DPP – 02

SOLUTION

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1. Initially $c_{eq} = \frac{4}{3}\ \mu F$

$(q_{flow})_{battery} = \frac{4}{3} \times 24\mu C$

$= 32\mu C$

When switch is closed

$C_{eq} = \frac{3 \times 3}{6} = \frac{3}{2}$

q_{flow} through battery

$= \frac{3}{2} \times 24 = 36\mu C$

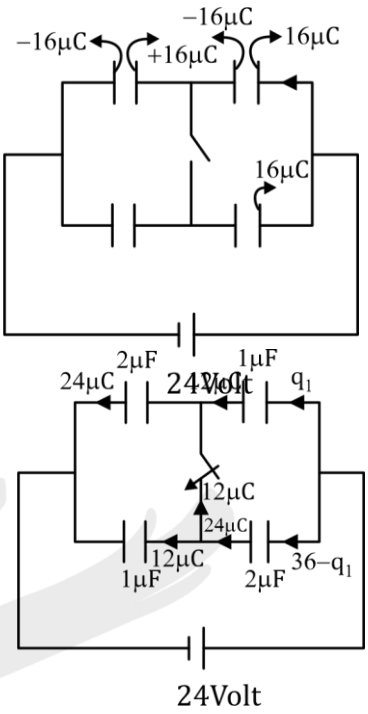
$Q = CV$

$\Rightarrow \frac{q_1}{1} = \frac{36 - q_1}{2}$

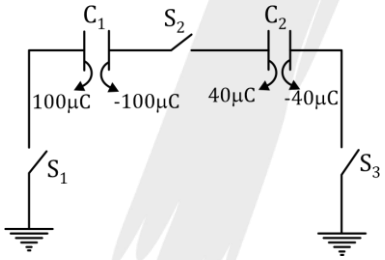
$\Rightarrow 2q_1 = 36 - q_1$

$3q_1 = 36$

$q_1 = 12\mu c$



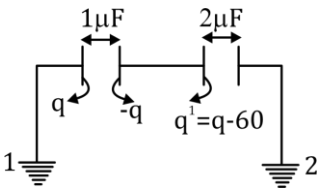
2. Initially

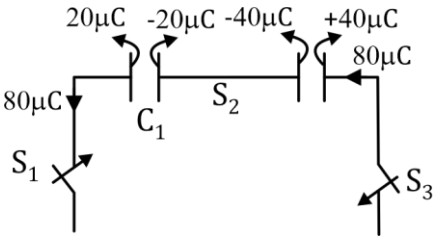


Sum of charge on negative plate of C_1 & +ive plate of c_2 is constant

$= -100 + 40 = -60\mu C$

After closing the switch





$q' - q = -60$

$q' = q - 60$

$V_1 - \frac{q}{1} - \frac{(q-60)}{2} = V_2$

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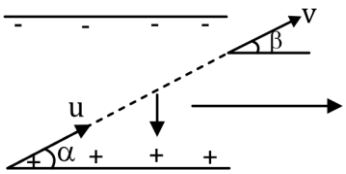
$q + \frac{(q-60)}{2} = 0 \Rightarrow 2q + q - 60 = 0$

$q = 60$

$q = 20\mu c$

3.



uniform electric field which produce constant acceleration downward.

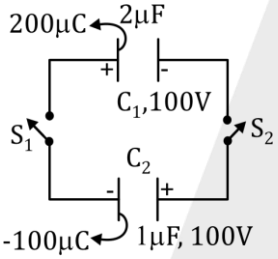
$\Rightarrow u\cos\alpha = v\cos\beta$

$v = u\left(\frac{\cos\alpha}{\cos\beta}\right)$

$\frac{k_i}{k_f} = \frac{\frac{1}{2}mu^2}{\frac{1}{2}mu^2\left(\frac{\cos\alpha}{\cos\beta}\right)^2}$

$\frac{k_i}{k_f} = \left(\frac{\cos\beta}{\cos\alpha}\right)^2$

4.



$\Rightarrow U_i = \frac{1}{2}c_1V_1^2 + \frac{1}{2}C_2V_2^2$

$= \frac{1}{2} \times 3 \times 100^2 = 1.5 \times 10^4 \mu J$

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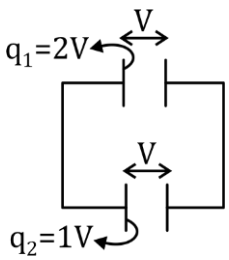
$\Rightarrow$ Finally

Sum of charge on +ive plate of q & negative plate of c_2 = Constant

$q_1 + q_2 = 200 - 100$

$3v = 100 \Rightarrow v = \frac{100}{3}$

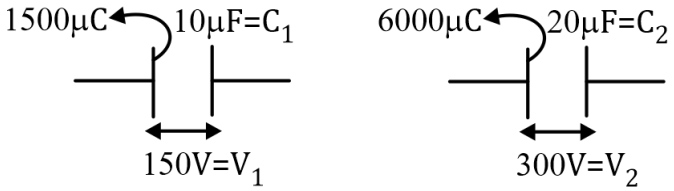


$U_f = \frac{1}{2}c_1v_f^2 + \frac{1}{2}c_2V_f^2$

$= \frac{1}{2} \times 3 \times \left(\frac{100}{3}\right)^2 = \frac{1.5 \times 10^4}{9}\mu J$

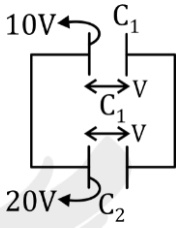
$\frac{U_f}{U_i} = \frac{1}{9}$

5.



$U_i = \frac{1}{2}c_1V_1^2 + \frac{1}{2}c_2V_2^2$

$U_i = \left[\frac{1}{2} \times 10 \times (150)^2 + \frac{1}{2} \times 20 \times (300)^2\right]\mu J$



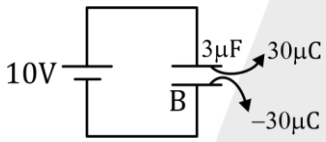
$30V = (1500 + 6000)$

$V = \frac{7500}{30} = 250$ volt

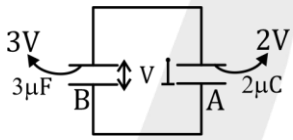
$U_f = \frac{1}{2}(c_1 + c_2)V^2$

$\Delta H = V_f - V_i$

6. when Sw_1 closed & Sw_2 open



When Sw_1 open & Sw_2 closed.



$3V + 2V = 30$

$V = 6$ Volt

$\Rightarrow q_A = 12\mu C$

$q_B = 18\mu C$

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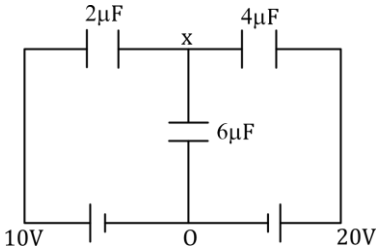
7. To determine the value of x.

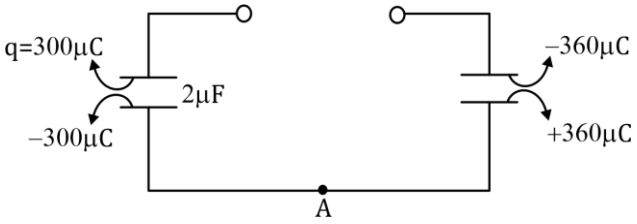


$\Rightarrow 6(x - 0) + 2(x - 10) + 4(x - 20) = 0$

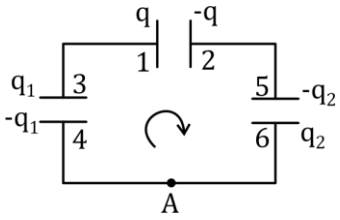
$x = \frac{25}{3}$ Volt

$\Rightarrow q_{6\mu F} = 6 \times \frac{25}{3} = 50\mu C$

8. Initially



Finally



⇒ Plate 1 & 3 are isolated.

$q + q_1 = 300\mu C$ _____(i)

Plate 4 & 5 are isolated.

$-q_1 + q_2 = -300 + 360$

$-q_1 + q_2 = 60$ _____(ii)

Plate (2) & (6) are isolated

$-q - q_2 = -360$

$q + q_2 = 360$ _____(iii)

Using $\frac{-q}{1.5} + \frac{q_2}{3} + \frac{q_1}{2} = 0$

$q = 180\mu C = q_1 = 120\mu C,\ q_2 = 180\mu C$

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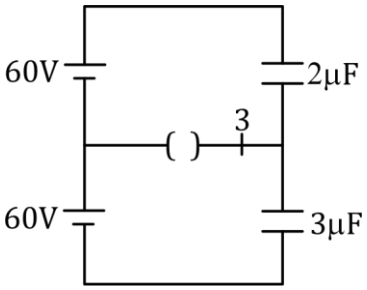
9. $C_{eq} = \frac{2\times3}{5} = \frac{6}{5}\mu F$



$Q = CV = \frac{6}{5} \times 120 = 6 \times 24$

$Q = 144\mu C$

When switch is closed

charged on $3\mu C = 180\mu C$

charged on $2\mu C = 120\mu C$

Initially charge on $2\mu C = 144$

charge flow through

$S_3 = (144 - 120) + (180 - 144)$

$= 24 + 36 = 60\mu C$

10.