Thursday 1.11

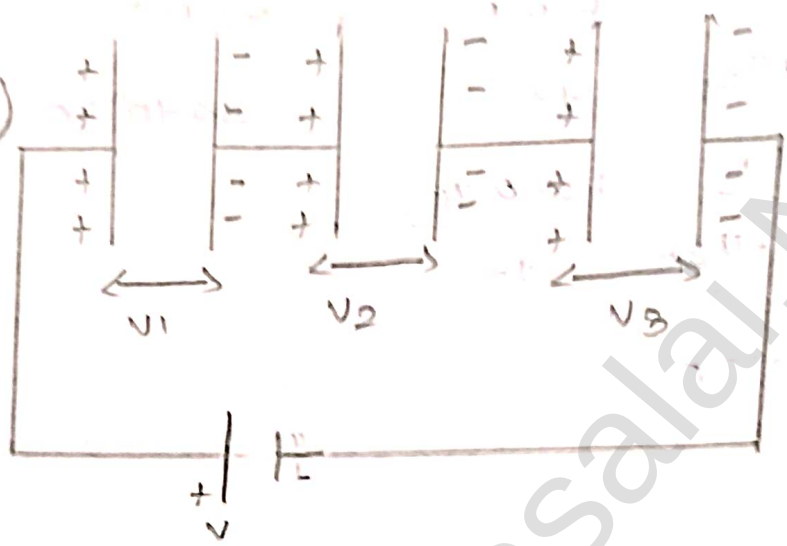
20]

3 mark

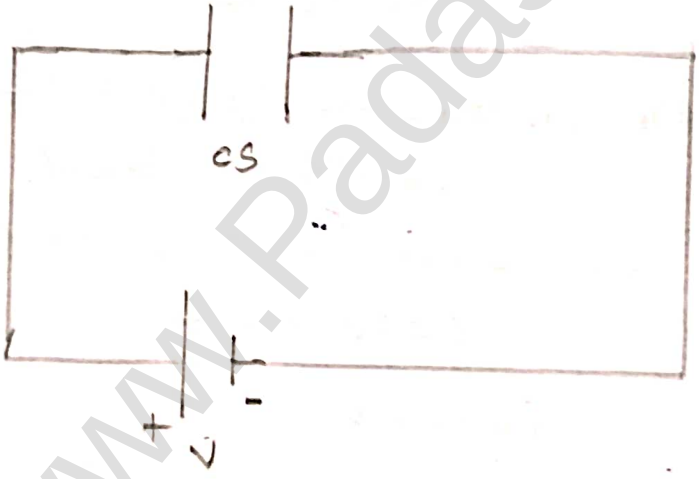
1) capacitor series connection (or) ~~Parallel~~ Prove That

$$\frac{1}{C_S} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

a)



b)



$$V = V_1 + V_2 + V_3$$

V → Potential difference

$$C = \frac{Q}{V}$$

$$V = \frac{Q}{C}$$

$$V_1 = \frac{Q}{C_1} \rightarrow (1)$$

$$V_2 = \frac{Q}{C_2} \rightarrow (2)$$

$$V_3 = \frac{Q}{C_3} \rightarrow (3)$$

Total potential difference

$$V = V_1 + V_2 + V_3$$

$$V = \frac{Q}{C_1} + \frac{Q}{C_2} + \frac{Q}{C_3}$$

$$V = \frac{Q}{C}$$

$$C = C_3$$

$$\frac{Q}{C_S} = \frac{Q}{C_1} + \frac{Q}{C_2} + \frac{Q}{C_3}$$

$$\frac{Q}{C_S} = Q\left(\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}\right)$$

$$\frac{1}{C_S} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

This equivalent capacitance C_S is always less than the smallest individual capacitance in the series

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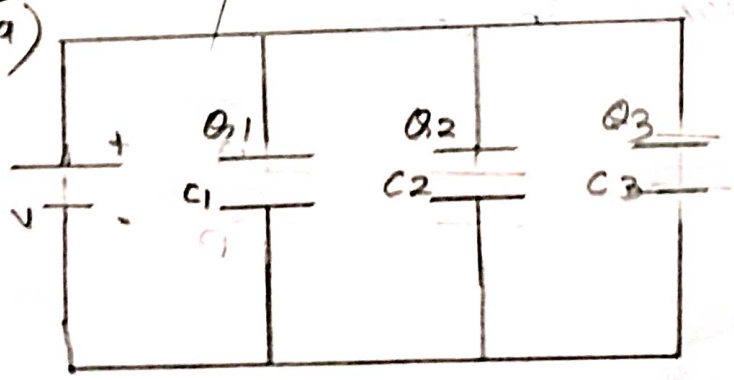
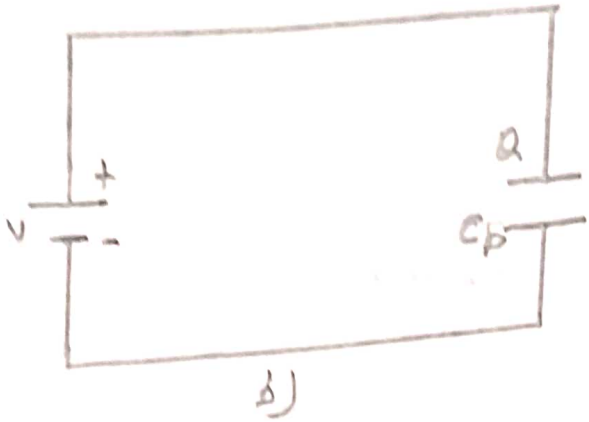
capacitance in parallel connection (OR) Prove that

$$C_P = C_1 + C_2 + C_3$$

a)





b)

$$Q = Q_1 + Q_2 + Q_3$$

$$C = Q/V$$

$$Q = CV$$

$$Q_1 = C_1 V \rightarrow (1)$$

$$Q_2 = C_2 V \rightarrow (2)$$

$$Q_3 = C_3 V \rightarrow (3)$$

$$CV = C_1V + C_2V + C_3V$$

$$C = C_p$$

$$C_pV = C_1V + C_2V + C_3V$$

$$C_pV = V(C_1 + C_2 + C_3)$$

$$C_p = C_1 + C_2 + C_3$$

In a parallel connection it is equivalent as area of each capacitance adds to give more effective area such that total capacitance increases

2) 2 μf, 2 μf, 2 μf series and Parallel connection

$C_1 = 2\mu f$

$C_2 = 2\mu f$

$C_3 = 2\mu f$

Series connection

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

$$\frac{1}{C_S} = \frac{1}{2} + 1/2 + 1/2$$

$$\frac{1}{C_S} = \frac{1+1+1}{2}$$

$$\frac{1}{C_S} = 3/2$$

$$C_S = \frac{2}{3}\mu f$$

$$C_S = 2/3 \times 10^{-6} f$$

Parallel connection

$C_p = C_1 + C_2 + C_3 = 2+2+2$

$= 6\mu f$

$= 6 \times 10^{-6} f$

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3) 9 Pf, 9 Pf, 9 Pf series and parallel connection

series:

$$\frac{1}{C_S} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

$$\frac{1}{C_S} = \frac{1}{9} + \frac{1}{9} + \frac{1}{9}$$

$$\frac{1}{C_S} = \frac{1+1+1}{9}$$

$$\frac{1}{C_S} = \frac{3}{9}$$

$$C_S = 9/3 = \frac{3\times 3}{3}$$

$$= 3\,pf$$

$$C_S = 3\times 10^{-12}\,f$$

Parallel connection

$$C_p = C_1 + C_2 + C_3$$

$$C_p = 9+9+9$$

$$C_p = 27\,pf$$

(09)

$$C_p = 27\times 10^{-12}\,f$$

4) 2 μf, 4 μf series and parallel connection

series connection

$$\frac{1}{C_S} = \frac{1}{C_1} + \frac{1}{C_2}$$

$$\frac{1}{C_S} = \frac{1}{2} + \frac{1}{4}$$

$$\frac{1}{C_S} = \left(\frac{2\times 1}{2\times 2}\right) + \frac{1\times 1}{1\times 4}$$

$$1/C_S = \frac{2}{4} + \frac{1}{4}$$

$$1/C_S = \frac{2+1}{4}$$

$C_S = 4/3\ \mu f$

(or)

$C_S = 4/3 \times 10^{-6} f$

Parallel connection

$C_p = C_1 + C_2$

$C_p = 2 + 4$

$= 6\ \mu f$

$= 6 \times 10^{-6} f.$

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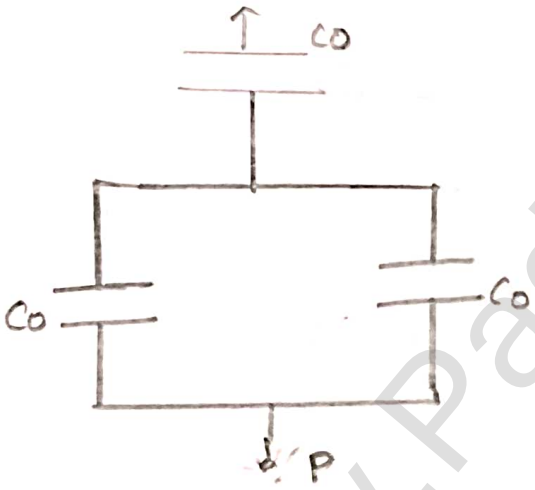
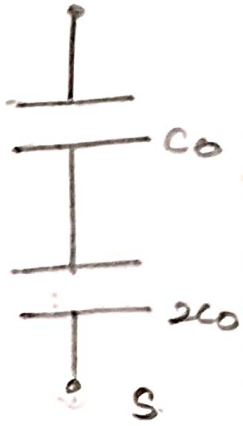
Exercise problem

11)





Parallel connection

$C_p = C_1 + C_2$

$C_p = C_0 + C_0$

$C_1 = 2C_0$

series connection

$\frac{1}{C_S} = \frac{1}{C_1} + \frac{1}{C_2}$

$\frac{1}{C_0} = \frac{1}{C_0} + \frac{1}{2C_0}$

$$\frac{1}{C_S} = \left(\frac{2\times1}{2\times C_0}\right) + \left(\frac{1\times1}{1\times2C_0}\right)$$

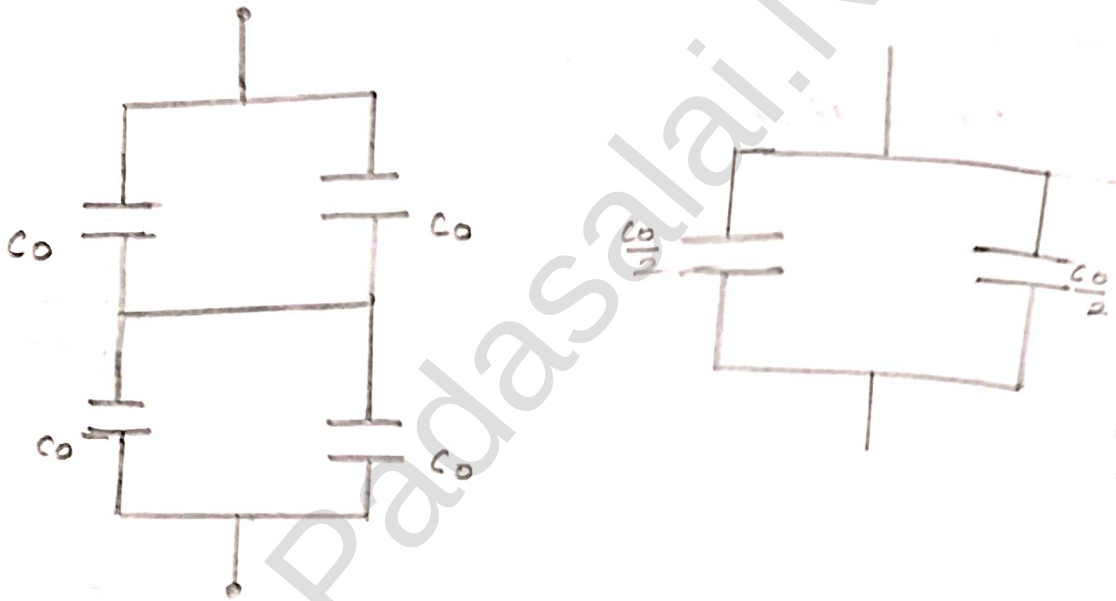
$$\frac{1}{C_S} = \frac{2}{2C_0} + \frac{1}{2C_0}$$

$$\frac{1}{C_S} = \frac{2+1}{2C_0}$$

$$\frac{1}{C_S} = 3/2C_0$$

$$C_S = 2/3\,C_0$$

ii)



Series

$$\frac{1}{C_{S_1}} = \frac{1}{C_1} + \frac{1}{C_2}$$

$$\frac{1}{C_{S_1}} = \frac{1}{C_0} + \frac{1}{C_0}$$

$$\frac{1}{C_{S_1}} = \frac{1+1}{C_0} = \frac{2}{C_0}$$

$$C_S = \frac{C_0}{2} \rightarrow (1)$$

$$\frac{1}{C_{S_2}} = \frac{1}{C_1} + \frac{1}{C_2}$$

$$\frac{1}{C_{S_2}} = \frac{1}{C_0} + \frac{1}{C_0}$$

$$\frac{1}{C_{S_2}} = \frac{1+1}{C_0}$$

$$\frac{1}{C_{S_2}} = \frac{2}{C_0}$$

$$C_{S_2} = \frac{C_0}{2} \longrightarrow (2)$$

$$C_1 = \frac{C_0}{2}$$

$$C_2 = 2/C_0$$

$$C_p = C_1 + C_2$$

$$C_p = \frac{C_0}{2} + \frac{C_0}{2}$$

$$C_p = \frac{2C_0}{2}$$

$$C_p = C_0$$

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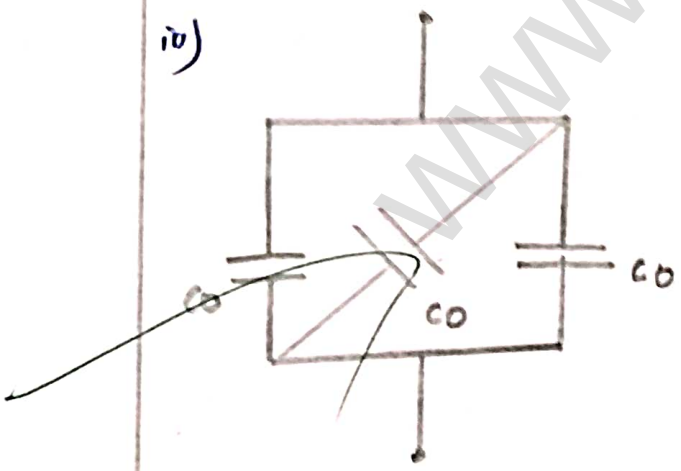
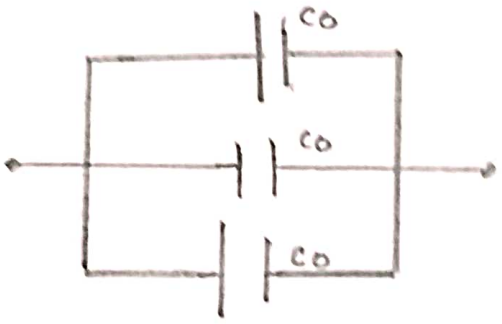
iv)





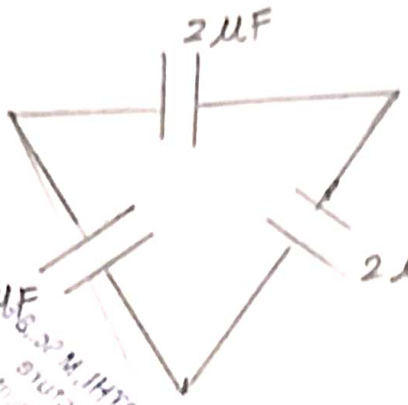
$$C_p = C_1 + C_2 + C_3$$

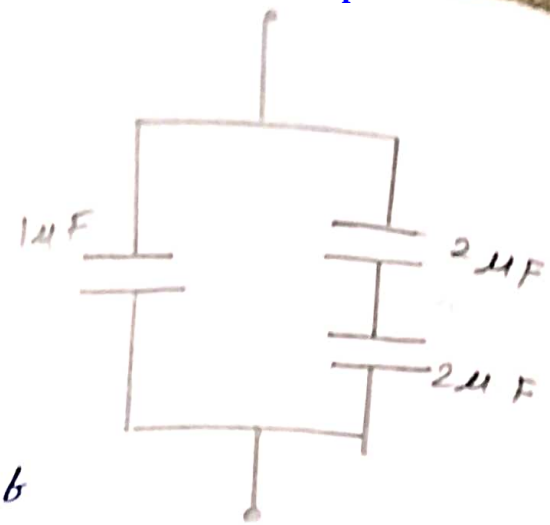
$$C_p = C_0 + C_0 + C_0$$

$$C_p = 3C_0$$

pg:73.
1 mark
14 14

iv)





i) $\frac{1}{C_S} = \frac{1}{C_1} + \frac{1}{C_2}$

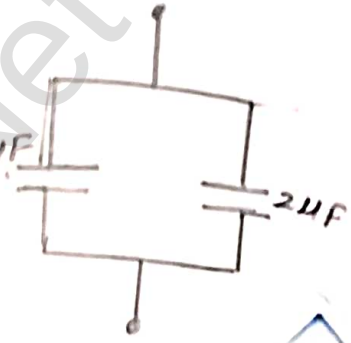
ii) $C_1 = 2\mu f$

$C_2 = 2\mu f$

$1/C_S = 1/2 + 1/2 = \frac{1+1}{2}$

$1/C_S = 2/2 = 1$

$C_S = 1\mu f = 1 \times 10^{-6} f$



iii) $C_p = C_1 + C_2$

$C_1 = 1 + 1$

$C_1 = 2\mu f = 2 \times 10^{-6} f$

11/04/2024

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