Nishant Jindal

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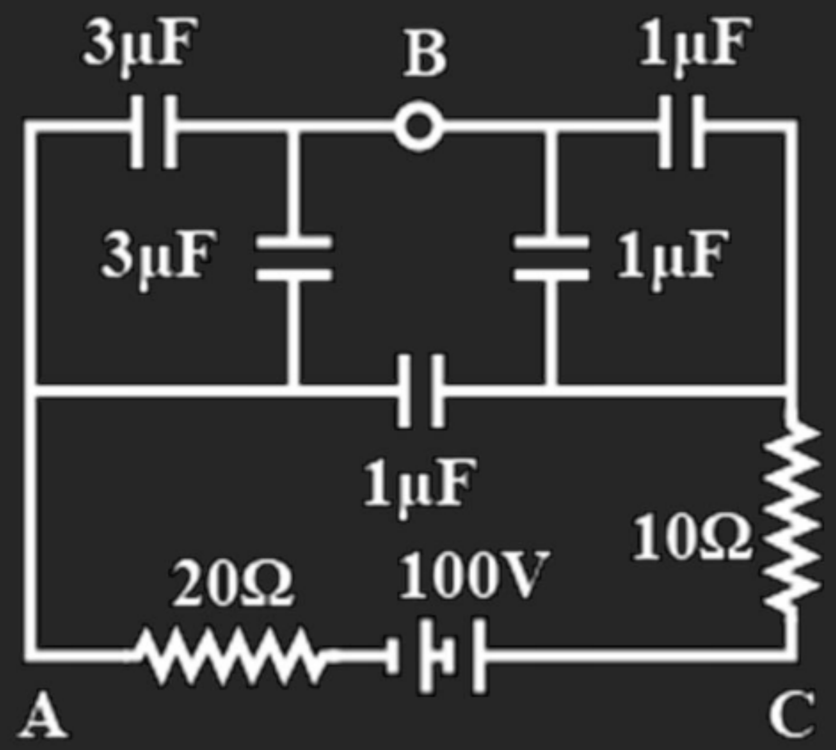
Equivalent capacitance (Symmetry) CAPACITOR

H.W

Q.1 In circuit shown in figure calculate the potential difference between the points A and B and between the points B and C in the steady state.



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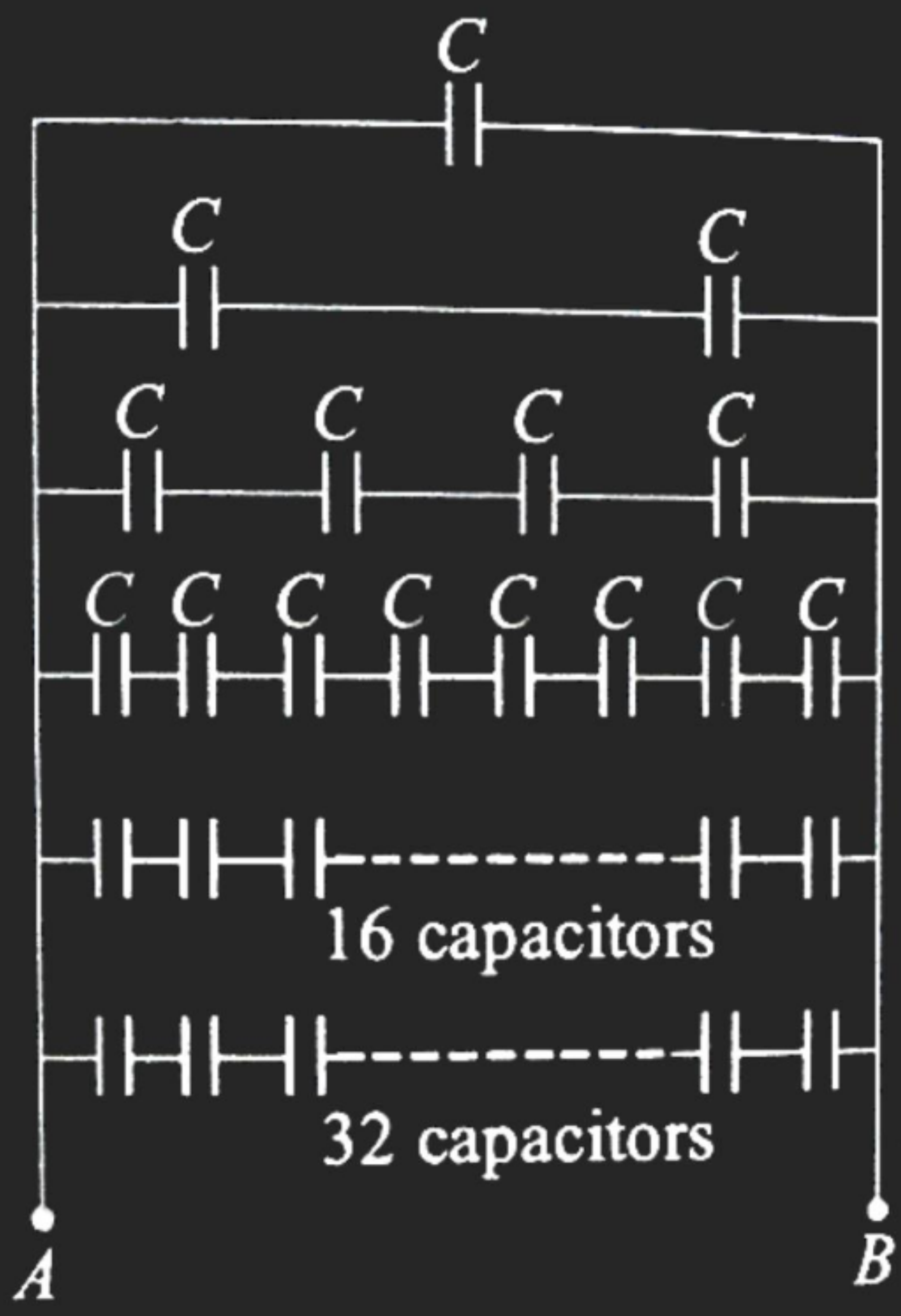
(iii) Infinite number of identical capacitors each of capacitance 1μF are connected as shown in figure. Find the equivalent capacitance of system between the terminals A and B shown in figure.



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Equivalent capacitance (Symmetry)

CAPACITOR

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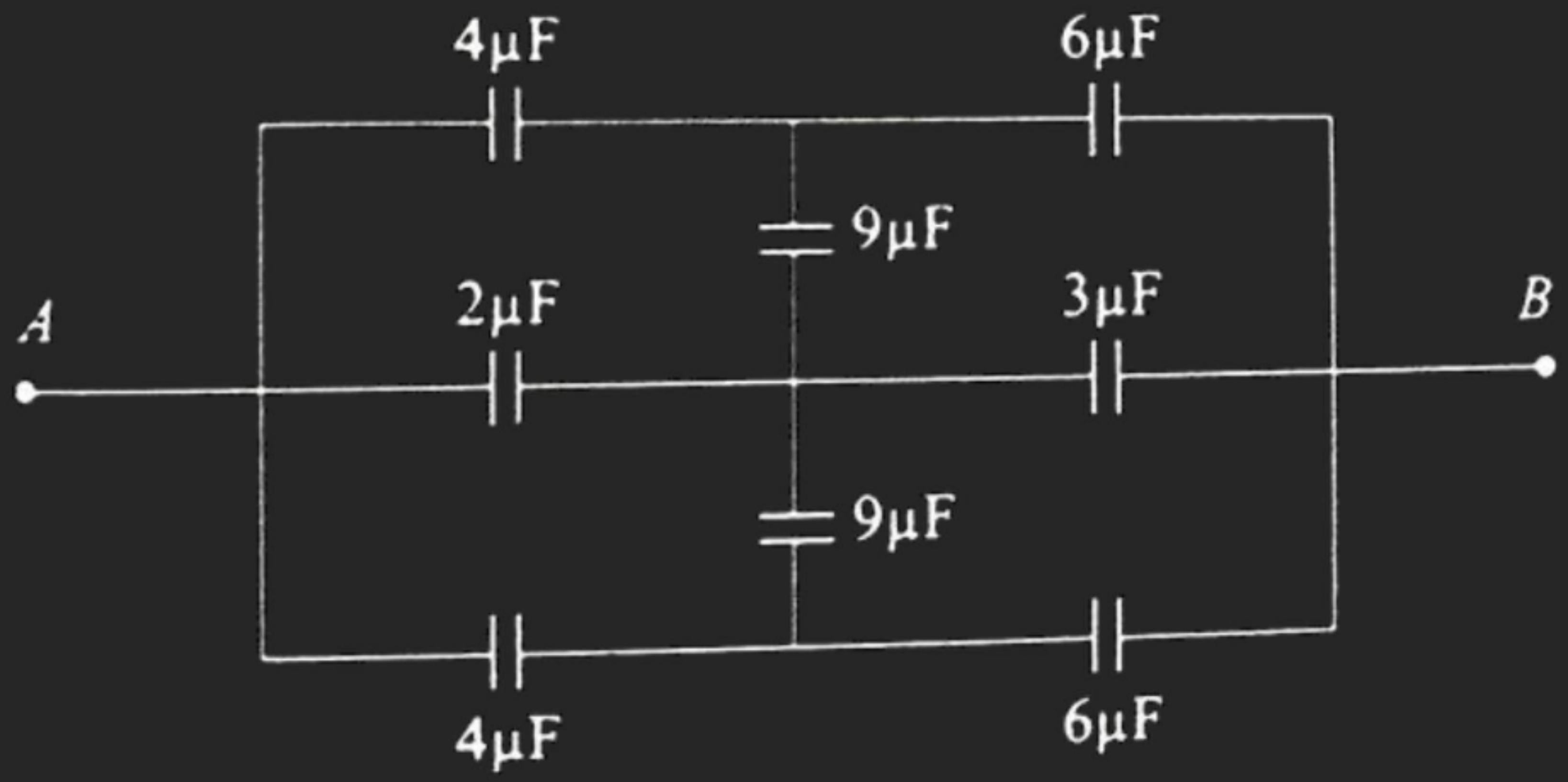
$(C_{eq})_{A-B} = ??$



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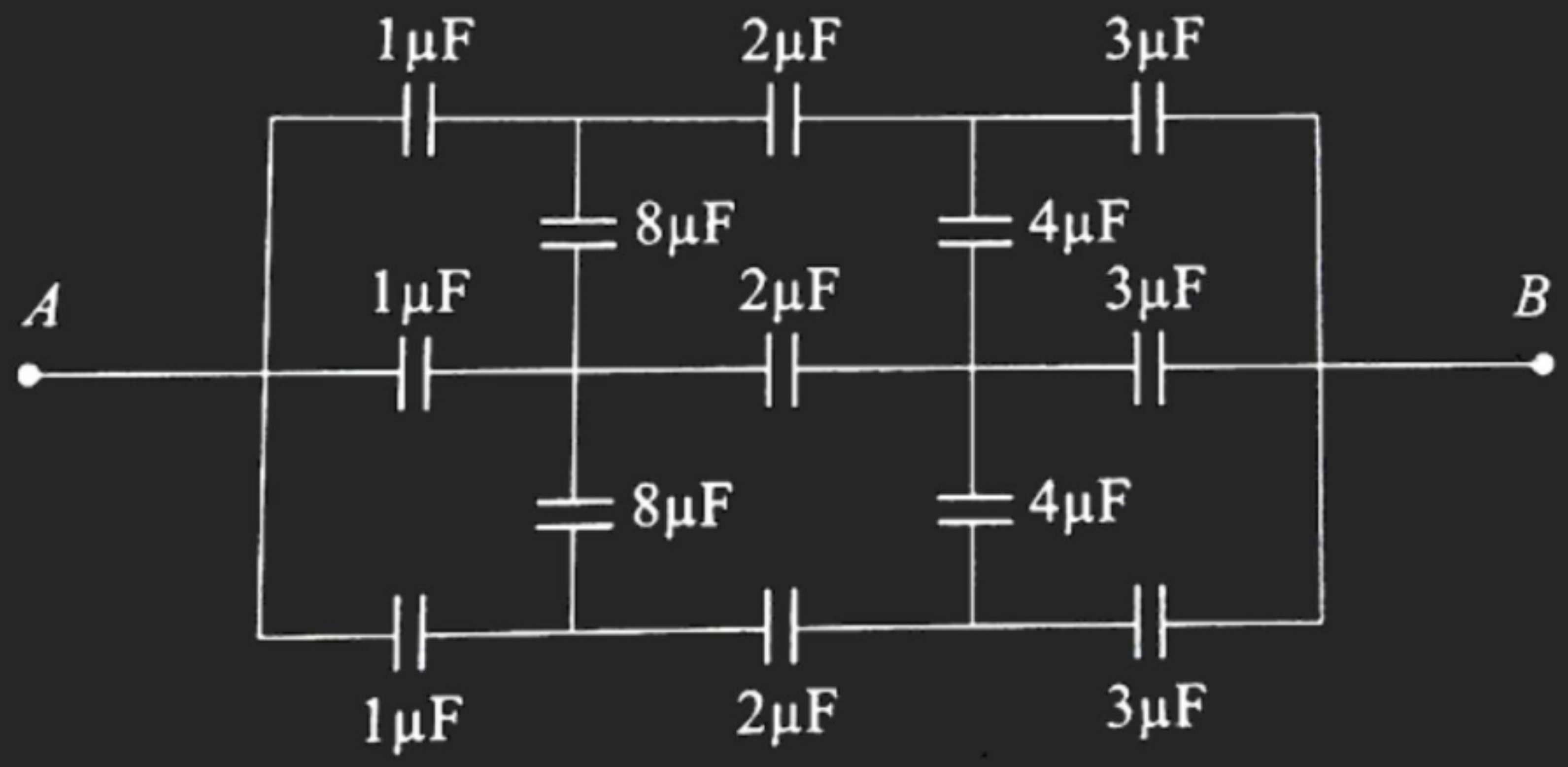
$(C_{eq})_{A-B} = ??$



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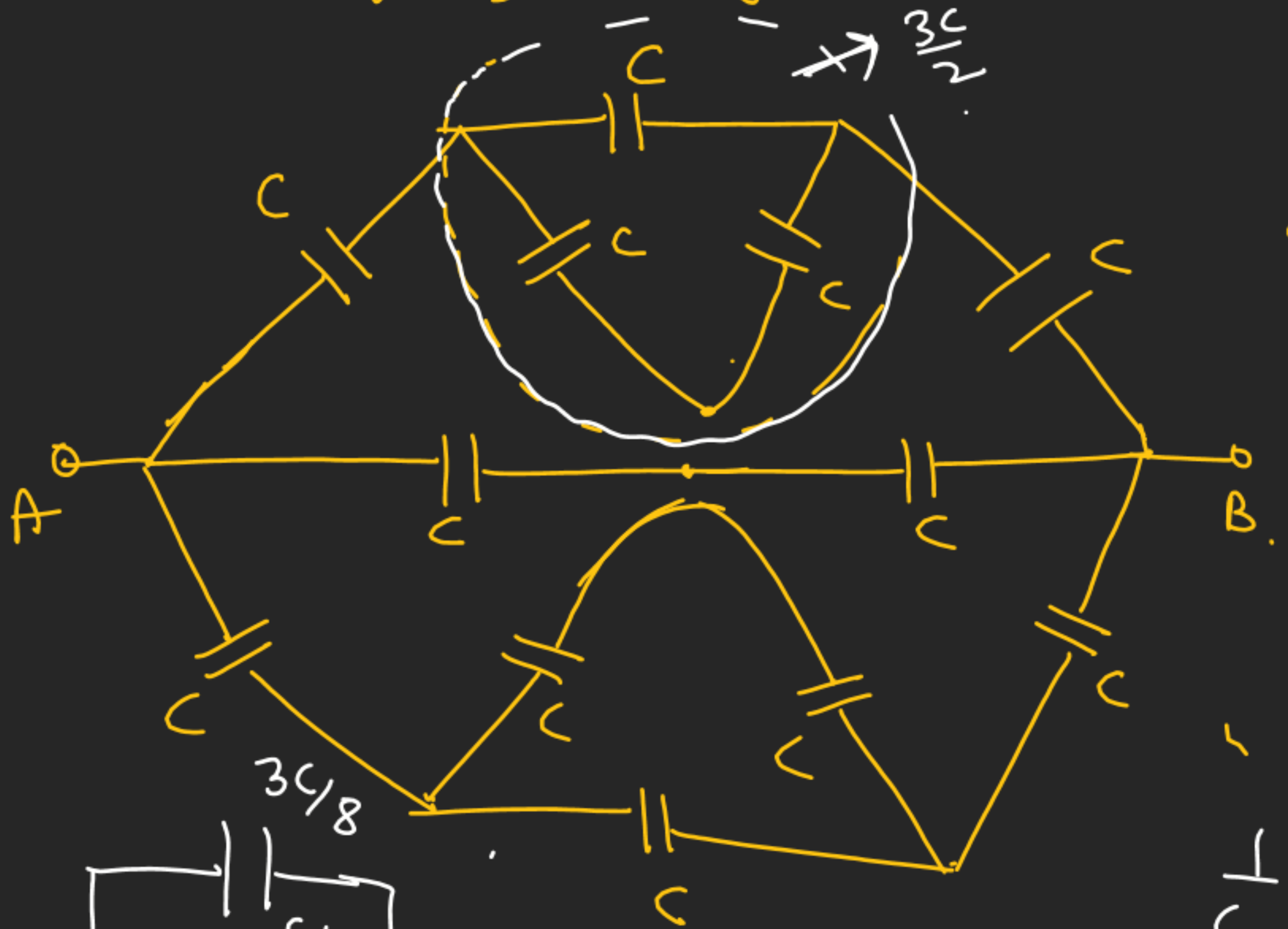
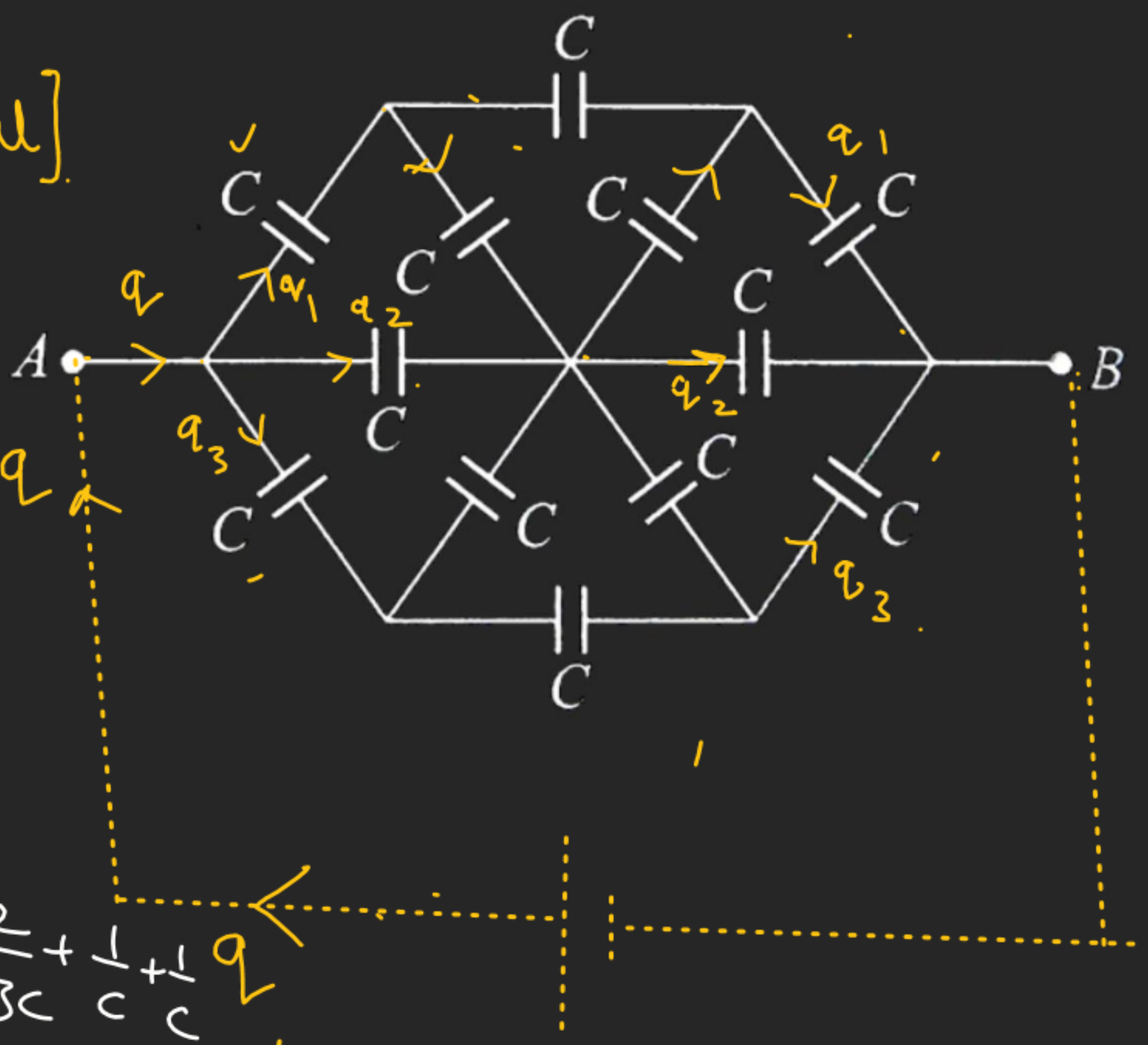
Equivalent capacitance (Symmetry)

CAPACITOR

Note: 1 [Nodes Symmetrical about axis of Symmetry have Same potential]

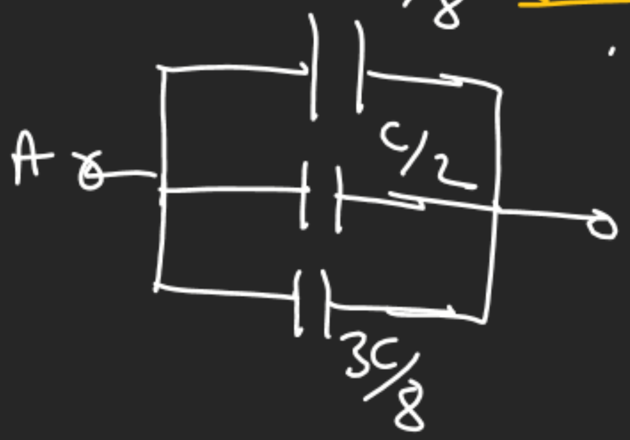




$$\frac{1}{C_{eq}} = \frac{2}{3C} + \frac{1}{C} + \frac{1}{C}$$

$$\frac{1}{C_{eq}} = \frac{2+3+3}{3C} = \left(\frac{8}{3C}\right)$$

$$C_{eq} = \left(\frac{3C}{8}\right)$$



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

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

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Another Method (Nodal analysis).

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

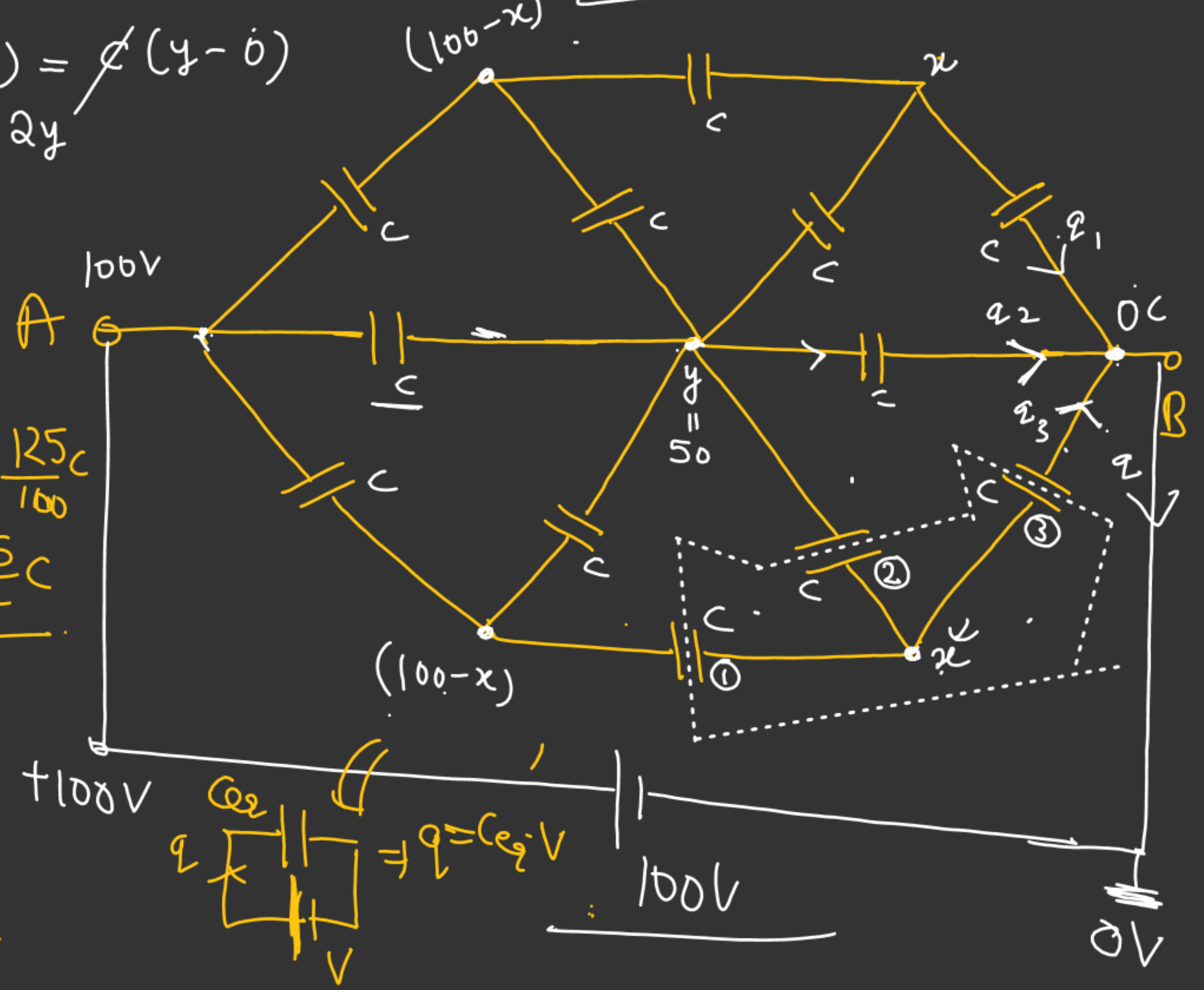
$$\cancel{c}(100-y) = \cancel{c}(y-0)$$
$$100 = 2y$$
$$\underline{y = 50\,V}.$$

At x (Nodal analysis)

$$c[x-(100-x)] + (x-50)c + (x-0)c = 0$$
$$2x - 100 + 2x - 50 = 0$$
$$4x - 150 = 0$$
$$x = \frac{150}{4} = \left(\frac{75}{2}\right)\text{Volt}$$

$$q = q_1 + q_2 + q_3$$
$$100C_{eq} = \underline{xC} + (50-0)c + (x-0)c$$
$$100C_{eq} = 2xC + 50C.$$
$$100C_{eq} = \cancel{2}C \times \frac{75}{\cancel{2}} + 50C = 125C$$

$$C_{eq} = \frac{125}{100}C = \frac{5}{4}C$$



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Equivalent capacitance (Symmetry) CAPACITOR

$(C_{eq})_{AB} \rightarrow$ [Body diagonal]

$\Downarrow$

[Cube Symmetry]

$$xC + [x-(100-x)]C \times 2 = 0$$

$$x + [(2x)-100]2 = 0$$

$$5x - 200 = 0$$

$$x = \frac{200}{5} = 40\text{ volt}$$

$$q_1 + q_2 + q_3 = q$$

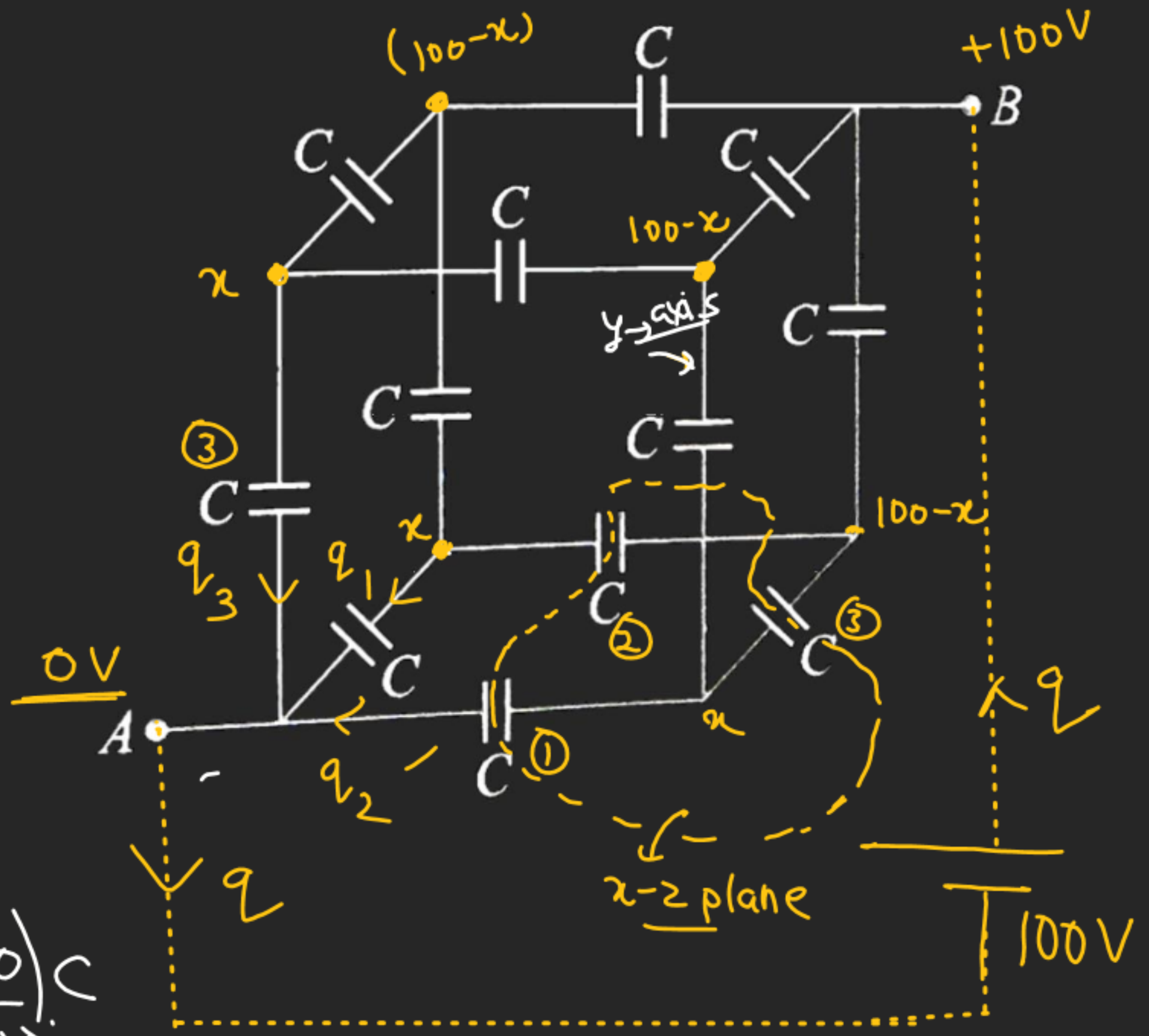
$$xC + xC + xC = C_{eq}(100)$$

$$3xC = 100C_{eq}$$

$$3C \times 40 = 100C_{eq}$$

$$C_{eq} = \left(\frac{120}{100}\right)C$$

$$C_{eq} = \frac{12}{10}C = \frac{6C}{5} \text{ Ans}$$



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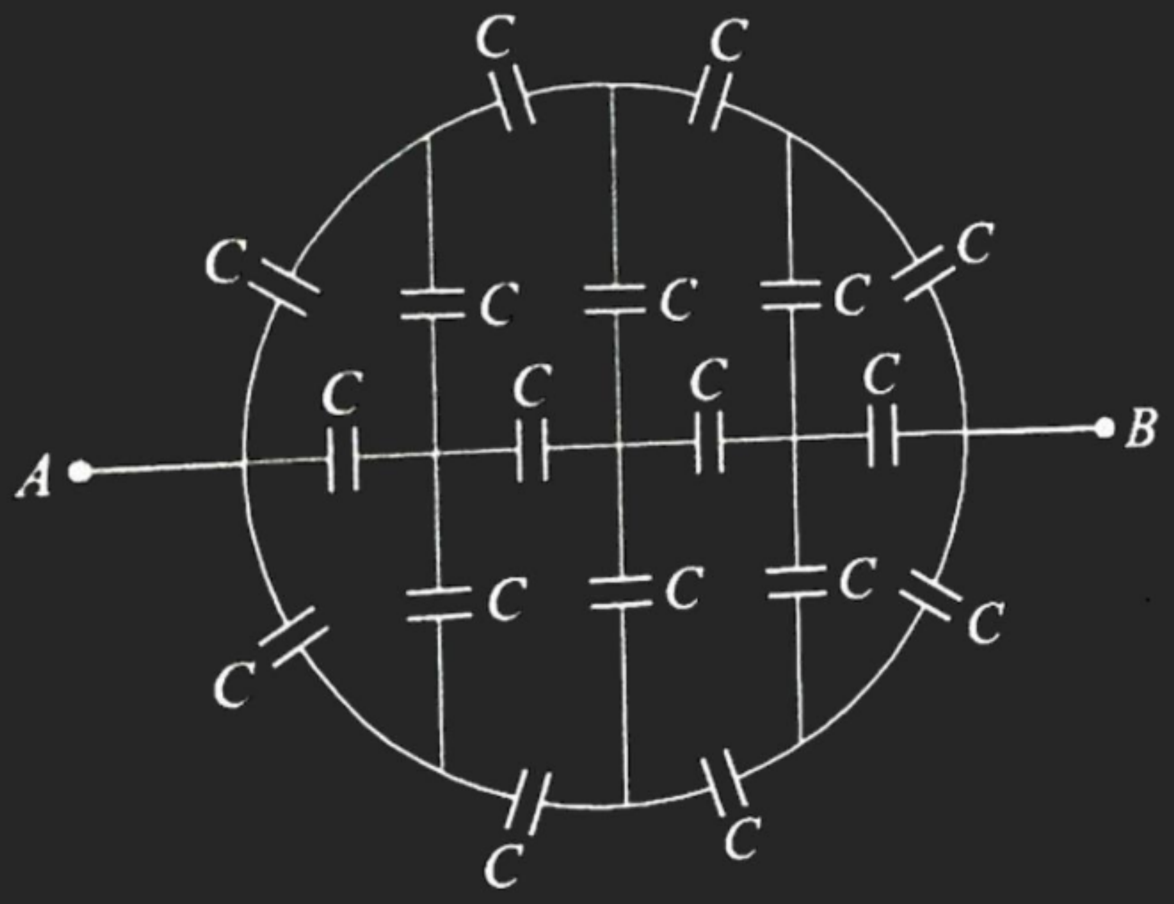
Equivalent capacitance (Symmetry) CAPACITOR

H.W.

$(C_{eq})_{A-B} = ??$



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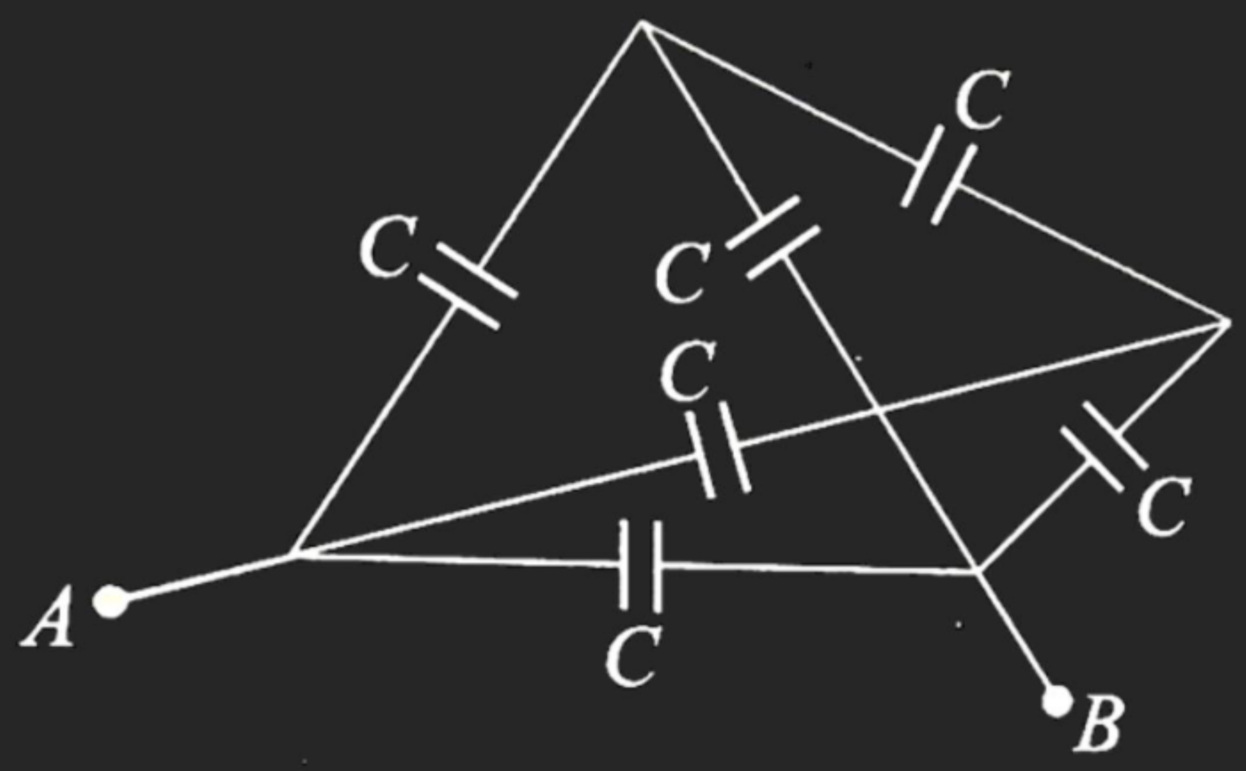
Equivalent capacitance (Symmetry) CAPACITOR

$(C_{eq})_{A-B} = ??$



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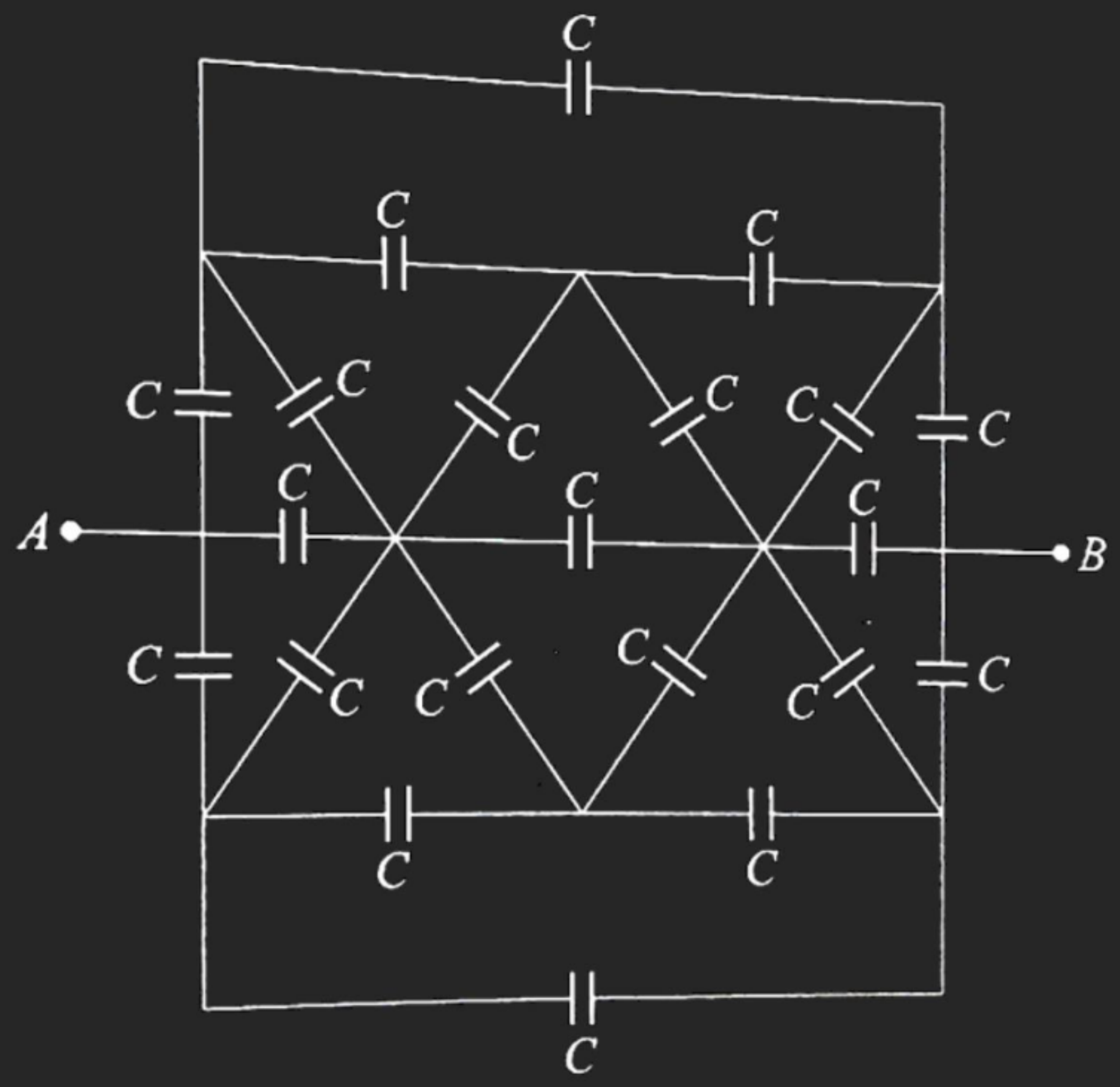
Equivalent capacitance (Symmetry)

CAPACITOR

$(C_{eq})_{A-B} = ??$



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Equivalent capacitance (Symmetry) CAPACITOR

Q.2 Figure shows a circuit of 12 capacitors each of capacitance C connected along the edges of a cubical wireframe as shown. Find the equivalent capacitance between terminals A & B.

C_{eq} About Edge.

For Node y

$C[y-(100-y)] + (y-x)C + (y-x)C = 0$

$4y - 2x = 100$

$2y - x = 50$ — ①

Nodal analysis for node x.

$(x-y)C + [x-(100-x)]C + (x-0)C = 0$

$(x+2x+x) - y = 100$

$4x - y = 100$ — ②

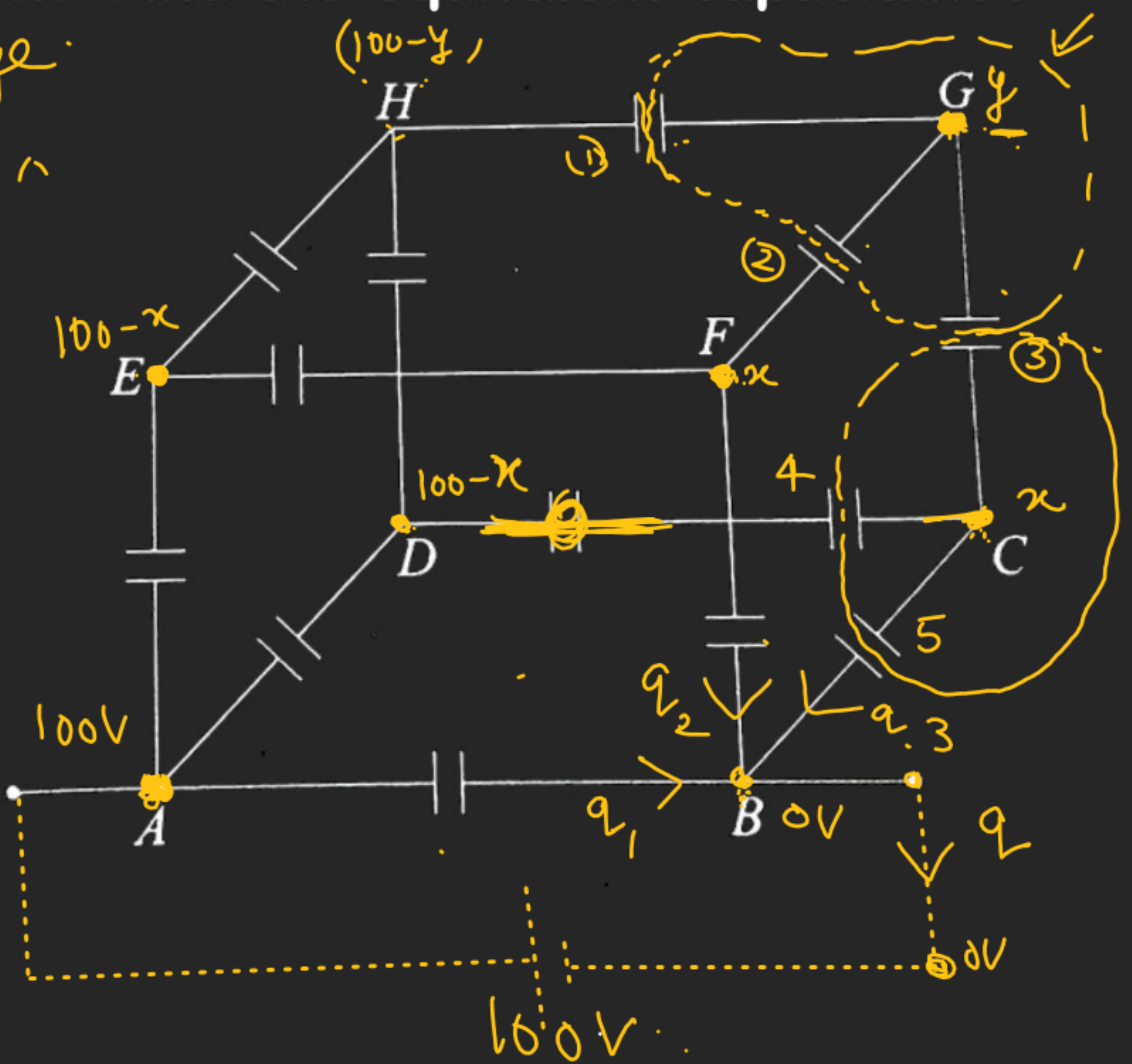
$8x - 2y = 200$ ← ×2

$7x = 250$

$x = \frac{250}{7}$ Volt

$y = \frac{4\times 250}{7} - 100$

$y = \frac{300}{7}$



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Junction law at point B.

$$q_1+q_2+q_3=q$$

$$(2x)C+(100)C=C_{eq}(100)$$

$$\left[2\times\frac{250}{7}+100\right]C=C_{eq}\cdot 100$$

$$\left(\frac{500+700}{7}\right)C=C_{eq}\times 100$$

$$\left(\frac{12\cancel{00}}{7\times 1\cancel{00}}\right)C=C_{eq}\Rightarrow C_{eq}=\frac{12C}{7}$$

H.W

Find C_{eq} about face diagonal of the cube. ??

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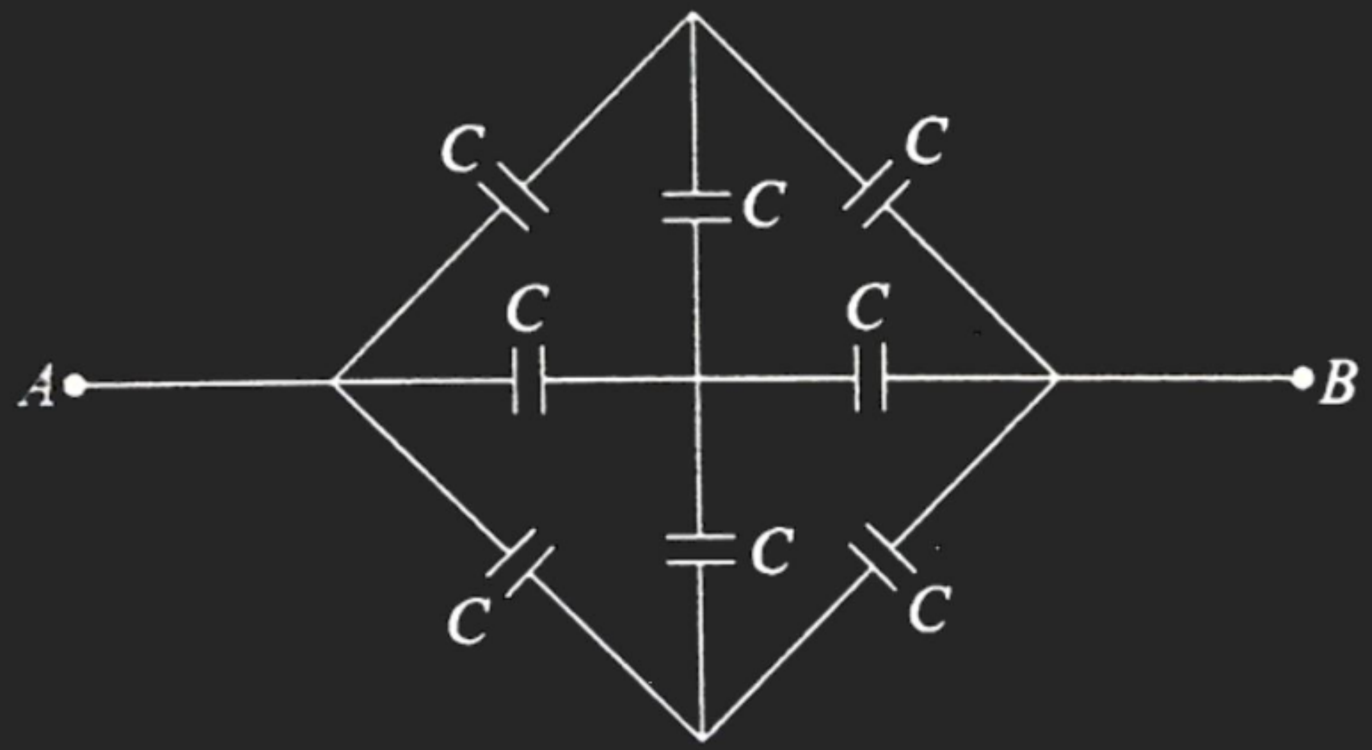
Equivalent capacitance (Symmetry) CAPACITOR

H-W

$(C_{eq})_{A-B} = ??$



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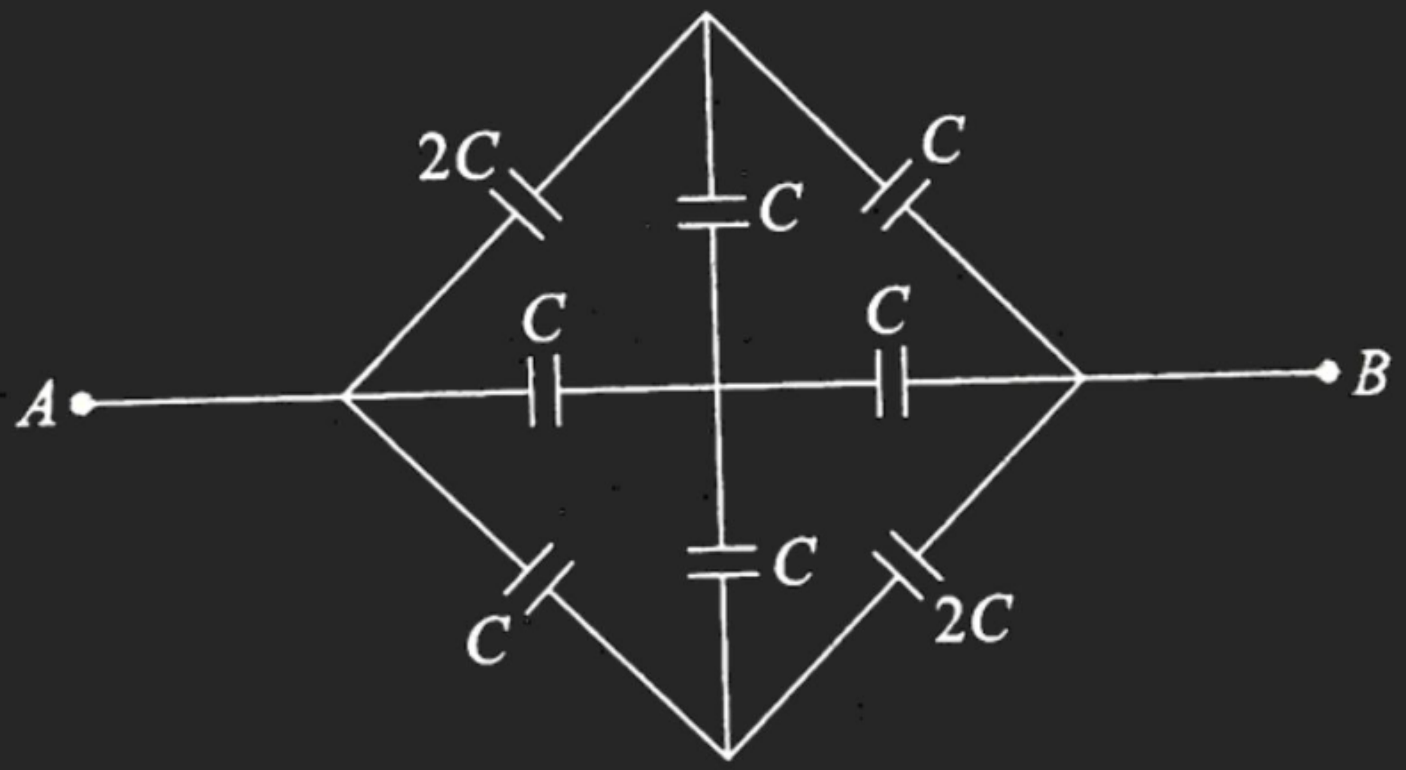
Equivalent capacitance (Symmetry)

CAPACITOR

$(C_{eq})_{A-B} = ??$

H.W



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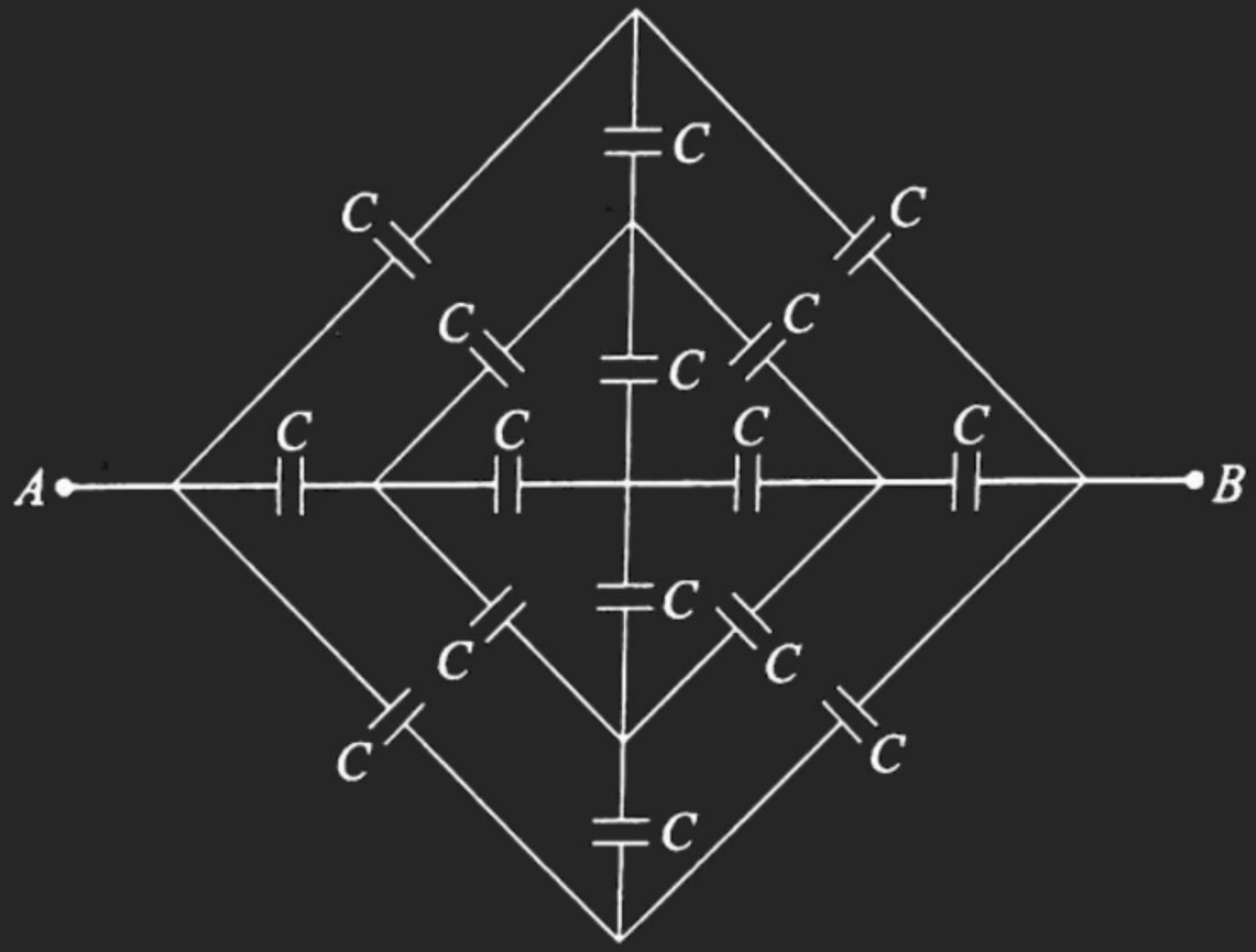
Equivalent capacitance (Symmetry) CAPACITOR

$(C_{eq})_{A-B} = ??$

H.W



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Equivalent capacitance (Symmetry)

CAPACITOR

$(C_{eq})_{A-B}$.

H.W