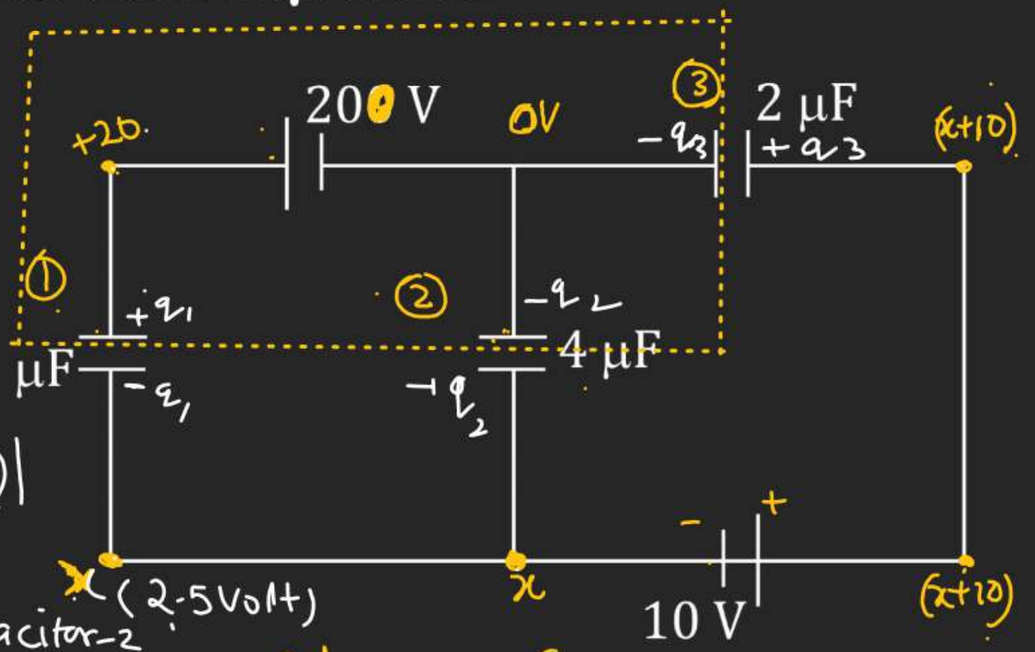
Nishant Jindal

CAPACITOR

Nodal method

$q = C\Delta V$

Q.1 In the circuit shown in Fig. determine charge on each capacitor.



$2(x-20) + (x-0)4 + [(x+10)-0]2 = 0$

↑ Charge on Capacitor ①

① ② Charge on Capacitor-2

③ → Charge on Capacitor-3.

$8x - 20 = 0$

$x = \frac{20}{8} = \left(\frac{5}{2}\text{ Volt}\right)$

Charge on Capacitor-1

$= |2(2.5-20)|$

$= 35\mu C$

[Initial Charge = 0]

At steady state = (final charge)

$0 = \text{Initial Charge} = \left[\sum_{i=1}^{n} q_i\right]$

Charge on Capacitor-2

$= (2.5 \times 4)$

$= [10\mu C]$

Charge on Capacitor-3

$= (x+10) \times 2$

$= (12-5) \times 2$

$= 25\mu C$

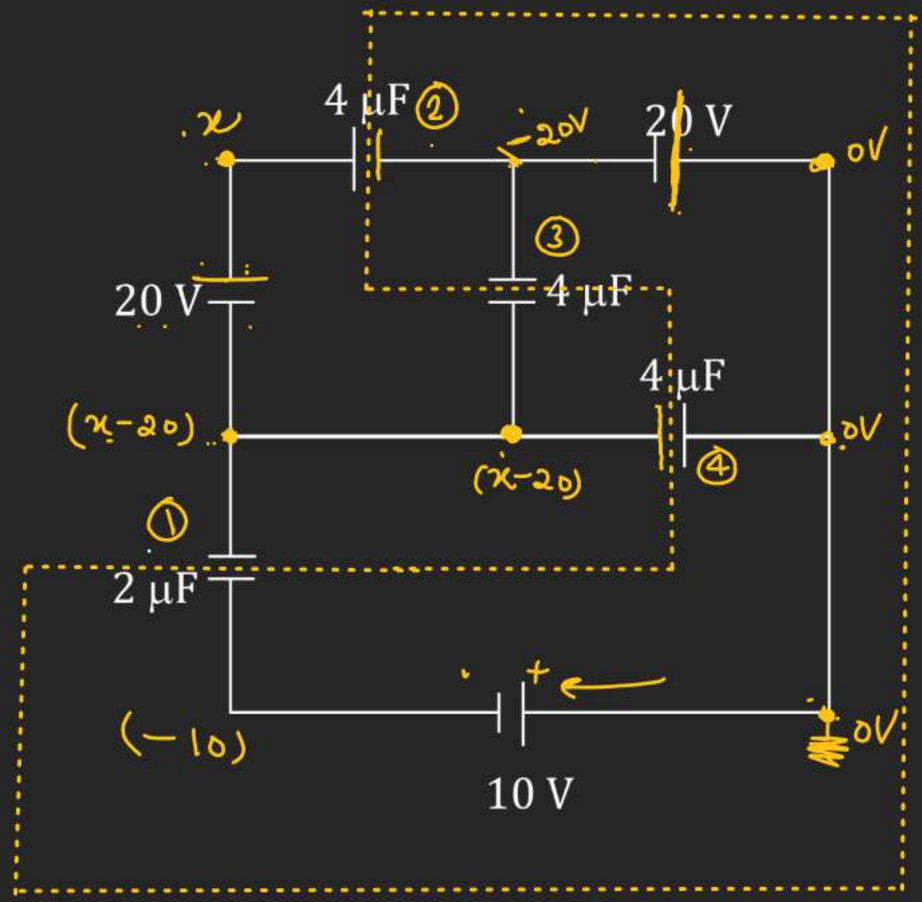
Nodal method

CAPACITOR

Q.2 Find charge on all the capacitors in circuit:

$$\underbrace{[(x-20)-(-10)]}_{q_1}2 + \underbrace{[x-(-20)]\times 4}_{q_2} + \underbrace{[(x-20)-(-20)]}_{q_3}4 + \underbrace{(x-20)4}_{q_4} = 0$$

$$x = \left(\frac{10}{7}\right) \text{Volt. Ans}$$



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CAPACITOR

Nodal method

M-2

q_1 q_2

$$3(x-0)+(x-200)\times 6=0$$

$$3x+6x-1200=0$$

$$9x=1200$$

$$x=\frac{1200}{9}=\frac{400}{3}\ \text{Volt}$$

$$q_1=3\times\frac{400}{3}=400\,\mu C$$

$$q_2=\left(\frac{400}{3}-200\right)\times 6$$

$$=-\frac{200}{3}\times 6$$

$$=-400\,\mu C$$

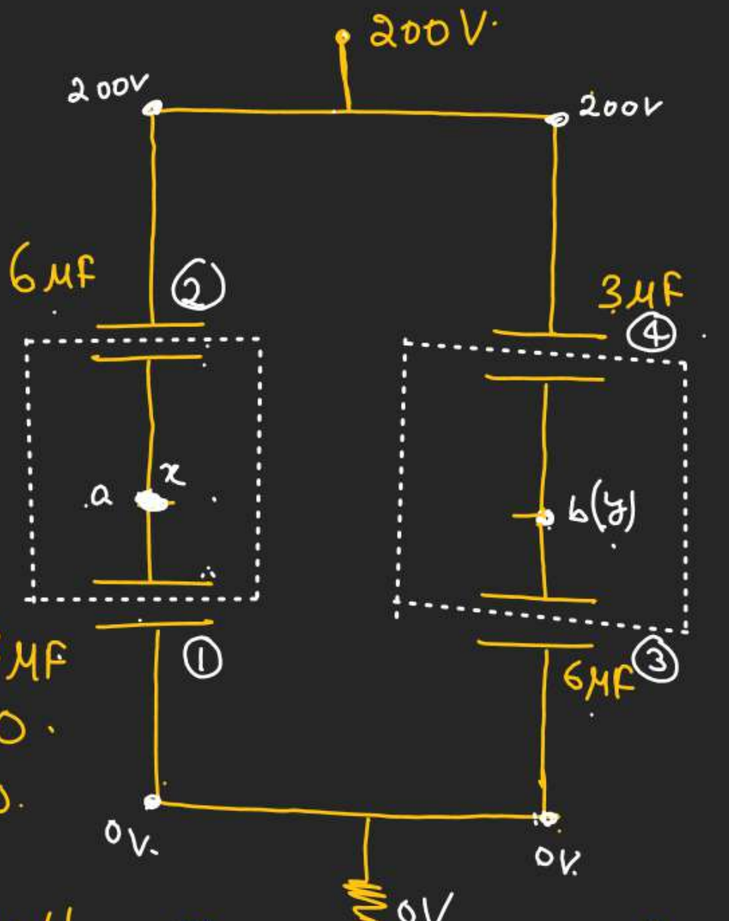
For plate ③ & ④

$$6(y-0)+(y-200)3=0$$

$$6y+3y-600=0$$

$$9y=600$$

$$y=\frac{600}{9}=\left(\frac{200}{3}\right)\text{Volt}$$



$$x-y=\frac{400}{3}-\frac{200}{3}=\left(\frac{200}{3}\right)\text{Volt}$$

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Nodal method

CAPACITOR

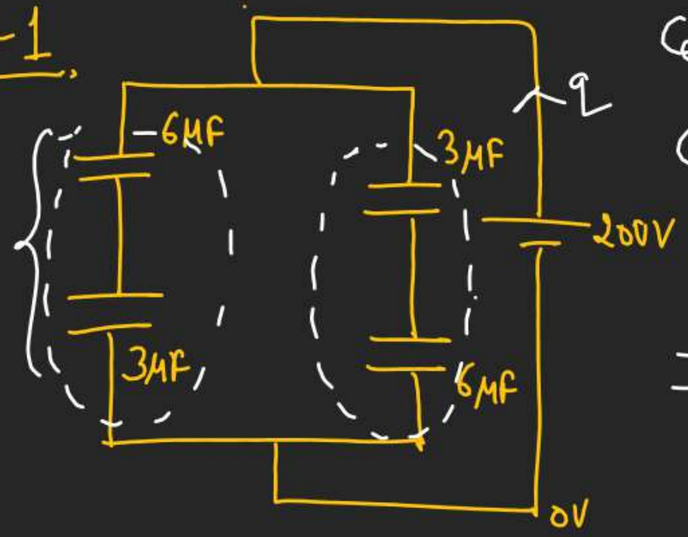
Q.3 Fig. shows a capacitive circuit, with a switch S_w.

(a) What is potential difference between a and b when switch is open ?

(b) What is potential of b after switch is closed ?

(c) What charge flows through switch when it is closed?

M-1

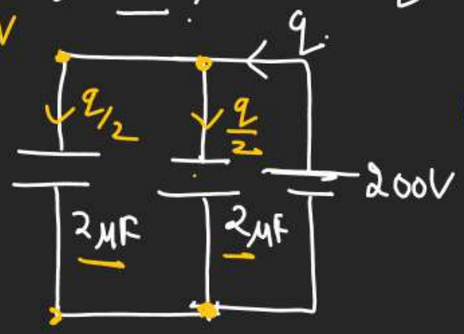


$C_{eq} = \left(\frac{3\times 6}{3+6}\right)\times 2$

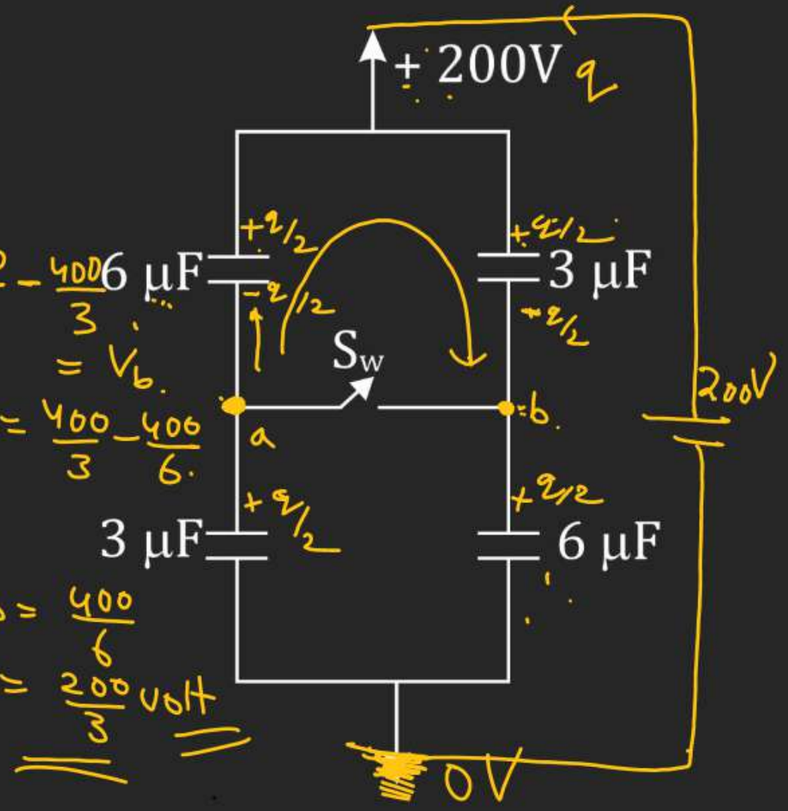
$C_{eq} = 4\,\mu F$

$q = 4 \times 200$

$q = 800\,\mu C$



$(q/2 = 400\,\mu C)$



$V_a + \frac{400}{6} - \frac{400}{3} = V_b$

$V_a - V_b = \frac{400}{3} - \frac{400}{6}$

$V_a - V_b = \frac{400}{6}$

$= \frac{200}{3}$ Volt

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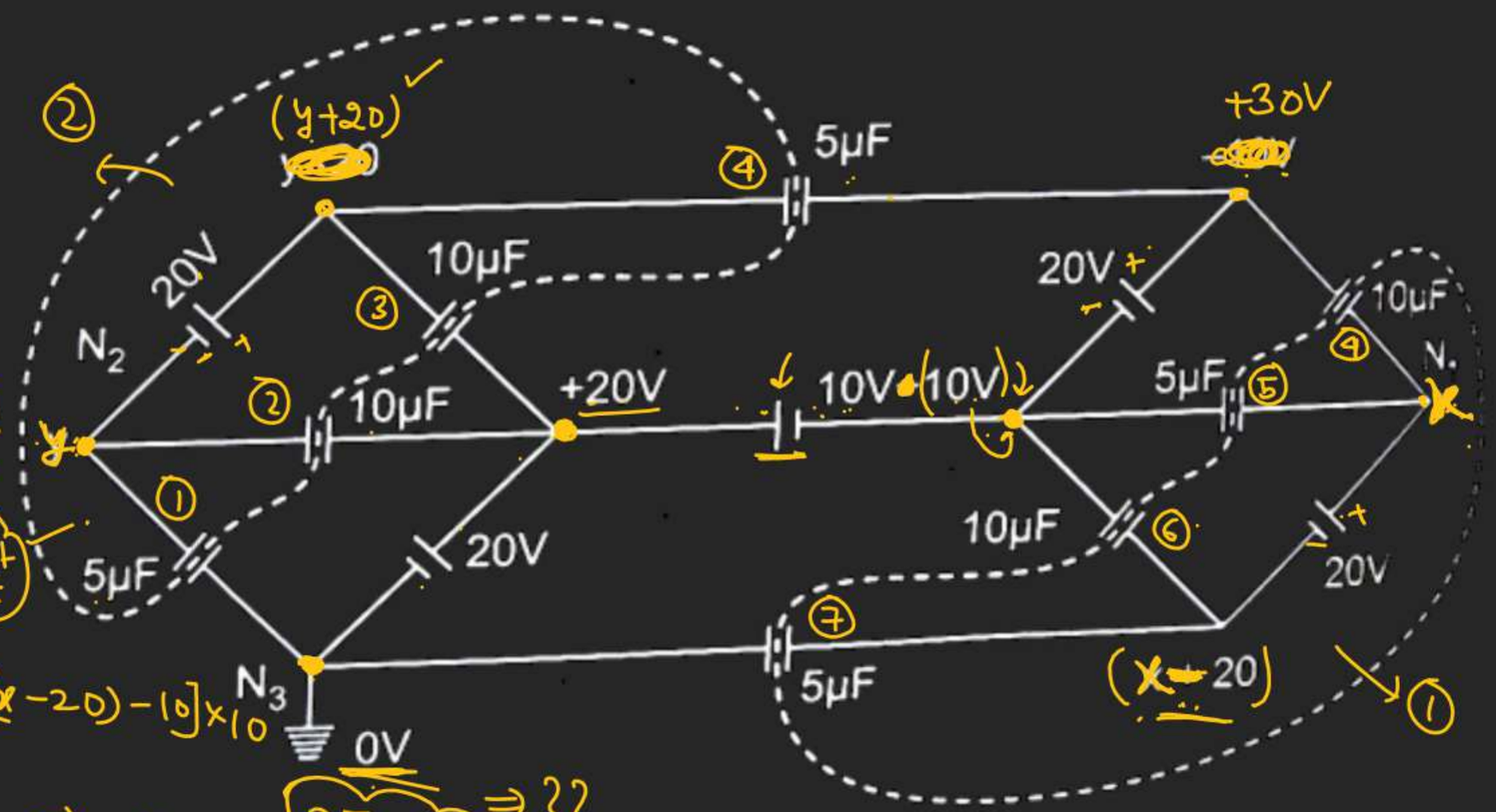
CAPACITOR

Nodal method

Q.5 Find the potential difference between point A and B in the circuit shown in figure.



For loop-2

$(5y) + (y-20)\times 10 + [(y+20)-20]10 + [(y+20)-30]\times 5 = 0$

$\Rightarrow y = \frac{25}{3}$ Volt

For loop-1

$(x-30)\times 10 + (x-10)\times 5 + [(x-20)-10]\times 10 + [(x-20)-0]\times 5 = 0$

$\Rightarrow x =$ 25 Volt

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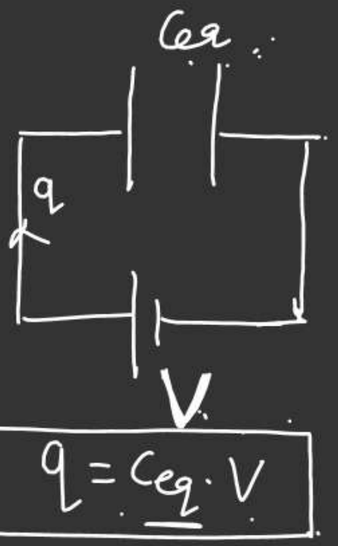
(*) Diagonal Symmetry =??

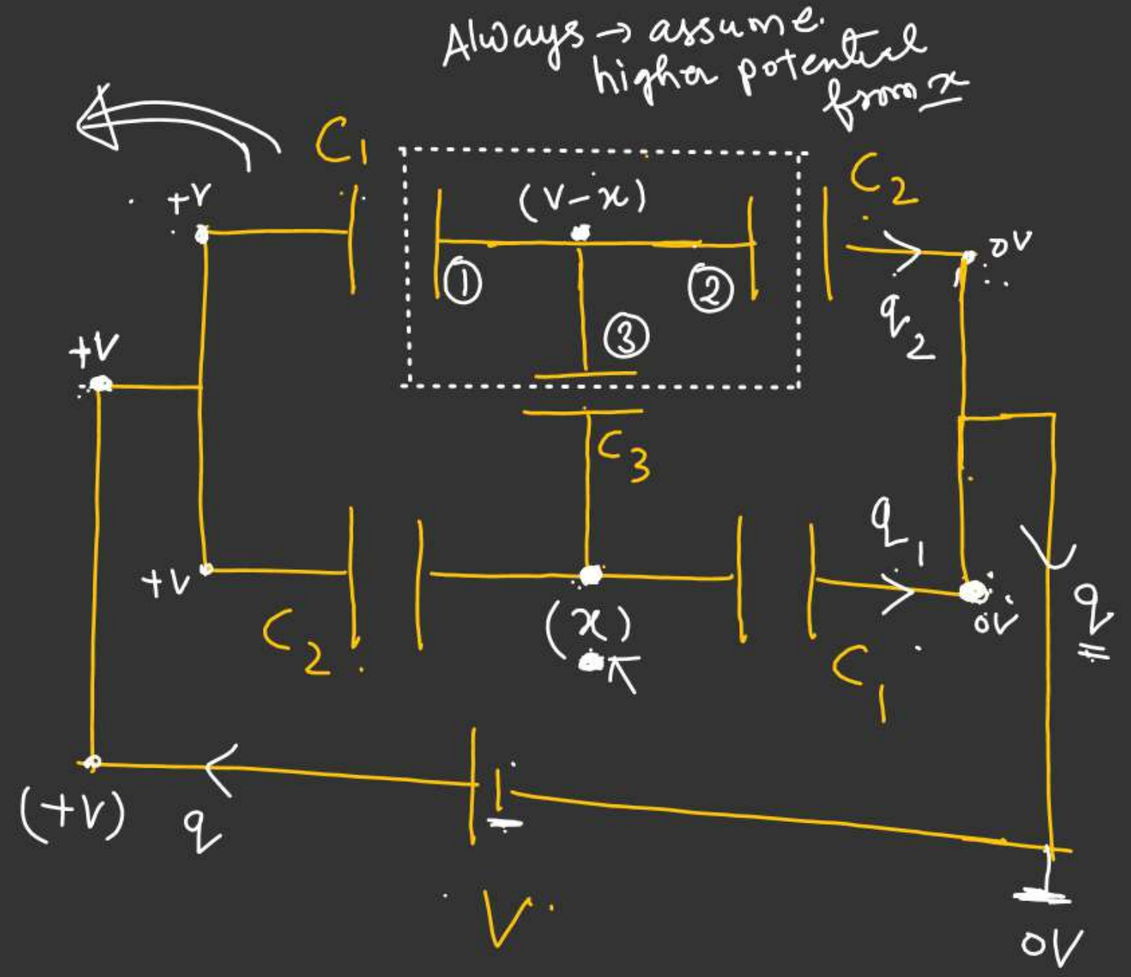
$$[(V-x)-V]C_1 + (V-x)C_2 + (V-2x)C_3 = 0$$

$$(-xC_1 - xC_2 - 2xC_3) + VC_2 + VC_3 = 0$$

$$x = \left[\frac{V(C_2+C_3)}{C_1+C_2+2C_3}\right]$$



$q = C_{eq} \cdot V$



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CAPACITOR

Nodal method

$$q = q_1 + q_2$$

$$q = xC_1 + (V-x)C_2$$

$$q = x(C_1 - C_2) + VC_2$$

$$q = \left[\frac{V(C_2+C_3)}{C_1+C_2+2C_3}\right](C_1-C_2) + VC_2$$

$$q = \left[\frac{(C_2+C_3)(C_1-C_2)}{C_1+C_2+2C_3} + C_2\right]V$$

$$q = \left[\frac{C_1C_2 - C_2^2 + C_3C_1 - C_2C_3}{C_1+C_2+2C_3} + C_2\right]V$$

$$q = \left[\frac{C_1C_2 - C_2^2 + C_3C_1 - C_2C_3 + C_1C_2 + C_2^2 + 2C_3}{C_1+C_2+2C_3}\right]V$$

$$q = \left[\frac{2C_1C_2 + C_2C_3 + C_3C_1}{C_1+C_2+2C_3}\right]V$$

$$\Downarrow$$

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

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Nodal method

HW

CAPACITOR

Q.7 A capacitor of capacitance $C_1 = 1.0\mu F$ with stands the maximum voltage $V_1 = 6.0kV$ while a capacitor of capacitance $C_2 = 2.0\mu F$, the maximum voltage $V_2 = 4.0kV$. What voltage will the system of these two capacitors withstand if they are connected in series?