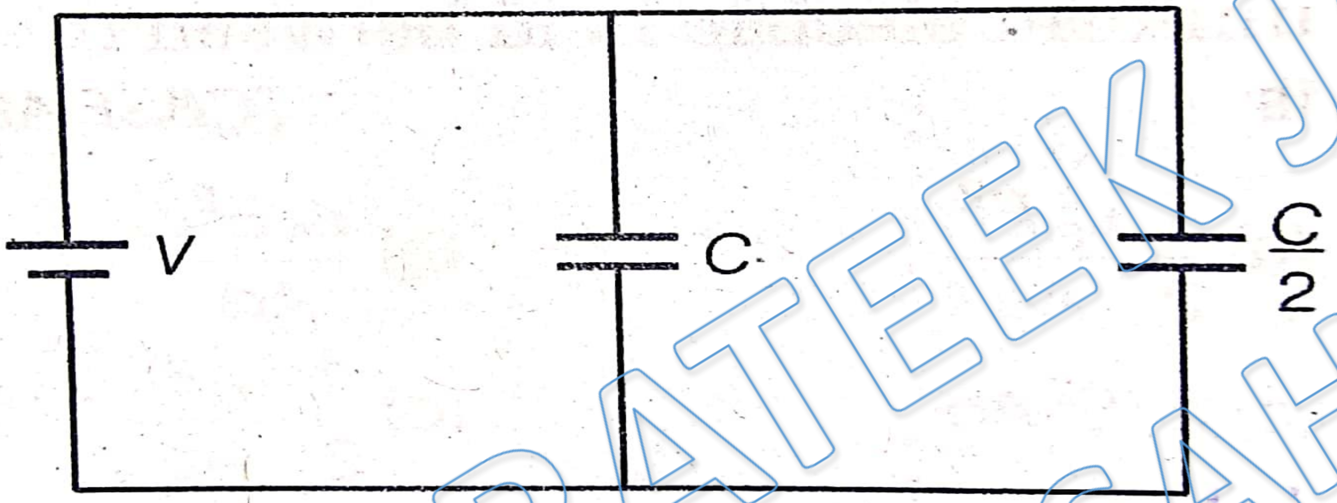
Ans(a)

PYQs on Following Subtopic:

Work done by battery, Heat generated in charging a capacitor

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

wrong

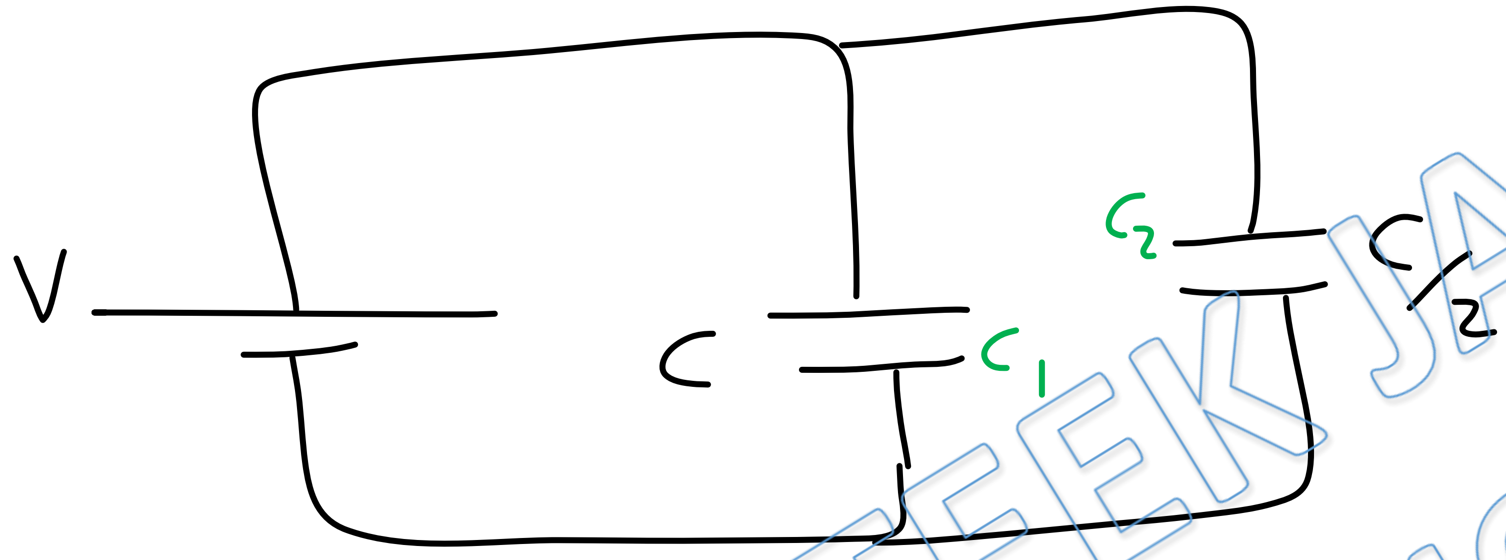


The work done in charging fully both the condensers is [CBSE AIPMT 2007]

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

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

Ans. ~~(c)~~ $\frac{3}{2} C V^2$



Charge on $C_1 = CV$, charge on $C_2 = \frac{CV}{2}$

total charge supplied by battery $= \frac{3}{2}CV$

work done by battery $= qV = \frac{3}{2}CV^2$

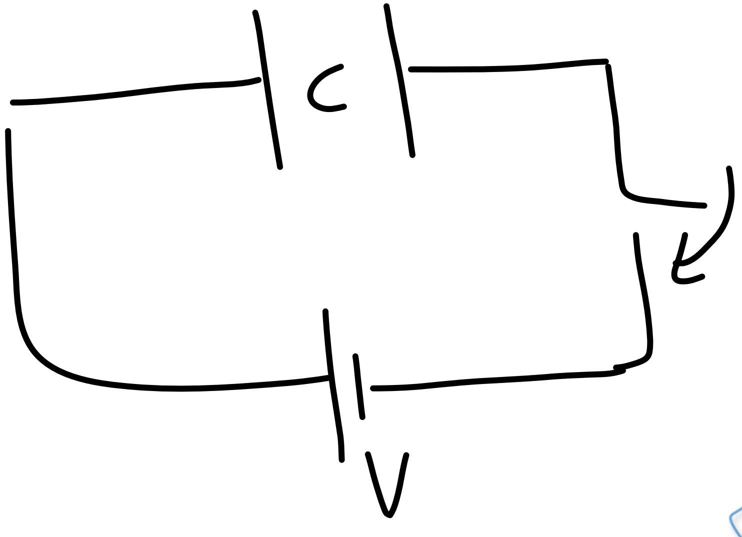
All answers are wrong.

The energy required to charge a parallel plate condenser of plate separation d and plate area of cross-section A such that the uniform electric field between the plates E, is [CBSE AIPMT 2008]

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

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

Ans. (c)



charge supplied by battery $= CV$

work done by battery $= V(CV) = CV^2$

Energy required to charge parallel plate capacitor $= CV^2 = \frac{A\epsilon_0}{d}V^2$

$= Ad\epsilon_0 \frac{V^2}{d^2} = \epsilon_0 E^2 Ad$ $\left(\text{Since } E = \frac{V}{d}\right)$

22. A conducting sphere of radius R carrying charge Q lies inside an uncharged conducting shell of radius $2R$. If they are joined by a metal wire, the amount of heat that will be produced is

(a) $\frac{1}{4\pi\varepsilon_0} \cdot \frac{Q^2}{4R}$

(b) $\frac{1}{4\pi\varepsilon_0} \cdot \frac{Q^2}{2R}$

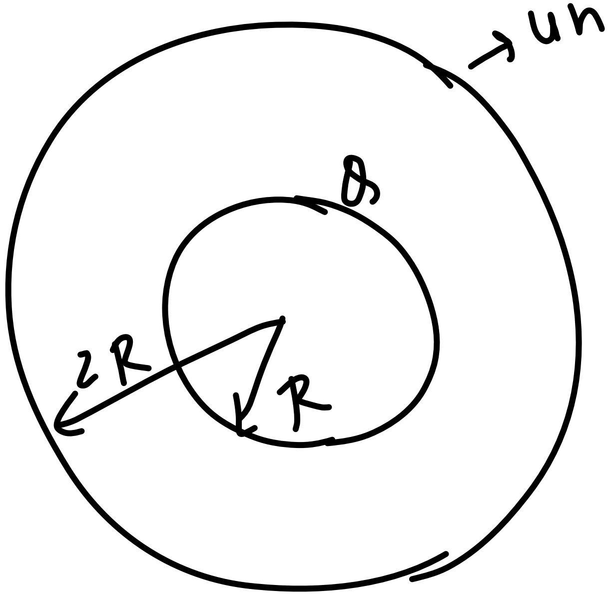
(c) $\frac{1}{4\pi\varepsilon_0} \cdot \frac{Q^2}{R}$

(d) $\frac{2}{4\pi\varepsilon_0} \cdot \frac{Q^2}{3R}$

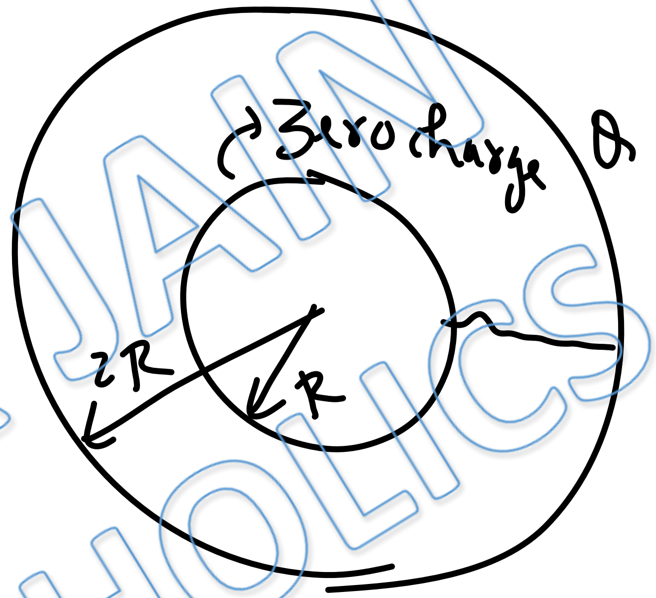
AIIMS

(2009)

Ans. (a)



$\Rightarrow$



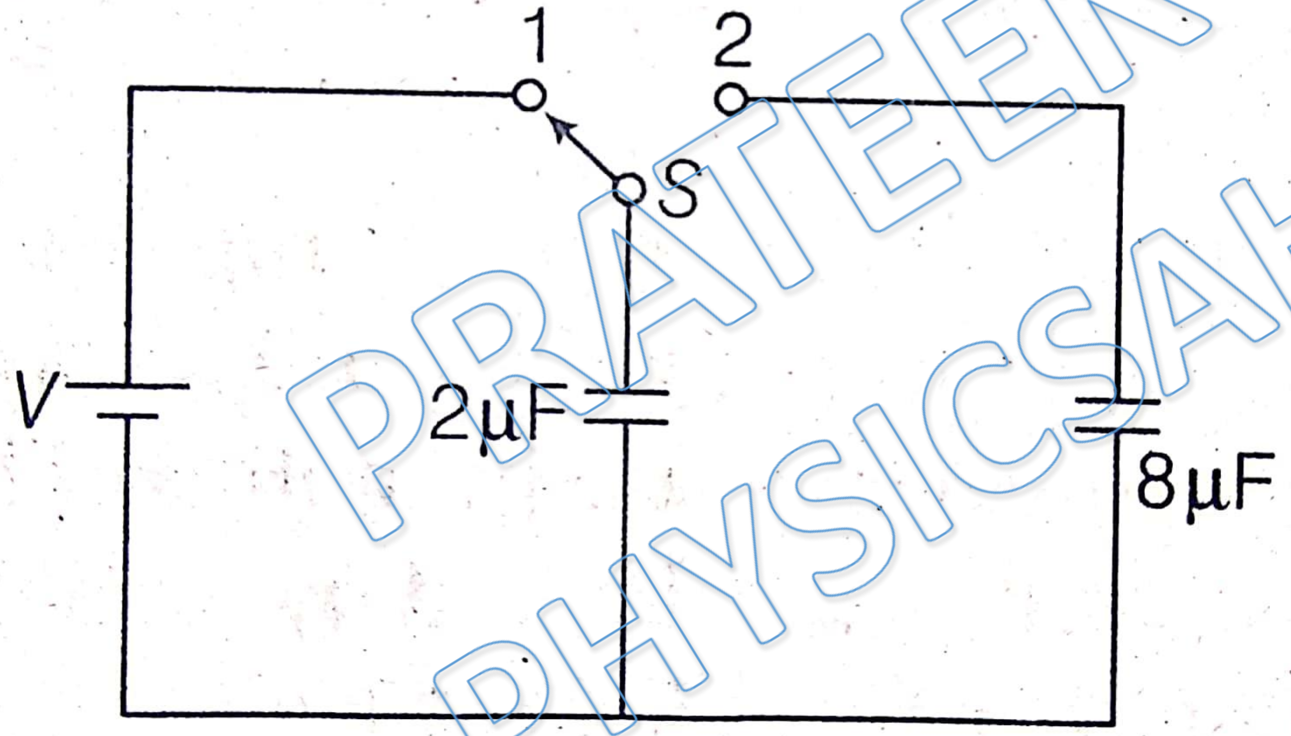
$$U_i = \frac{Q^2}{2(4\pi\epsilon_0 R)} \qquad U_f = \frac{Q^2}{2(8\pi\epsilon_0 R)}$$

$$\text{loss in energy} = U_i - U_f = \frac{Q^2}{16\pi\epsilon_0 R}$$

$$\text{Heat produced} = \frac{Q^2}{16\pi\epsilon_0 R}$$

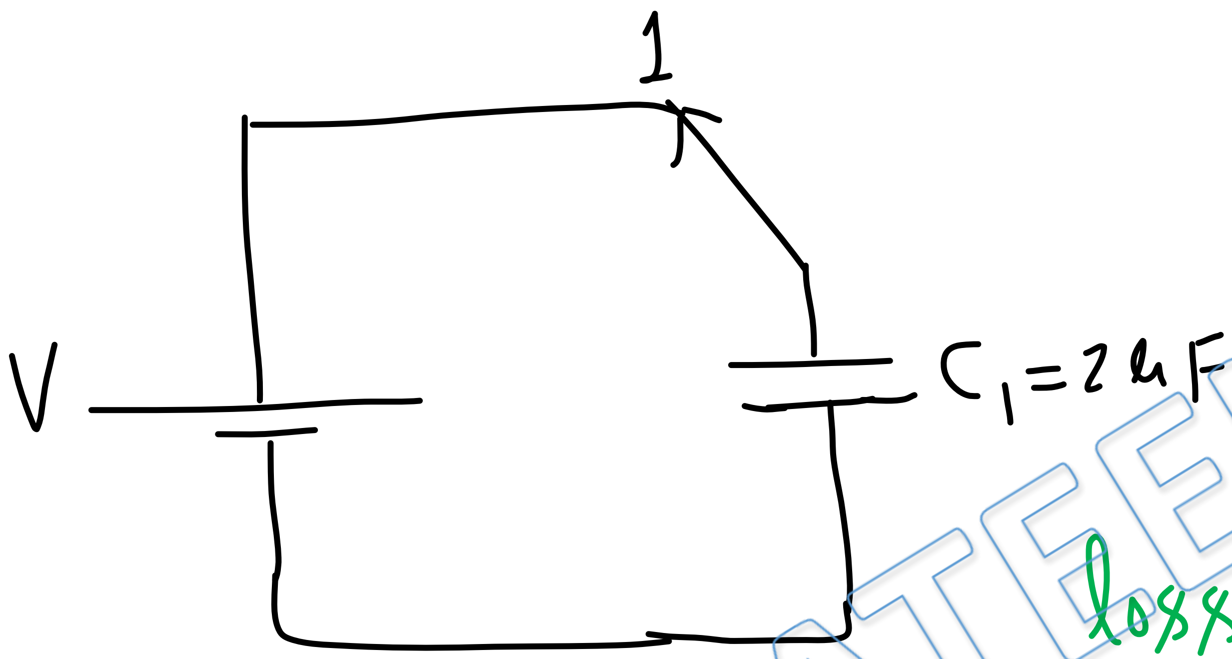
Ans (a)

A capacitor of $2\,\mu F$ is charged as shown in the figure. When the switch S is turned to position 2, the percentage of its stored energy dissipated is *[NEET 2016]*



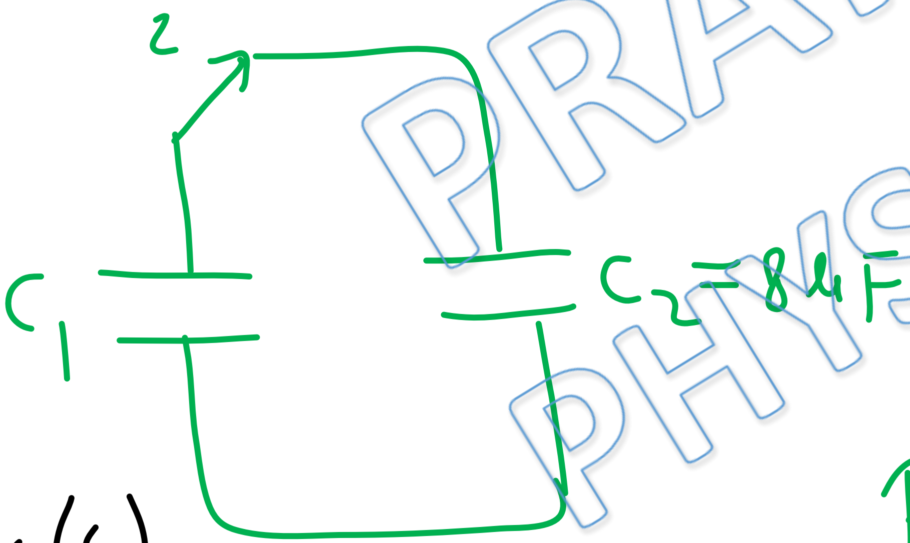
(a) 20% (b) 75% (c) 80% (d) 0%

Ans. (c)



$U_i = \frac{1}{2} C_1 V^2 = \mu V^2$

loss in energy after shifting switch $= \frac{1}{2}\left(\frac{C_1 C_2}{C_1 + C_2}\right)(V_1 - V_2)^2$



$= \frac{1}{2}\left(\frac{2 \times 8}{2+8}\mu\right)(V-0)^2 = \frac{4\mu V^2}{5}$

Percentage loss $= \frac{4\mu V^2/5}{\mu V^2} \times 100 = 80\%$

Ans (c)

A 4 μF capacitor is charged to 400 V and then its plates are joined through a resistance of 1 kΩ. The heat produced in the resistance is *[CBSE AIPMT 1989]*

(a) 0.16 J
(b) 1.28 J
(c) 0.64 J
(d) 0.32 J

Ans. (d)

Heat produced in resistance

= Initial energy of Capacitor

$$= \frac{1}{2} \times 4\mu\,(400)^2$$

$$= 2 \times 10^{-6} \times 16 \times 10^4$$

$$= .32\,J$$

Ans (d)

PYQs on Following Subtopic:

Force between capacitor plates

Assertion : The force between the plates of a parallel plate capacitor is proportional to charge on it.

Reason : Electric force is equal to charge per unit area. *(2018)*

AIIMS

Ans. (d)

force between plates of parallel plate capacitor

$$F = \frac{q^2}{2A\epsilon_0} \Rightarrow F \propto q^2$$

Assertion is wrong.

Reason is also wrong.

A parallel plate air capacitor has capacity C, distance of separation 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 [CBSE AIPMT 2015]

(a) $\frac{C^2V^2}{2d}$ (b) $\frac{CV^2}{2d}$ (c) $\frac{CV^2}{d}$ (d) $\frac{C^2V^2}{2d^2}$

Ans. (b)

$$F = \frac{q^2}{2A\epsilon_0} = \frac{(CV)^2}{2A\epsilon_0} = \frac{C(CV^2)}{2A\epsilon_0}$$

$$= \frac{(CV^2)\,A\epsilon_0/d}{2A\epsilon_0} = \frac{CV^2}{2d}$$

Ans (b)

PYQs on Following Subtopic:

R-C Circuit- Time Constant (τ)

The time constant of C-R circuit is

[CBSE AIPMT 1992]

(a) $\frac{1}{CR}$

(b) $\frac{C}{R}$

(c) CR

(d) $\frac{R}{C}$

Ans. c

$\tau = RC$

Ans (c)

PYQs on Following Subtopic:

Effect of Dielectric Slab

A parallel plate condenser with oil (dielectric constant 2) between the plates has capacitance C. If oil is removed, the capacitance of capacitor becomes

[CBSE AIPMT 1999]

(a) $\sqrt{2}\,C$ (b) $2C$

(c) $\frac{C}{\sqrt{2}}$ (d) $\frac{C}{2}$

Ans. (d)

Dielectric Constant

$$C_{oil} = K\, C_{vaccum}$$

C_{vaccum} → Capacitance if medium is Vaccum

C_{oil} → Capacitance in presence of medium

$$C_{vaccum} = \frac{C_{oil}}{K} = \frac{C}{K} = \frac{C}{2}$$

Ans(d)

Q) the capacitance of a parallel plate capacitor with air as medium is 6μF. With the introduction of a dielectric medium, the capacitance becomes 30 μF. The permittivity of the medium is :

($\in_0 = 8.85 \times 10^{-12}\ C^2\ N^{-1} m^{-2}$)

NEET 2020

(1) $0.44 \times 10^{-10}\ C^2\ N^{-1}\ m^{-2}$

(2) $5.00\ C^2\ N^{-1}\ m^{-2}$

(3) $0.44 \times 10^{-13}\ C^2\ N^{-1}\ m^{-2}$

(4) $1.77 \times 10^{-12}\ C^2\ N^{-1}\ m^{-2}$

Ans. 1

$$C_{medium} = K\, C_{vaccum}$$

$$K = \frac{C_{medium}}{C_{vaccum}} = \frac{30\mu}{6\mu} = 5$$

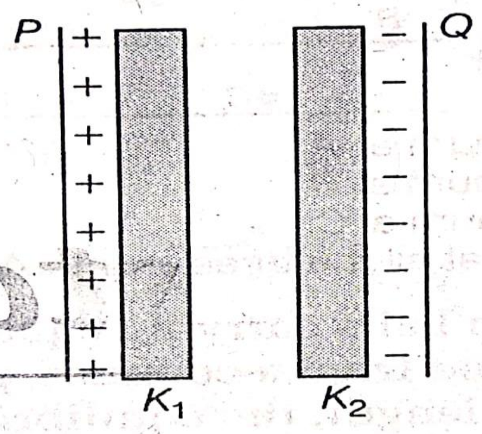
$$\epsilon = \epsilon_0 K = 8.85 \times 10^{-12} \times 5$$

$$= 44.25 \times 10^{-12}$$

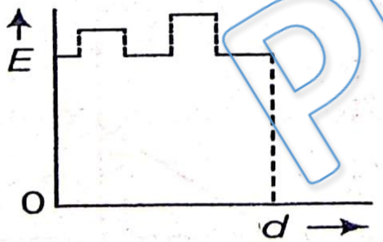
$$= .4425 \times 10^{-10}$$

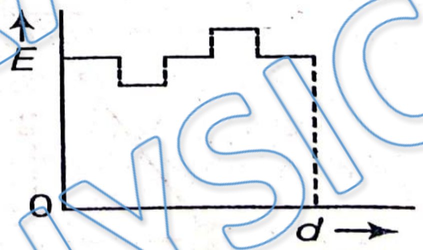
Ans (1)

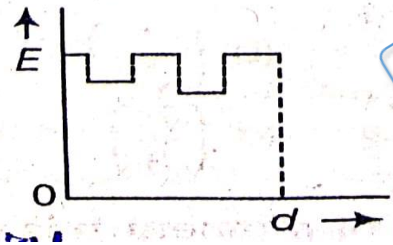
12. Two thin dielectric slabs of dielectric constants K_1 and K_2 ($K_1 < K_2$) are inserted between plates of a parallel plate capacitor, as shown in the figure.

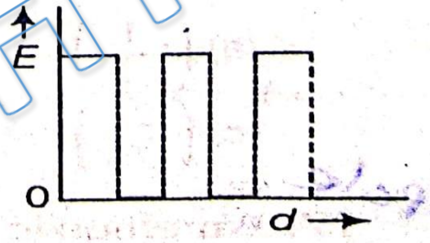


The variation of electric field E between the plates with distance d as measured from plate P is correctly shown by
[CBSE AIPMT 2014]

(a)


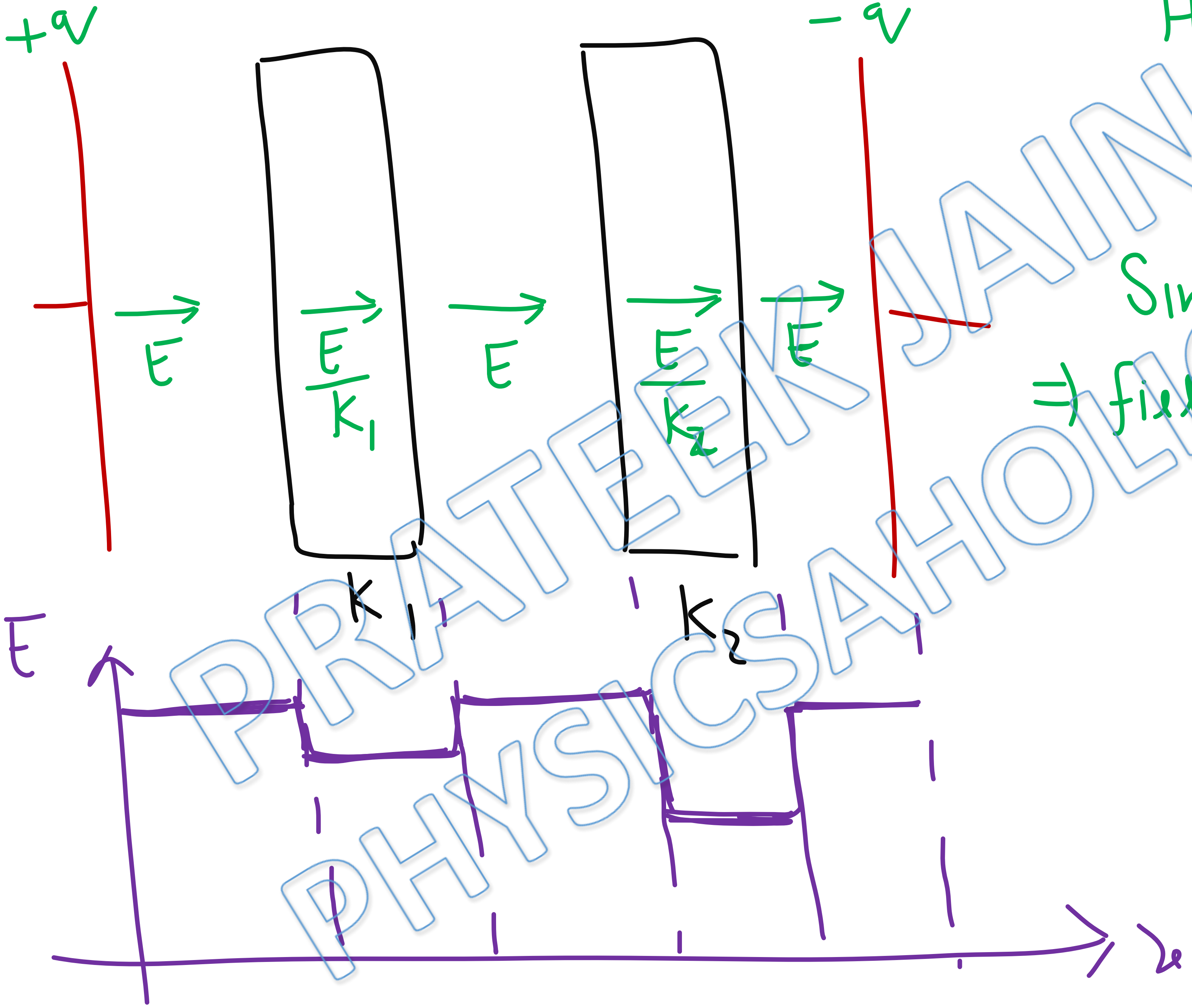
(b)


(c)


(d)


field

Ans. (c)



Here $E = \frac{q}{A\epsilon_0}$

Since $K_1 < K_2$

$\Rightarrow$ field in $K_1 >$ field in K_2

Ans (c)

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

[CBSE AIPMT 2015]

(a) The potential difference between the plates decreases K times

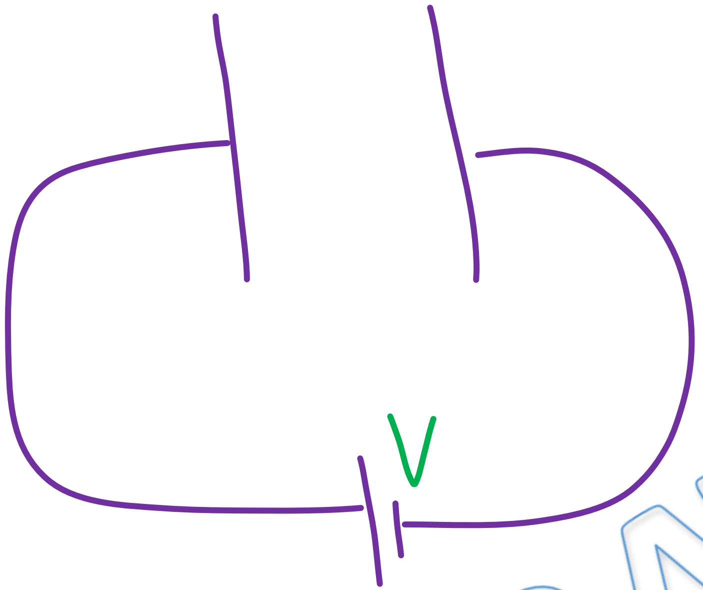
(b) The energy stored in the capacitor decreases K times

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

(d) The charge on the capacitor is not conserved

Ans. (d)

Capacitance = C



Capacitance = KC

Since cell is connected, Potential difference across Capacitor remains V (unchanged).

$U_i = \frac{1}{2}CV^2$, $U_f = \frac{1}{2}KCV^2 \Rightarrow$ Energy increases to K times

Change in energy $= U_f - U_i$

$$= \frac{1}{2} C V^2 (K-1)$$

Initial charge on Capacitor $= CV$

final " " " $= KCV$

$\Rightarrow$ Charge is not Conserved

Ans (d)

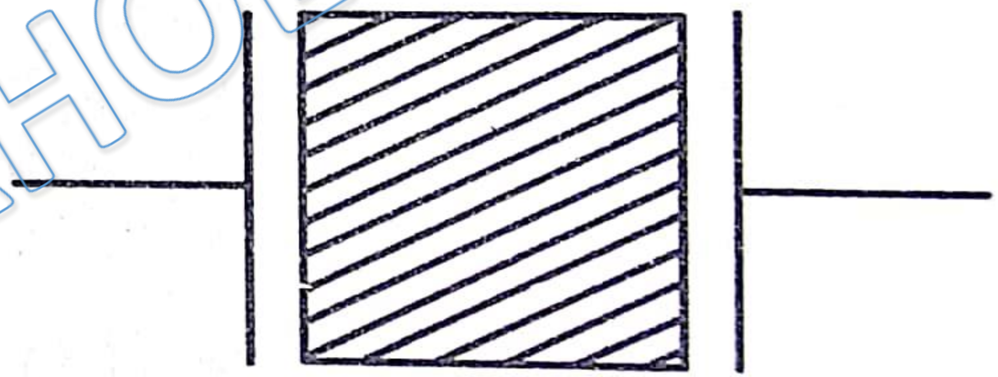
Electric field inside the given capacitor with dielectric is E and dielectric constant of material is K. Find charge density s on the plates. (Given $E = 6 \times 10^5$ V/m, $K = 6$)

(a) 18.3×10^{-6} C/m^2

(b) 8.1×10^{-7} C/m^2

(c) 3.18×10^{-5} C/m^2

(d) 3.18×10^{-10} C/m^2



(2018)

AIIMS

Ans. (c)

$$E = \frac{\sigma}{\epsilon_0 K}$$

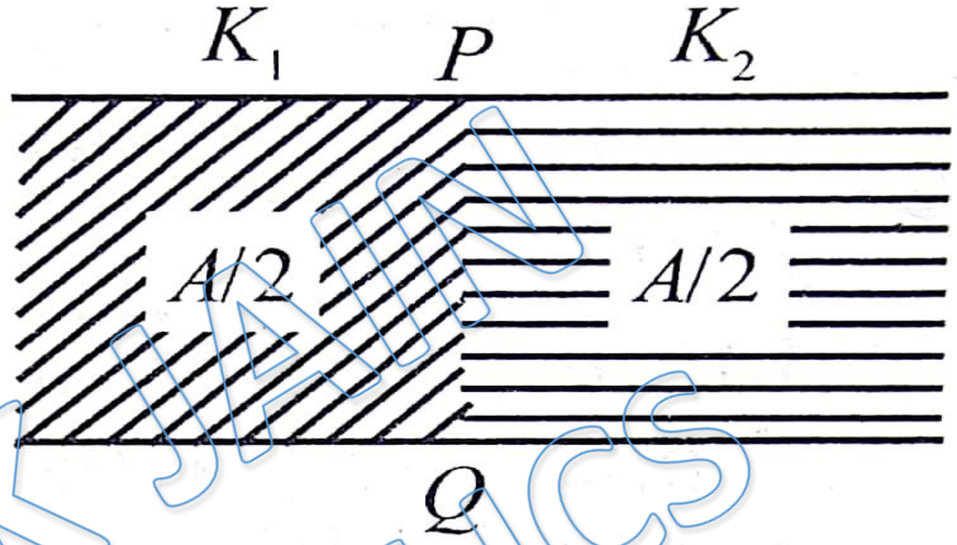
$$\Rightarrow \quad \sigma = E\,\epsilon_0 K = 6 \times 10^{5} \times 8.85 \times 10^{-12} \times 6$$

$$= 318 \times 10^{-7}$$

$$= 3.18 \times 10^{-5}\ C/m^2$$

Ans (c)

From the figure, find the capacitance of the capacitor?



dielectric

(a) $C = \dfrac{\varepsilon_0 A}{d}\left(\dfrac{K_1 + K_2}{2}\right)$

(b) $C = \dfrac{\varepsilon_0 A}{2d}\left(\dfrac{K_1 K_2}{K_1 + K_2}\right)$

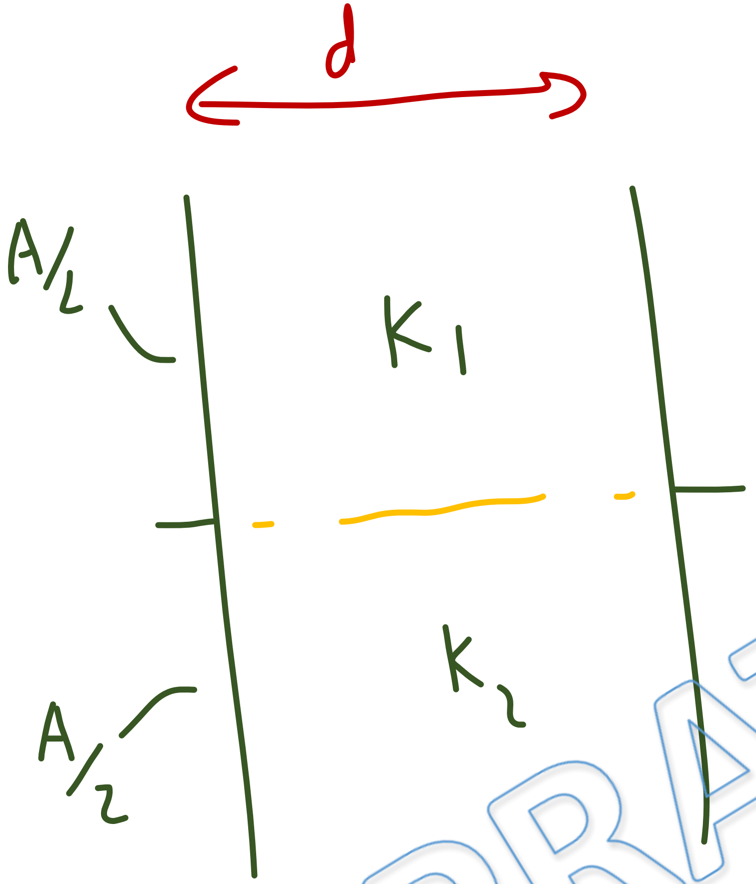
(c) $C = \dfrac{\varepsilon_0 A}{d}\left(\dfrac{K_1}{K_2}\right)$

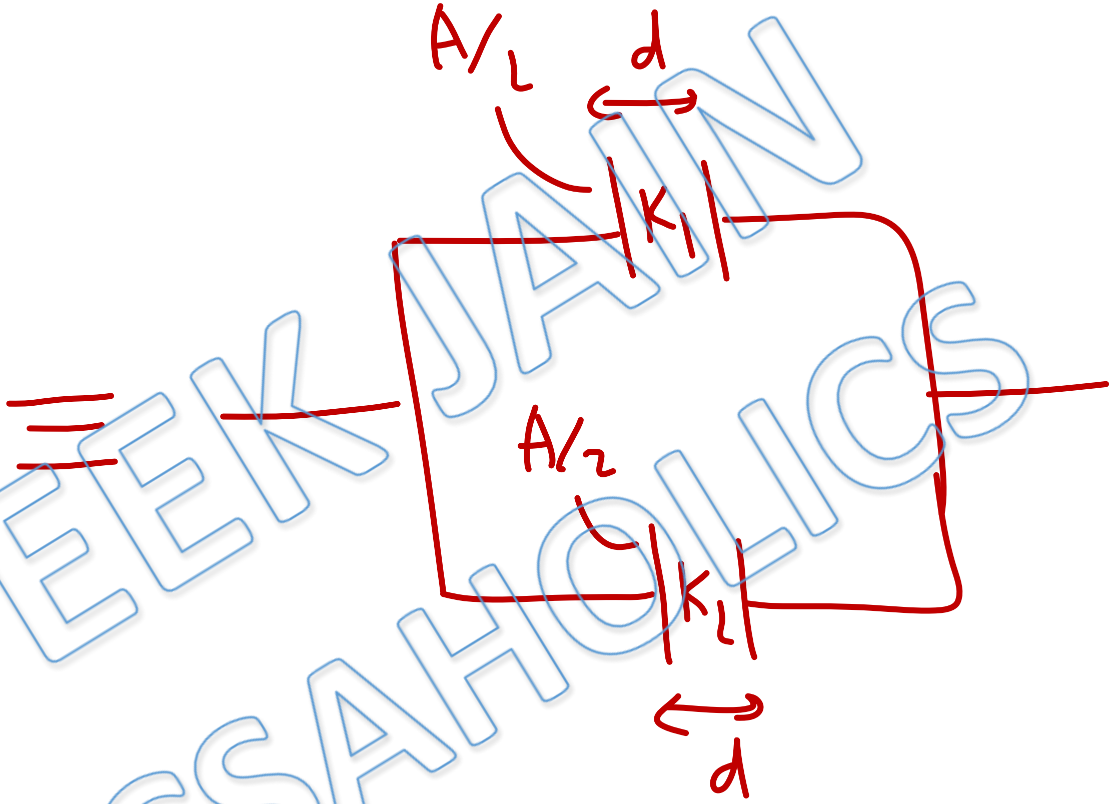
(d) $C = \dfrac{\varepsilon_0 A}{d}\left(\dfrac{2K_1 K_2}{K_1 + K_2}\right)$.

AIIMS

(2001)

Ans. (a)



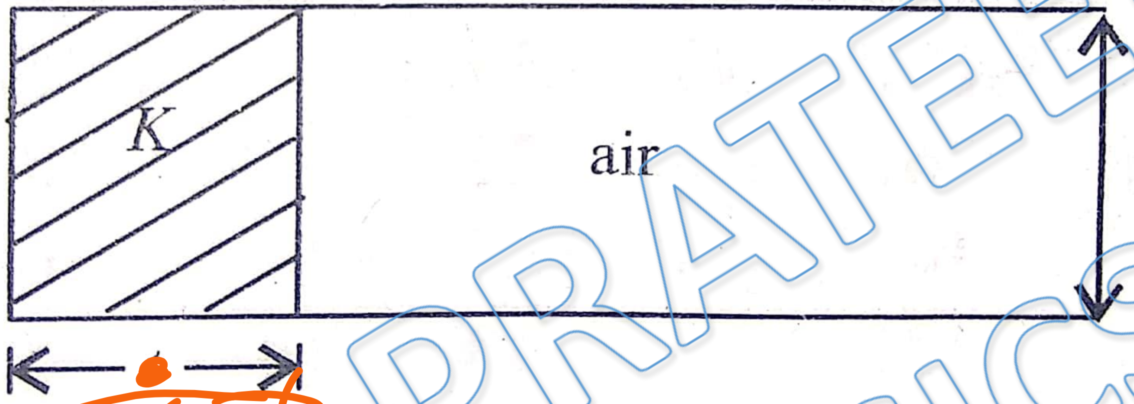


$$C = C_1 + C_2 = \frac{A\epsilon_0 K_1}{2d} + \frac{A\epsilon_0 K_2}{2d} = \frac{A\epsilon_0}{d}\left(\frac{K_1+K_2}{2}\right)$$

Ans (a)

A parallel plate capacitor with air as a dielectric has capacitance C. A slab of dielectric constant K, having same thickness as the separation between the plates is introduced so as to fill one-fourth of the capacitor as shown in the figure. The new capacitance will be

wrong figure.



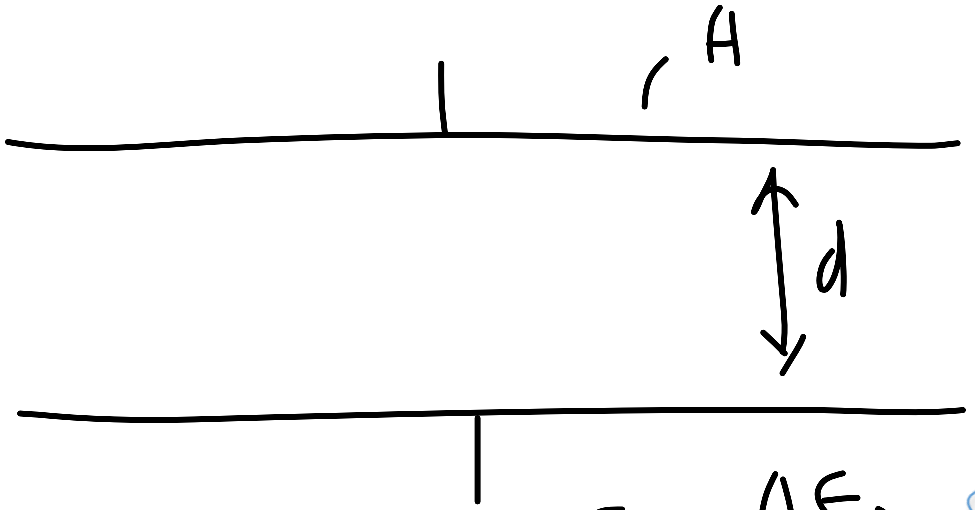
A/4

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

AIIMS

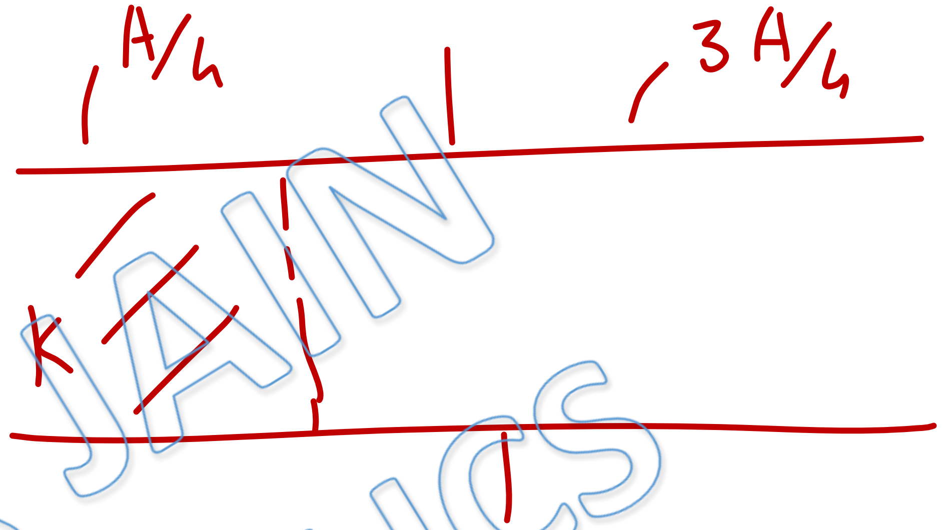
(c) $(K+1)\frac{C}{4}$ (d) $\frac{KC}{4}$ (2017)

Ans. (a)



$$C = \frac{A\epsilon_0}{d}$$

$\Rightarrow$



$$C_f = C_1 + C_2$$

$$= \frac{A\epsilon_0 K}{4d} + \frac{3A\epsilon_0}{4d}$$

$$= \frac{A\epsilon_0}{4d}(K+3)$$

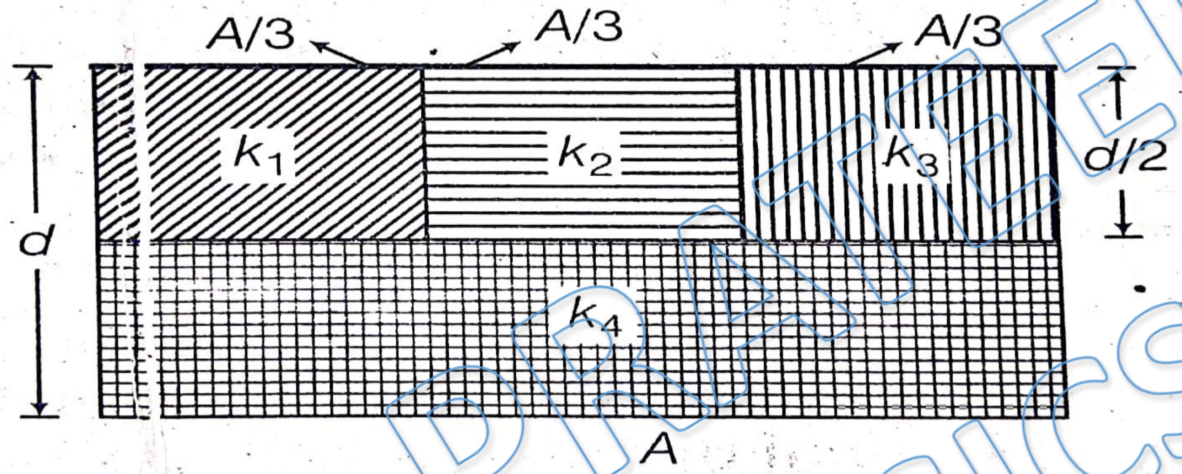
$$= \frac{C}{4}(K+3)$$

Ans (a)

A parallel-plate capacitor of area A, plate separation d and capacitance C is filled with four dielectric materials having dielectric constants k_1, k_2, k_3 and k_4 as shown in the figure below. If a single dielectric material is to be used to have the same capacitance C in this capacitor, then its dielectric constant k is given by

(wrong)

[NEET 2016]



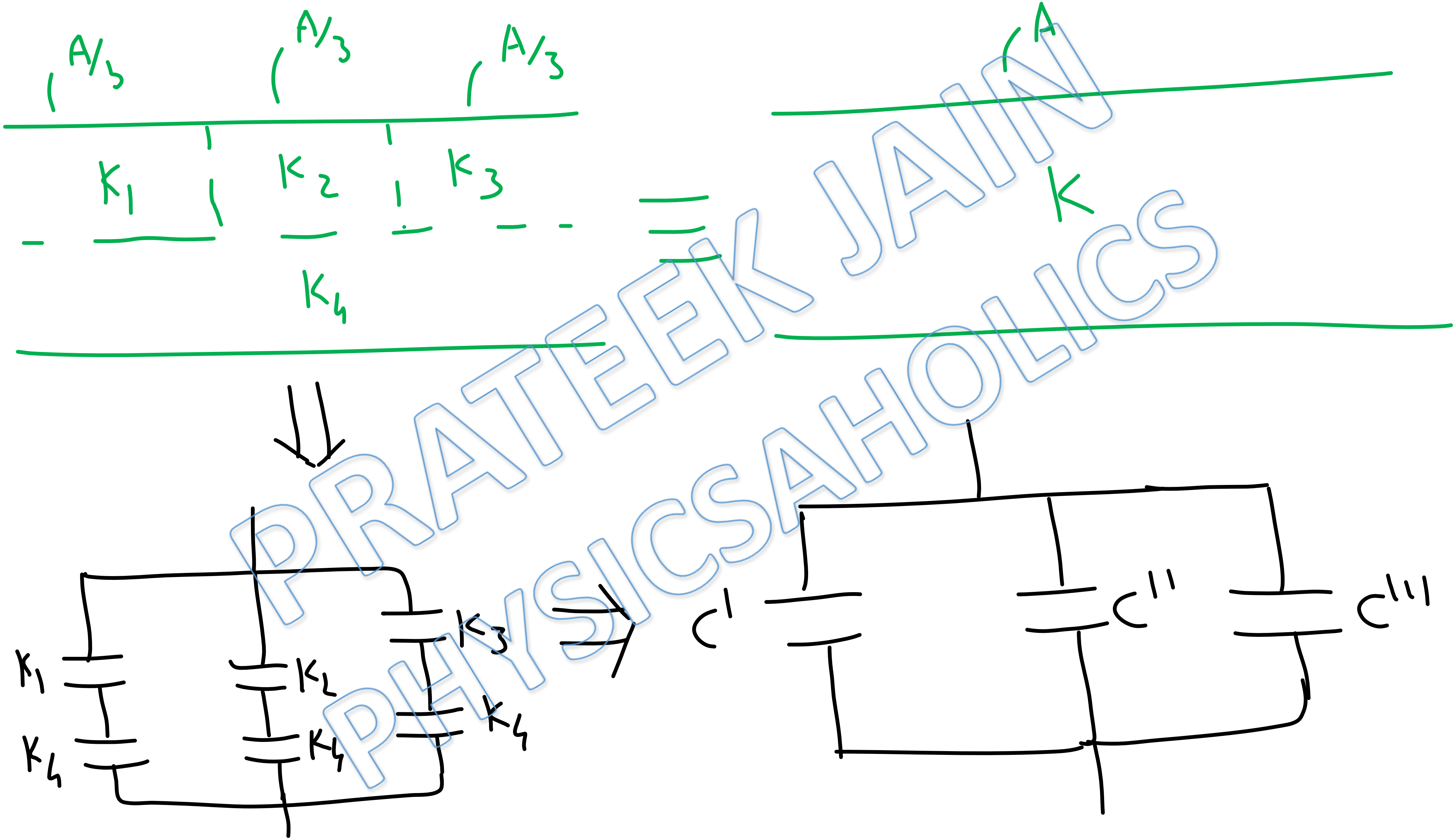
(a) $k = k_1 + k_2 + k_3 + 3k_4$

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

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

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

all given answers are wrong


A/3
A/3
A/3
K1
K2
K3
K4
A
K
K1
K4
K2
K4
K3
K4
C'
C''
C'''

$$\frac{1}{C'} = \frac{3d}{2A\epsilon_0 K_1} + \frac{3d}{2A\epsilon_0 K_4} = \frac{3d\,(K_1+K_4)}{2A\epsilon_0 K_1 K_4}$$

$$C' = \frac{2A\epsilon_0 K_1 K_4}{3d\,(K_1+K_4)}$$

$$C'' = \frac{2A\epsilon_0 K_2 K_4}{3d\,(K_2+K_4)}$$

$$C''' = \frac{2A\epsilon_0 K_3 K_4}{3d\,(K_3+K_4)}$$

$$C = C' + C'' + C'''$$

$$\frac{A\epsilon_0 K}{d} = \frac{2A\epsilon_0}{3d}\left[\frac{K_1K_4}{K_1+K_4} + \frac{K_2K_4}{K_2+K_4} + \frac{K_3K_4}{K_3+K_4}\right]$$

$$K = \frac{2K_4}{3}\left[\frac{K_1}{K_1+K_4} + \frac{K_2}{K_2+K_4} + \frac{K_3}{K_3+K_4}\right]$$

All options are wrong.

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