PRAYAS

JEE 2025

Lecture - 3

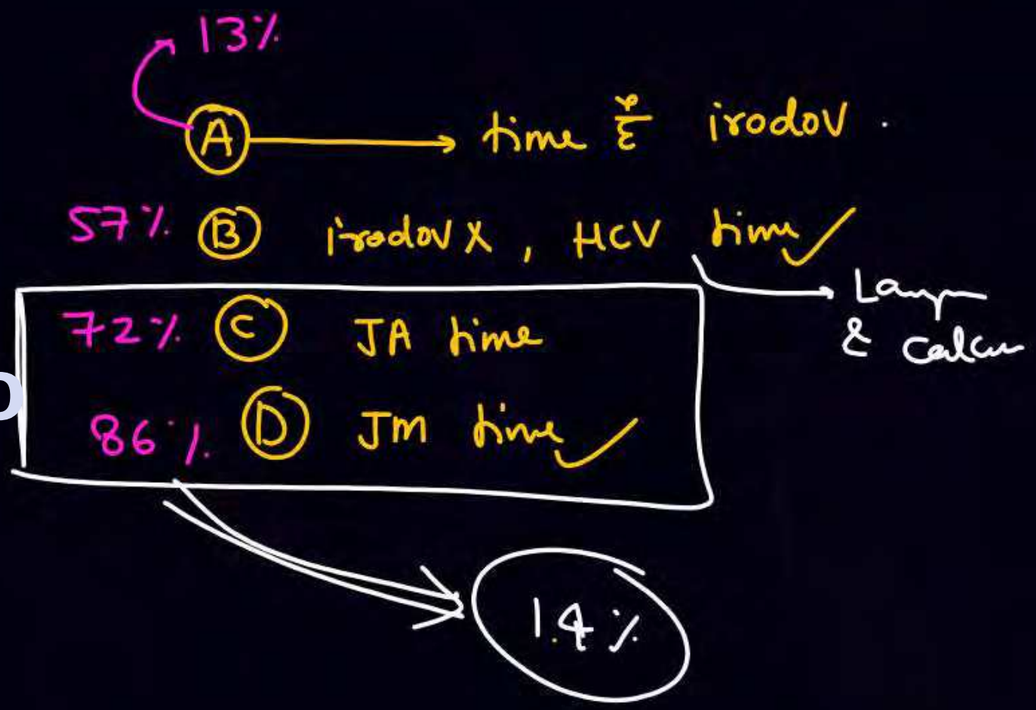
Physics

Capacitor

By- Saleem Ahmed Sir

Topics to be covered

1. Ceq, Series-parallel
2. Slab inserted b/w Cap. band ques.
3. .
4. .



Resistance ≡) series $R_{eq} = R_1 + R_2$

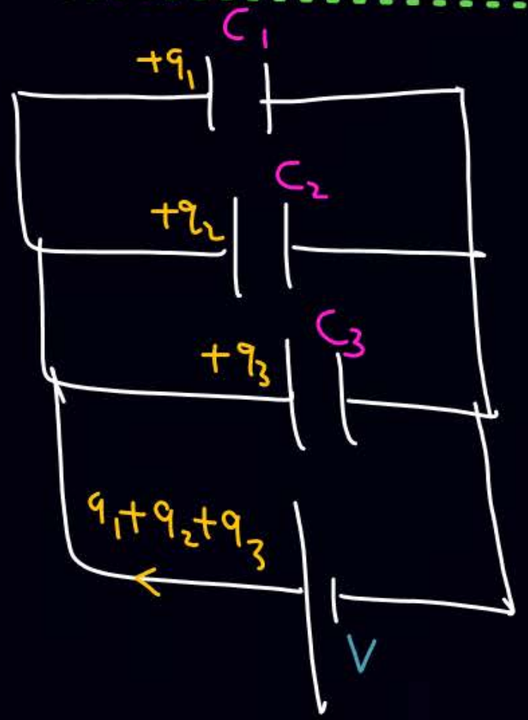
parallel $R_{eq} = ?$

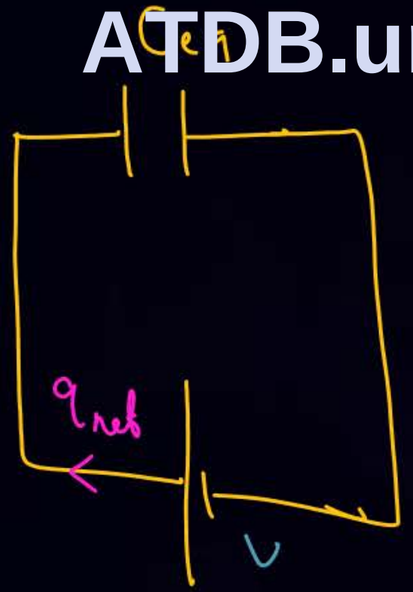
$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$$

Capacitor parallel ≡ $C_{eq} = C_1 + C_2 + C_3 + \cdots$

Capacitor series ≡) $\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \cdots$

(1)

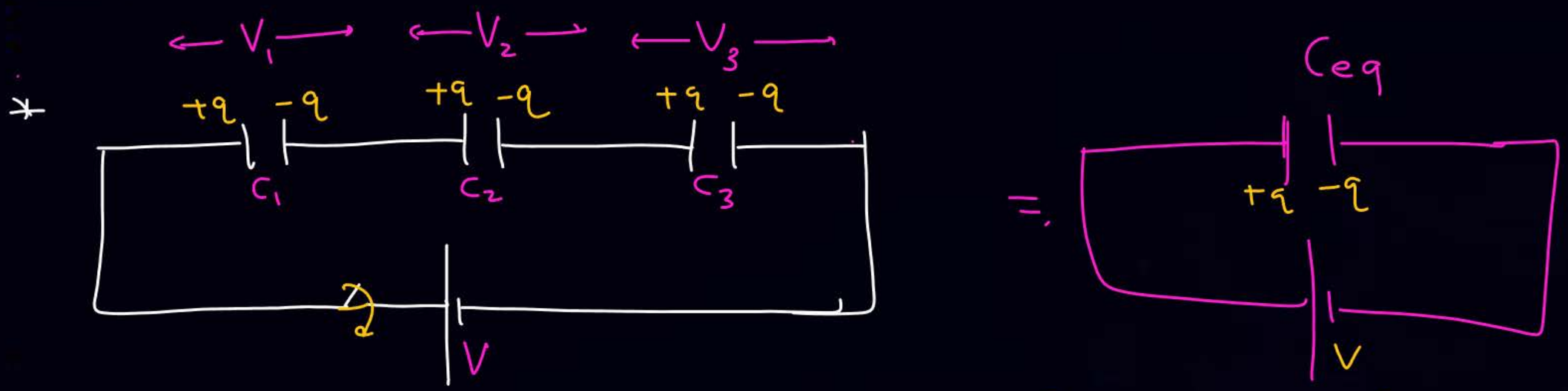




$$q_1 + q_2 + q_3 = C_1V + C_2V + C_3V = q_{net}$$

$$= C_{eq} \cdot V$$

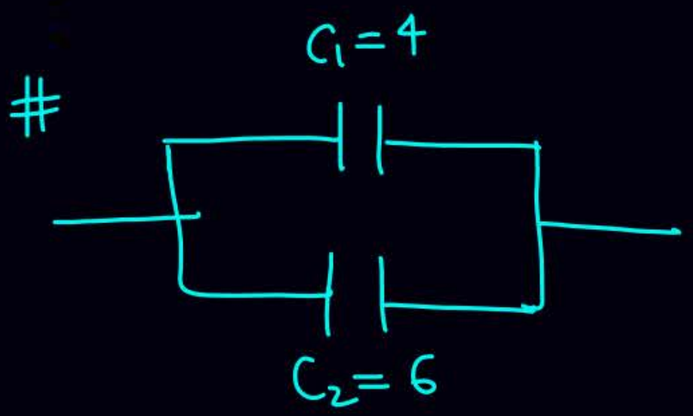
$$\boxed{C_{eq} = C_1 + C_2 + C_3 \cdots}$$



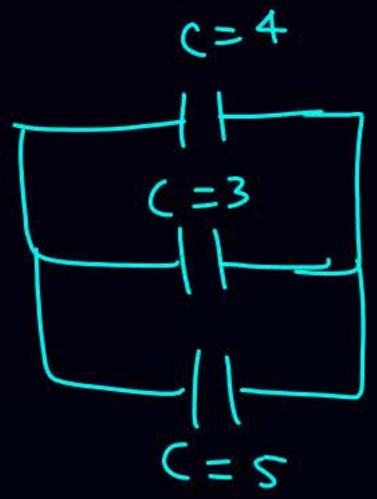
$$V = V_1 + V_2 + V_3 = \frac{q}{C_1} + \frac{q}{C_2} + \frac{q}{C_3} = \frac{q}{C_{eq}}$$

$$V = \frac{q}{C_{eq}}$$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + - -$$



$C_{eq} = 4 + 6 = 10$

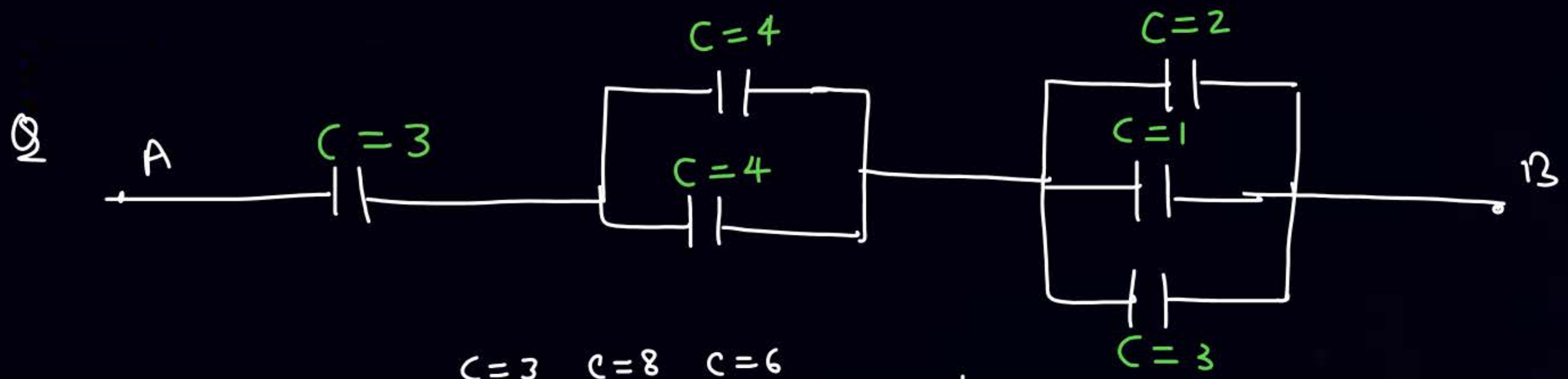


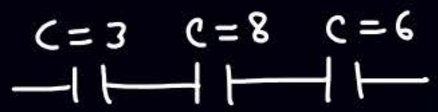
$C_{eq} = 12$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{C_1 + C_2}{C_1 C_2}$$

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

$$C_{eq} = \frac{18}{9} = 2$$

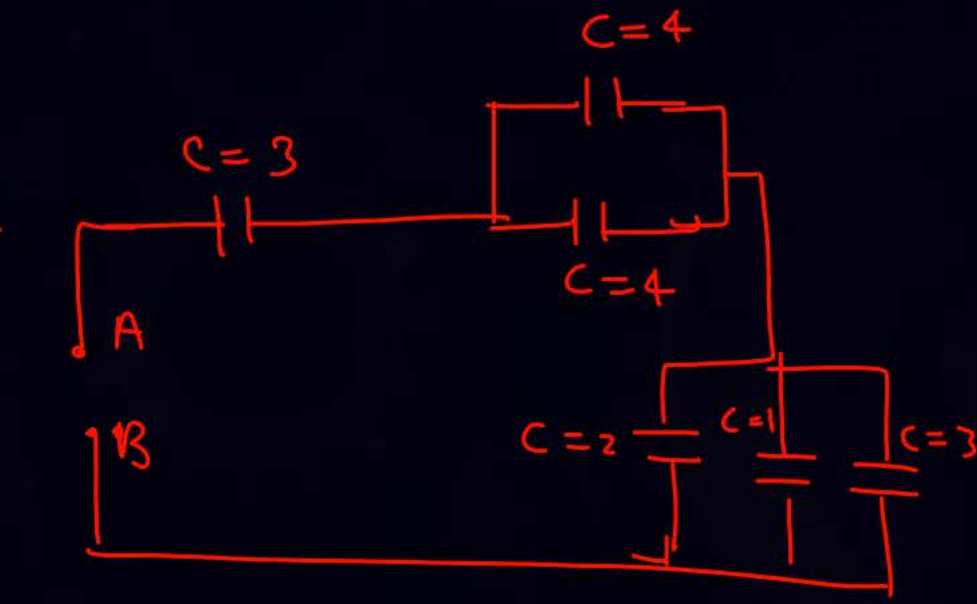




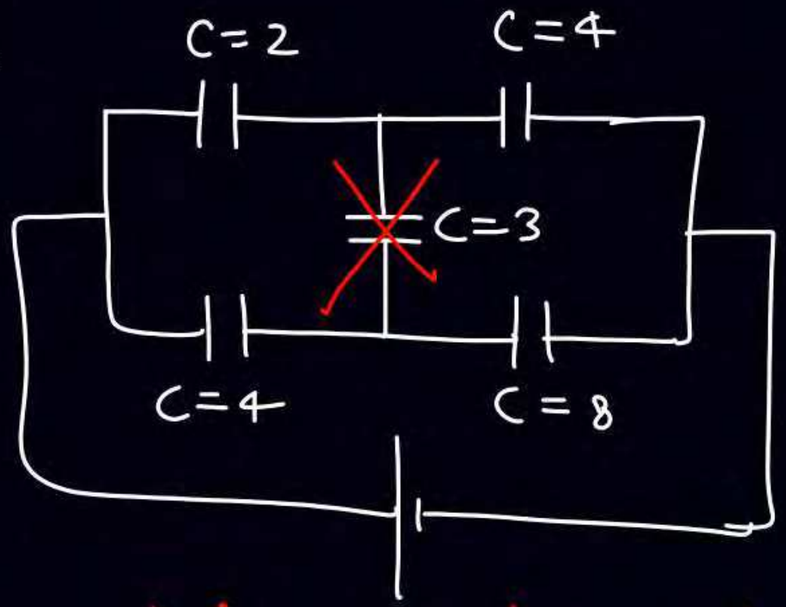
$(C_{eq})_{AB} = ?$

$$C_{eq} = \frac{2 \times 8}{2+8} = 1.6$$

Same

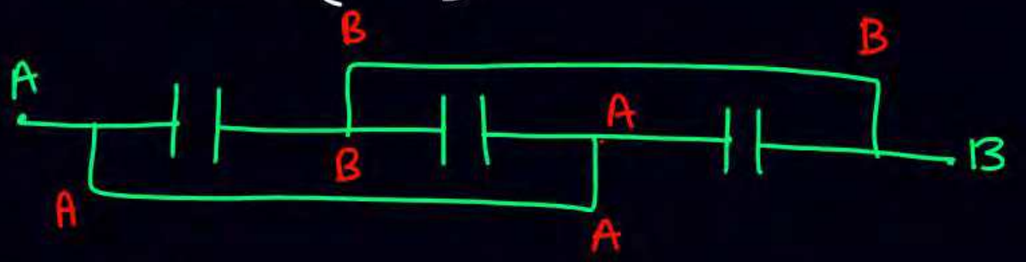


Q

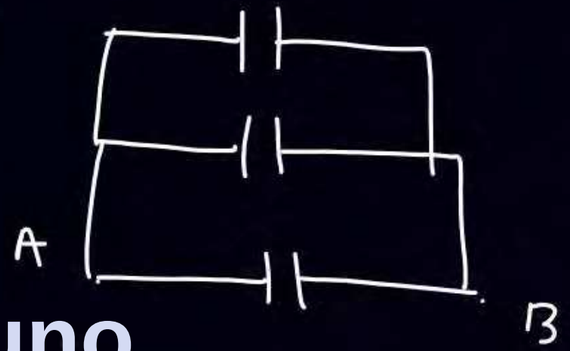


Balance wheatstone

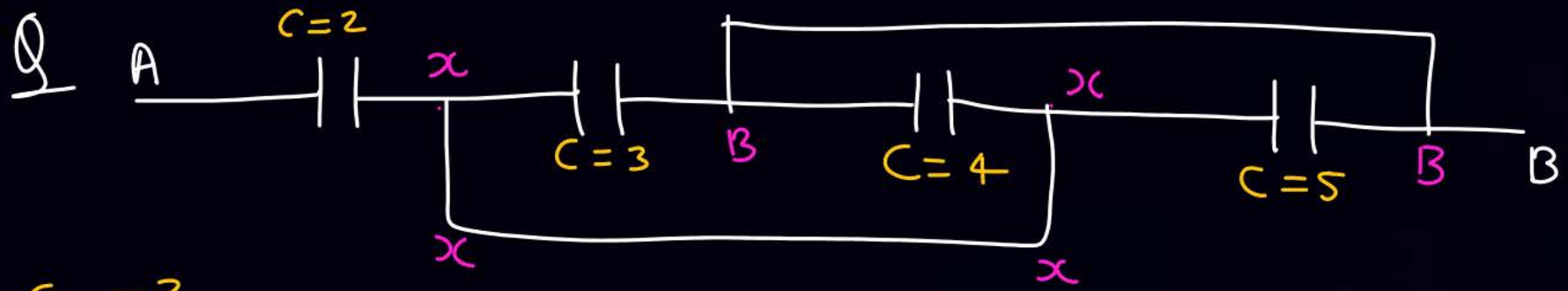
Q



$C_{AB} = ?$

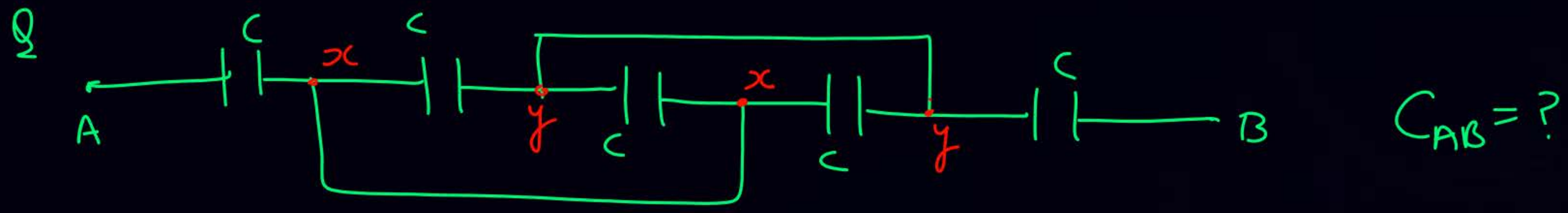


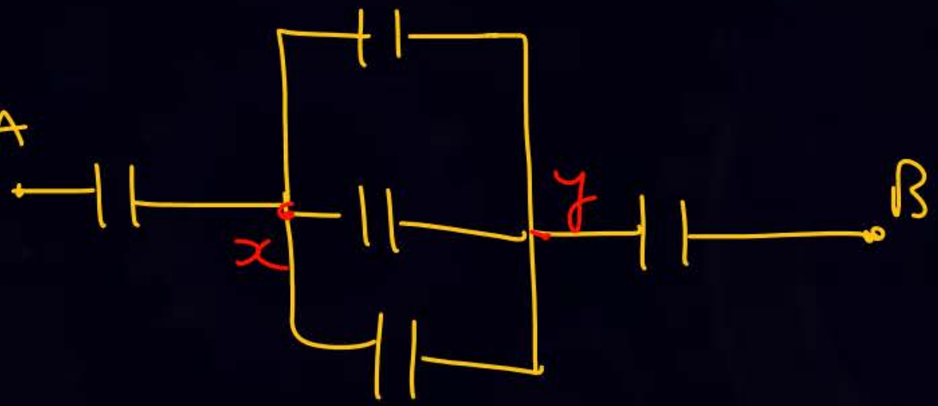
$C_{AB} = 2+2+2$

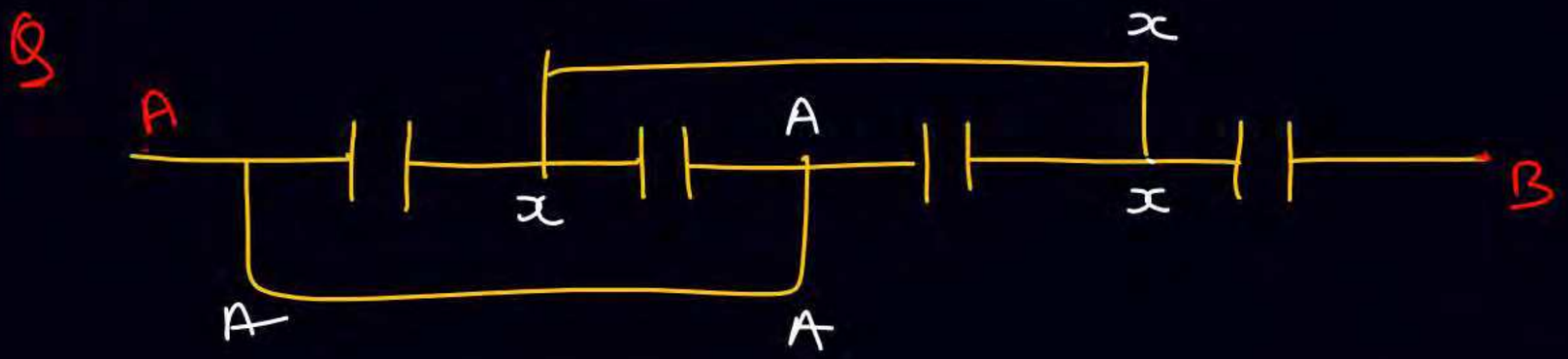


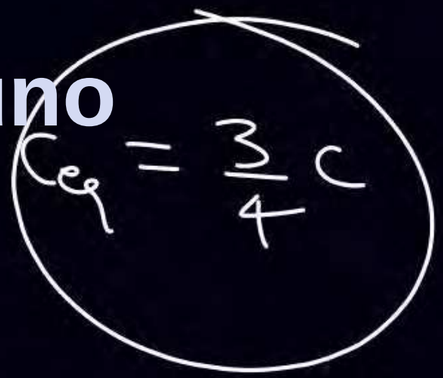
$C_{AB} = ?$

$C_{AB} = \frac{24}{14}$

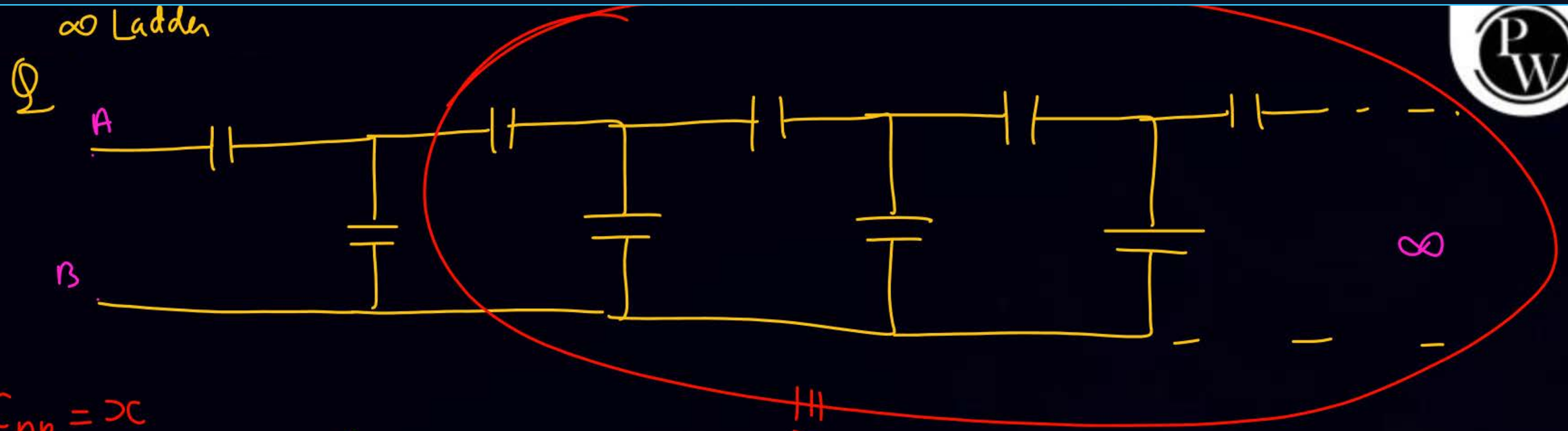




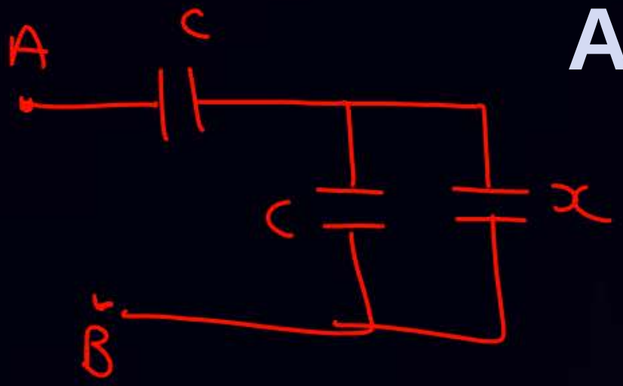




∞ Ladder



$C_{AB} = x$



$$C_{AB} = \frac{(C+x)\cdot C}{(C+x)+C} = x$$

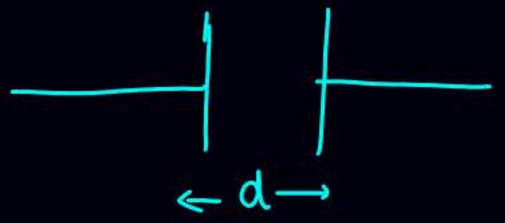
$$C^2 + xC = xC + x^2 + Cx$$

$$\boxed{x^2 + xC - C^2 = 0}$$

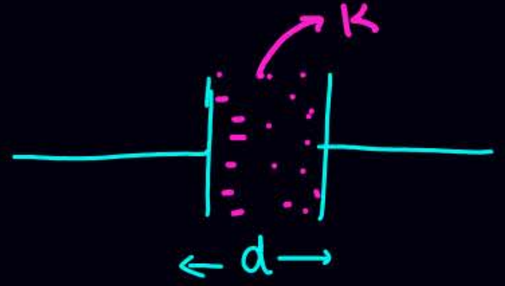
$$x = \frac{-C + \sqrt{5C^2}}{2}$$

(parallel plate cap.)

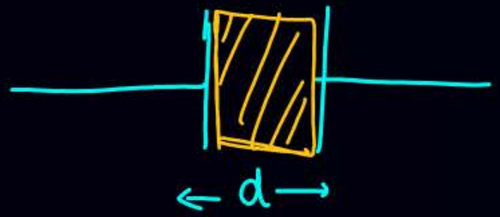
#

① 

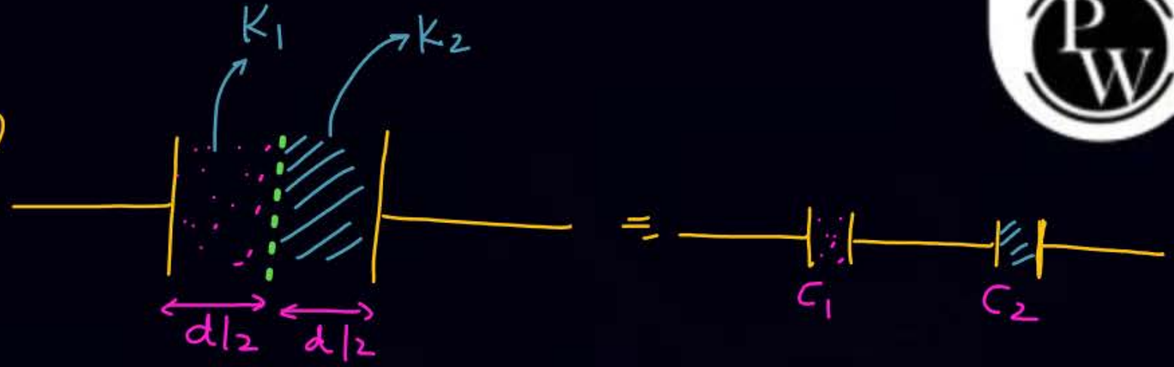
$$C = \frac{A\epsilon_0}{d}$$

② 

$$C_{new} = \frac{A\epsilon_0 K}{d} = kC$$

③ 

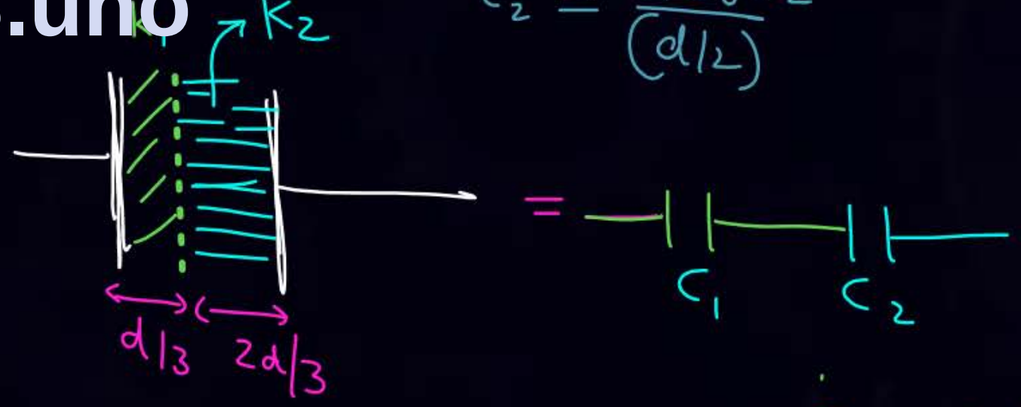
$$C_{new} = \frac{A\epsilon_0 K}{d} = kC$$

④ 

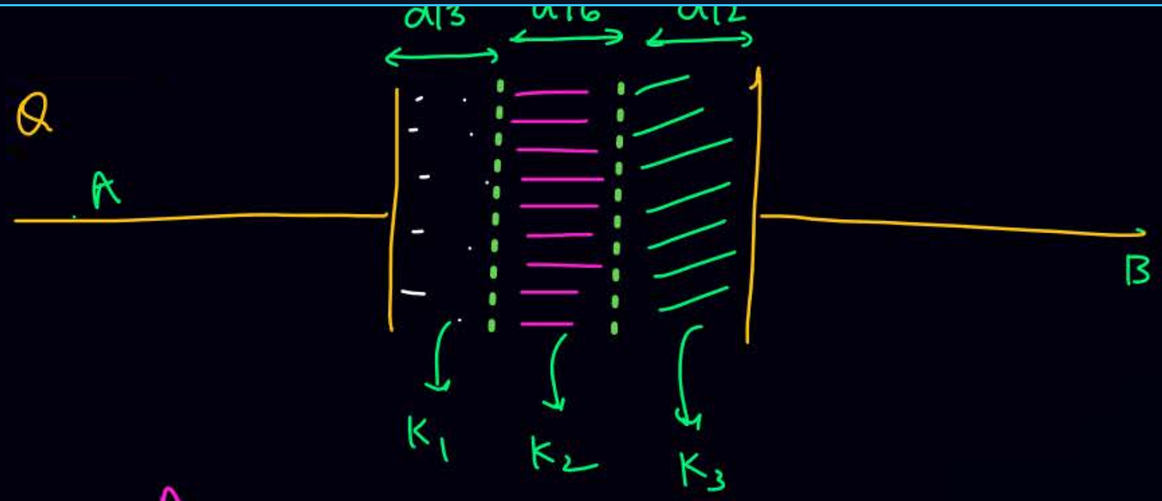
$$C_1 = \frac{A\epsilon_0 K_1}{(d/2)}$$

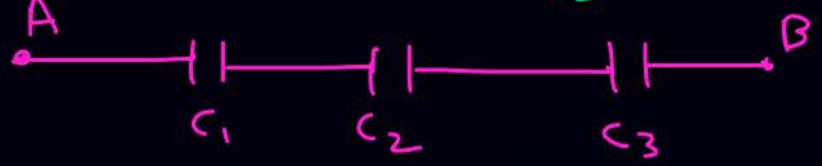
$$C_2 = \frac{A\epsilon_0 K_2}{(d/2)}$$

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

⑤ 

$$C_1 = \frac{A\epsilon_0 K_1}{d/3} \qquad C_2 = \frac{A\epsilon_0 K_2}{2d/3}$$



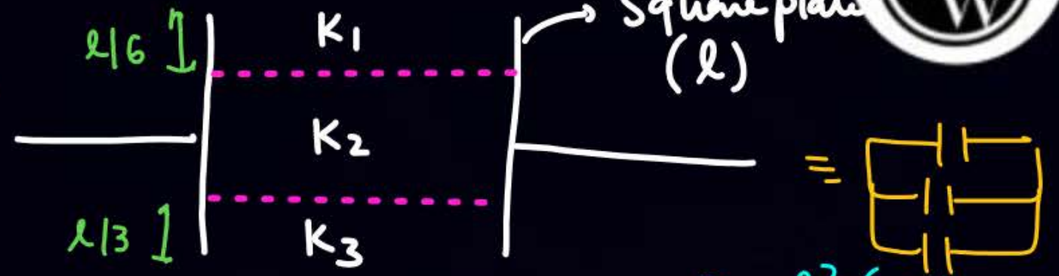


$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

$$C_1 = \frac{A\epsilon_0 K_1}{d/3} \qquad C_2 = \frac{A\epsilon_0 K_2}{d/6}$$

$$C_3 = \frac{A\epsilon_0 K_3}{d/2}$$

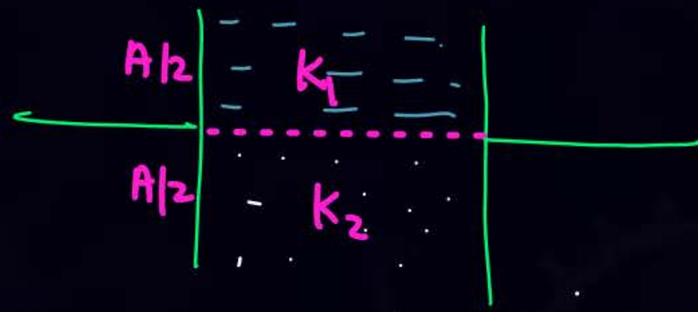
Q

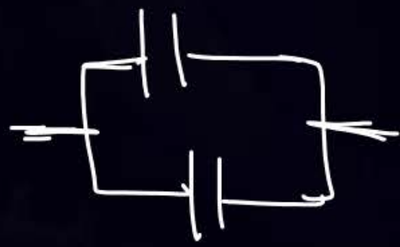


$$C_{eq} = C_1 + C_2 + C_3$$

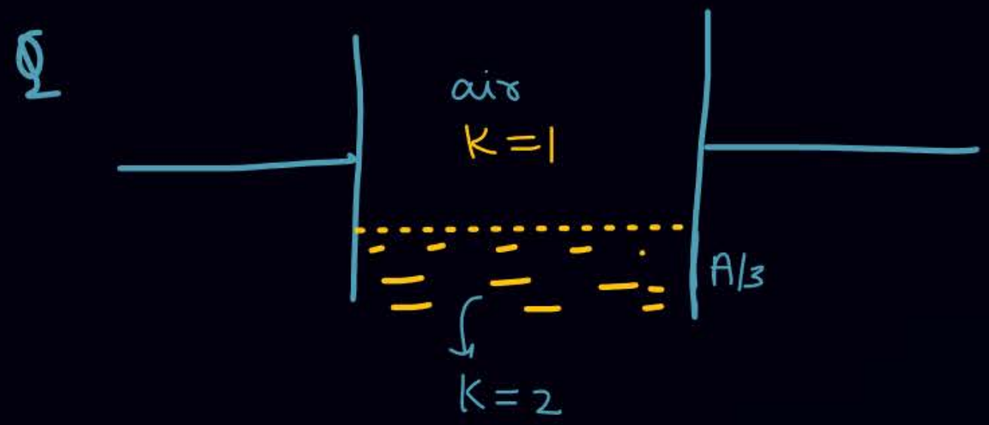
$$= \frac{\frac{A}{6}\cdot\epsilon_0 K_1}{d} + \frac{\frac{A}{2}\epsilon_0 K_2}{d} + \frac{\frac{A}{3}\epsilon_0 K_3}{d}$$

Q





$$C_{eq} = C_1 + C_2 = \frac{(A/2)\epsilon_0 K_1}{d} + \frac{(A/2)\epsilon_0 K_2}{d}$$



$$C_{eq} = C_1 + C_2 = \frac{\frac{2A}{3}\epsilon_0}{d} + \frac{(A/3)\,\epsilon_0 \times 2}{d}$$

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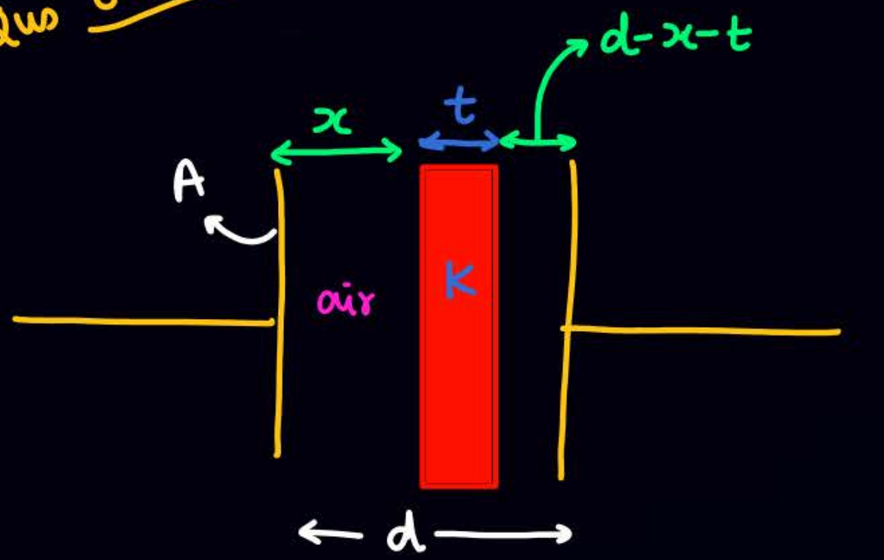
Q

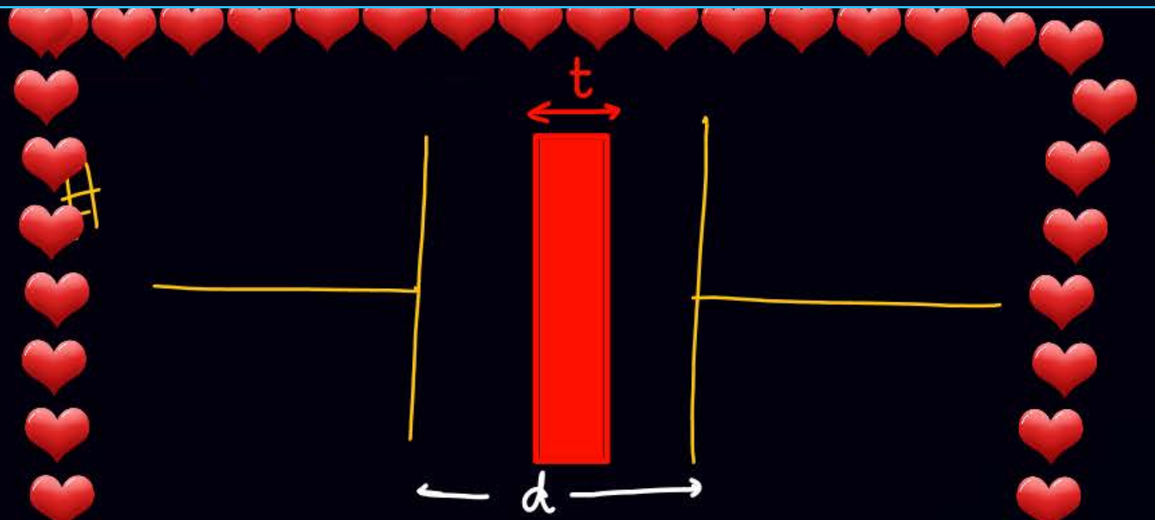


$\equiv$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

$$\frac{1}{C_{eq}} = \frac{1}{\left(\frac{A\epsilon_0}{x}\right)} + \frac{1}{\frac{A\epsilon_0 k}{t}} + \frac{1}{\frac{A\epsilon_0}{(d-x-t)}} = \frac{1}{A\epsilon_0}\left[x + \frac{t}{k} + d - x - t\right]$$

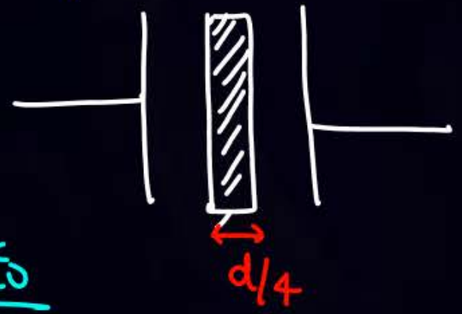
$$C_{eq} = \frac{A\epsilon_0}{\frac{t}{k} + d - t} = \frac{A\epsilon_0}{d - t\left(1 - \frac{1}{k}\right)}$$



$$C = \frac{A\epsilon_0}{d - t\left(1 - \frac{1}{k}\right)}$$

Q Between the parallel plate capacitor of capacitance C, (plate area A & distance b/w plate is d) a dielectric slab of dielectric const $K=3$ is inserted as shown in daigram.

If thickness of slab is $\frac{d}{4}$ find Ratio of $\frac{C_{new}}{C_{old}} = ?$

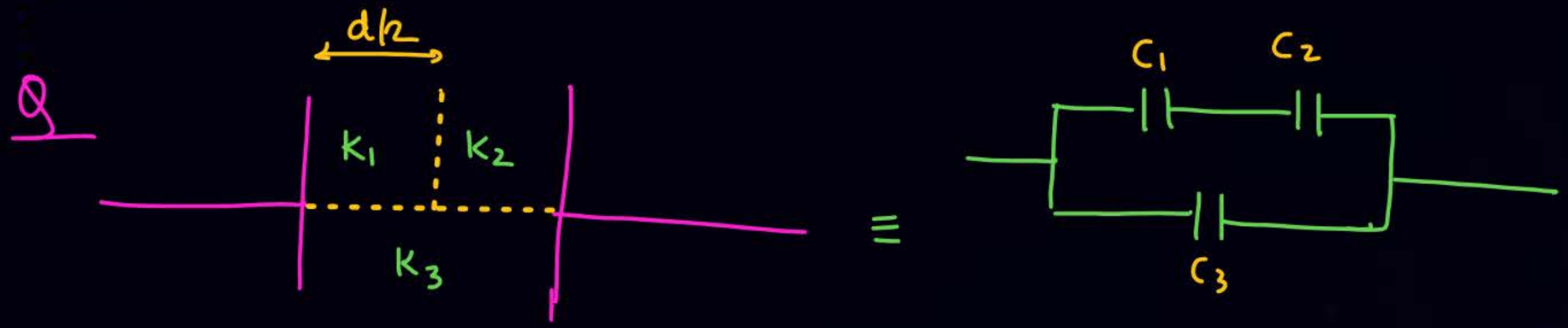


Soln

$$\frac{C_{new}}{\left(\frac{A\epsilon_0}{d}\right)} = \frac{C_{new}}{C_{old}} = \frac{12}{12-3+1} = \frac{12}{10}$$

$$= \frac{6}{5}$$

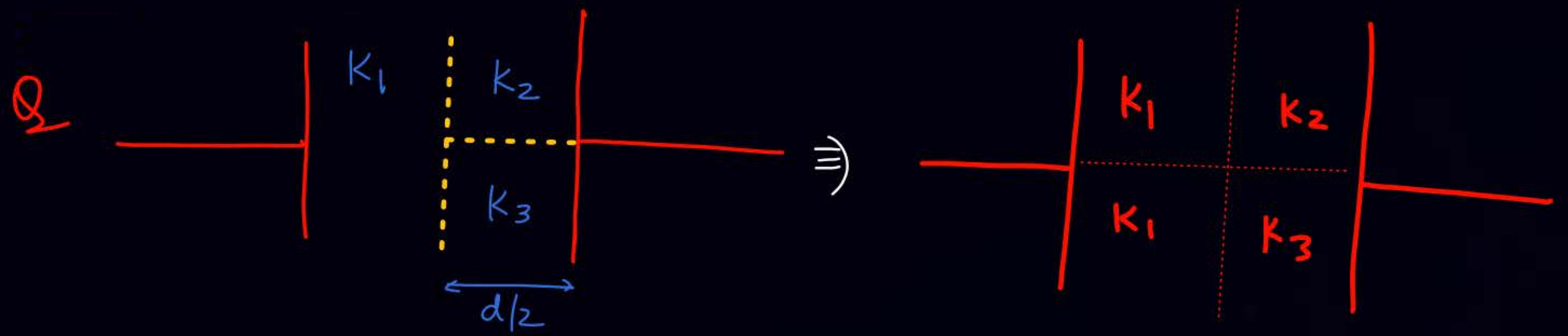
$$C_{new} = \frac{A\epsilon_0}{d - \frac{d}{4}\left(1 - \frac{1}{3}\right)} = \frac{A\epsilon_0}{d\left[1 - \frac{1}{4} + \frac{1}{12}\right]}$$



≡

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

$$C_3 = \frac{(A/2)\epsilon_0 K_3}{d}$$



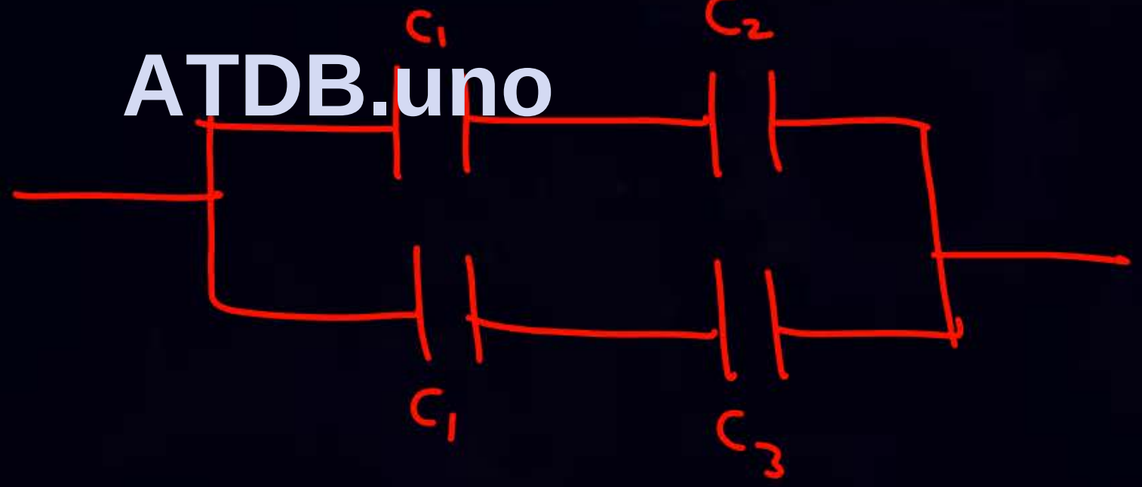
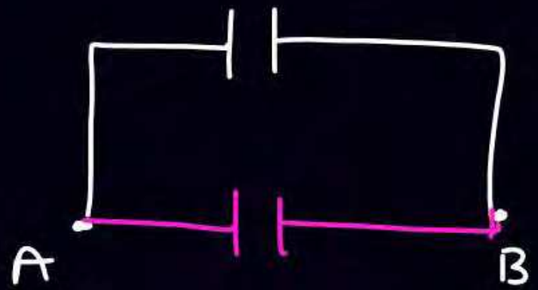
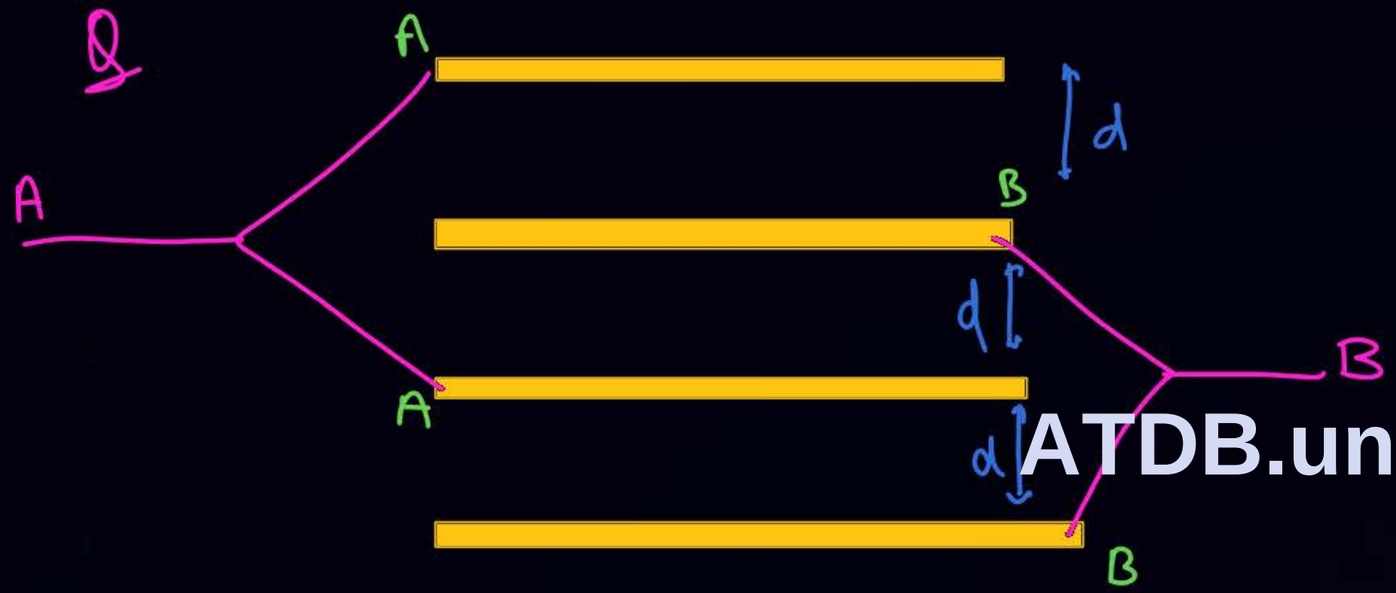
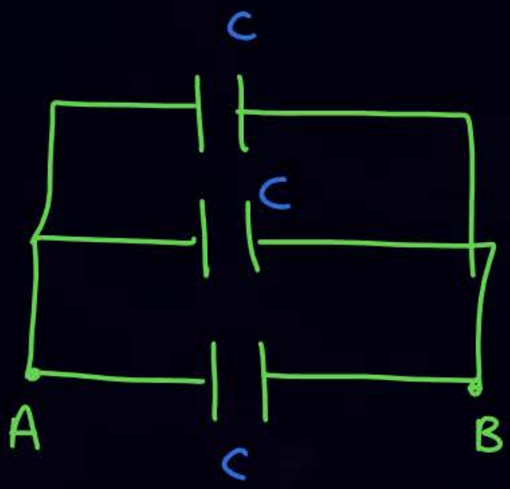


plate वाले Qus

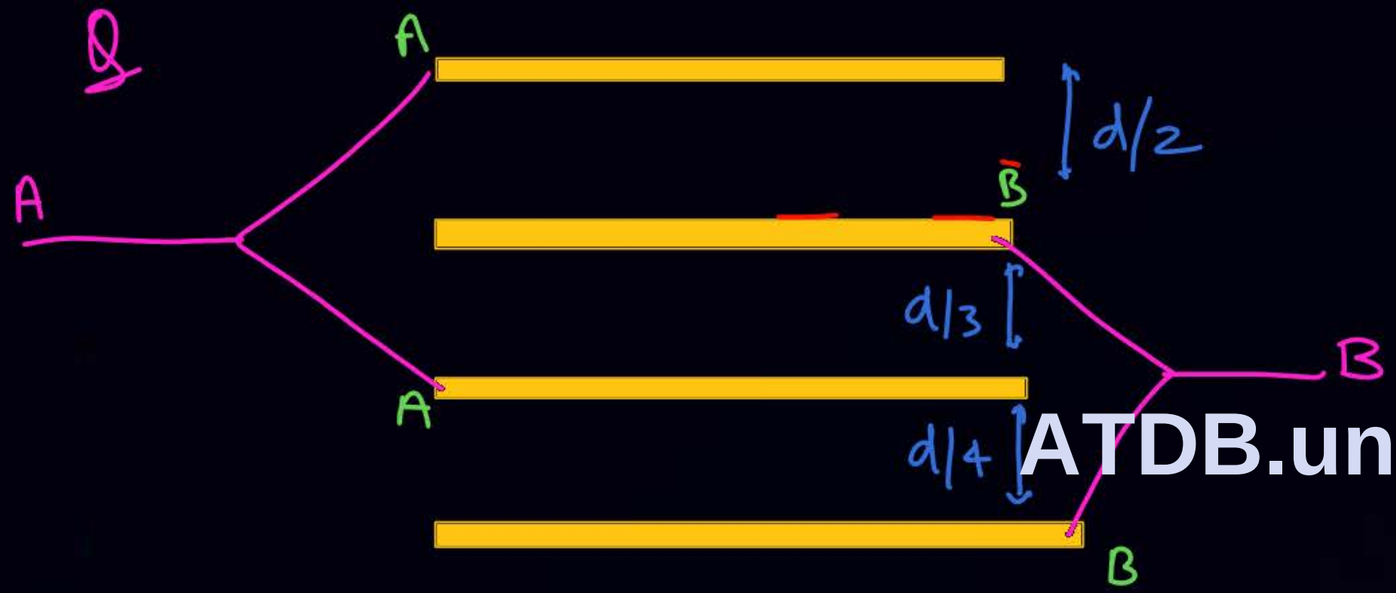


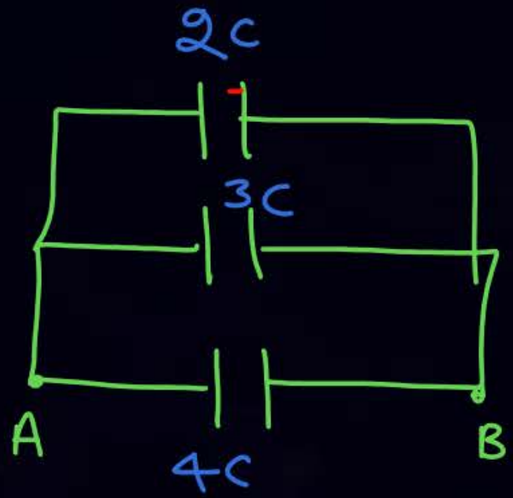




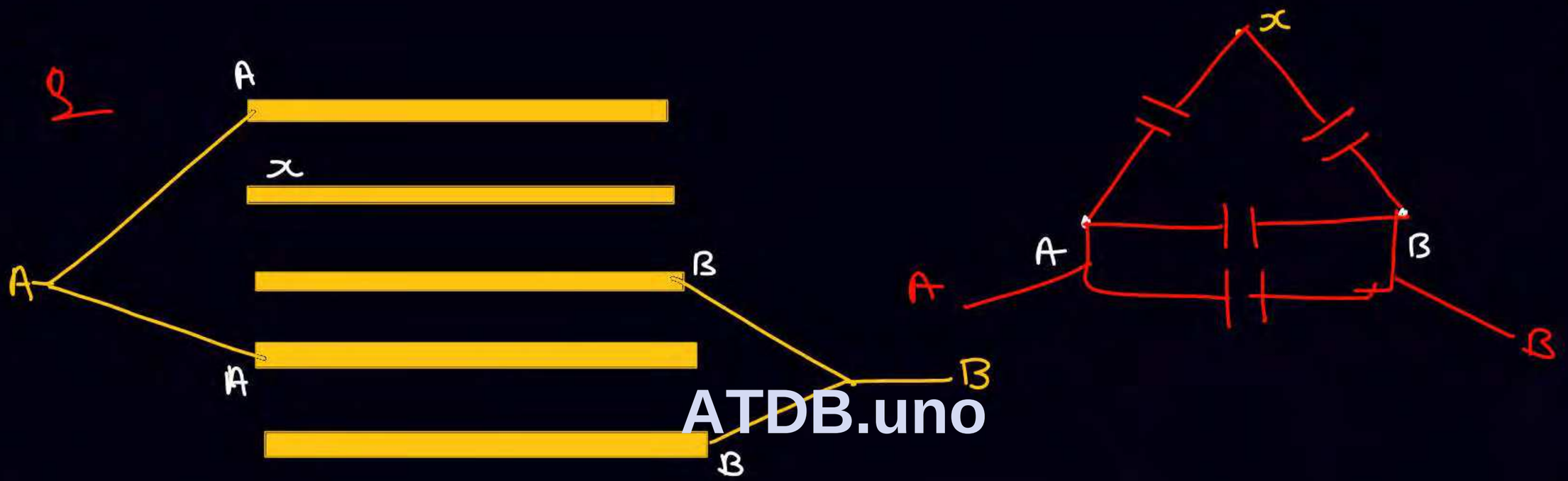
$$C = \frac{A\epsilon_0}{d}, \quad C_{eq} = 3C$$

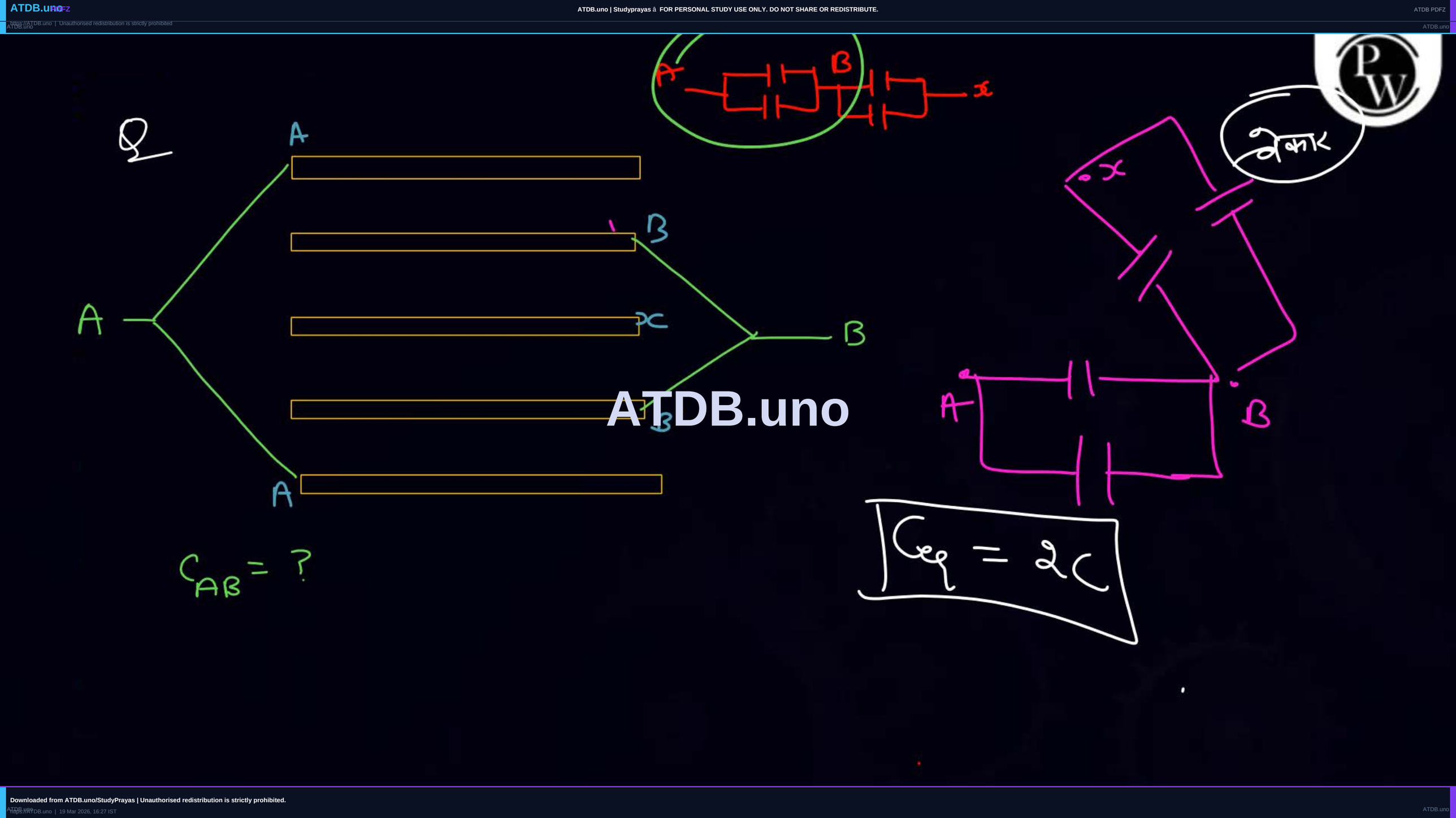
$$C = \frac{A\epsilon_0}{d}$$

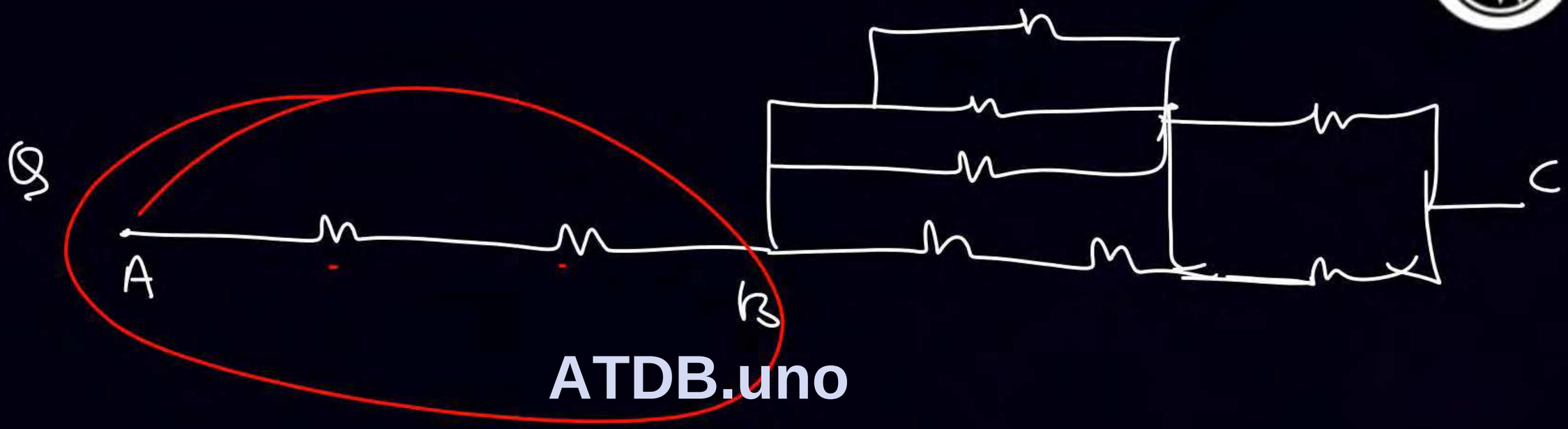


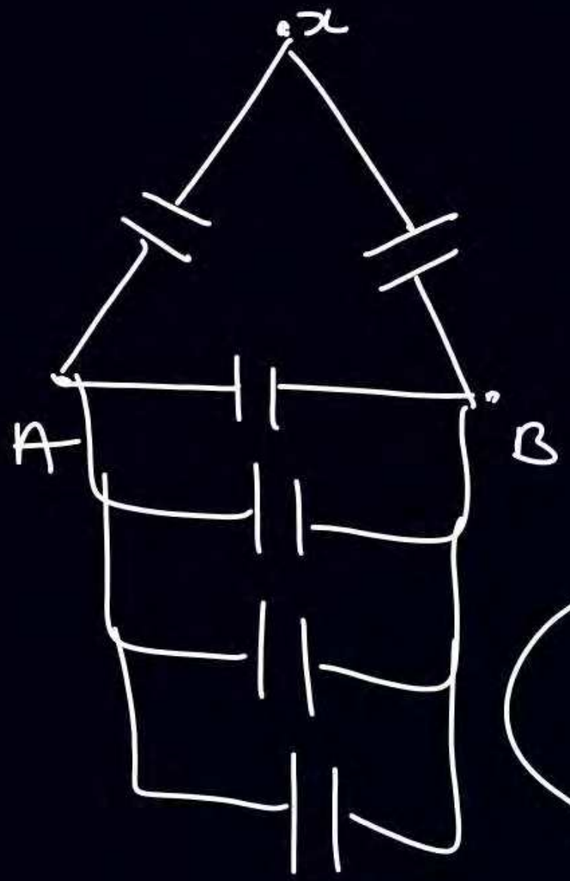


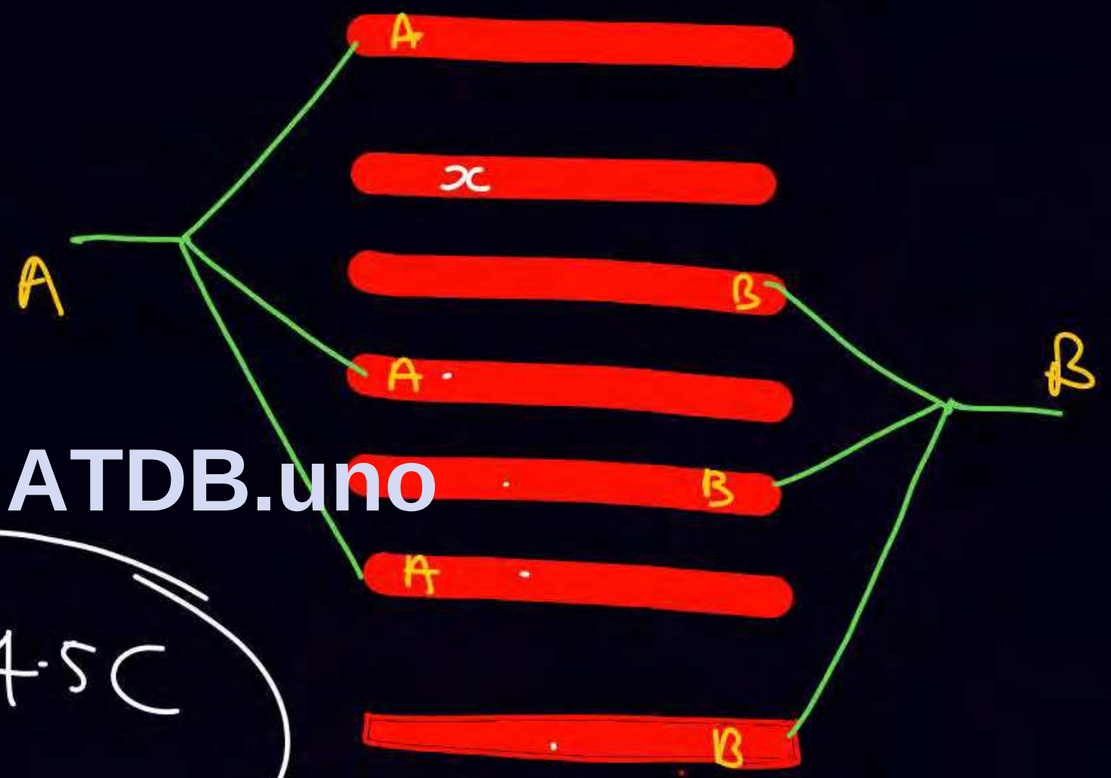
$$C = \frac{A\epsilon_0}{d}, \quad C_{eq} = 9C$$







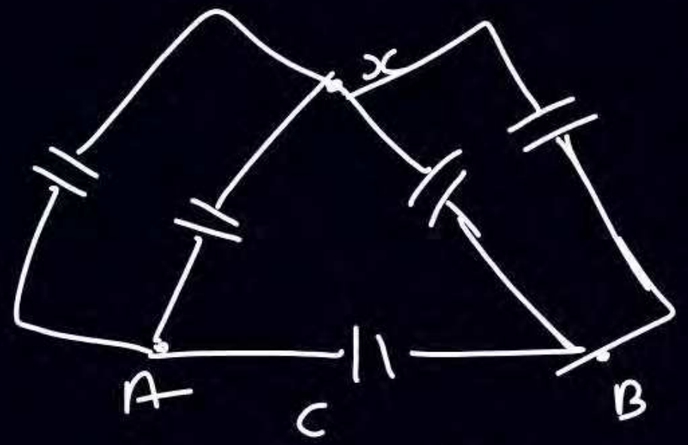




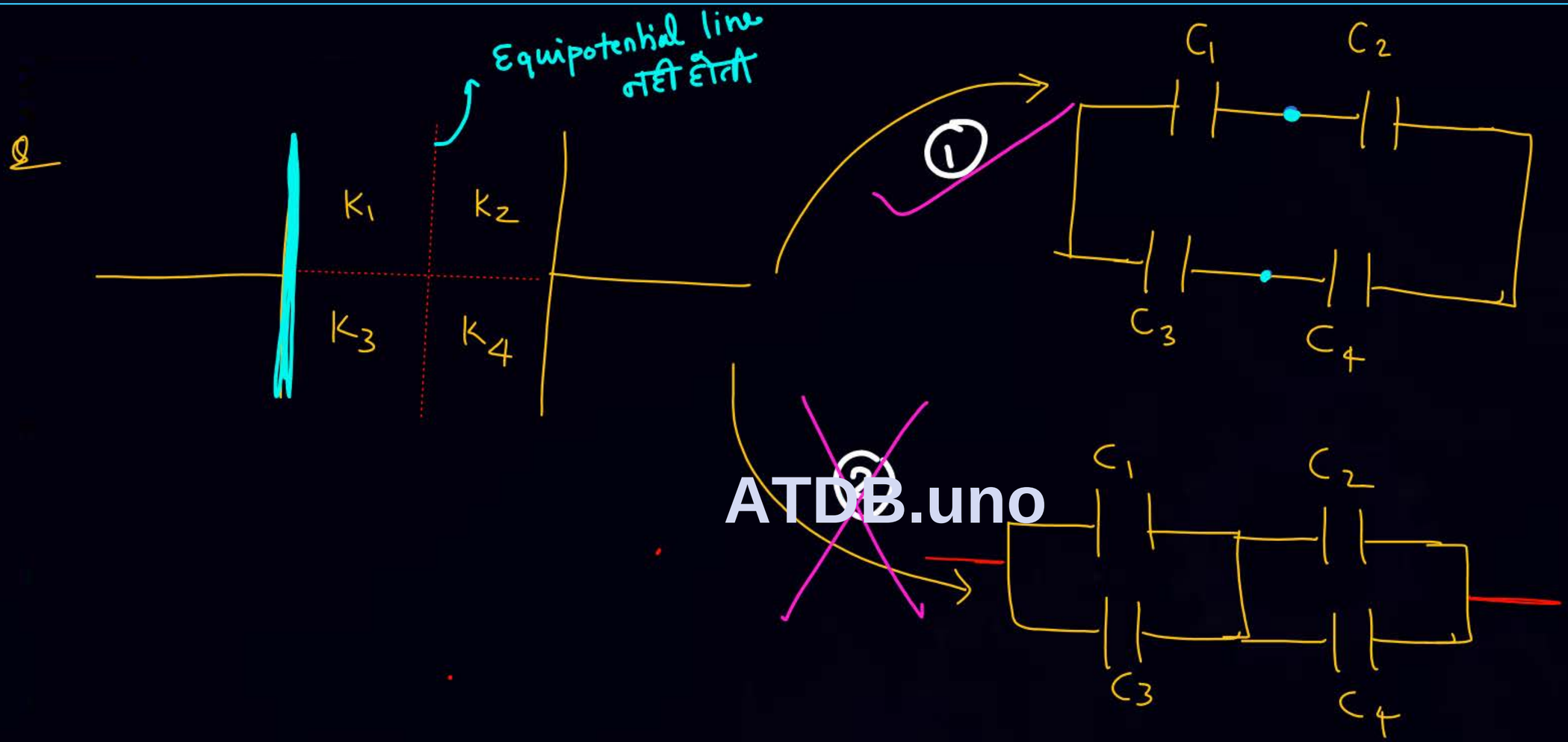
$C_{eq} = 4.5C$

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

Q



$C_{eq} = 2C$



If two appliances with rating (W_1, V) & (W_2, V) are connected to V

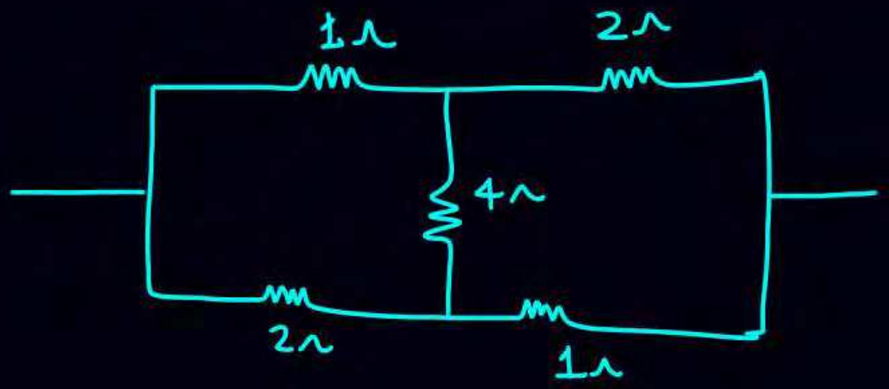
① In parallel $\Rightarrow$ Total power dissipated $= W_1 + W_2$

② In series $\Rightarrow$ " " $= W_{net}$ then $\frac{1}{W_{net}} = \frac{1}{W_1} + \frac{1}{W_2}$

$\mathcal{X}$ $P_{net} = \frac{V^2}{R_{eq}}$, $P_{net} = i^2 R_{eq}$

Dissipated Dissipated

Q find R_{eq} = ?

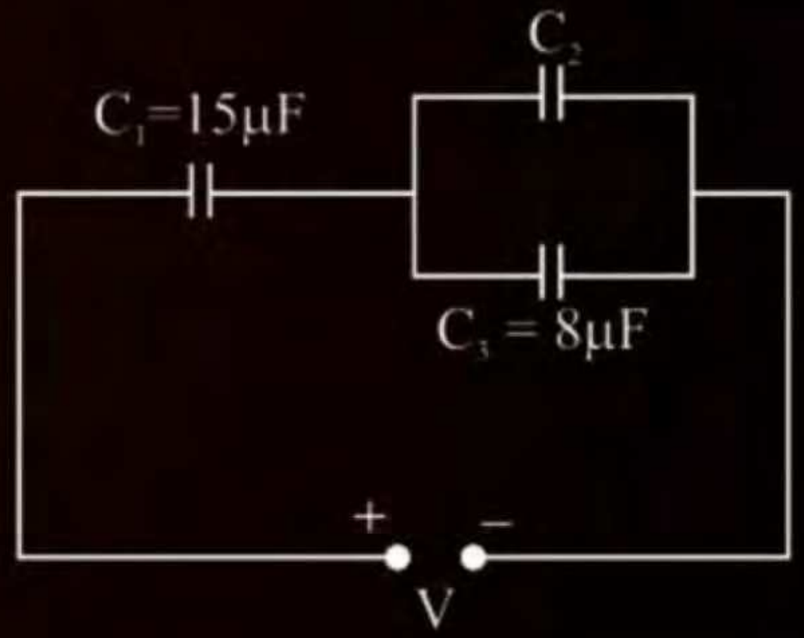


QUESTION –

In the circuit shown in the figure, the total charge is 750 μC and the voltage across capacitor C_2 is 20 V. Then the charge on capacitor C_2 is:

[JEE Mains-2020]

1. 590 μC
2. 450 μC
3. 650 μC
4. 160 μC



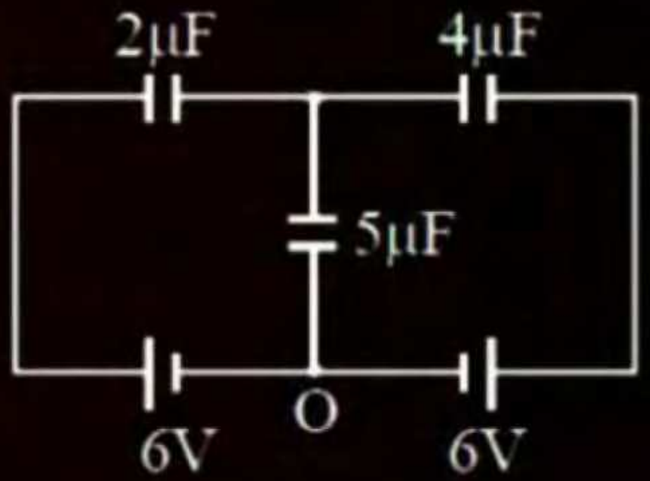
Ans. (1)

QUESTION –

In the circuit shown, charge on the 5μF capacitor is:

[JEE Mains-2020]

1. 5.45μ C
2. 16.36μ C
3. 10.90μ C
4. 18.00μ C

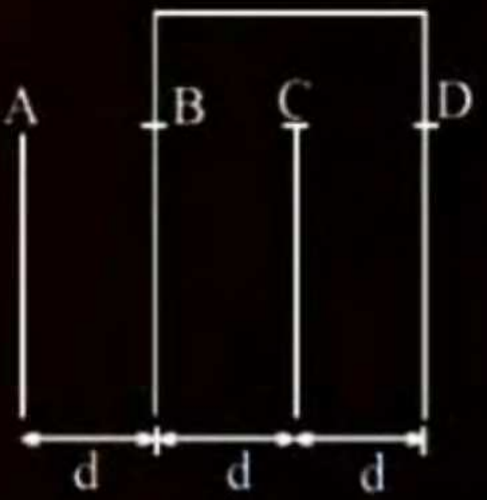


Ans. (2)

QUESTION –

Four identical rectangular plates with length, l = 2 cm and breadth, b = $\frac{3}{2}$ cm are arranged as shown in figure. The equivalent capacitance between A and C is $\frac{X\varepsilon_0}{d}$. The value of x is _____. (Round off to the Nearest Integer)

[JEE Mains-2021]

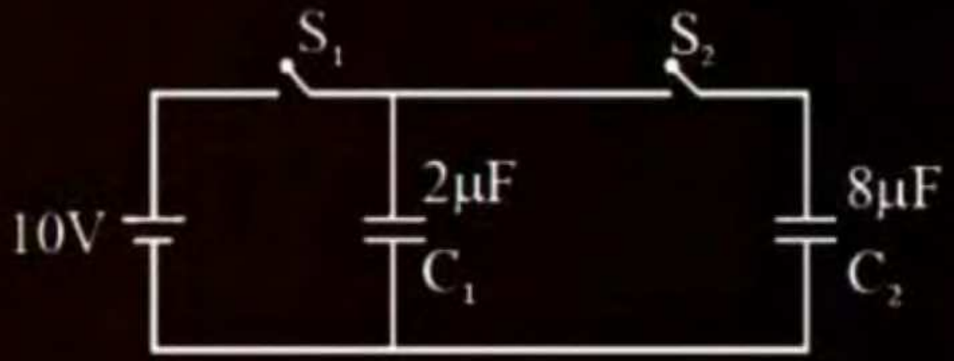


Ans. (2)

QUESTION –

A 2 μF capacitor C_1 is first charged to a potential difference of 10 V using a battery. Then the battery is removed and the capacitor is connected to an uncharged capacitor C_2 of 8 μF. The charge in C_2 on equilibrium condition is _____ μC. (Round off to the Nearest Integer)

[JEE Mains-2021]

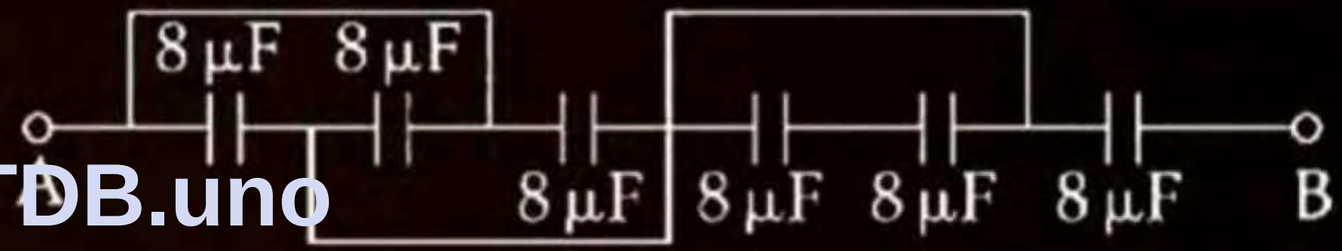


Ans. (16)

QUESTION –

The equivalent capacitance between points A and B on below shown figure will be _____μF

[JEE Mains-2022]

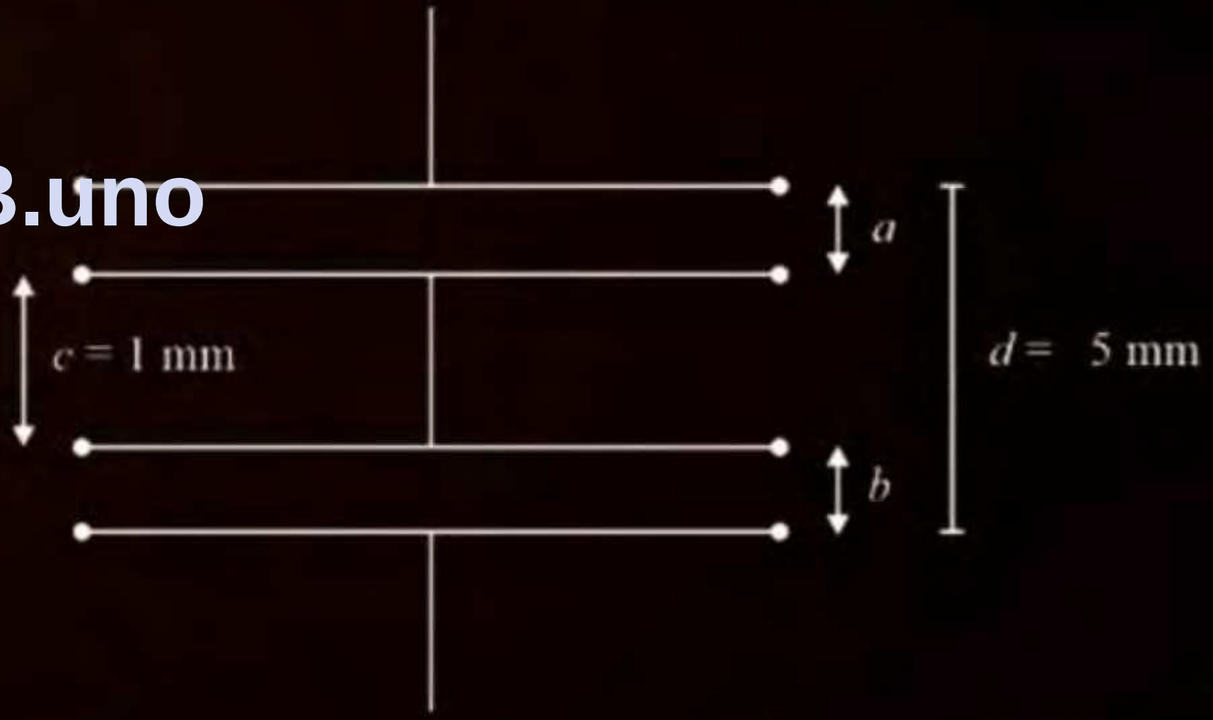


Ans. (6)

QUESTION –)

As shown in the figure, two parallel plate capacitors having equal plate area of 200 cm^2 are joined in such a way that a ≠ b. The equivalent capacitance of the combination is $x\varepsilon_0$ F. The value of x is _____.

[06 April 2023 - Shift 2]



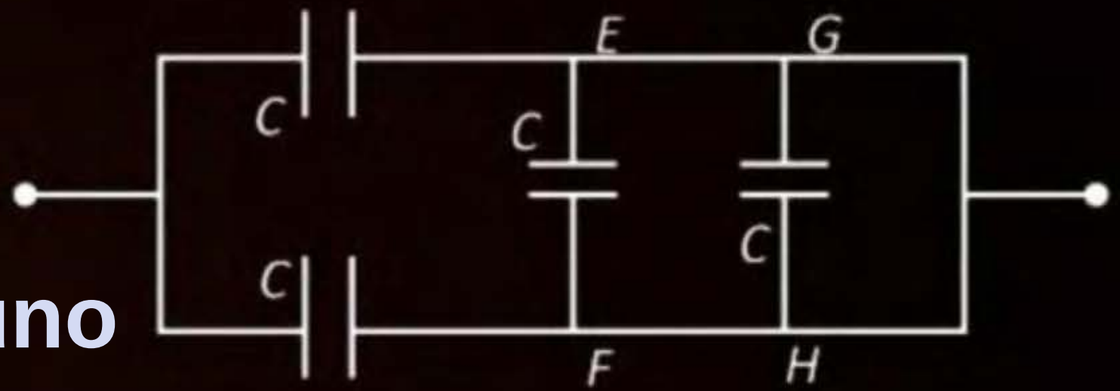
Ans : (5)

QUESTION –

The equivalent capacitance of the combination shown is

[10 April 2023 - Shift 1]

1. 2C
2. $\frac{5}{3}$C
3. $\frac{C}{2}$
4. 4C

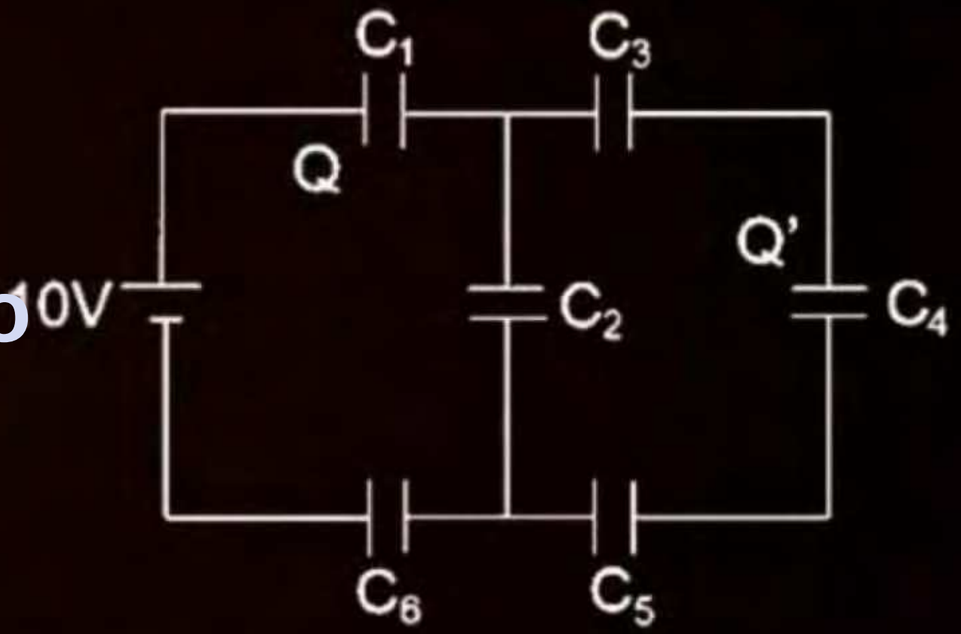


Ans. (1)

QUESTION –

In the given circuit. $C_1 = 2\mu F$, $C_2 = 0.2\mu F$, $C_3 = 2\mu F$, $C_4 = 4\mu F$, $C_5 = 2\mu F$, $C_6 = 2\mu F$. The charge stored on capacitor C_4 is _____ μC.

[11 April 2023 - Shift 2]

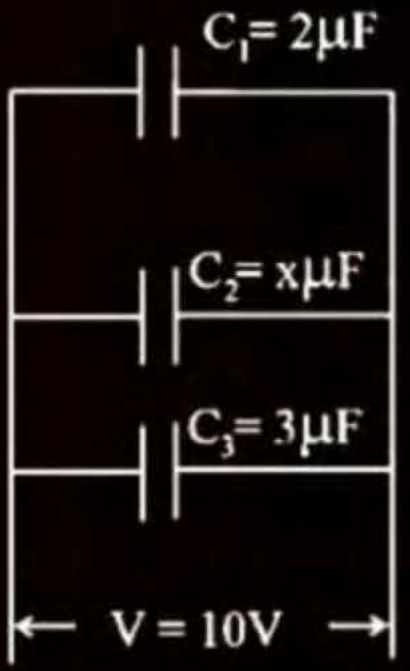


Ans. (4)

QUESTION –

In the given figure the total charge stored in the combination of capacitors is 100μC. The value of 'x' is _____.

[15 April 2023 - Shift 1]

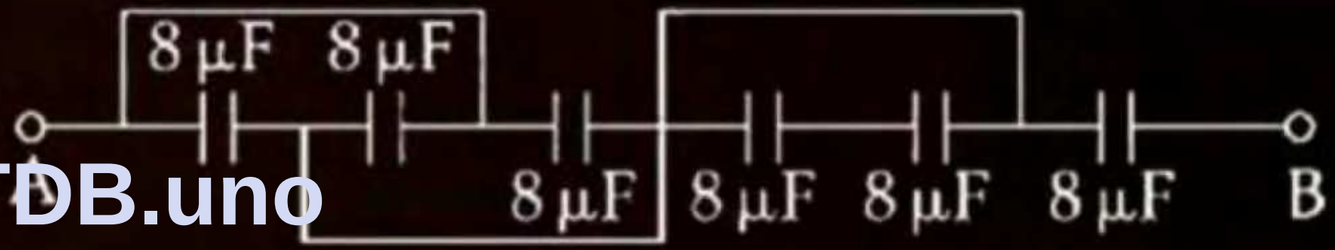


Ans. (5)

QUESTION –

The equivalent capacitance between points A and B on below shown figure will be _____μF

[JEE Mains-2022]



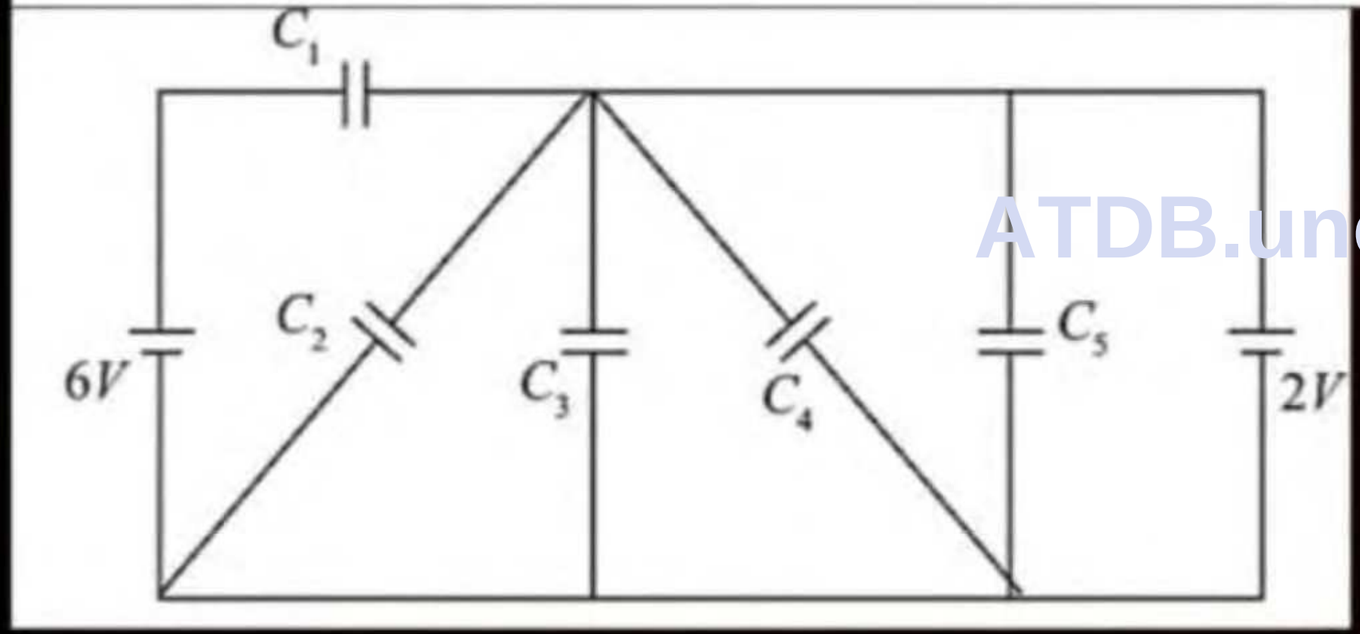
Ans. (6)

QUESTION

ε

12. In the following circuit $C_1 = 12\mu F$, $C_2 = C_3 = 4\mu F$ and $C_4 = C_5 = 2\mu F$. The charge stored in C_3 is _____ μC.

(JEE Adv. 2022)

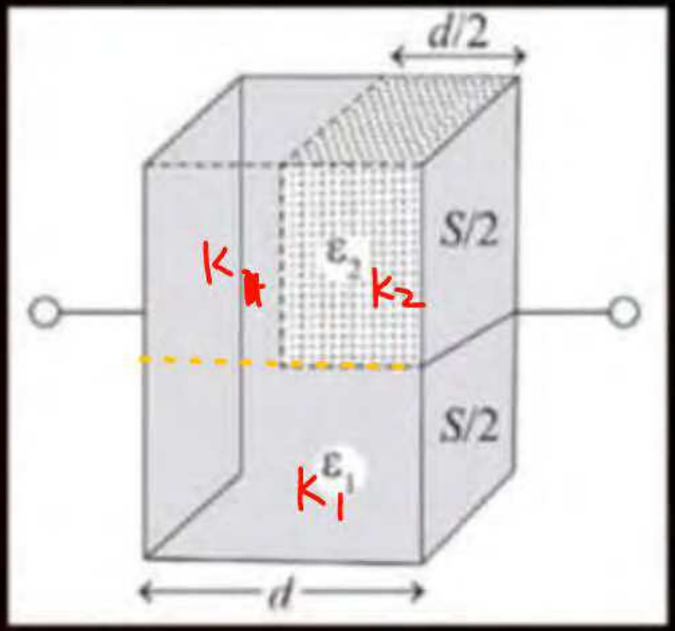


Ans. (8)

QUESTION

$C_1 = \frac{A\varepsilon_0}{d}$

14. A parallel plate capacitor having plates of area S and plate separation d, has capacitance C_1 in air. When two dielectrics of different relative permittivity's ($\varepsilon_1 = 12$ and $\varepsilon_2 = 4$) are introduced between the two plates as shown in the figure, the capacitance becomes C_2. The ratio $\frac{C_2}{C_1}$ is **(JEE Adv. 2015)**



(1) $\frac{6}{5}$ (2) $\frac{5}{3}$

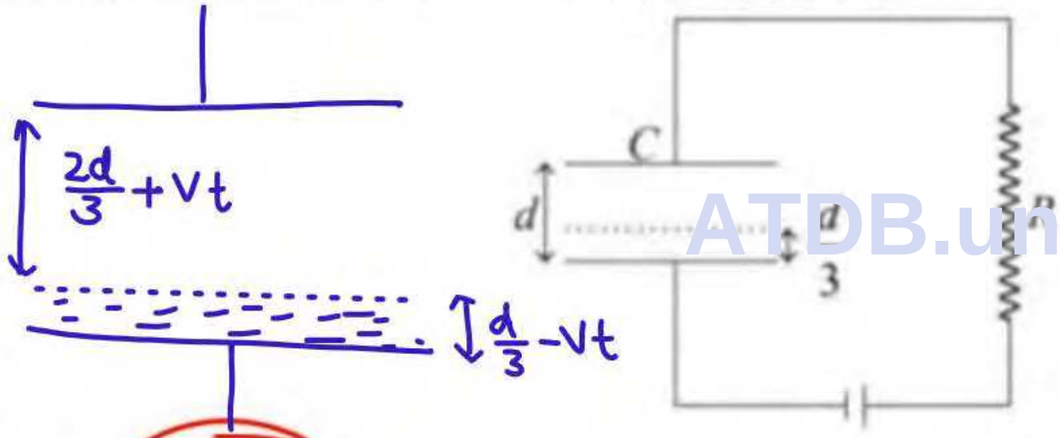
(3) $\frac{7}{5}$ (4) $\frac{7}{3}$

Ans. (4)

QUESTION

Ex

26. A parallel plate capacitor C with plates of unit area and separation d is filled with a liquid of dielectric constant $K = 2$. The level of liquid is $d/3$ initially. Suppose the liquid level decreases at a constant speed v, the time constant as a function of time t is **(IIT-JEE 2008)**



$\tau = R C_{eq}$

(a) $\dfrac{6\varepsilon_0 R}{5d+3vt}$

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

(c) $\dfrac{6\varepsilon_0 R}{5d-3vt}$

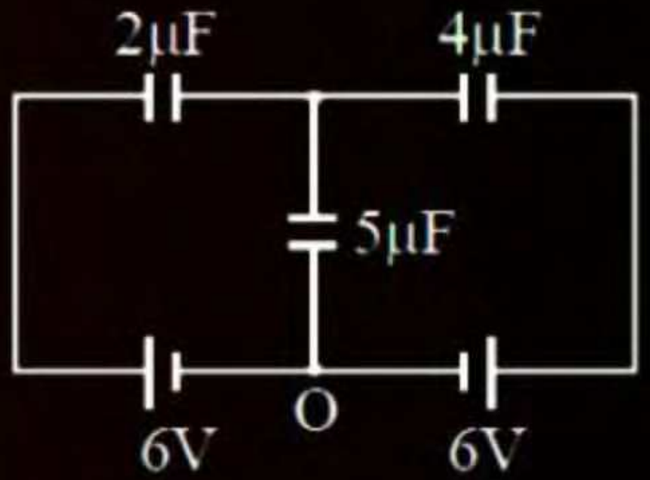
(d) $\dfrac{(15d-9vt)\varepsilon_0 R}{2d^2+3dvt-9v^2t^2}$

QUESTION – 02

In the circuit shown, charge on the 5μF capacitor is:

[JEE Mains-2020]

1. 5.45μ C
2. 16.36μ C
3. 10.90μ C
4. 18.00μ C



Ans. (2)

QUESTION – 03

Two equal capacitors are first connected in series and then in parallel. The ratio of the equivalent capacities in the two cases will be:

[JEE Mains-2021]

1. 4 : 1
2. 2 : 1
3. 1 : 4
4. 1 : 2

Ans. (3)

QUESTION – 04

Consider the combination of 2 capacitors C_1 and C_2, with $C_2 > C_1$, when connected in parallel, the equivalent capacitance is $\frac{15}{4}$ time the equivalent capacitance of the same connected in series. Calculate the ratio of capacitors, $\frac{C_2}{C_1}$.

[JEE Mains-2021]

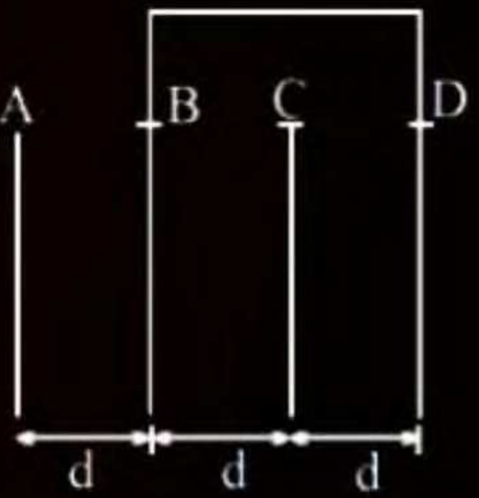
1. $\frac{15}{11}$
2. $\frac{111}{80}$
3. $\frac{29}{15}$
4. None of these

Ans. (4)

QUESTION – 07

Four identical rectangular plates with length, $l = 2$ cm and breadth, $b = \frac{3}{2}$ cm are arranged as shown in figure. The equivalent capacitance between A and C is $\frac{X\varepsilon_0}{d}$. The value of x is _____. (Round off to the Nearest Integer)

[JEE Mains-2021]

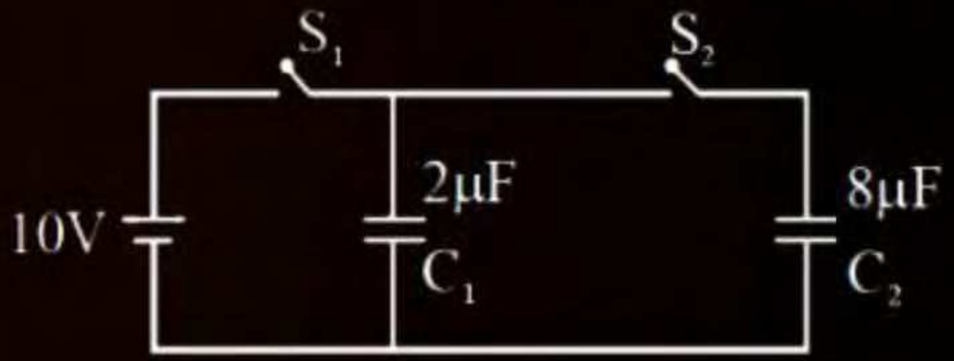


Ans. (2)

QUESTION – 08

A 2 μF capacitor C_1 is first charged to a potential difference of 10 V using a battery. Then the battery is removed and the capacitor is connected to an uncharged capacitor C_2 of 8 μF. The charge in C_2 on equilibrium condition is _____ μC. (Round off to the Nearest Integer)

[JEE Mains-2021]

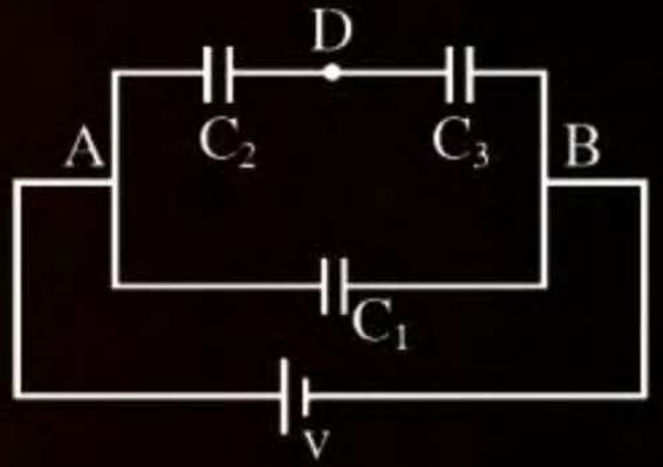


Ans. (16)

QUESTION – 12

Three capacitors $C_1 = 2\ \mu F$, $C_2 = 6\ \mu F$ and $C_3 = 12\ \mu F$ are connected as shown in figure. Find the ratio of the charges on capacitors C_1, C_2 and C_3 respectively: **[JEE Mains-2021]**

1. 2 : 1 : 1
2. 2 : 3 : 3
3. 1 : 2 : 2
4. 3 : 4 : 4



Ans. (3)

QUESTION – 15

The total charge on the system of capacitance $C_1 = 1\mu F$, $C_2 = 2\ \mu F$, $C_3 = 4\ \mu F$ and $C_4 = 3\ \mu F$ connected in parallel is (Assume a battery of 20V is connected to the combination)

[JEE Mains-2022]

1. $200\mu C$
2. $200C$
3. $10\mu C$
4. $10C$

Ans. (1)

QUESTION – 19

If the charge on a capacitor is increased by 2C, the energy stored in increases by 44%. The original charge on the capacitor is (in C):

[JEE Mains-2022]

1. 10
2. 20
3. 30
4. 40

Ans. (1)

QUESTION – 20

The equivalent capacitance between points A and B on below shown figure will be _____μF

[JEE Mains-2022]

Ans. (6)

QUESTION – 21

Two metallic plated form a parallel plate capacitor. The distance between the plates is 'd'. A metal sheet of thickness $\frac{d}{2}$ and of area equal to area of each plate is introduced between the plates. What will be the ratio of the new capacitance to the original capacitance of the capacitor?

[JEE Mains-2022]

1. 2 : 1
2. 1 : 3
3. 1 : 4
4. 4 : 1

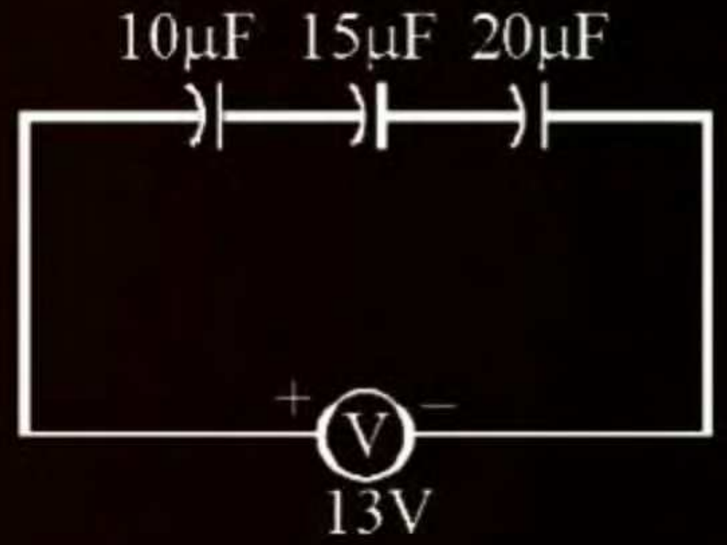
Ans. (1)

QUESTION – 22

The charge on capacitor of capacitance 15μF in the figure given below is :

[JEE Mains-2022]

1. 60μC
2. 130μC
3. 260μC
4. 585μC



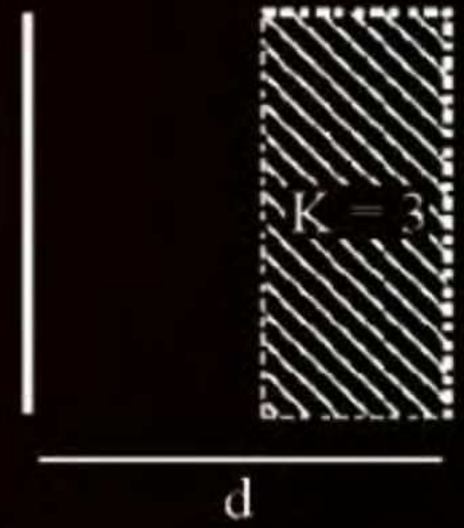
Ans. (1)

QUESTION – 23

A parallel plate capacitor with plate area A and plate separation d = 2 m has a capacitance of 4 μF. The new capacitance of the system if half of the space between them is filled with a dielectric material of dielectric constant K = 3 (as shown in figure) will be :

[JEE Mains-2022]

1. 2μF
2. 32μF
3. 6μF
4. 8μF



Ans. (3)

QUESTION – 24

A force of 10N acts on a charged particle placed between two plates of a charged capacitor. If one plate of capacitor is removed, then the force acting on that particle will be:

[JEE Mains-2022]

1. 5 N
2. 10 N
3. 20 N
4. Zero

Ans. (1)

QUESTION – 25

A parallel plate capacitor filled with a medium of dielectric constant 10, is connected across a battery and is charged. The dielectric slab is replaced by another slab of dielectric constant 15. Then the energy of capacitor will: **[JEE Mains-2022]**

1. increase by 50%
2. decrease by 15%
3. increase by 25%
4. increase by 33%

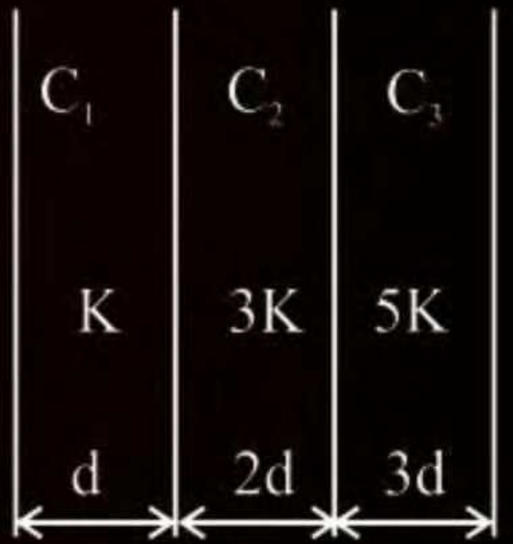
Ans. (1)

QUESTION – 40

In the reported figure, a capacitor is formed by placing a compound dielectric between the plates of parallel plate capacitor. The expression for the capacity of the said capacitor will be: (Given area of plate = A)

[JEE Mains-2021]

1. $\frac{15}{34}\frac{K\varepsilon_0 A}{d}$
2. $\frac{15}{6}\frac{K\varepsilon_0 A}{d}$
3. $\frac{25}{6}\frac{K\varepsilon_0 A}{d}$
4. $\frac{9}{6}\frac{K\varepsilon_0 A}{d}$



Ans. (1)

QUESTION – 49

A composite parallel plate capacitor is made up of two different dielectric materials with different thickness (t_1 and t_2) as shown in figure. The two different dielectric material are separated by a conducting foil F. The voltage of the conducting foil is _____V.

[JEE Mains-2022]

Ans. (60)

QUESTION – 59

A parallel plate capacitor with air between the plate has a capacitance of 15 pF. The separation between the plate becomes twice and the space between them is filled with a medium of dielectric constant 3.5. Then the capacitance becomes $\frac{x}{4}$ pF. The value of x is:

[24 January 2023 - Shift 2]

Ans. (105)

QUESTION – 60

A parallel plate capacitor has plate area $40cm^2$ and plates separation 2 mm. The space between the plates is filled with a dielectric medium of a thickness 1 mm and dielectric constant 5 . The capacitance of the system is:

[25 January 2023 - Shift 1]

1. $24\varepsilon_0$ F
2. $\frac{3}{10}\varepsilon_0$ F
3. $\frac{10}{3}\varepsilon_0$ F
4. $10\varepsilon_0$ F

Ans. (3)

QUESTION – 61

A capacitor has capacitance 5 μF when it's parallel plates are separated by air medium of thickness d. A slab of material of dielectric constant 1.5 having area equal to that of plates but thickness $\frac{d}{2}$ is inserted between the plates. Capacitance of the capacitor in the presence of slab will be _____μF.

[25 January 2023 - Shift 2]

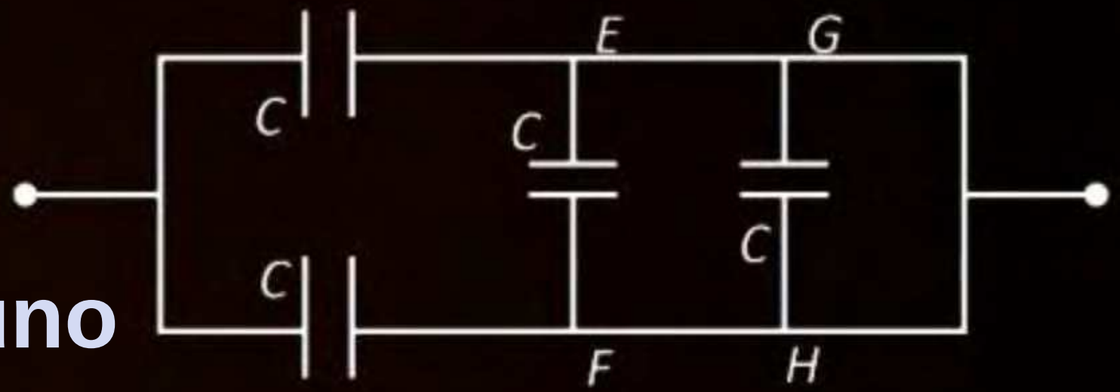
Ans. (6)

QUESTION – 67

The equivalent capacitance of the combination shown is

[10 April 2023 - Shift 1]

1. $2C$
2. $\frac{5}{3}C$
3. $\frac{C}{2}$
4. $4C$



Ans. (1)

QUESTION – 68

The distance between two plates of a capacitor is d and its capacitance is C_1, when air is the medium between the plates. If a metal sheet of thickness $\frac{2d}{3}$ and of the same area as plate is introduced between the plates, the capacitance of the capacitor becomes C_2. The ratio $\frac{C_2}{C_1}$ is.

[10 April 2023 - Shift 2]

1. 3 : 1
2. 2 : 1
3. 4 : 1
4. 1 : 1

Ans. (1)

QUESTION – 71

A capacitor of capacitance C is charged to a potential V. The flux of the electric field through a closed surface enclosing the positive plate of the capacitor is:

[11 April 2023 - Shift 2]

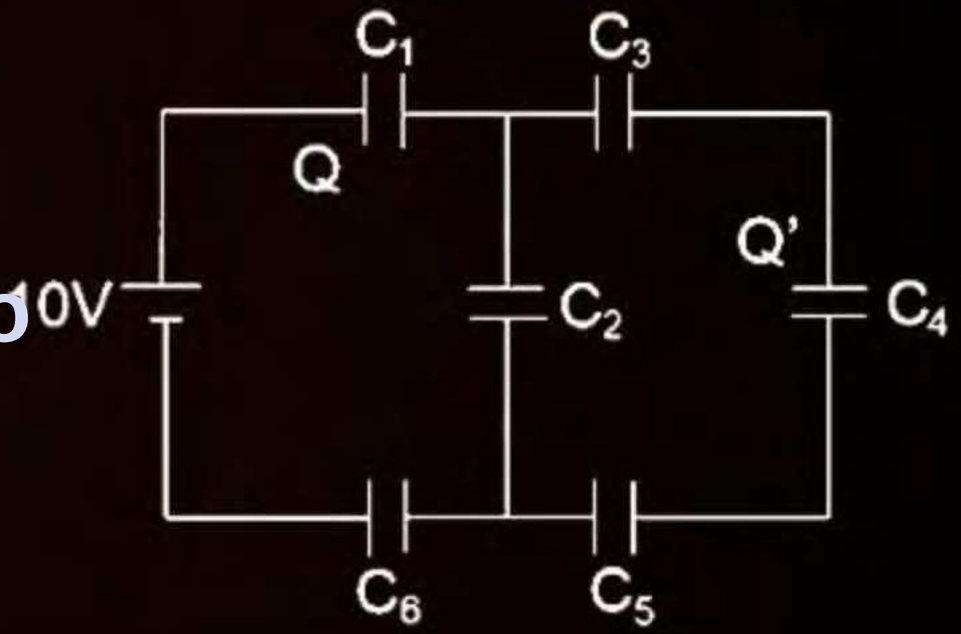
1. $\frac{CV}{\varepsilon_0}$
2. Zero
3. $\frac{2CV}{\varepsilon_0}$
4. $\frac{CV}{2\varepsilon_0}$

Ans. (1)

QUESTION – 72

In the given circuit. $C_1 = 2\mu F$, $C_2 = 0.2\mu F$, $C_3 = 2\mu F$, $C_4 = 4\mu F$, $C_5 = 2\mu F$, $C_6 = 2\mu F$. The charge stored on capacitor C_4 is _____ μC.

[11 April 2023 - Shift 2]

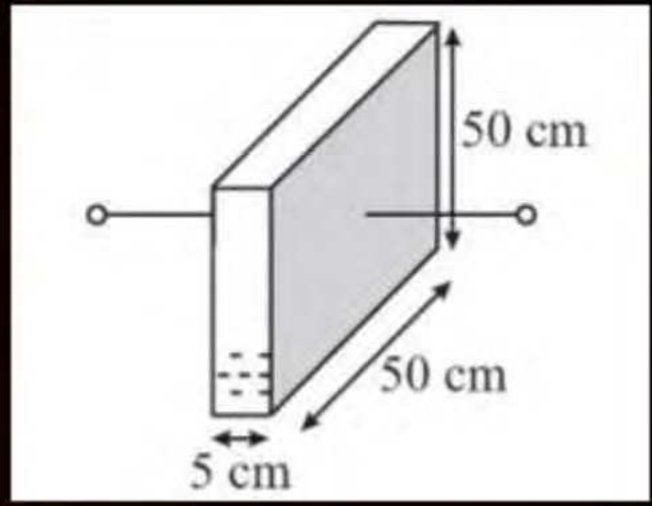


Ans. (4)

QUESTION

8. A container has a base of 50 cm × 5 cm and height 50 cm, as shown in the figure. It has two parallel electrically conducting walls each of area 50 cm × 50 cm. The remaining walls of the container are thin and non-conducting. The container is being filled with a liquid of dielectric constant 3 at a uniform rate of 250 cm^3s^{-1}. What is the value of the capacitance of the container after 10 seconds? [Given: Permittivity of free space $\epsilon_0 = 9 \times 10^{-12}$ C $2N^{-1}m^{-2}$, the effects of the non-conducting walls on the capacitance are negligible]

(JEE Adv. 2023)



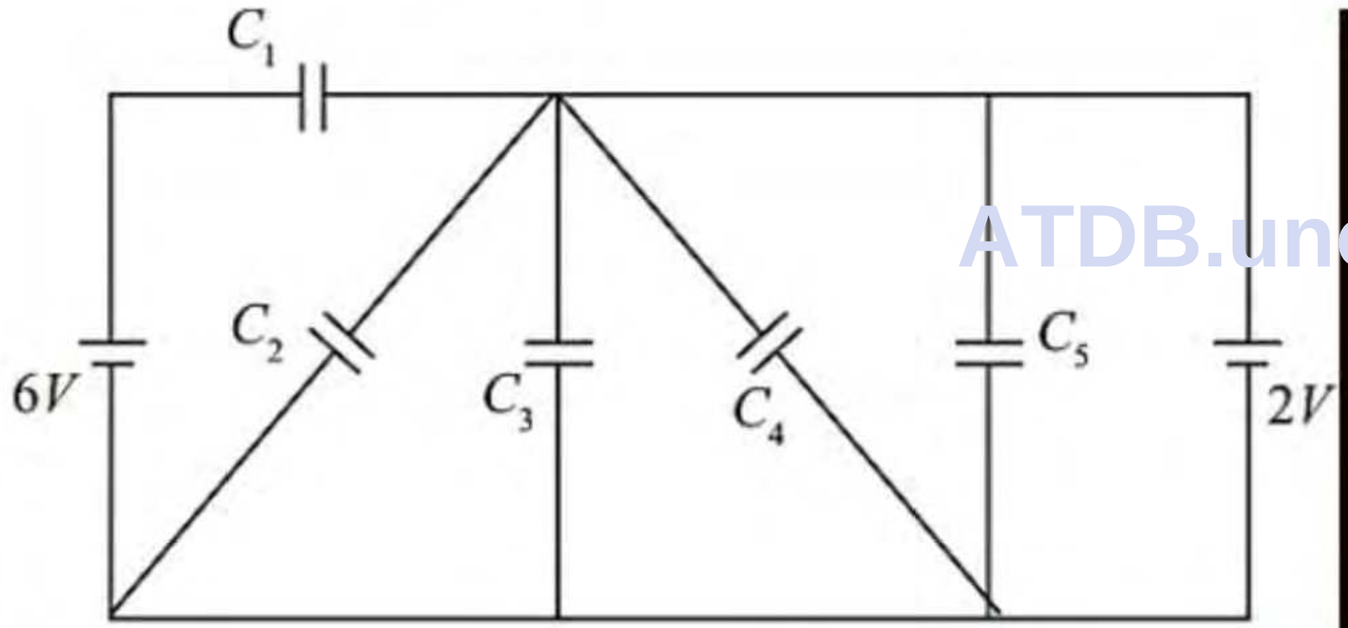
(1) 27 *pF*
(2) 63 *pF*
(3) 81 *pF*
(4) 135 *pF*

Ans. (2)

QUESTION

12. In the following circuit $C_1 = 12\mu F$, $C_2 = C_3 = 4\mu F$ and $C_4 = C_5 = 2\mu F$. The charge stored in C_3 is _____ μC.

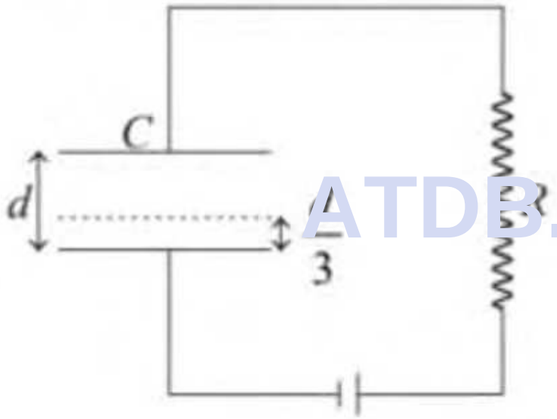
(JEE Adv. 2022)



Ans. (8)

QUESTION

26. A parallel plate capacitor C with plates of unit area and separation d is filled with a liquid of dielectric constant $K = 2$. The level of liquid is $d/3$ initially. Suppose the liquid level decreases at a constant speed v, the time constant as a function of time t is **(IIT-JEE 2008)**



(a) $\dfrac{6\varepsilon_0 R}{5d + 3vt}$

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

(c) $\dfrac{6\varepsilon_0 R}{5d - 3vt}$

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

Ans : (a)

Hcv Quey

ATDB.uno

9. *The negative plate of a parallel plate capacitor is given a charge of* -20×10^{-8} *C. Find the charges appearing on the four surfaces of the capacitor plates.*

Ans. $Q = 10 \times 10^{-8}$ C.

13. *Find the capacitance of the infinite ladder shown in figure (31-W11).*

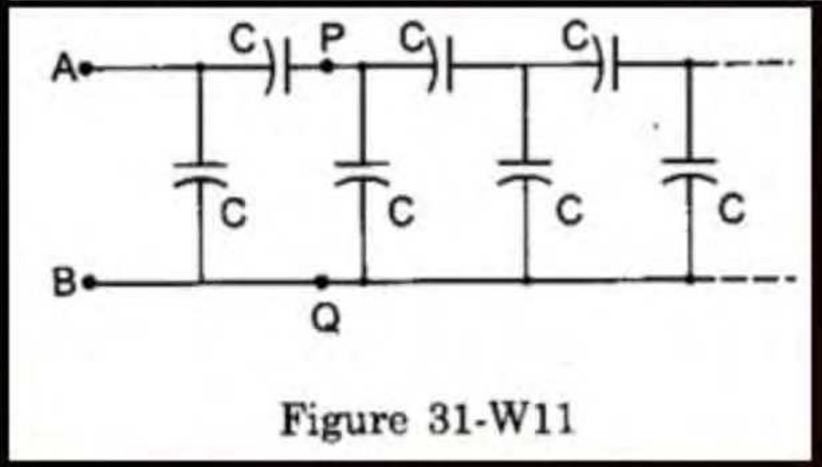


Figure 31-W11

Ans. $C = \frac{C + \sqrt{C^2 + 4C^2}}{2} = \frac{1 + \sqrt{5}}{2} C$

14. *Find the energy stored in the electric field produced by a metal sphere of radius R containing a charge Q.*

Ans. $U = \frac{Q^2}{2C} = \frac{Q^2}{8\pi\varepsilon_0 R}$.

16. *An uncharged capacitor is connected to a battery. Show that half the energy supplied by the battery is lost as heat while charging the capacitor.*

Ans. $U = \frac{1}{2} CV^2 = \frac{1}{2} QV.$

19. *The space between the plates of a parallel-plate capacitor of capacitance C is filled with three dielectric slabs of identical size as shown in figure (31-W13). If the dielectric constants of the three slabs are K_1, K_2 and K_3, find the new capacitance.*

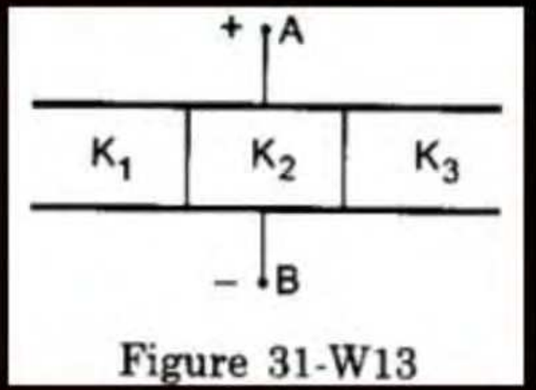


Figure 31-W13

Ans. *

EXERCISES

1. When $1{\cdot}0 \times 10^{12}$ electrons are transferred from one conductor to another, a potential difference of 10 V appears between the conductors. Calculate the capacitance of the two-conductor system.

Ans. 1.6×10^{-8} F

2. The plates of a parallel-plate capacitor are made of circular discs of radii 5·0 cm each. If the separation between the plates is 1·0 mm, what is the capacitance ?

Ans. 6.95×10^{-5} μF

4. A parallel-plate capacitor having plate area 25 cm^2 and separation 1·00 mm is connected to a battery of 6·0 V. Calculate the charge flown through the battery. How much work has been done by the battery during the process ?

Ans. $1{\cdot}33 \times 10^{-10}$ C, $8{\cdot}0 \times 10^{-10}$ J

6. Find the charges on the three capacitors connected to a battery as shown in figure (31-E1). Take $C_1 = 2{\cdot}0\ \mu F$, $C_2 = 4{\cdot}0\ \mu F$, $C_3 = 6{\cdot}0\ \mu F$ and $V = 12$ volts.

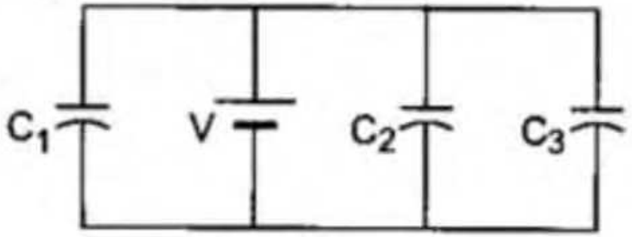


Figure 31-E1

Ans. 24 μC, 48 μC, 72 μC

8. Find the charge appearing on each of the three capacitors shown in figure (31-E2).

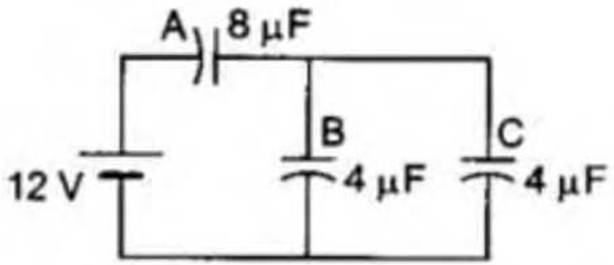


Figure 31-E2

Ans. 48 μC on the 8 μF capacitor and 24 μC on each of the

9. Take $C_1 = 4{\cdot}0\ \mu F$ and $C_2 = 6{\cdot}0\ \mu F$ in figure (31-E3). Calculate the equivalent capacitance of the combination between the points indicated.

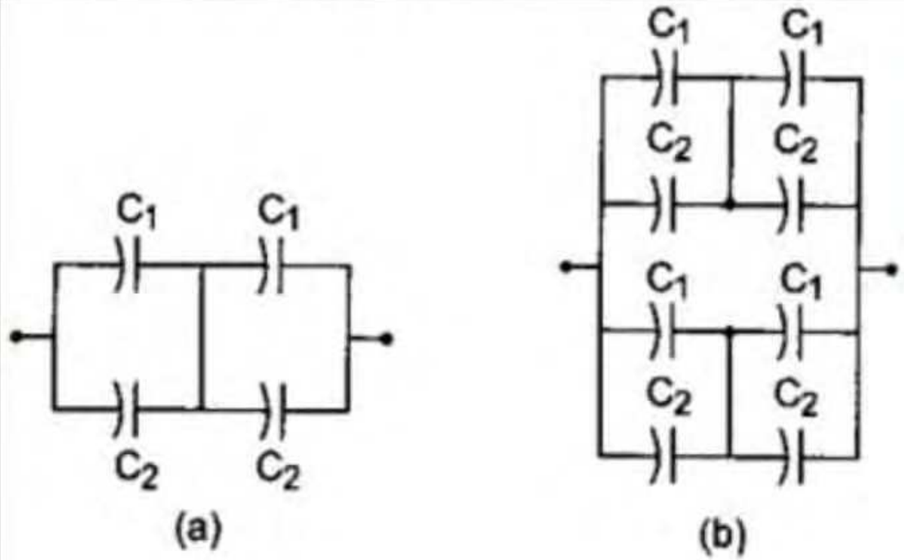


Figure 31-E3

Ans. (a) 5 μF, (b) 10 μF

10. Find the charge supplied by the battery in the arrangement shown in figure (31-E4).

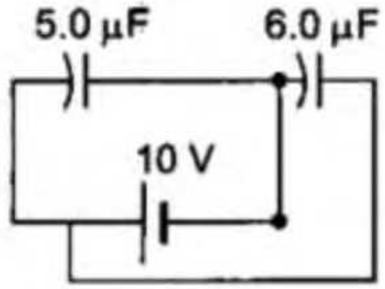


Figure 31-E4

Ans. 110 μC

16. Find the equivalent capacitance of the system shown in figure (31-E8) between the points a and b.

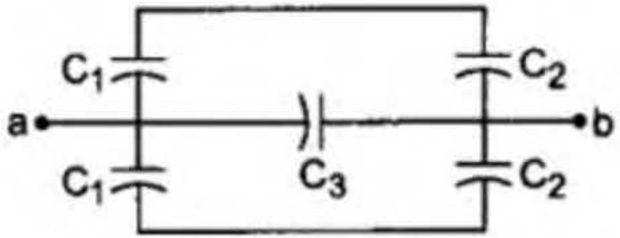


Figure 31-E8

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

20. Each capacitor shown in figure (31-E10) has a capacitance of 5·0 μF. The emf of the battery is 50 V. How much charge will flow through *AB* if the switch *S* is closed ?

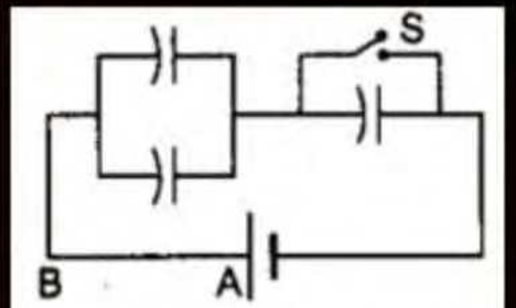
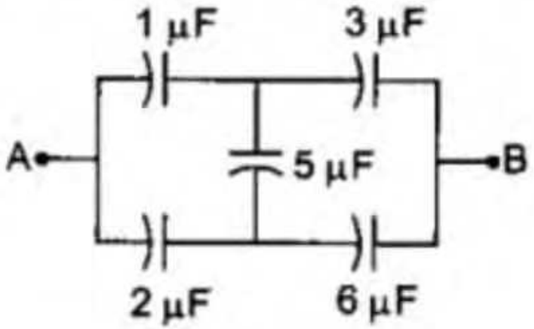


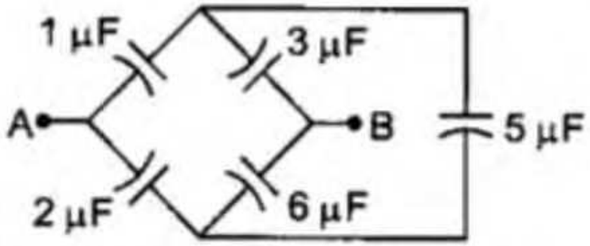
Figure 31-E10

Ans. 3.3×10^{-4} C

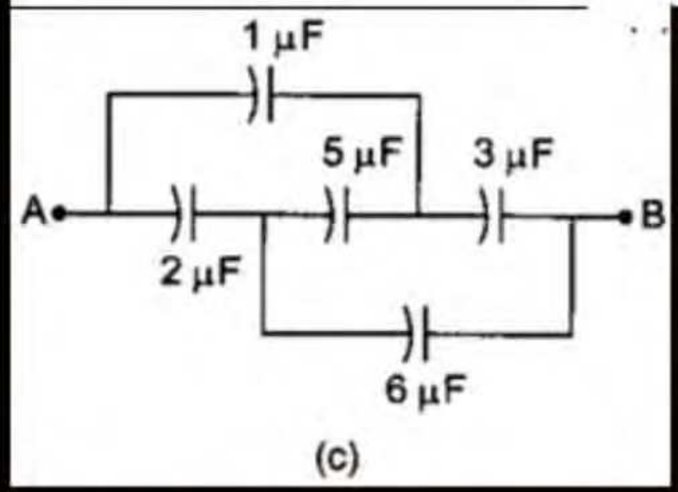
24. Convince yourself that parts (a), (b) and (c) of figure (31-E13) are identical. Find the capacitance between the points A and B of the assembly.



(a)



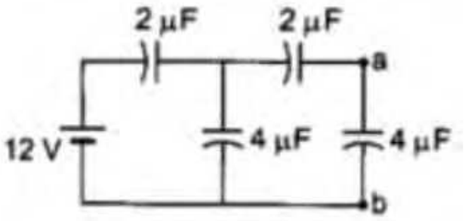
(b)



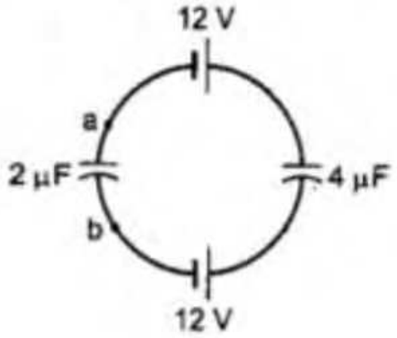
(c)

Ans. 2.25 μF

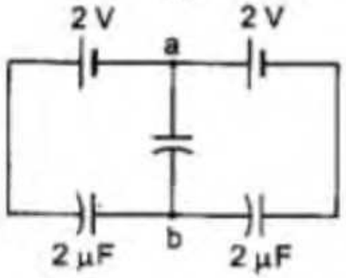
25. Find the potential difference $V_a - V_b$ between the points a and b shown in each part of the figure (31-E14).



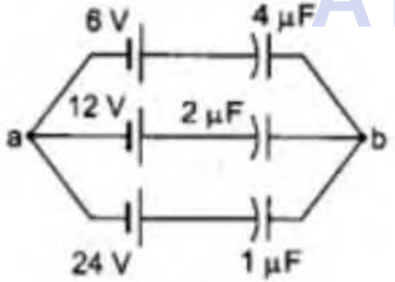
(a)



(b)



(c)



(d)

Figure 31-E14

Ans. (a) $\frac{12}{11}$ V (b) – 8 V (c) zero (d) – 10·3 V

26. Find the equivalent capacitances of the combinations shown in figure (31-E15) between the indicated points.

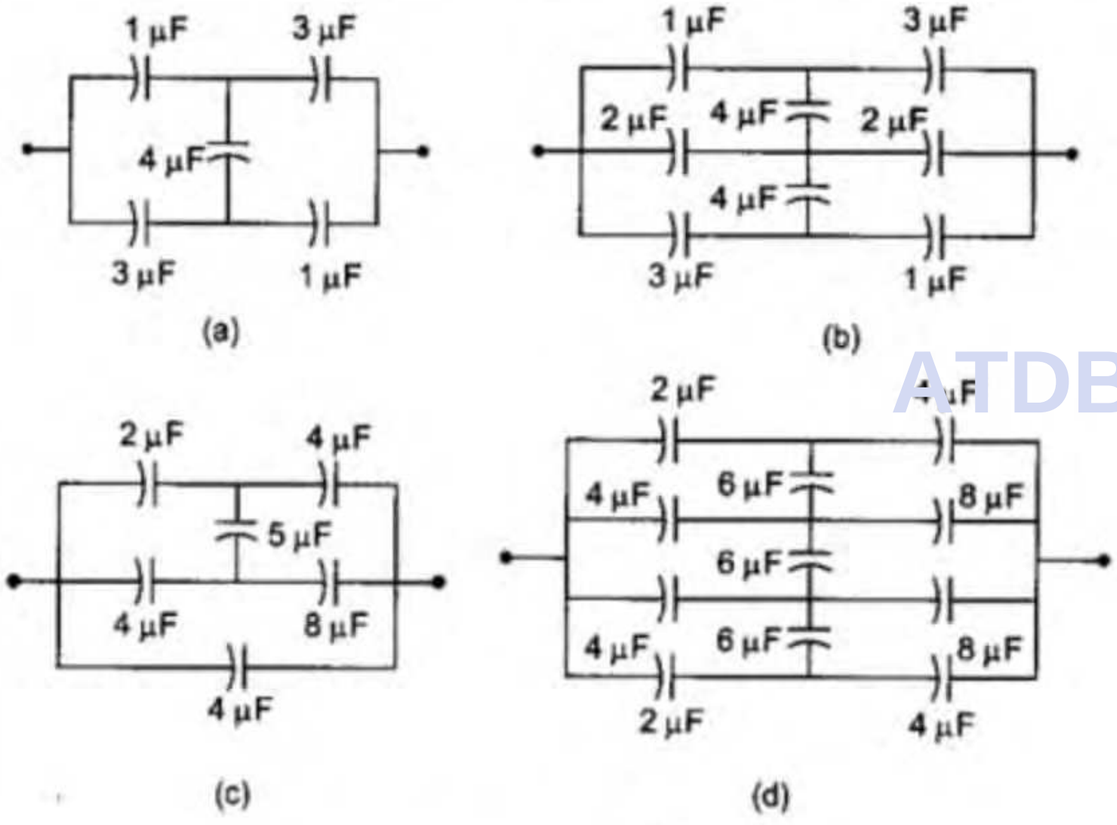


Figure 31-E15

Ans. (a) $\frac{11}{}$ μF (b) $\frac{11}{}$ μF (c) 8 μF (d) 8 μF

27. Find the capacitance of the combination shown in figure (31-E16) between A and B.

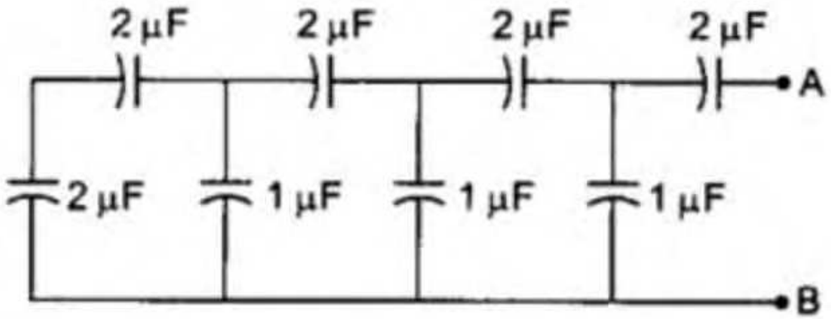


Figure 31-E16

Ans. 1 μF

28. Find the equivalent capacitance of the infinite ladder shown in figure (31-E17) between the points A and B.

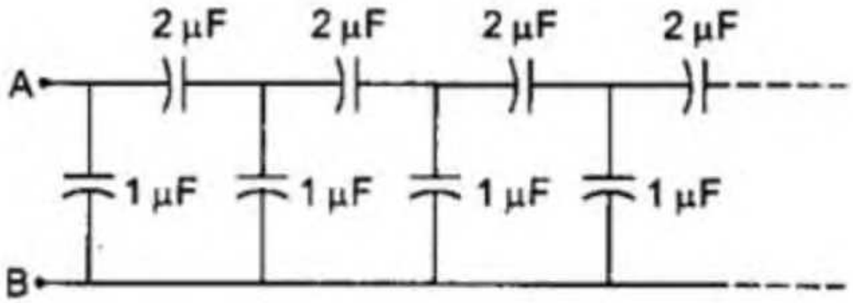


Figure 31-E17

Ans. 2 μF

32. A charge of 1 μC is given to one plate of a parallel-plate capacitor of capacitance 0·1 μF and a charge of 2 μC is given to the other plate. Find the potential difference developed between the plates.

Ans. 5 V