Physicsaholics

DPP – 3 (Capacitor)

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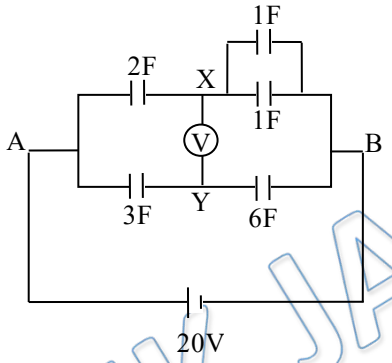
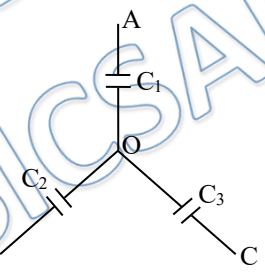
Q 1. Calculate the reading of voltmeter between X and Y then (Vx – Vy) is equal to -



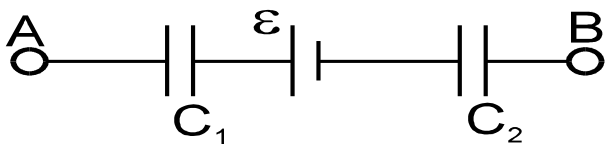
(a) 10 V (b) 13.33V (c) 3.33 V (d) 10.33 V

Q 2. Three capacitors of capacitors C1 , C2 , C3 are connected as shown in the figure. The points A , B and C are at potential V1 , V2 and V3 respectively. Then the potential at O will be –



(a) $\frac{V_1+V_2+V_3}{2}$ (b) $\frac{V_1V_2+V_2V_3+V_3V_1}{V_1+V_2+V_3}$ (c) $\frac{V_1C_1+V_2C_2+V_3C_3}{C_1+C_2+C_3}$ (d) zero

Q 3. A circuit has a section AB shown in the figure. The emf of the source equals e = 10V, the capacitance as of the capacitors are equal to C_1 = 1.0 mF and C_2 = 2.0 mF, the potential difference f_A - f_B = 5.0V. The voltage across capacitor C_1 & C_2 is respectively :



(a)10/3 V, 5/3 V (b) 10/3 V, 10/3 V
(c) 5/3 V, 5/3 V (d) 0 V,0 V

Q 4. 2μF capacitance has P.D across its two terminals of 200 V. It is disconnected from the battery and when another uncharged capacitor is connected in parallel to it, P.D becomes 20 V. The capacity of another capacitor will be:
(a) 2 μF (b) 4 μF
(c) 18 μF (d) 16 μF

Q 5. A capacitor of 10μF charged upto 250 V is connected in parallel with another capacitor of 5μF charged upto 100 V (plates of like charges connected together). The common potential is :
(a) 200 V (b) 300 V
(c) 400 V (d) 500 V

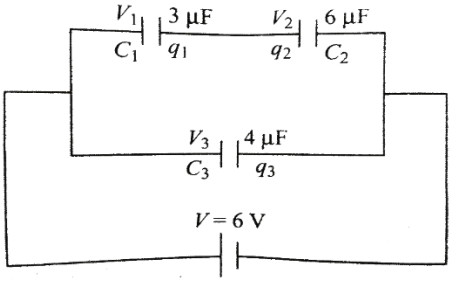
Q 6. A 10μF capacitor is charged to a potential difference of 1000V. The terminals of the charged capacitor are disconnected from the power supply and connected to the terminals of an uncharged 6μF capacitor. What is the final potential difference across each capacitor ?
(a) 167 V (b) 100 V
(c) 625 V (d) 250 V

Q 7. A 10μF capacitor and a 20μF capacitor are connected in series across a 200V supply line. The charged capacitors are then disconnected from the line and reconnected with their positive plates together and negative plates together and no external voltage is applied. what is the potential difference across each capacitor?
(a) $\frac{400}{9}$ V (b) $\frac{800}{9}$ V
(c) 400 V (d) 200 V

Q 8. Three capacitors of capacitance 1μF,2μF and 3μF are connected in series and a potential difference of 11V is applied across the combination. Then, the potential difference across the plates of 1μF capacitor is
(a) 2 V (b) 4 V
(c) 1 V (d) 6 V

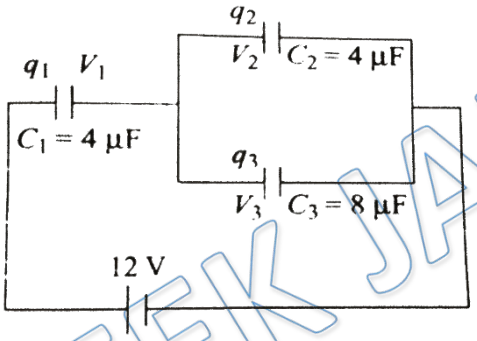
Q 9. The capacitor of capacitance 4μF and 6μF are connected in series. A potential difference of 500 volts applied to the outer plates of the two capacitor system. Then the charge on each capacitor is numerically
(a) 6000 C (b) 1200 C
(c) 1200 μC (d) 6000 μC

Q 10. Three capacitors of capacitances 3μF, 6μF, and 4μF are connected as shown across a battery of emf 6V. Find the potential difference and charge on capacitor C_2.



(a) 2 V, 12 μC (b) 4 V, 12 μC
(c) 6 V, 36 μC (d) 4 V, 24 μC

Q 11. Three capacitors of capacitances 4μF, 4μF, and 8μF, are connected as shown across a battery of emf 12V. Find the potential difference and charge on capacitor C_2.



(a) 3 V, 12 μC (b) 2 V, 8 μC
(c) 1 V, 4 μC (d) 4 V, 16 μC

Q 12. Two capacitors of capacitance of 6μFand12μF are connected in series with a battery. The voltage across the 6μF capacitor is 2V. Compute the total battery voltage.
(a) 2 V (b) 3 V
(c) 4 V (d) 6 V

Q 13. Two capacitors C_1 and C_2 are charged to 120V and 200V respectively. It is found that connecting them together the potential on each one can be made zero. Then
(a) $5C_1 = 3C_2$ (b) $3C_1 = 5C_2$
(c) $3C_1 + 5C_2 = 0$ (d) $9C_1 = 4C_2$

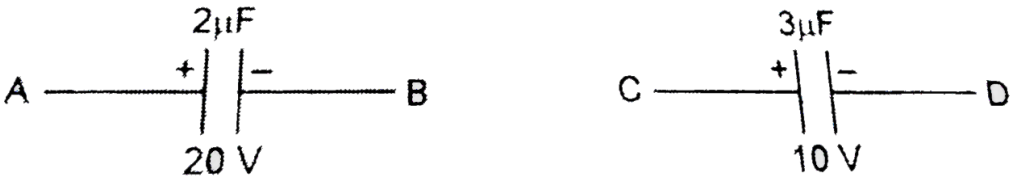
Q 14. A capacitor of 5μF is charged to a potential of 100V. Now, this charged capacitor is connected to a battery of 100V with the positive terminal of the battery connected to the negative plate of the capacitor . For the given situation, mark the correct statement.

(a) The charge flowing through the 100V battery is 500μC
(b) The charge flowing through the 100V battery is 1000μC
(c) The charge flowing through the 100V battery is 2000μC
(d) The charge flowing through the 100V battery is 3000μC

Q 15. A 1μF capacitor and a 2μF capacitor are connected in series across a 1200V supply line. The charged capacitors are disconnected from the line and from each other and reconnected with terminals of like sign together. Find the final charge on each and the voltage across them.

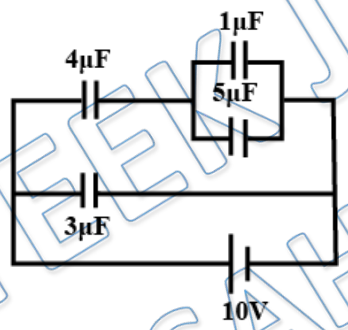
(a) $\frac{1600}{3}$ μC, $\frac{3200}{3}$ μC, $\frac{1600}{3}$ V (b) $\frac{1500}{7}$ μC, $\frac{3000}{7}$ μC, $\frac{1500}{7}$ V
(c) $\frac{900}{5}$ μC, $\frac{1800}{5}$ μC, $\frac{900}{5}$ V (d) $\frac{500}{3}$ μC, $\frac{1000}{3}$ μC, $\frac{500}{3}$ V

Q 16. If A is connected with C and B is connected with D. How much charge flows in the circuit.



(a) 12 μC (b) 10 μC
(c) 8 μC (d) 4 μC

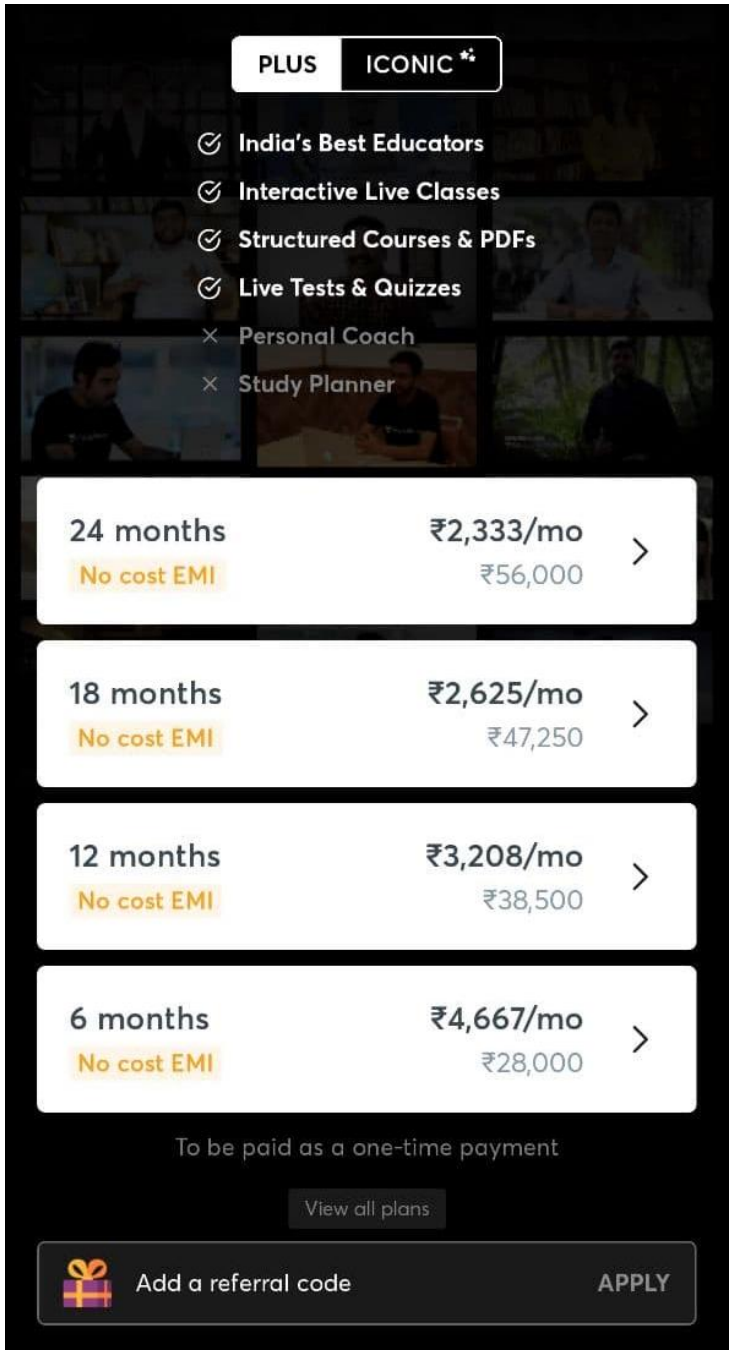
Q 17. In the given circuit, the charge on 4μF capacitor will be :



(a) 5.4 μC (b) 24 μC
(c) 13.4 μC (d) 9.6 μC

Answer Key

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



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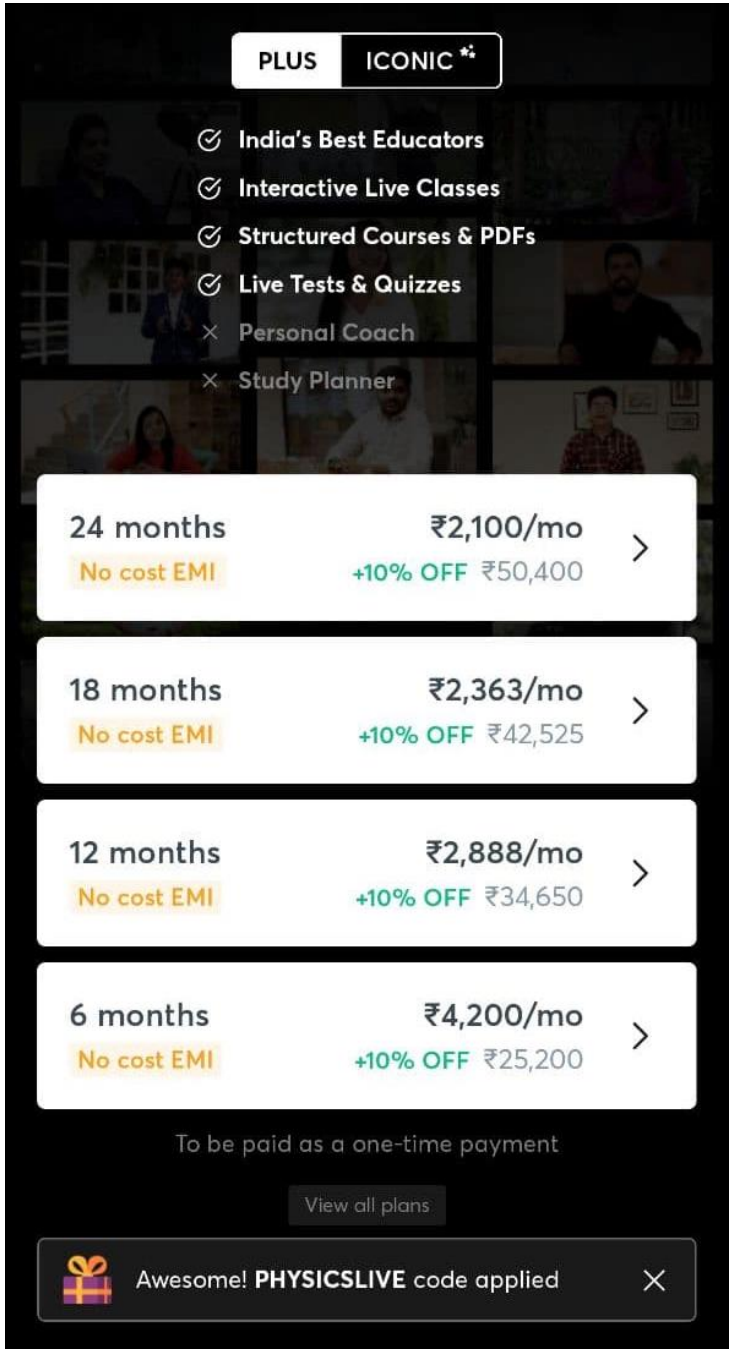
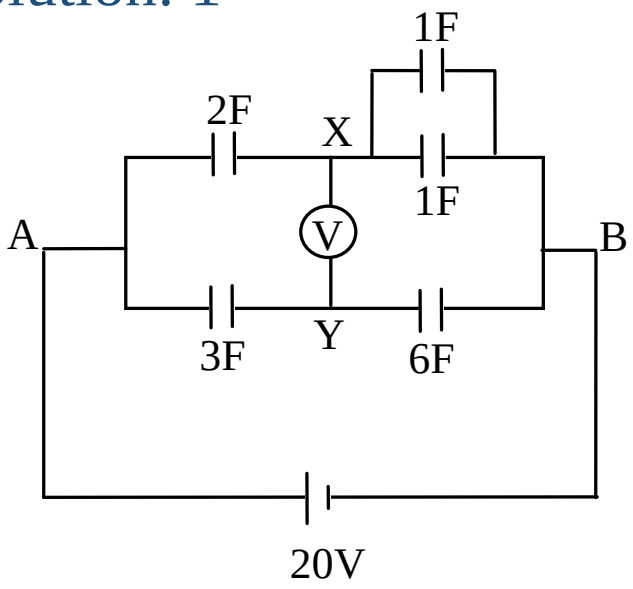


Written Solution

DPP- 3, Capacitor: Kirchhoff's 1st & 2nd Law

By Physicsaholics Team

Solution: 1



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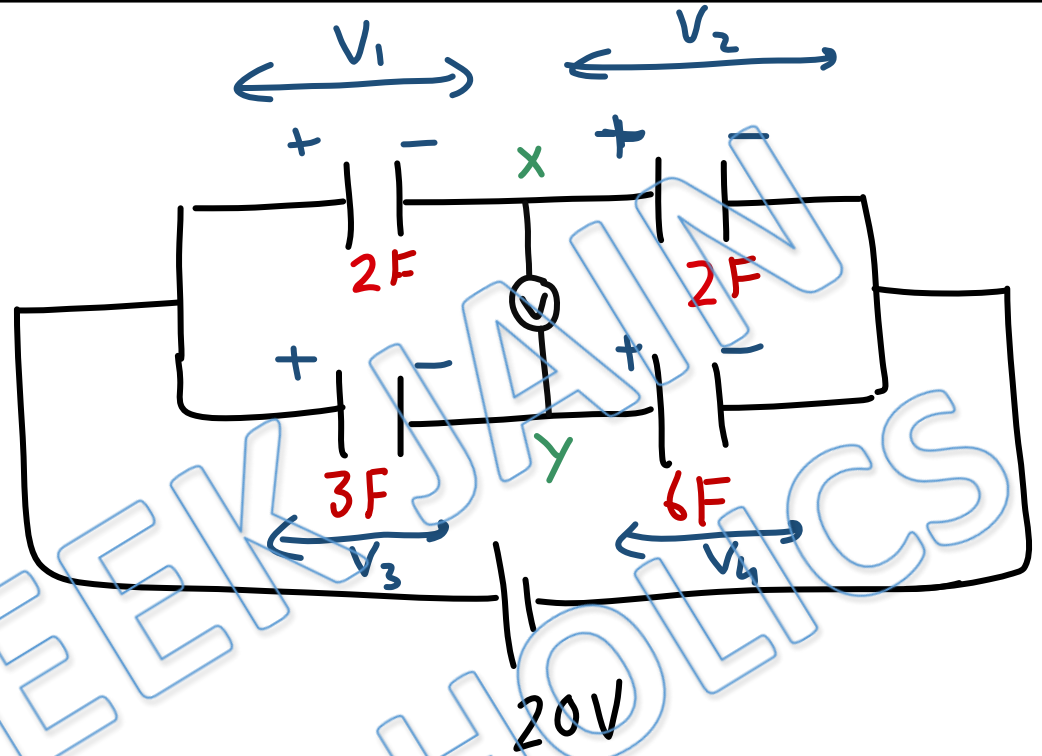


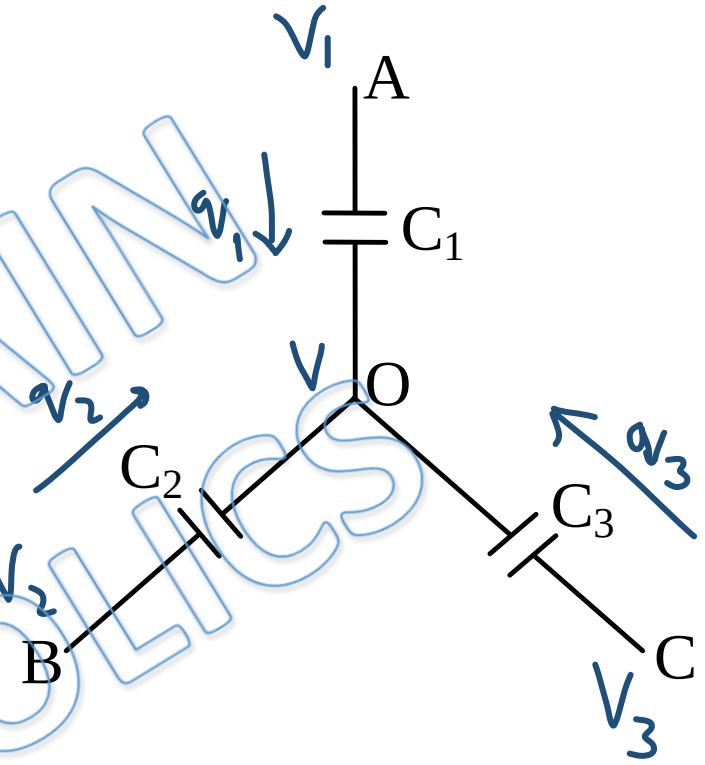
$\frac{V_1}{V_2} = \frac{2}{2} = 1$ & $V_1 + V_2 = 20 \Rightarrow V_1 = 10V$, $V_2 = 10V$

$\frac{V_3}{V_4} = \frac{6}{3} = 2$ & $V_3 + V_4 = 20 \Rightarrow V_3 = \frac{40}{3}V$, $V_4 = \frac{20}{3}V$

$V_x - V_y = +V_3 - V_1 = \frac{40}{3} - 10 = \frac{10}{3}V$

Ans (c)

Solution: 2



by Kirchoff's first Law →

$$q_1 + q_2 + q_3 = 0$$

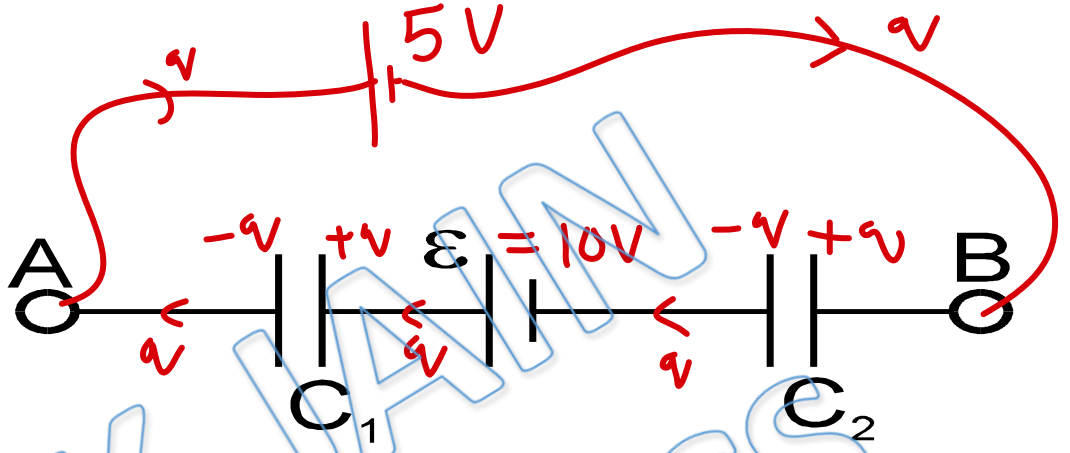
$$C_1(V_1 - V) + C_2(V_2 - V) + C_3(V_3 - V) = 0$$

$$\Rightarrow C_1V_1 + C_2V_2 + C_3V_3 - V(C_1 + C_2 + C_3) = 0$$

$$\Rightarrow V = \frac{C_1V_1 + C_2V_2 + C_3V_3}{C_1 + C_2 + C_3}$$

Ans (c)

Solution: 3



by Using K.V.L →

$$10 - \frac{q}{1m} - 5 - \frac{q}{2m} = 0$$

$$\frac{3q}{2m} = 5$$

$$q = \frac{10m}{3}$$

Voltage across $C_1 = \frac{q}{C_1} = \frac{10m}{3 \times 1m} = \frac{10}{3} V$

Voltage across $C_2 = \frac{q}{C_2} = \frac{10m}{3 \times 2m} = \frac{5}{3} V$

Ans(a)

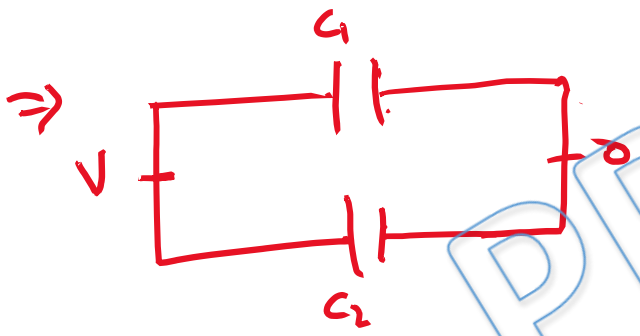
Solution: 4

$C_1 = 2\mu F$

$V_1 = 200\,V$

$C_2 = ?$

$V_2 = 0$



$$V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$$

$$20 = \frac{(2\mu F)(200) + 0}{(2\mu F) + C_2}$$

$$\Rightarrow (2\mu F) + C_2 = \frac{(2\mu F)(200)}{20} \quad (16)$$

$$2\mu F + C_2 = 20\,\mu F$$

$$\boxed{C_2 = 18\,\mu F}\ \text{Ans}$$

Ans. c

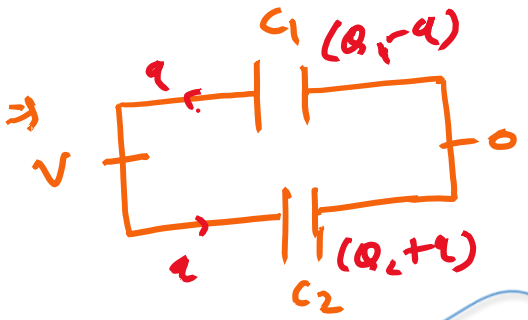
Solution: 5

$C_1 = 10\mu F,\ V_1 = 250V$

$Q_1 = 2500\ \mu C$

$C_2 = 5\mu F,\ V_2 = 100V$

$Q_2 = 500\ \mu C$



$$V = \frac{Q_1 - q}{C_1} = \frac{Q_2 + q}{C_2}$$

$$\frac{Q_1 - q}{10\mu F} = \frac{Q_2 + q}{5\mu F}$$

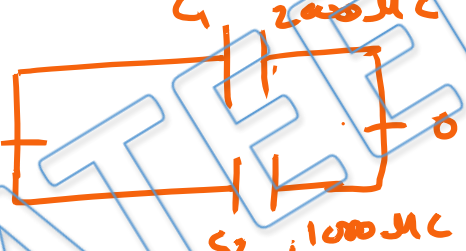
$$\Rightarrow Q_1 - q = 2Q_2 + 2q$$

$$Q_1 - 2Q_2 = 3q$$

$$2500 - 2(500) = 3q$$

$$1500 = 3q$$

$$\boxed{q = 500}$$



$$V = \frac{2000\ \mu C}{C_1} = \frac{2000\ \mu C}{10\mu F}$$

$$\boxed{V = 200\ \text{Volt}}$$

(Or)

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

$$V = \frac{(10\mu F)(250) + (5\mu F)(100)}{10\mu F + 5\mu F}$$

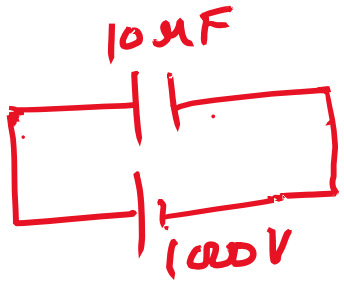
$$V = \frac{(2500 + 500)\ \mu C}{15\mu F}$$

$$V = \frac{3000\ \mu C}{15\mu F}$$

$$\boxed{V = 200\ \text{Volt}}$$

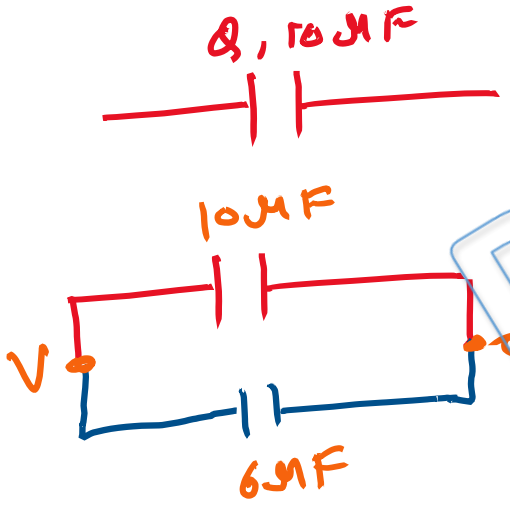
Ans. a

Solution: 6



$Q = CV = 10\,\mu F \times 1000\,V$

$Q = 10{,}000\,\mu C$



Q = Constant

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

$$V = \frac{10{,}000\,\mu C}{10\,\mu F + 6\,\mu F}$$

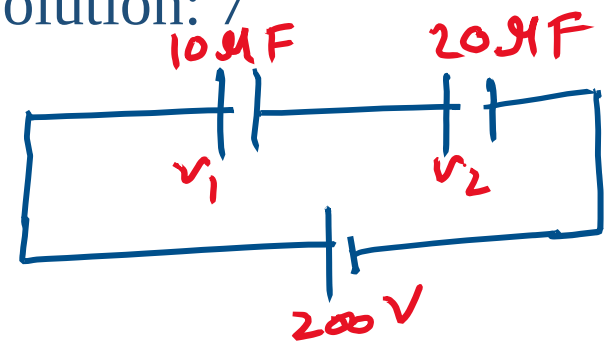
$$V = \frac{10{,}000\,\mu C}{16\,\mu F}$$

$$V = \frac{10{,}000}{16}\ \text{Volt}$$

$$\boxed{V = 625\ \text{Volt}}$$ Ans

Ans. c

Solution: 7



$V_1 + V_2 = 200\,V$ — (1)

Q = same on both

$\Rightarrow C_1V_1 = C_2V_2$

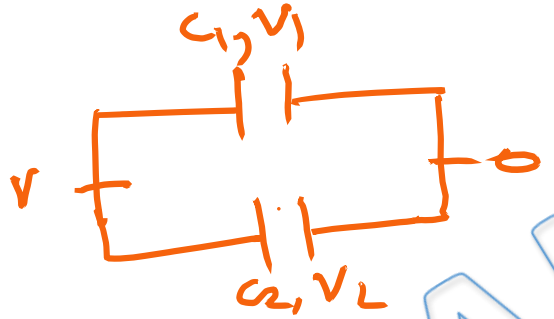
$(10\,\mu F)V_1 = (20\,\mu F)V_2$

$V_1 = 2V_2$

$\Rightarrow 2V_2 + V_2 = 200$

$V_2 = \frac{200}{3}$ Volt

$V_1 = \frac{400}{3}$ Volt



$V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2} = \frac{(10\,\mu F)\left(\frac{400}{3}\right) + (20\,\mu F)\left(\frac{200}{3}\right)}{10\,\mu F + 20\,\mu F}$

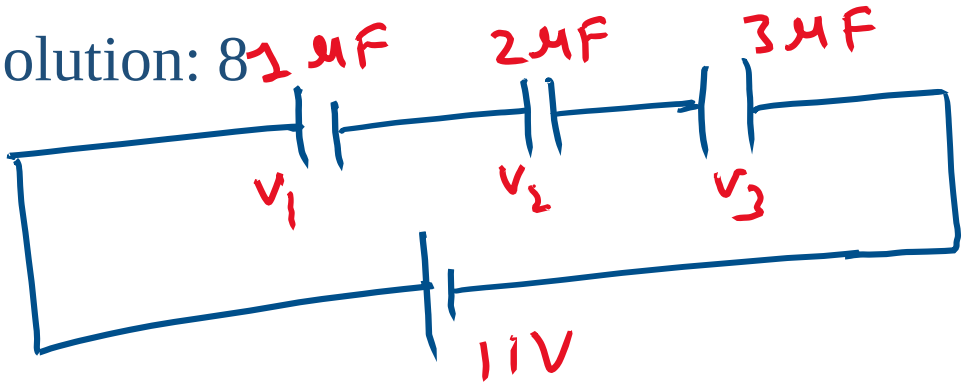
$V = \frac{\left(\frac{4000}{3} + \frac{4000}{3}\right)\mu C}{30\,\mu F}$

$V = \frac{8000}{3 \times 30}$ Volt

$V = \frac{800}{9}$ Volt Ans.

Ans. b

Solution: 8



Q = Same on all

$Q = C_{eq} \cdot V$

$\frac{1}{C_{eq}} = \frac{1}{1} + \frac{1}{2} + \frac{1}{3} = \frac{6+3+2}{6} = \frac{11}{6}$

$C_{eq} = \frac{6}{11}\ \mu F$

$Q = \frac{6}{11} \times 11$

$\boxed{Q = 6\ \mu C}$

$Q = CV$

$Q = C_1 V_1$

$6\ \mu C = (1\ \mu F) V_1$

$\boxed{V_1 = 6\ \text{Volt}}$

Ans. d

Solution: 9

in series ⇒ charg is same

$Q = C_{eq} V$

$\frac{1}{C_{eq}} = \frac{1}{4} + \frac{1}{6} = \frac{10}{24} = \frac{5}{12}$

$C_{eq} = \frac{12}{5}\ \mu F$

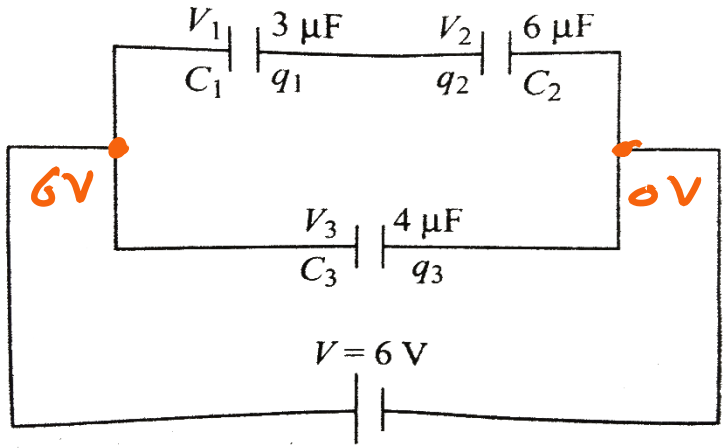
$Q = C_{eq} V$

$= \frac{12}{5} \times 500$

$Q = 1200\ \mu C$ Ans

Ans. c

Solution: 10



$V_1 + V_2 = 6$ Volt

$C_1 V_1 = C_2 V_2$ [$\because C_1$ & C_2 in series]

$(3\mu F)\, V_1 = (6\mu F)\, V_2$

$V_1 = 2V_2$

$2V_2 + V_2 = 6$

$\boxed{V_2 = 2 \text{ Volt}}$

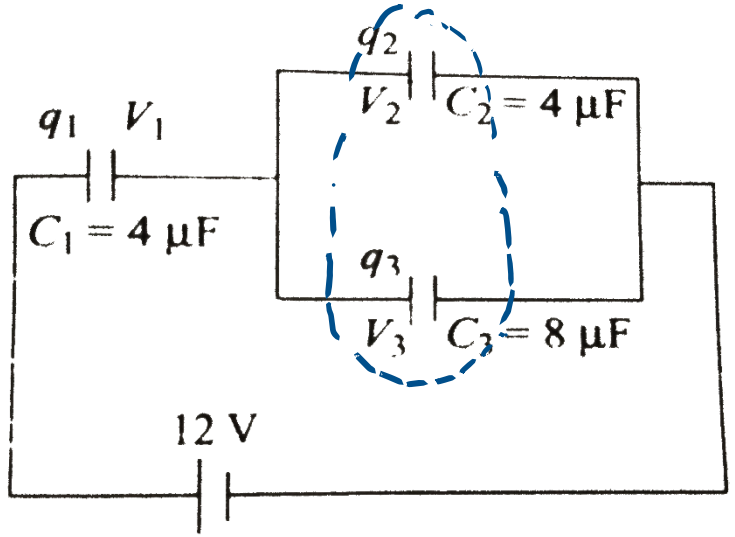
So; $Q_2 = C_2 V_2$

$= 6\mu F \times 2$ Volt

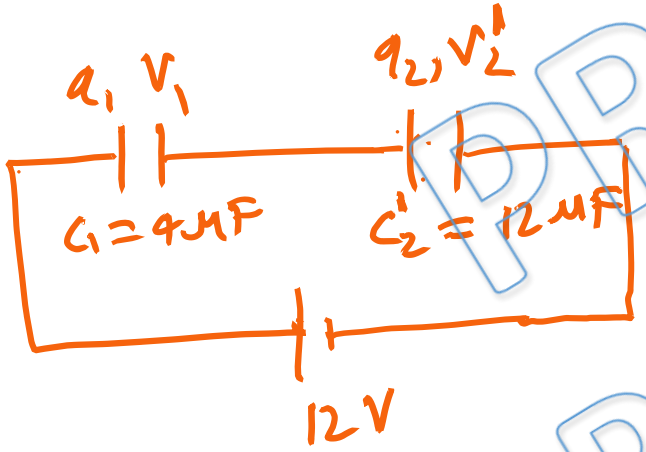
$\boxed{Q_2 = 12\ \mu C}$ Ans

Ans. a

Solution: 11



$V_2 = V_3$ [$\because$ C_2 & C_3 are parallel]



$\Rightarrow V_1 + V_2' = 12$ Volt

$C_1 V_1 = C_2' V_2'$ [$\because$ C_1 & C_2' are in series]

$(4\mu F)(V_1) = (12\mu F) V_2$

$\boxed{V_1 = 3V_2}$

$V_1 + V_2' = 12$

$3V_2 + V_2' = 12$

$\boxed{V_2' = 3\text{ Volt}}$

$V_2' = V_2$

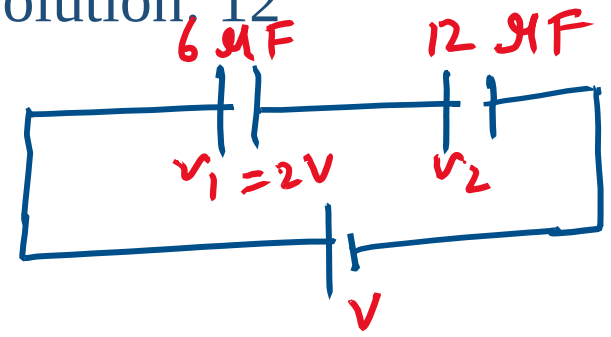
$\boxed{V_2 = 3\text{ Volt}}$

$Q_2 = C_2 V_2 = 4\mu F \times 3$ Volt

$\boxed{Q_2 = 12\ \mu C}$ Ans

Ans. a

Solution: 12



$$V_1 + V_2 = V \quad -(1)$$

$$C_1V_1 = C_2V_2$$

$$(6\mu F)V_1 = (12\mu F)V_2$$

$$\boxed{V_1 = 2V_2}$$

$$V_2 = \frac{V_1}{2}$$

put in eq^n (1)

$$V_1 + \frac{V_1}{2} = V$$

$$\frac{3V_1}{2} = V$$

$$V_1 = \frac{2V}{3}$$

$$V = \frac{3}{2}(V_1)$$

$$V = \frac{3}{2}(2)$$

$$\boxed{V = 3 \text{ volt}}$$ Ans.

Ans. b

Solution: 13

C_1, 120V

$q_1 = C_1(120)$

C_2, 200 V

$q_2 = C_2(200)$

is after joining together

$q_{net} = 0$

they should be connected in opposite polarity and

$|q_1| = |q_2|$

$C_1(120) = C_2(200)$

$\boxed{3C_1 = 5C_2}$ Ans

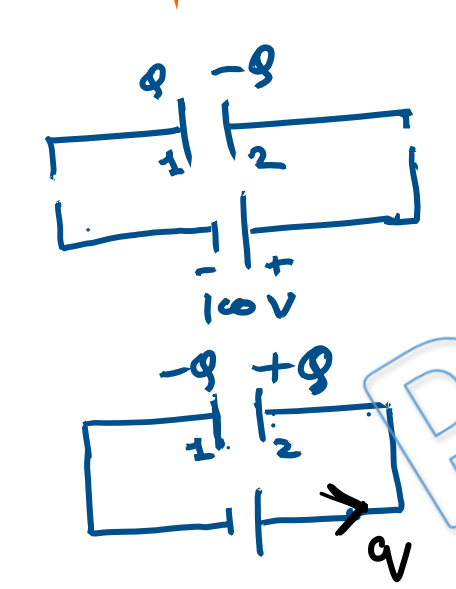
Ans. b

Solution: 14

$C = 5\mu F$

$q = CV = 5\mu F \times 100$

$q = 500\ \mu C$



Let q is charge supplied by battery.

$$-q + q = +q$$

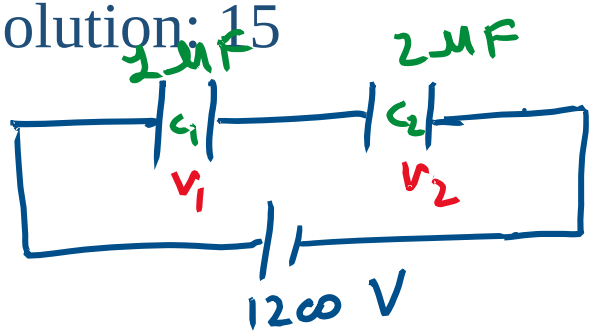
$$q = 2q$$

$$= 2 \times 500\mu C$$

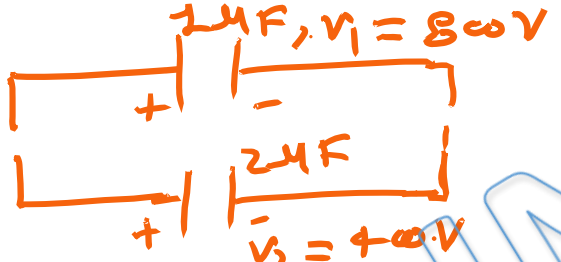
$$= 1000\mu C$$

Ans. b

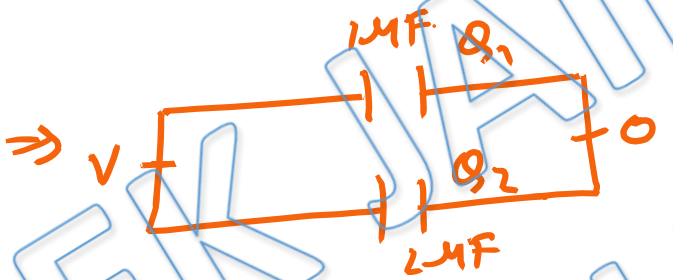
Solution: 15



$\Rightarrow$



$\Rightarrow$



$V_1 + V_2 = 1200$ —①

$C_1 V_1 = C_2 V_2$

$1 \times V_1 = 2 V_2$

$V_1 = 2 V_2$

Put in eq^n ①

$2V_2 + V_2 = 1200$

$V_2 = 400$ Volt

$V_1 = 800$ Volt

$V = \dfrac{V_1 C_1 + V_2 C_2}{C_1 + C_2} = \dfrac{(800)(1\,MF) + (400)(2\,MF)}{1\,MF + 2\,MF}$

$V = \dfrac{1600}{3}$ Volt

$V = \dfrac{1600}{3}$ Volt Ans

$Q_1 = CV = 1 \times \dfrac{1600}{3} \Rightarrow Q_1 = \dfrac{1600}{3}\ \mu C$

$Q_2 = C_2 V = 2 \times \dfrac{1600}{3} \Rightarrow Q_2 = \dfrac{3200}{3}\ \mu C$ Ans

Ans. a

Solution: 16

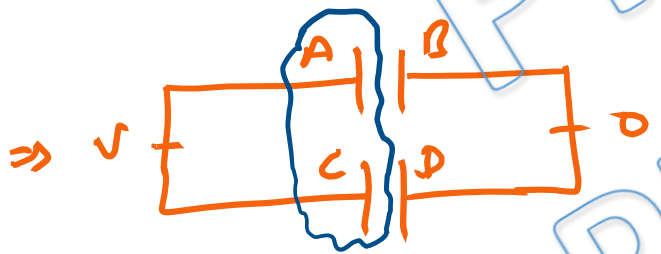
A + C
B + D
] like charged plates.

$q_A = 2\mu F \times 20 = 40\ \mu C$

$q_B = -40\ \mu C$

$q_C = 3\mu F \times 10 = 30\ \mu C$

$q_D = -30\ \mu C$



$\Rightarrow V = \dfrac{C_1V_1 + C_2V_2}{C_1 + C_2} = \dfrac{40 + 30}{2 + 3} = \dfrac{70}{5} = 14\ V$ Volt

$q_A' = 14 \times 2\mu F = 28\ \mu C$

$q_B' = 14 \times 3 = 42\ \mu C$

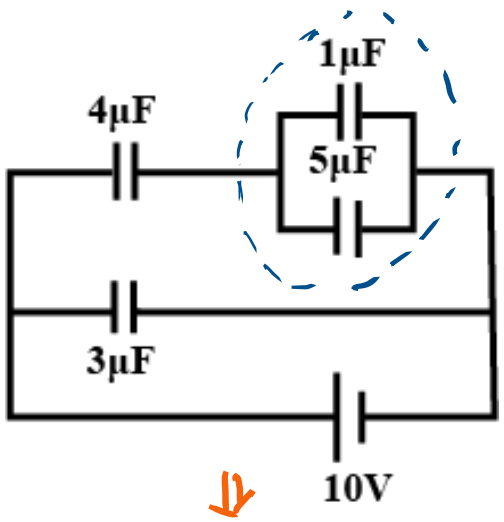
$\Delta q = q_A - q_A'$

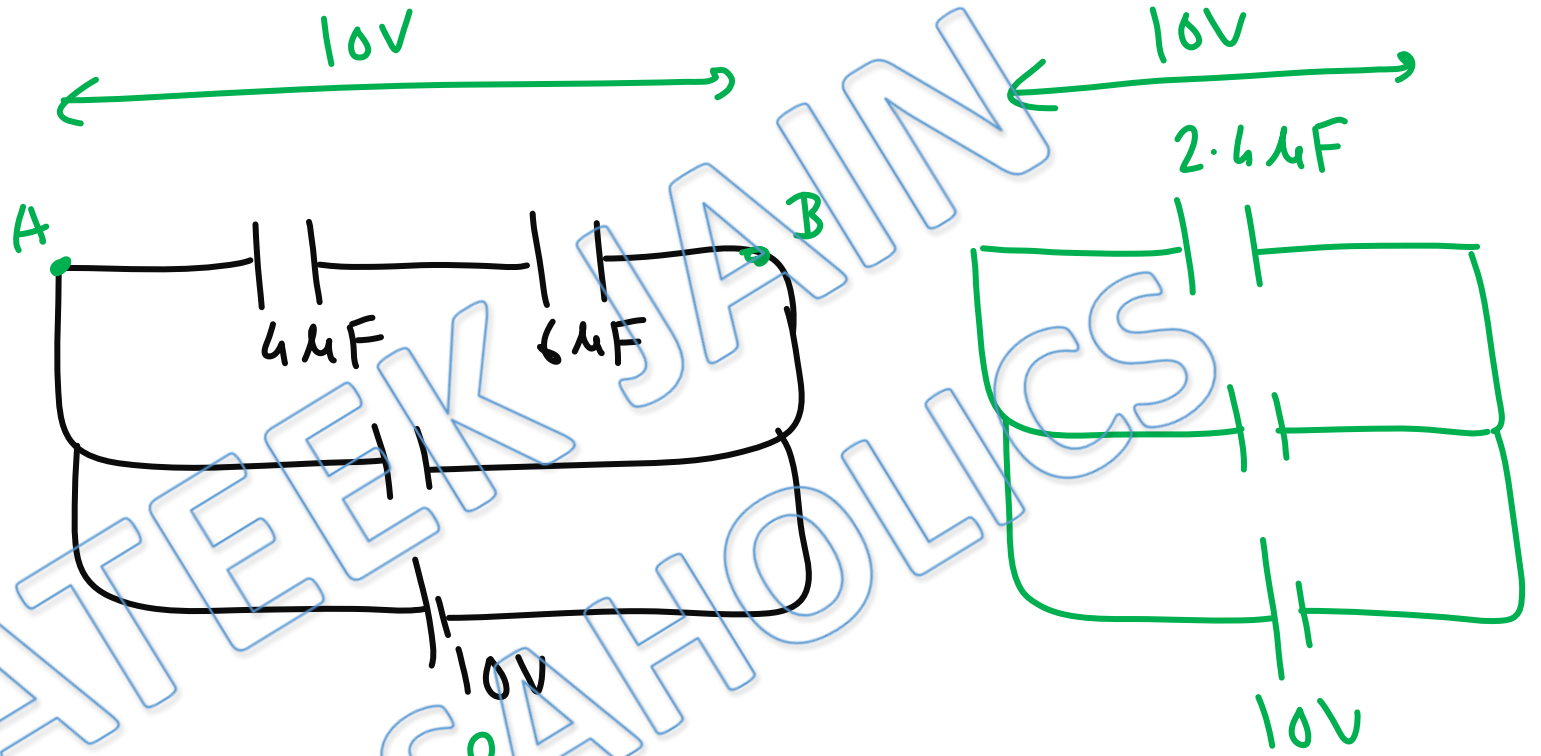
$= 40\mu C - 28\ \mu C$

$\Delta q = 12\ \mu C$

Ans. a

Solution: 17





Effective capacitance of 4μF & 6μF

$= \frac{4 \times 6}{4+6}\,\mu F = 2.4\,\mu F$

Charge on 4μF = charge of effective 2.4μF = $10 \times 2.4\mu = 24\,\mu C$

Ans. b

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