HW #4

(1)

$C = 10\,\mu F = 10 \cdot 10^{-6} F$

$Q = 40\,\mu C = 40 \cdot 10^{-6} C$

then $\Delta V = \frac{Q}{C} = \frac{40 \cdot 10^{-6}}{10 \cdot 10^{-6}} = \underline{4\,V}$

(2) (a) $C_{eq} = C_1 + C_2 + C_3 = 10 + 20 + 40 = \underline{70\,\mu F}$

(b) $\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} = \frac{1}{10} + \frac{1}{20} + \frac{1}{40} = 0.175 \Rightarrow \underline{C_{eq} = 5.7\,\mu F}$

(3) $U = \frac{C \Delta V^2}{2}$ then $20 = \frac{5 \cdot 10^{-6} \cdot \Delta V^2}{2} \Rightarrow \Delta V = \sqrt{\frac{2 \cdot 20}{5 \cdot 10^{-6}}} = \underline{2828\,V}$

(4) $V = k_e \frac{Q}{R} \Rightarrow Q = \frac{VR}{k_e} = \frac{100 \cdot 0.02}{9 \cdot 10^9} = 0.2 \cdot 10^{-9} C = \underline{0.2\,nC}$

(5)

$A = a^2 = (0.01)^2 = 10^{-4} m^2$

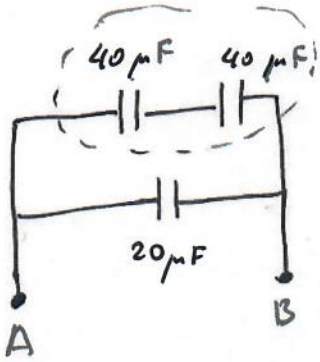
$h = 0.2\,mm = 0.2 \cdot 10^{-3} m$

(a) $C = \frac{\varepsilon_0 A}{h} = \frac{8.85 \cdot 10^{-12} \cdot 10^{-4}}{0.2 \cdot 10^{-3}} = \underline{0.44 \cdot 10^{-11} F}$

(b) $Q = C \cdot \Delta V = 0.44 \cdot 10^{-11} \cdot 30 = \underline{13.2 \cdot 10^{-11} C}$

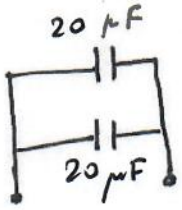
$Q_1 = 13.2 \cdot 10^{-11} C$, $Q_2 = -13.2 \cdot 10^{-11} C$

(6)



$\rightarrow \quad \frac{1}{C_{eq}} = \frac{1}{40} + \frac{1}{40} \Rightarrow \underline{C_{eq} = 20\,\mu F}$

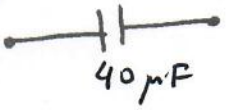
$\Rightarrow$



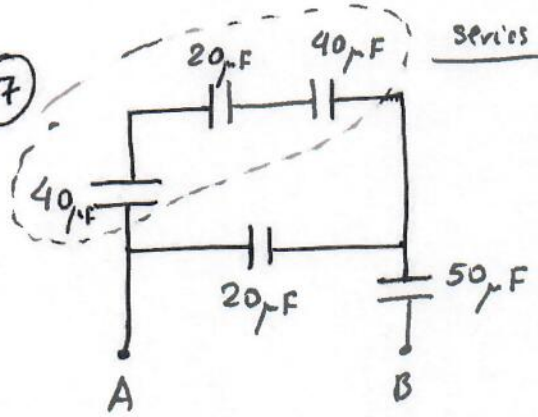
$\rightarrow C_{eq} = C_1 + C_2 =$

$= 40\,\mu F$

$\Rightarrow$



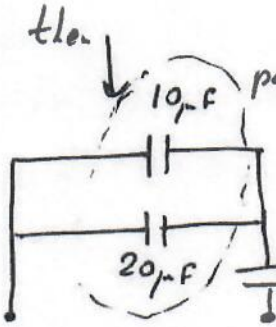
(7)



series $\rightarrow \quad \frac{1}{C_{eq}^{(1)}} = \frac{1}{40} + \frac{1}{20} + \frac{1}{40} = \frac{4}{40} = \frac{1}{10}$

$C_{eq}^{(1)} = 10\,\mu F$

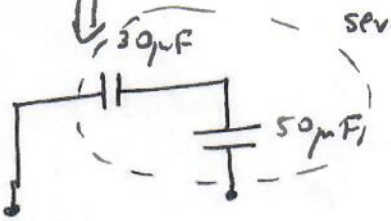
then



parallel.

$\rightarrow C_1 + C_2 = 10 + 20 = 30\,\mu F$

$\Downarrow$



series

$\frac{1}{C_{eq}} = \frac{1}{30} + \frac{1}{50} = 0.053$

$C_{eq} = 18.75\,\mu F$