Physicsaholics

DPP – 2 (Capacitor)

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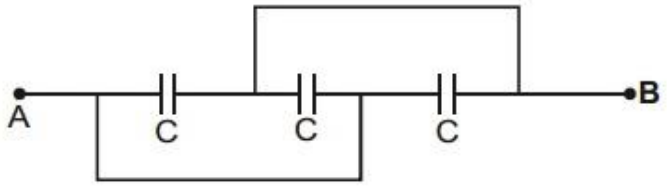
Q 1. Find the equivalent capacitance of the given circuit:

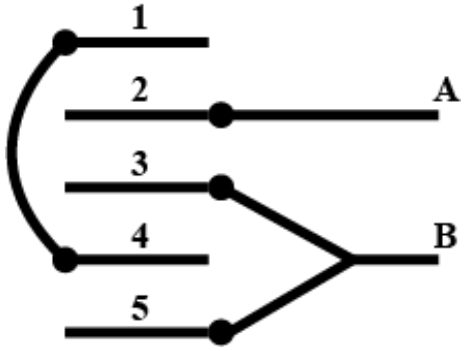


(a) $\frac{3C}{2}$ (b) $\frac{C}{3}$
(c) 3C (d) C

Q 2. A capacitor $C_1 = 4\ \mu F$ is connected in series with another capacitor $C_2 = 1\ \mu F$. he combination is connected across a D.C. source of voltage 200 V. The ration of potential across C_1 and C_2 is:
(a) 1 : 4 (b) 4 : 1
(c) 1 : 2 (d) 2 : 1

Q 3. The equivalent capacitance of three capacitors of capacitance C_1, C_2 and C_3 connected in parallel is 12 units and the product $C_1C_2C_3$ =48. When the capacitors C_1 and C_2 are connected in parallel the equivalent capacitance is 6 units. Then the capacitance are :
(a) 1.5, 2.5, 8 (b) 2, 3, 7
(c) 4, 2, 6 (d) 1, 5, 6

Q 4. Five identical metal plates 1, 2, 3, 4 and 5 each of area A on one side are fixed parallel and equidistant (d) to each other. The plates 1 and 4 are joined by a conductor, and plates 3 and 5 are also joined by a conductor as shown in figure. Then, the capacitance of this system between A and B is-



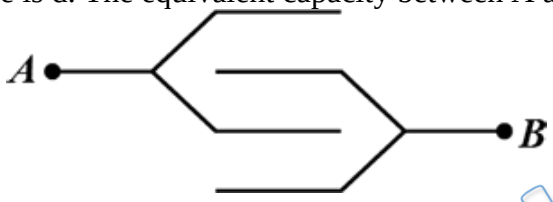
(a) $\frac{5\varepsilon_o A}{d}$ (b) $\frac{4\varepsilon_o A}{d}$

(c) $\frac{5\varepsilon_o A}{3d}$ (d) none of these

Q 5. Three capacitors of capacitances 2 pF, 3pF and 4pF are connected in parallel. What is the total capacitance of the combination?

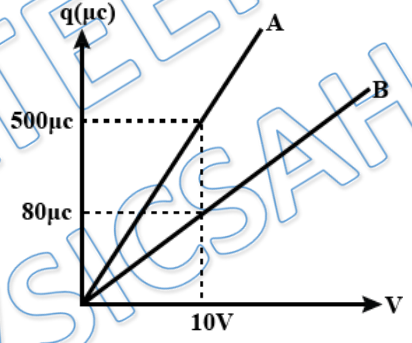
(a) 9 pF (b) 1 pF
(c) 5 pF (d) 15 pF

Q 6. Four plates of same area of cross-section A are joined as shown in figure. The distance between each plate is d. The equivalent capacity between A and B will be



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

Q 7. Plot A&B represent variation of charge with potential difference across the combination (series and parallel) of two capacitors. Then find the value of capacitance of capacitors.

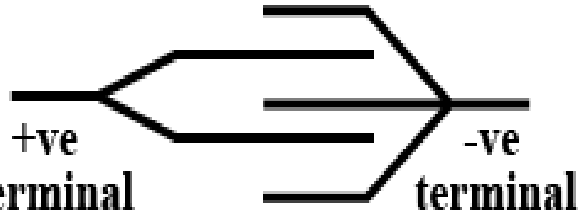


(a) 20 μF, 30 μF (b) 10 μF, 40 μF
(c) 10 μF, 15 μF (d) 25 μF, 25 μF

Q 8. Find the total capacitance for three capacitors of 10f,15f and 35f in parallel with each other?

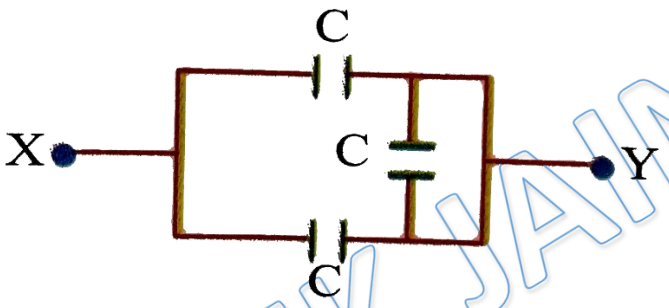
(a) 20 F (b) 50 F
(c) 60 F (d) 10 F

Q 9. Five identical parallel conducting plates each of area A have separation 'd' between successive surface. The plates are connected to the terminal of a battery as shown in the figure. The effective capacitance of the circuit is



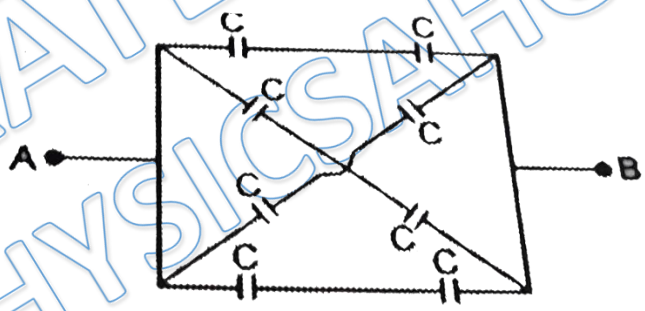
(a) $\frac{A\varepsilon_o}{4d}$ (b) $\frac{4A\varepsilon_o}{d}$
(c) $\frac{A\varepsilon_o}{3d}$ (d) $\frac{3A\varepsilon_o}{4d}$

Q 10. The equivalent capacity between the points X and Y in the circuit with C=1μF.



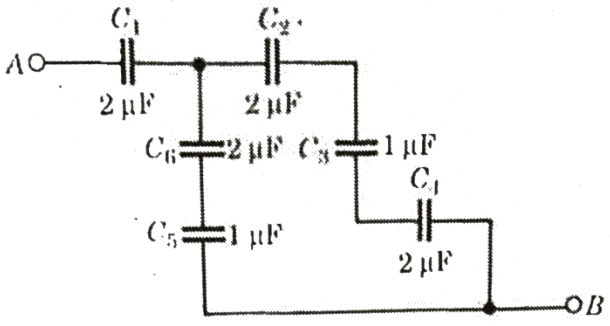
(a) 2 μF (b) 3 μF
(c) 1 μF (d) 0.5 μF

Q 11. In the adjoining circuit, the capacity between the points A and B will be -



(a) C (b) 2C
(c) 3C (d) 4C

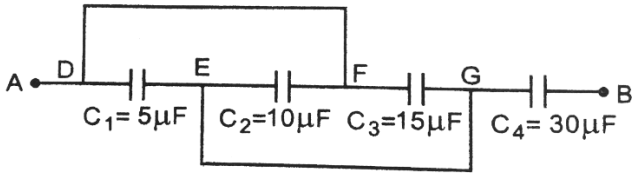
Q 12. Calculate the equivalent capacitance between the points A and B of the circuit given below.



(a) $\frac{14}{19}$ μF (b) $\frac{13}{17}$ μF

(c) $\frac{21}{13}$ μF (d) $\frac{11}{21}$ μF

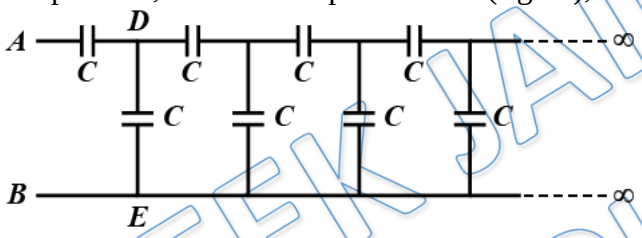
Q 13. Calculate the equivalent capacitance between the points A and B in the combination shown in Fig.



(a) 15 μF (b) 10 μF

(c) 20 μF (d) 25 Mf

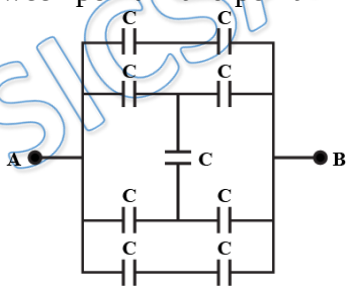
Q 14. The capacitance of a infinite circuit formed by the repetition of the same link consisting of two identical capacitors, each with capacitance C (figure), is :



(a) xero (b) $\frac{\sqrt{5}-1}{2}C$

(c) $\frac{\sqrt{5}+1}{2}C$ (d) infinite

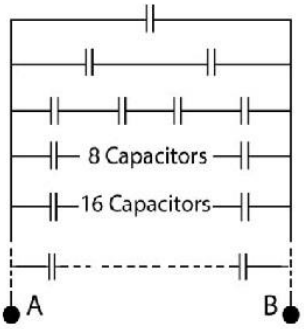
Q 15. The resultant capacity between point A and point B in the following circuit will be:



(a) C (b) $\frac{C}{2}$

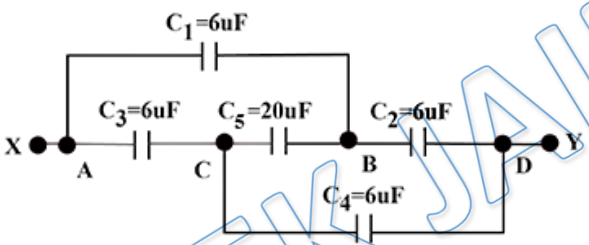
(c) 2C (d) 3C

Q 16. An infinite number of identical capacitors, each of capacitance 1μF are connected as shown in the figure. Then the equivalent capacitance between A and B is :



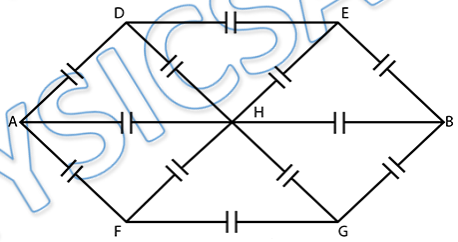
(a) 1 μF (b) 2 μF
(c) $\frac{1}{2}$ μF (d) infinite

Q 17. What is the equivalent capacitance between X and Y?



(a) 10 μF (b) 15 μF
(c) 18 μF (d) 6 μF

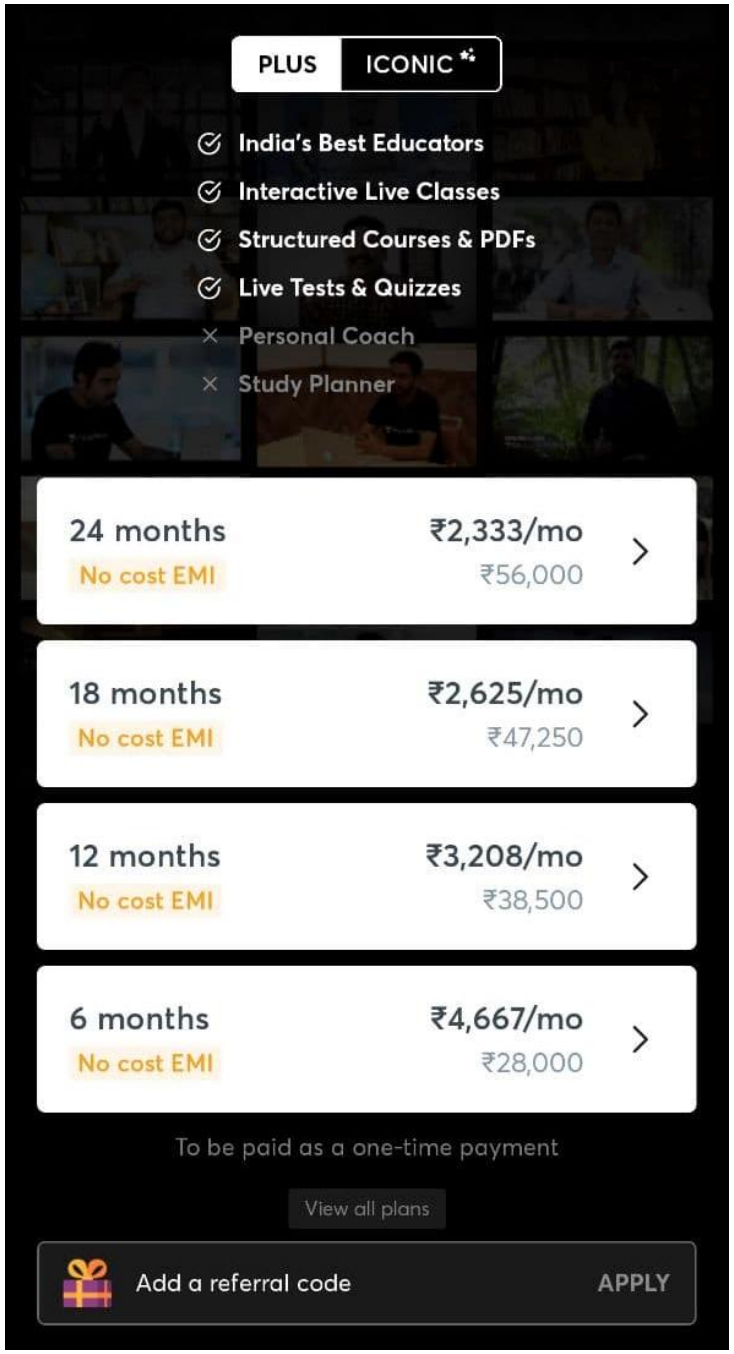
Q 18. What is the equivalent capacitance between A and B if capacitance of each capacitor is C?



(a) $\frac{5C}{4}$ (b) $\frac{3C}{2}$
(c) $\frac{2C}{3}$ (d) $\frac{4C}{5}$

Answer Key

Q.1 c	**Q.2 a**	**Q.3 c**	**Q.4 c**	**Q.5 a**
Q.6 c	**Q.7 b**	**Q.8 c**	**Q.9 b**	**Q.10 a**
Q.11 b	**Q.12 a**	**Q.13 a**	**Q.14 b**	**Q.15 c**
Q.16 b	**Q.17 d**	**Q.18 a**		



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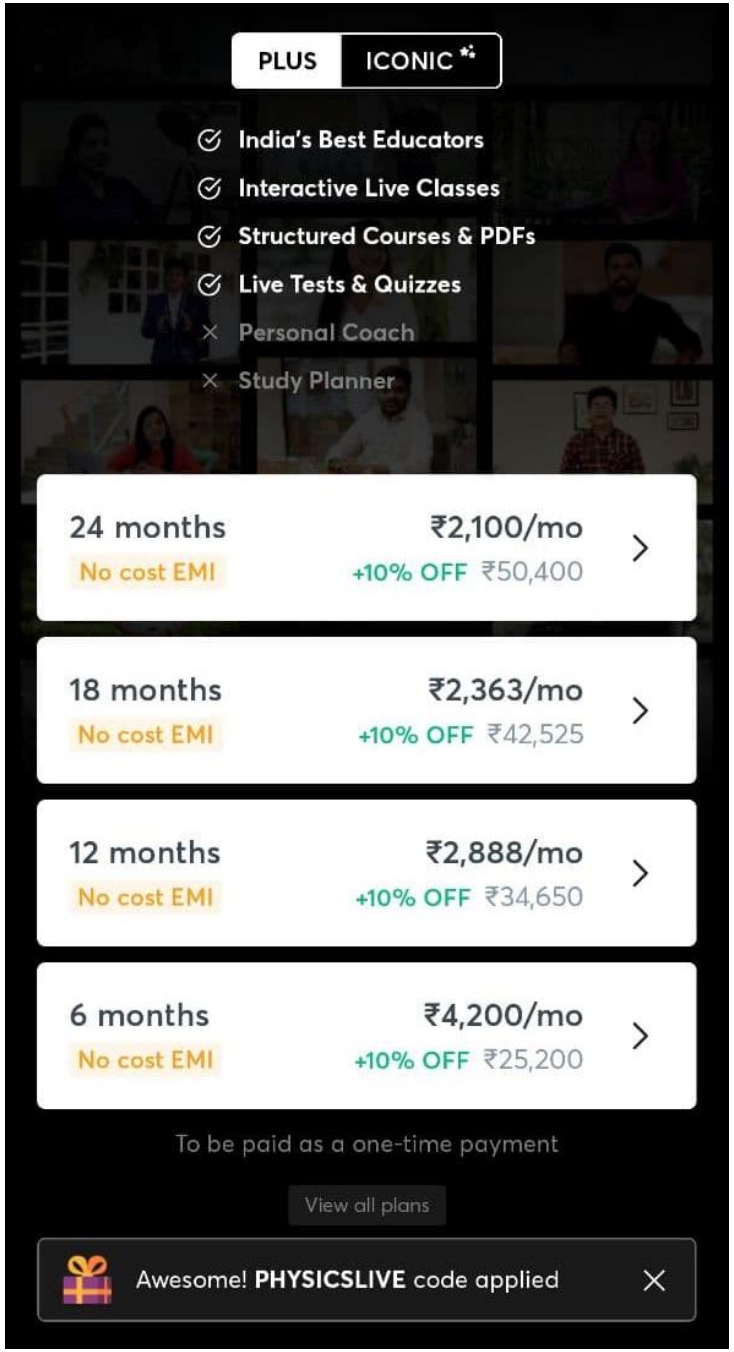
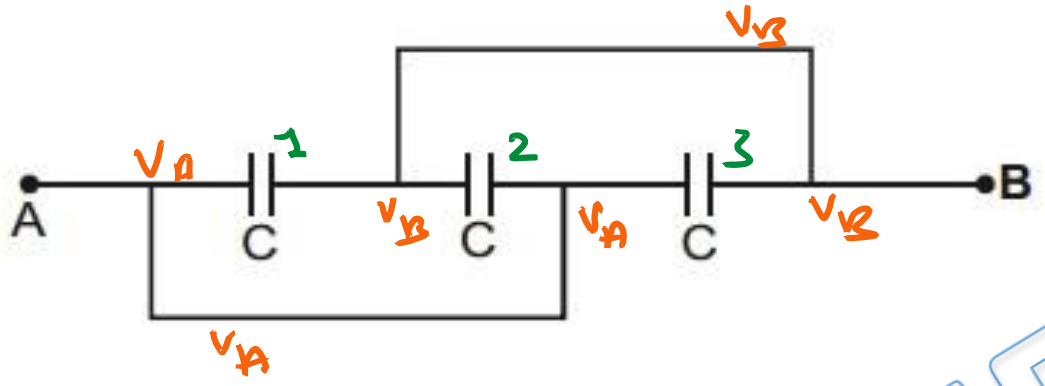


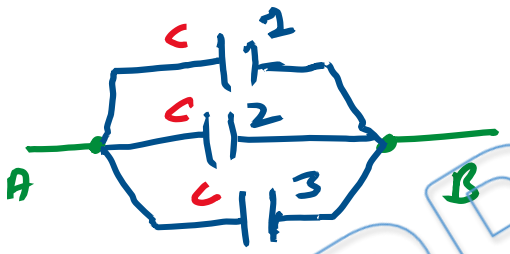
Written Solution

DPP 2 - Combination of Series and Parallel Capacitor

By Physicsaholics Team

Solution: 1





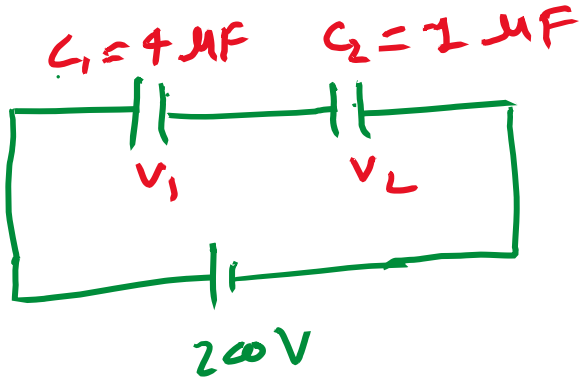
$C_{eq} = C_1 + C_2 + C_3$

$= C + C + C$

$C_{eq} = 3C$ Ans

Ans. c

Solution: 2



$\because$ C_1 & C_2 both are in series

so, charge on both capacitors will be equal

$$q = C_1 V_1 = C_2 V_2$$

$$(4\,\mu F) V_1 = (1\,\mu F) V_2$$

$$\boxed{V_2 = 4 V_1}$$

$$\Rightarrow \boxed{\frac{V_1}{V_2} = \frac{1}{4}} \quad \text{Ans}$$

Ans. a

Solution: 3

in parallel;

$$12 = C_1 + C_2 + C_3 \quad -(1)$$

given; $C_1 C_2 C_3 = 48 \quad -(2)$

when, C_1 & C_2 in parallel

$$C_1 + C_2 = 6 \quad -(3)$$

put $C_1 + C_2$ in eq^n (1)

$$12 = 6 + C_3$$

$$\boxed{C_3 = 6 \text{ unit}}$$

put value of C_3 in eq^n (2)

$$C_1 C_2 (6) = 48$$

$$\Rightarrow \boxed{C_1 C_2 = 8} \quad -(4)$$

$$C_1 = \frac{8}{C_2}$$

put 'C_1' in eq^n (3)

$$\frac{8}{C_2} + C_2 = 6 \Rightarrow C_2^2 - 6C_2 + 8 = 0$$

$$C_2 = \frac{-(-6) \pm \sqrt{(-6)^2 - 4 \times 1 \times 8}}{2(1)}$$

$$C_2 = \frac{6 \pm \sqrt{36 - 32}}{2} = \frac{6 \pm 2}{2}$$

$$C_2 = 4 \text{ or } 2$$

when; $C_2 = 4$; $\Rightarrow C_1 = 2$

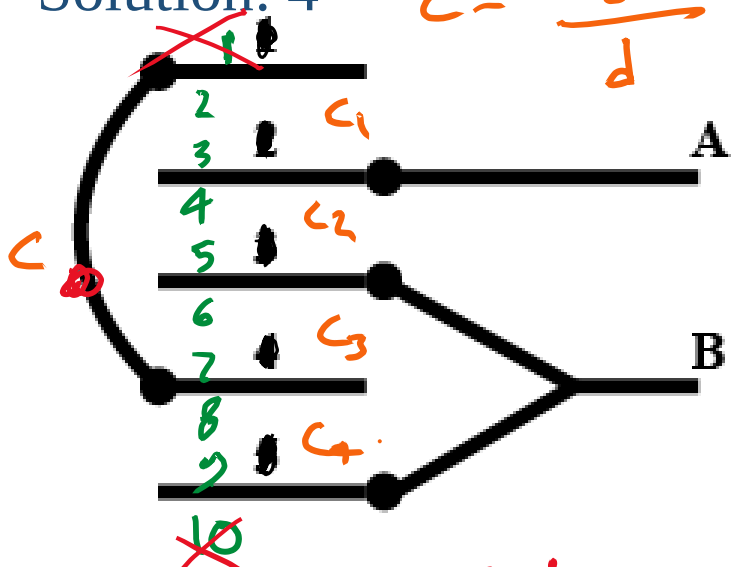
when; $C_2 = 2$; $\Rightarrow C_1 = 4$

So; $\boxed{C_1, C_2, C_3 \equiv 2, 4, 6 \text{ (or) } 4, 2, 6}$ Ans

Ans. c

Solution: 4

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

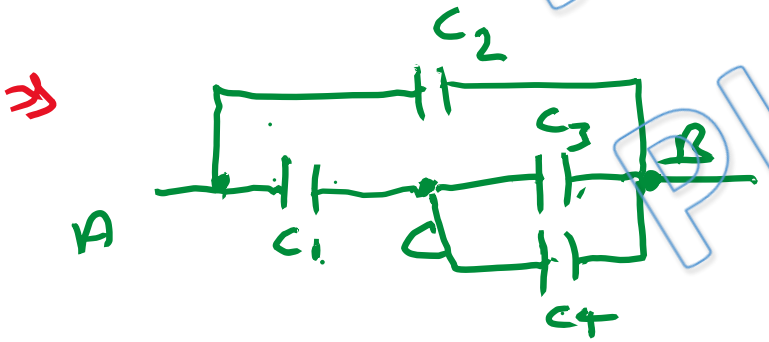


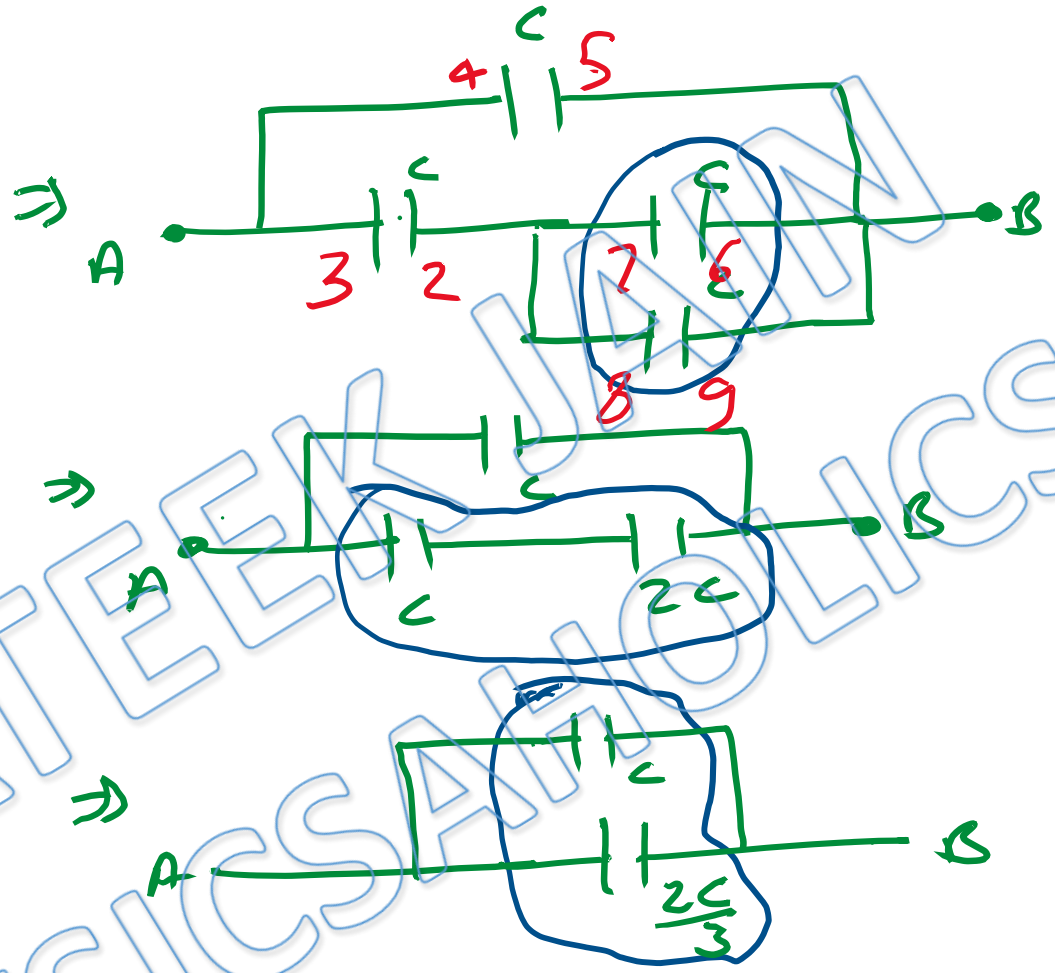
C_1 → between A & C

C_2 → between A & B

C_3 → between B & C

C_4 → between B & C





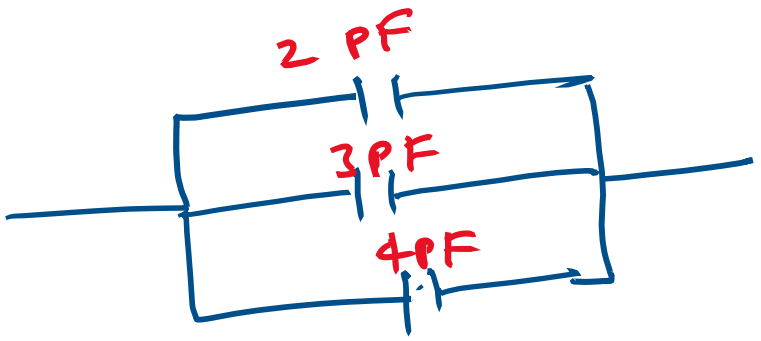
$\Rightarrow C_{eq} = C + \frac{2C}{3}$

$\Rightarrow C_{eq} = \frac{5C}{3}$

$\Rightarrow C_{eq} = \frac{5\epsilon_0 A}{3d}$ Ans

Ans. c

Solution: 5



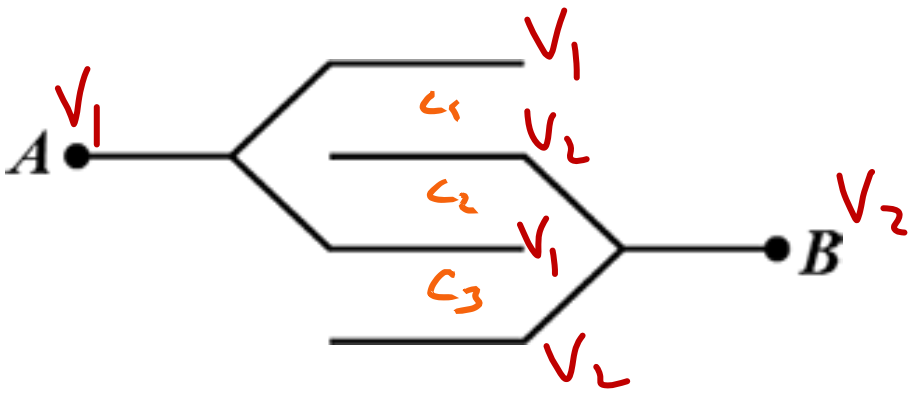
$C_{eq} = C_1 + C_2 + C_3$

$= 2pF + 3pF + 4pF$

$C_{eq} = 9\ pF$ Ans

Ans. a

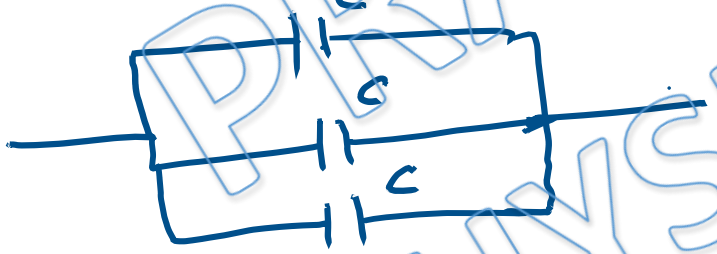
Solution: 6



C_1, C_2 & C_3 have equal Potential difference.

so; all capacitors are in parallel

$\Rightarrow$



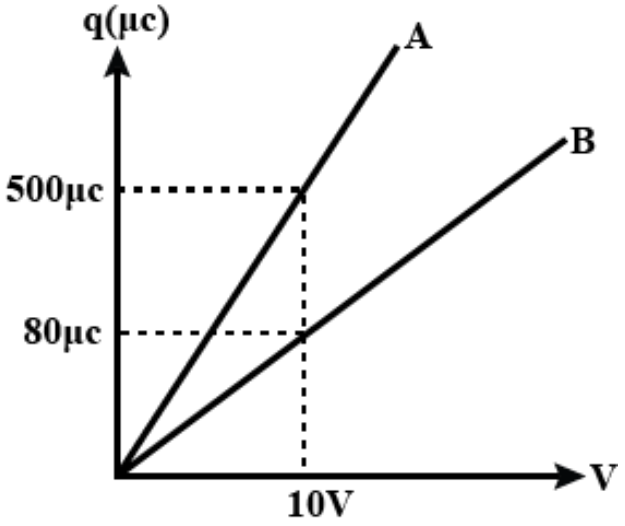
$C_{eq} = 3C$

$C_{eq} = 3\left(\frac{\epsilon_0 A}{d}\right)$

$C_{eq} = \frac{3\epsilon_0 A}{d}$ Ans

Ans. c

Solution: 7



Let capacitance are C_1 & C_2

$\because (C)_{in\ parallel} > (C)_{in\ series}$

$q = CV$

$q \propto C$ (for V = constant)

$\therefore q_A > q_B \Rightarrow C_A > C_B$

So; A → for Parallel

B → for series.

$C_A = C_1 + C_2$, $C_B = \frac{C_1 C_2}{C_1 + C_2}$

$q_A = C_A V$ — (1) $q_B = C_B V$

$C_A = \frac{500\mu C}{10} = 50\mu F$, $C_B = \frac{80\mu C}{10} = 8\mu F$

$C_A \cdot C_B = C_1 C_2 = \frac{40}{100} \times 10^{-9} = 4 \times 10^{-10}$ — (1)

$\frac{C_A}{C_B} = \frac{(C_1+C_2)^2}{C_1 C_2} = \frac{50}{8} = \frac{25}{4}$

$(C_1+C_2)^2 = \frac{25}{4} \times 4 \times 10^{-10} = 25 \times 10^{-10}$

$C_1 + C_2 = 5 \times 10^{-5}\ F$ — (2)

from (1) & (2)

$C_1 = 1 \times 10^{-5} F = 10\ \mu F$

$C_2 = 4 \times 10^{-5} F = 40\ \mu F$ Ans

Ans. b

Solution: 8

in parallel combination

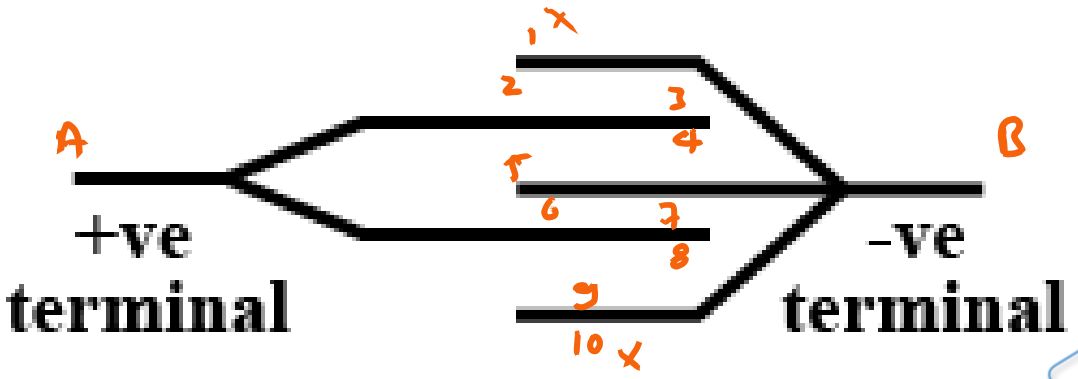
$C = C_1 + C_2 + C_3$

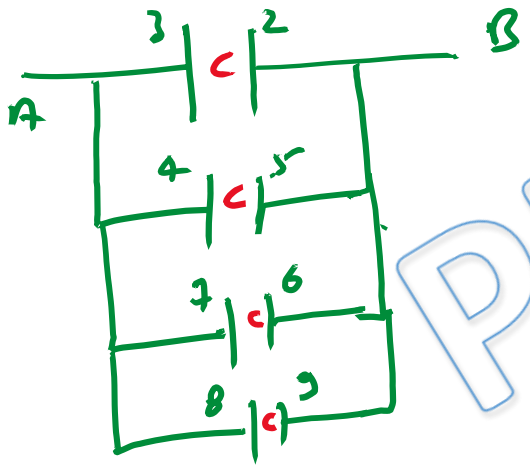
$C = 10 + 15 + 35$

$\boxed{C = 60\ F}$ Ans

Ans. c

Solution: 9



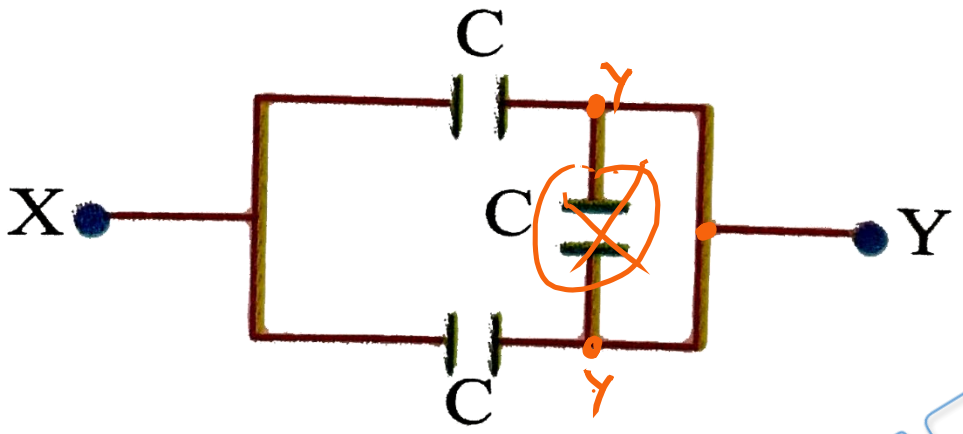


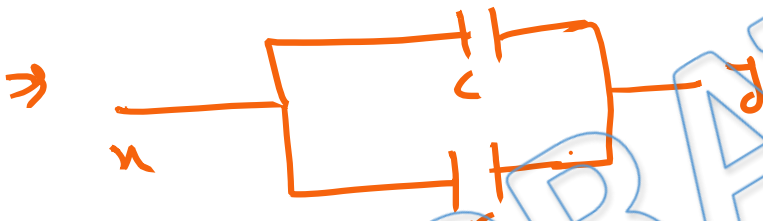
$$\Rightarrow C_{eq} = 4C = 4\frac{\epsilon_0 A}{d}$$

$$\boxed{C_{eq} = 4\frac{\epsilon_0 A}{d}} \quad \text{Ans.}$$

Ans. b

Solution: 10



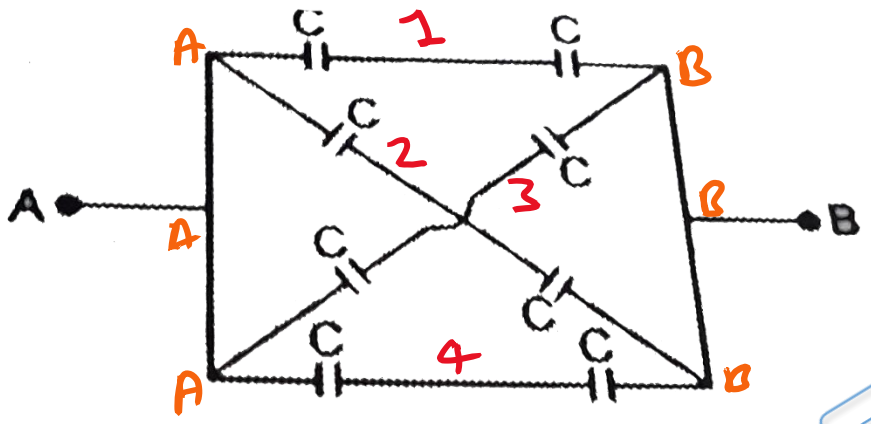


$C_{eq} = 2C$ $[\because C = 1\ \mu F]$

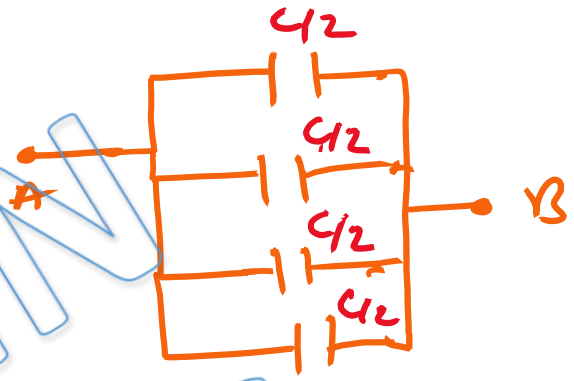
$C_{eq} = 2\ \mu F$ Ans.

Ans. a

Solution: 11



$\Rightarrow$



$C_{eq} = 4(C/2)$

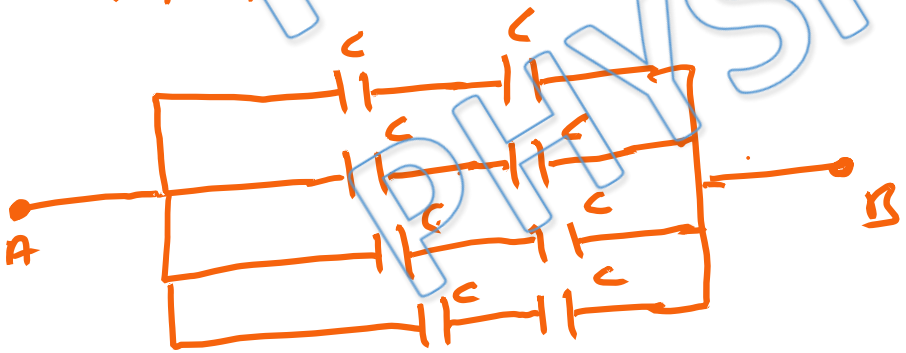
$\boxed{C_{eq} = 2C}$

$\therefore$ from diagram we can see that

Potential difference between branch 1, 2, 3 & 4 is same $(V_A - V_B)$

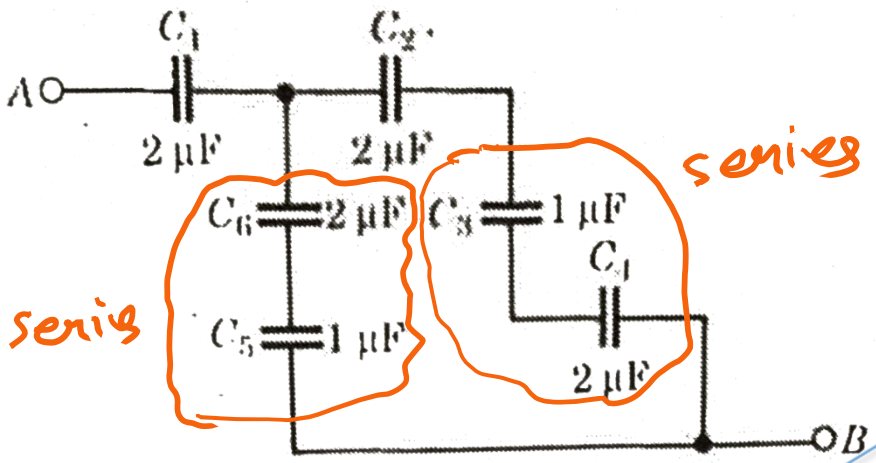
so, 1, 2, 3 & 4 all branches are in parallel

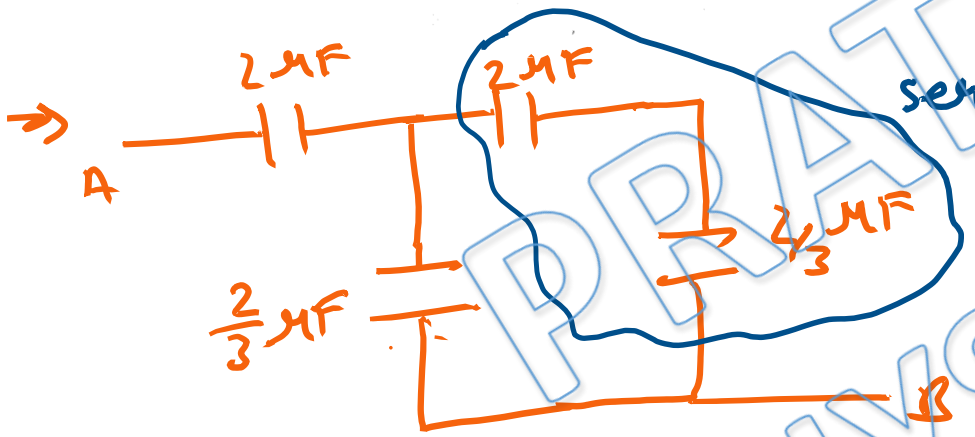
$\Rightarrow$

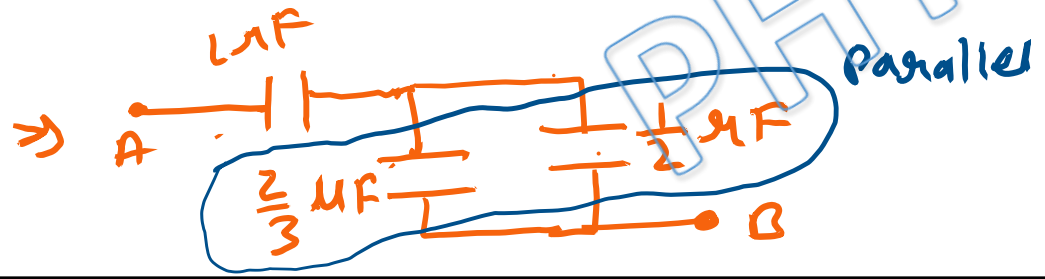


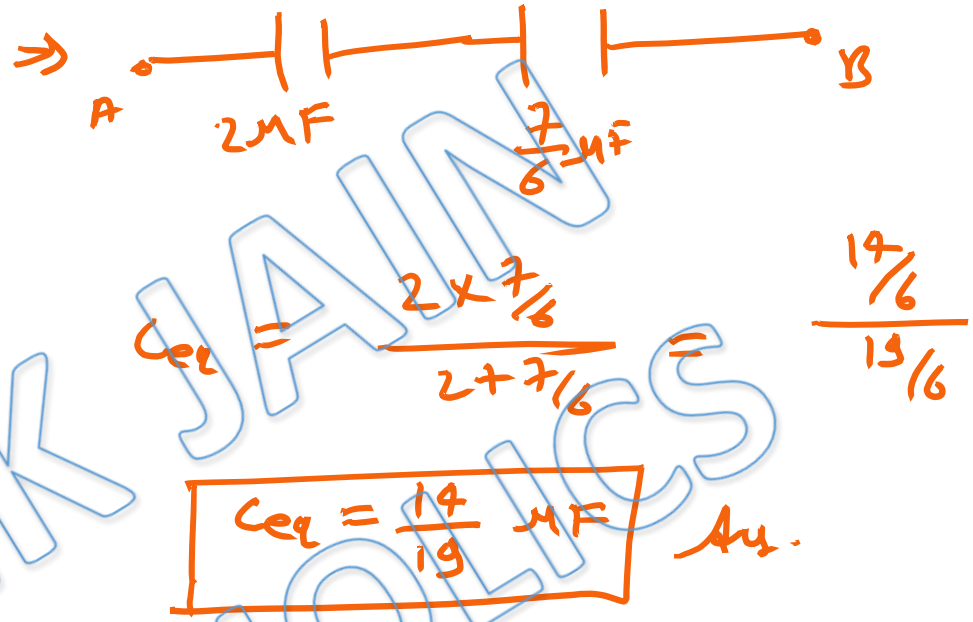
Ans. b

Solution: 12



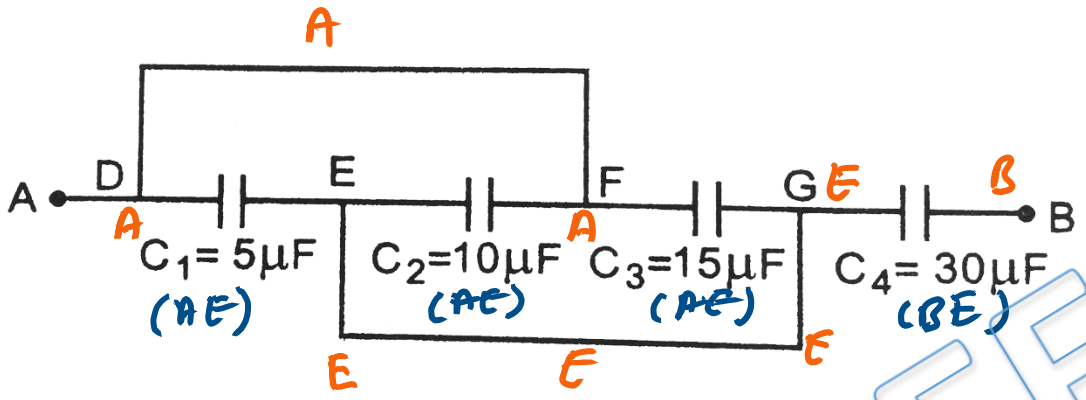


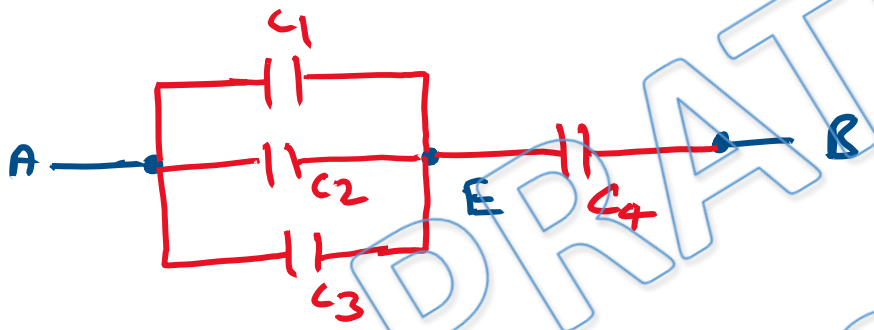


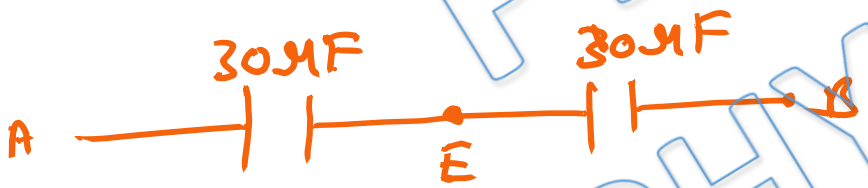


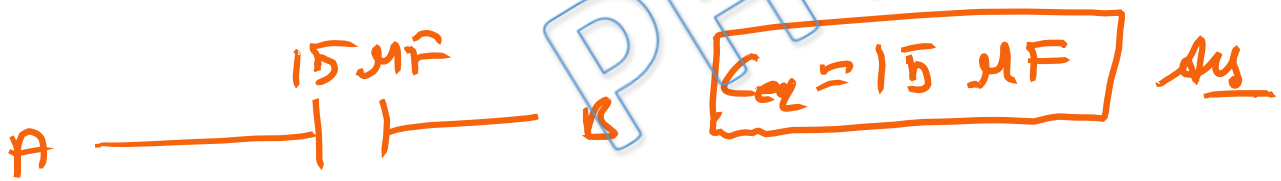
Ans. a

Solution: 13



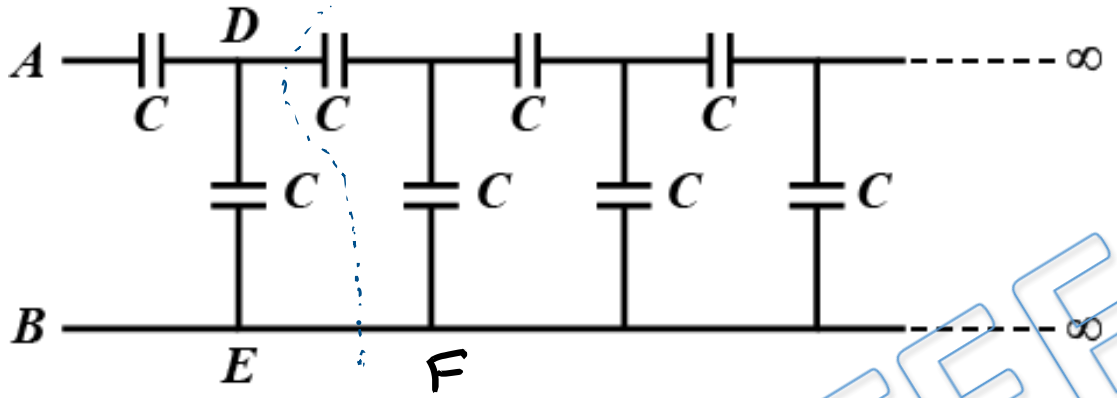




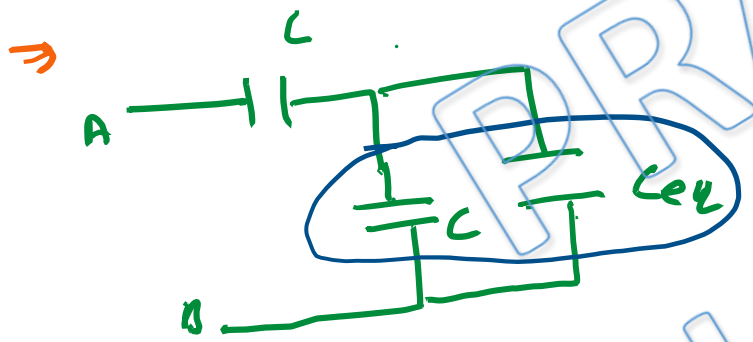


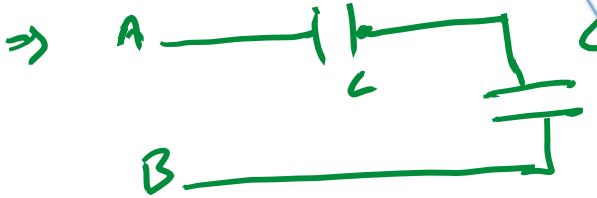
Ans. a

Solution: 14



$C_{AB} = C_{DF} = C_{eq}$





$\because C_{AB} = C_{eq}$

$\Rightarrow C_{eq} = C + \dfrac{C(C + C_{eq})}{C + (C + C_{eq})}$

Let $C_{eq} = x$

$\Rightarrow x = \dfrac{C(C+x)}{C + C + x} = \dfrac{C^2 + Cx}{2C + x}$

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

$x^2 + Cx - C^2 = 0$

$x = \dfrac{-(C) \pm \sqrt{(C)^2 - 4(1)(-C^2)}}{2}$

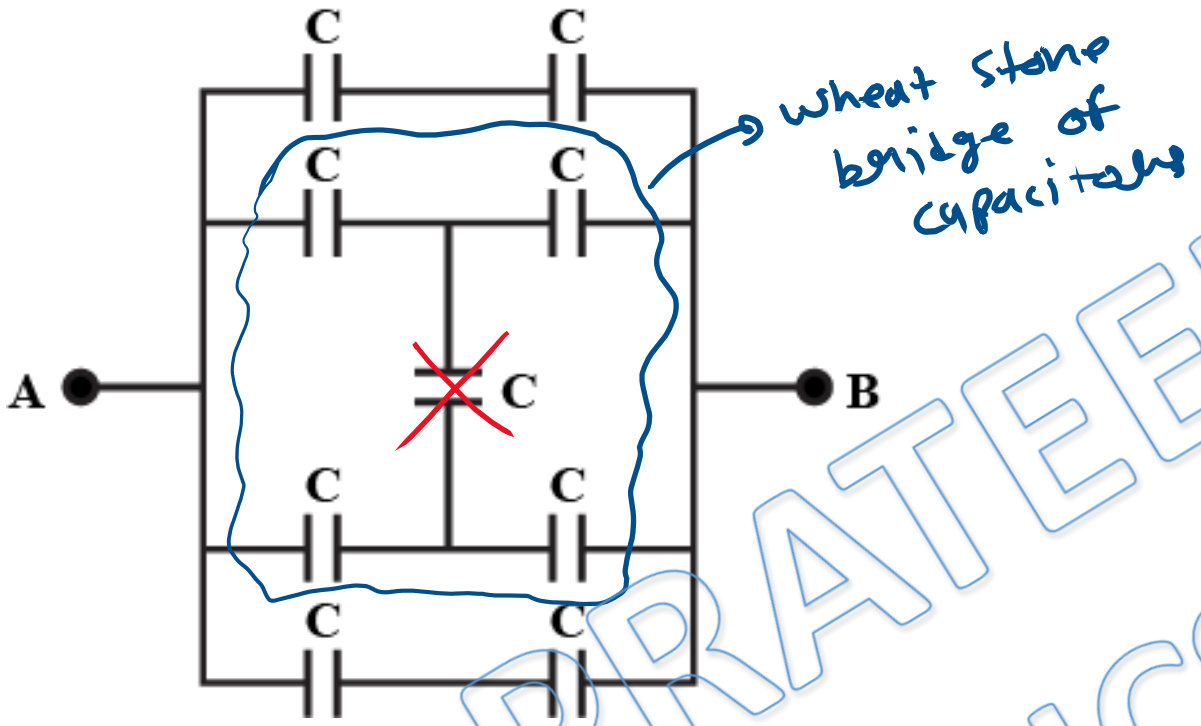
$x = \dfrac{-C \pm \sqrt{5C^2}}{2} = \dfrac{-C \pm \sqrt{5}\,C}{2}$

$x = \dfrac{-C + \sqrt{5}C}{2}$, $\dfrac{-C - \sqrt{5}C}{2}$ ✗

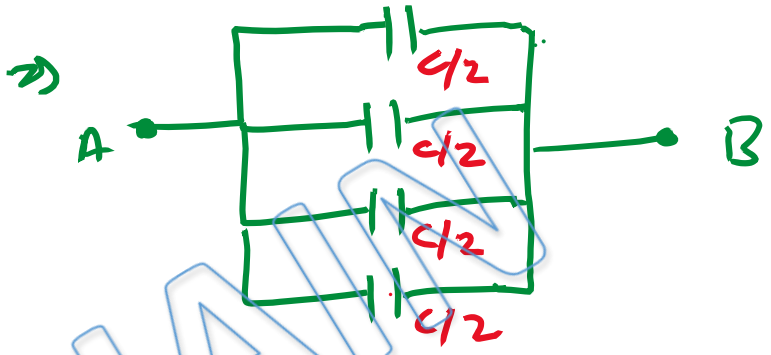
$\Rightarrow \boxed{x = \dfrac{\sqrt{5} - 1}{2} C}$ Ans

Ans. b

Solution: 15

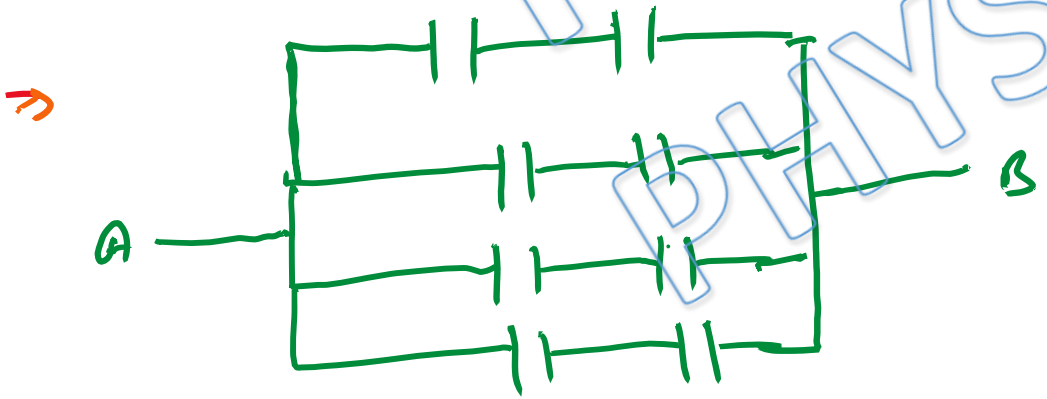


wheat stone bridge of capacitors



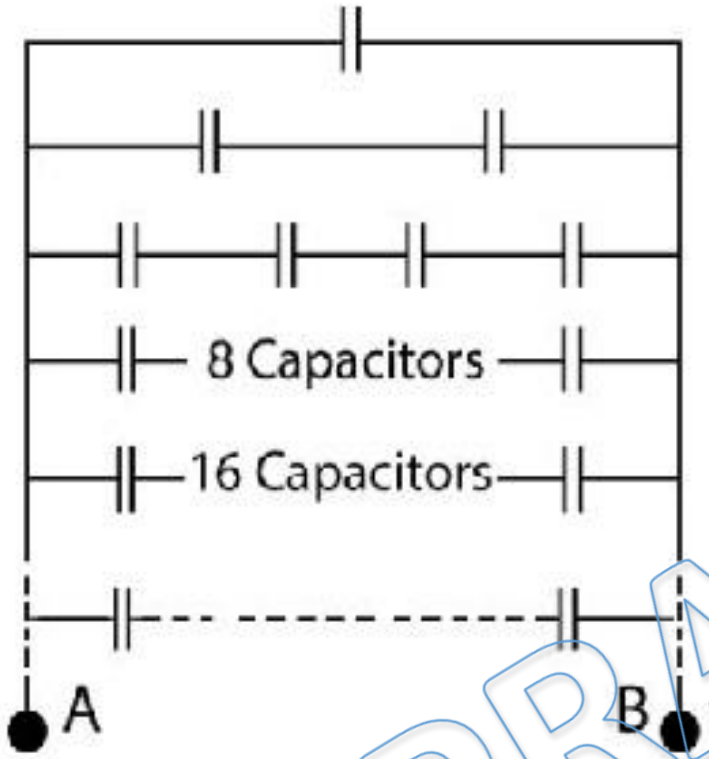
$C_{eq} = 4(C/2)$

$C_{eq} = 2C$ Ans

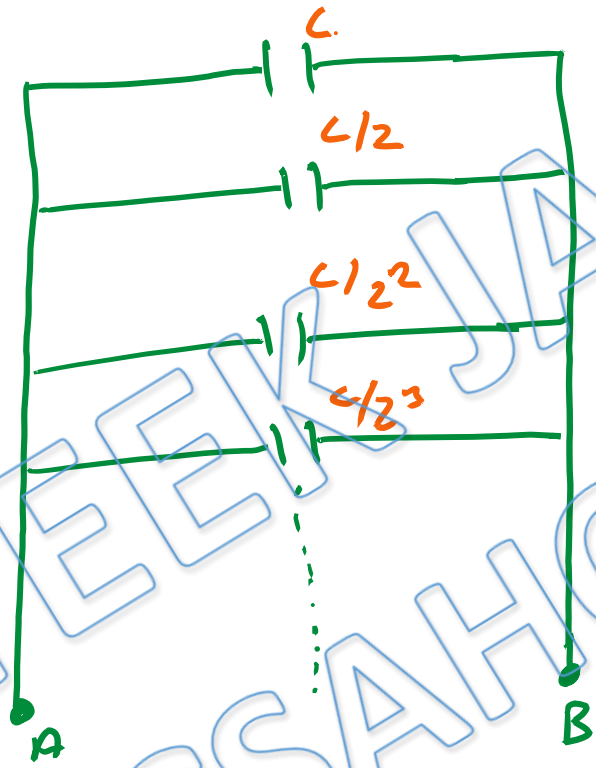


Ans. c

Solution: 16



⇒



$a = 1, \quad r = \frac{1}{2}$

$C_{eq} = C\left[\frac{1}{1-\frac{1}{2}}\right]$

$C_{eq} = C\left[\frac{1}{\frac{1}{2}}\right]$

$\boxed{C_{eq} = 2C}$ Ans.

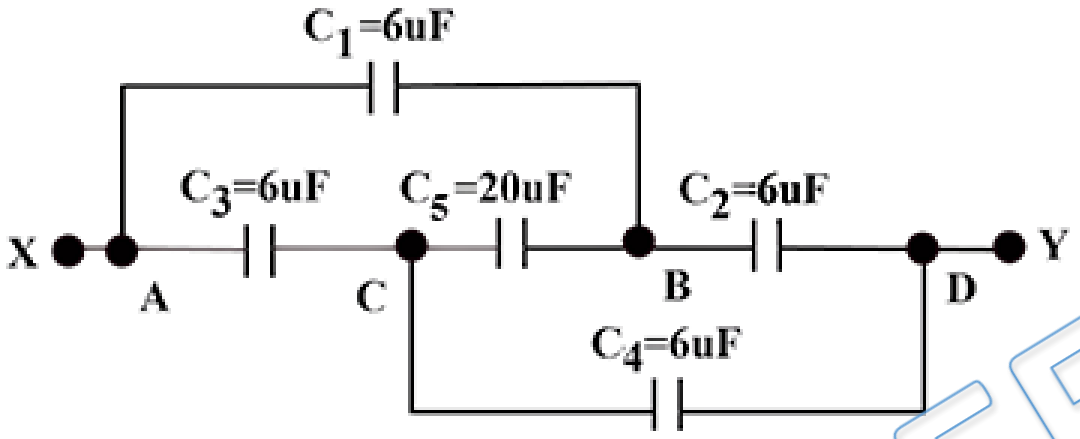
$C_{eq} = C + \frac{C}{2} + \frac{C}{2^2} + \frac{C}{2^3} + \frac{C}{2^4} + \cdots \infty$

$S_n = \frac{a}{1-r}$ [sum of ∞ G.P., whose $r < 1$]

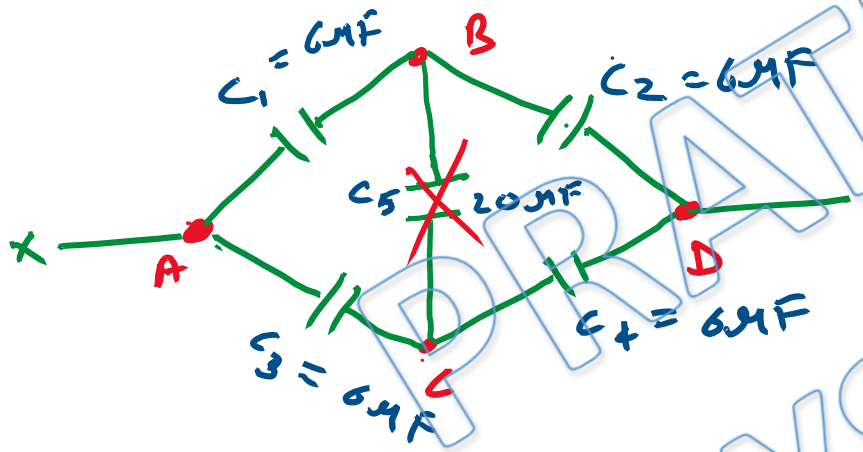
So; $C_{eq} = C\left[1 + \frac{1}{2} + \frac{1}{2^2} + \frac{1}{2^3} + \frac{1}{2^4} + \cdots\right]$

Ans. b

Solution: 17



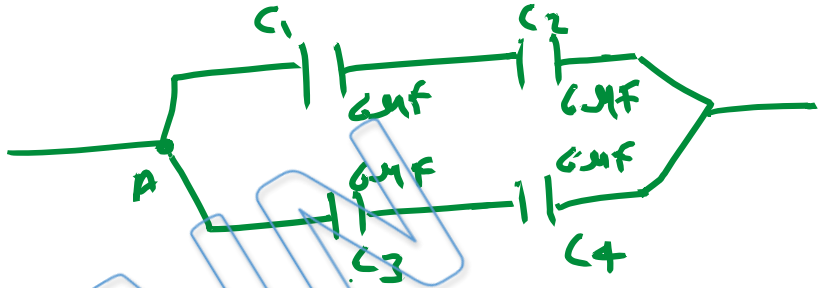
⇒



∵ here; $C_1 C_4 = C_3 C_2$

so; wheat stone bridge is balanced.

⇒



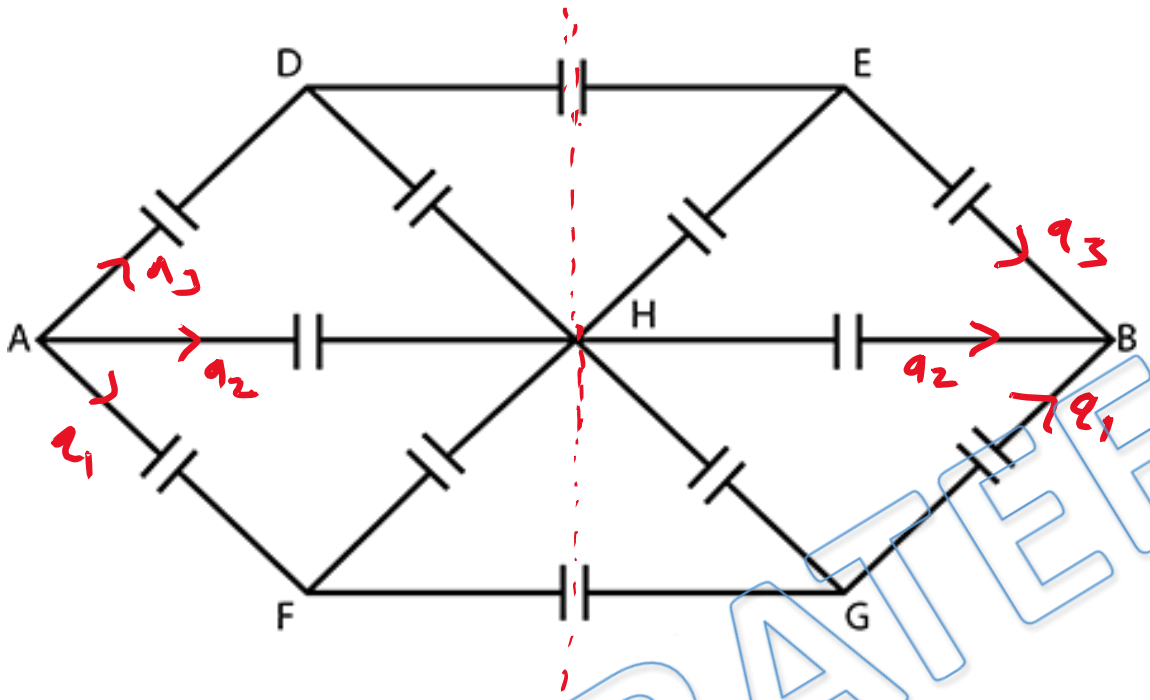
here $C_1 = C_2 = C_3 = C_4 = C = 6\mu F$

so; $C_{eq} = C$

$C_{eq} = 6\mu F$ Ans

Ans. d

Solution: 18



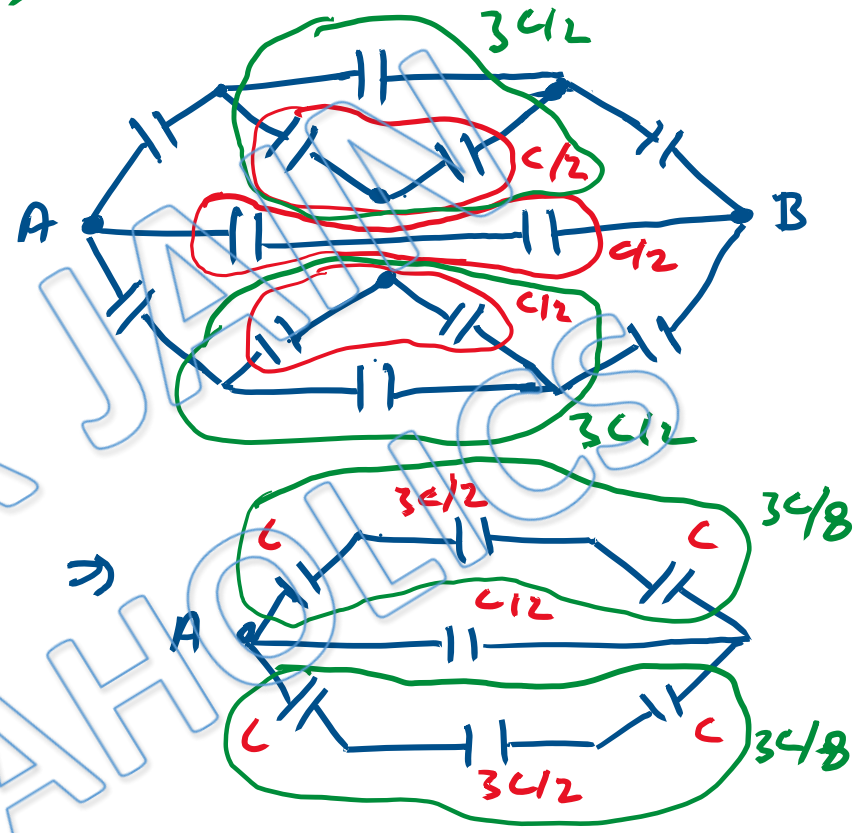
∵ circuit is symmetric

Let q_1, q_2, q_3 charges enters at 'A'

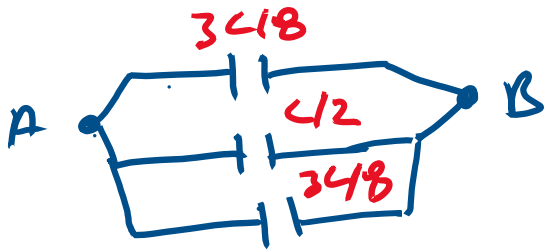
then q_1, q_2 & q_3 charges will be ejected from circuit at 'B' & circuit is symmetric.

⇒ so, there charge is flowing forward only

so we can break the joint at 'H'



⇒



$$C_{eq} = \frac{5C}{4}$$ Ans

Ans. a

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