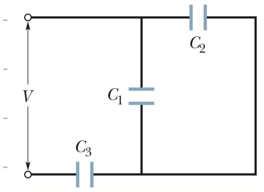
Leen Sabri

Q2



$\frac{q_{12}}{C_{12}} = \frac{q_1}{C_1} + \frac{q_2}{}$

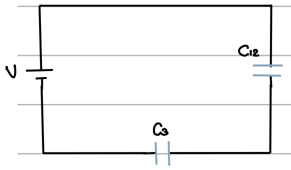
$V = 75\,V$, $C_1 = 10\,\mu F$, $C_2 = 5\,\mu F$, $C_3 = 15\,\mu F$

a) $q_3 = ??$ b) $V_3 = ??$ c) $U_3 = ??$ d) $q_1 = ??$ e) $V_1 = ??$ f) $U_1 = ??$ g) $q_2 = ??$ h) $V_2 = ??$ i) $U_2 = ??$

C_1 & C_2 are in parallel $\Rightarrow C_{12}$ $\Rightarrow$

q_3

$C_{12} = C_1 + C_2 = 10 + 5 = 15\,\mu F$



C_{12} & C_3 are in series : $\Longrightarrow q = q_{12} = q_3$, $V = V_{12} + V_3$

$V_{123} = \frac{q_{12}}{C_{12}} + \frac{q_3}{C_3} = \frac{q}{C_{12}} + \frac{q}{C_3} \Rightarrow V_{123} = q\left(\frac{1}{C_{12}} + \frac{1}{C_3}\right) \Rightarrow 75 = q\left(\frac{1}{15\times10^{-6}} + \frac{1}{15\times10^{-6}}\right) \Rightarrow 75 = \frac{2q}{15\times10^{-6}} \Rightarrow \boxed{q_{123} = 5.625\times10^{-4} = q_3 = q_{12}}$

Now find $V_3 \Rightarrow V_3 = \frac{q_3}{C_3} = \frac{5.625\times10^{-4}}{15\times10^{-6}} \Rightarrow \boxed{V_3 = 37.5\,V} \Rightarrow$ and $V = V_{12} + V_3$ so $\Rightarrow 75 = V_{12} + 37.5 \Rightarrow \boxed{V_{12} = 37.5} \Rightarrow$ and $\boxed{V_{12} = V_1 = V_2 = 37.5}$

" " $U_3 \Rightarrow U_3 = \frac{1}{2} C_3 V_3^2 = \frac{1}{2} \times 15\times10^{-6} \times (37.5)^2 \Rightarrow \boxed{U_3 \approx 0.01054\ J}$

Now find q_1 & $q_2 \Rightarrow V_{12} = V_1 = V_2 \Rightarrow \frac{q_{12}}{C_{12}} = \frac{q_1}{C_1} \Rightarrow \frac{5.625\times10^{-4}}{15\times10^{-6}} = \frac{q_1}{10\times10^{-6}} \Rightarrow \boxed{q_1 = 3.75\times10^{-4}} \Rightarrow q_{12} = q_1 + q_2 \Rightarrow 5.625\times10^{-4} = 3.75\times10^{-4} + q_2 \Rightarrow \boxed{q_2 = 1.875\times10^{-4}}$

$U_1 = \frac{1}{2} C_1 V_1^2 = \frac{1}{2}(10\times10^{-6})(37.5)^2 \Rightarrow \boxed{U_1 = 7.03125\times10^{-3}}$, $U_2 = \frac{1}{2} C_2 (V_2)^2 = \frac{1}{2}(5\times10^{-6})(37.5)^2 \Rightarrow \boxed{U_2 = 3.515625\times10^{-3}\ J}$

C_1: $\rightarrow q_1 = 3.75\times10^{-4}\,C$; $\rightarrow V_1 = 37.5\,V$; $\rightarrow U_1 = 7.03125\times10^{-3}\,J$

C_2: $\rightarrow q_2 = 1.875\times10^{-4}\,C$; $\rightarrow V_2 = 37.5\,V$; $\rightarrow U_2 = 3.515625\times10^{-3}\,J$

C_3: $\rightarrow q_3 = 5.625\times10^{-4}\,C$; $\rightarrow V_3 = 37.5\,V$; $\rightarrow U_3 \approx 0.01054\,J$

Q10

$A = 40\,cm^2$ $d = 1\,mm$ $V = 500\,V$ $p = 10^{-12}$

* التحويل من cm^2 إلى $m^2 \Leftarrow \times10^{-4}$

a) $C = \frac{\epsilon_0 A}{d} = \frac{(8.85\times10^{-12})(40\times10^{-4})}{1\times10^{-3}} = 3.5\times10^{-11}F = 35\,pF$

b) $q = CV = (35\times10^{-12})(500) = 1.75\times10^{-8}\,C$

c) $U = \frac{1}{2} C V^2 = \frac{1}{2}(35\times10^{-12})(500)^2 \approx 4.375\times10^{-6}\,J$

d) $V = Ed \Rightarrow E = \frac{V}{d} = \frac{500}{1\times10^{-3}} = 500\,000 = 5\times10^5\ V/m$ / $E = \frac{\sigma}{\epsilon_0} = \frac{q}{A\epsilon_0} = \frac{17.5\,nC}{0.004(\epsilon_0)} = \frac{17.5\times10^{-9}}{0.004(8.85\times10^{-12})} = 0.5\times10^6$, $\sigma = \frac{q}{A}$

e) $u = \frac{1}{2}\epsilon_0 E^2 = \frac{1}{2}(8.85\times10^{-12})(5\times10^5)^2 = 1.10625\ J/m^3$ / $u = \frac{U}{\text{Volume}}$  لحاسوي 2Plates يعني الحجم متوازي مستطيلات

Q11

$C_0 = 8\,pF$, $U = 3.2\,\mu F$ $V = 360.8\,v$

$C_0 = \frac{\epsilon_0 A}{d} \Rightarrow C = \frac{K\epsilon_0 A}{d} \Rightarrow \boxed{\frac{C}{C_0} = K} \Rightarrow$ so now we should to find C befor we find k

$U = \frac{1}{2} C V^2 \Rightarrow 3.2\times10^{-6} = \frac{1}{2} C (360.8)^2 \Rightarrow C = 52\,pF$

$K = \frac{C}{C_0} = \frac{52\times10^{-12}}{8\times10^{-12}} = 6.5$

Q12

$C_0 = 21\,pF = 21\times10^{-12}F$ $d_f = 2d_i$, $C_f = 26\,pF = 2.6\times10^{-12}F$

$C_0 = \frac{\epsilon_0 A}{d} \xrightarrow{\text{after}} C = \frac{K\epsilon_0 A}{2d}$

$\frac{C_0}{C} = \frac{\epsilon_0 A}{d} \div \frac{K\epsilon_0 A}{2d} \Rightarrow \frac{C_0}{C} = \frac{\cancel{\epsilon_0 A}}{\cancel{d}} \cdot \frac{2\cancel{d}}{K\cancel{\epsilon_0 A}} \Rightarrow \frac{C_0}{C} = \frac{2}{K} \Rightarrow K = \frac{2C}{C_0} = \frac{2(2.6\times10^{-12})}{(2.1\times10^{-12})} \approx 2.476$

Q17

$A = 8.5\,cm^2$, $d = 8\,mm$, $V_i = 16\,v$ $\xrightarrow[\text{تم دفع اللوحين لبعض لتصبح المسافة}]{\text{بعد فصلها عن مصدر فرق الجهد}}$ $d_2 = 3\,mm$

a) * بما أنه لم يتم نفي يغ الألواح ∴ المجال الكهربائي قبل وبعد ثابت فبإمكاننا استخدام قانون ← $E = \frac{V}{d}$ (لأنه الشحنة ما تغيرت)

$E_i = E_f \Rightarrow \frac{V_i}{d_i} = \frac{V_f}{d_f} \Rightarrow V_f = \frac{V_i \cdot d_f}{d_i} = \frac{16 V(3\times10^{-3} m)}{8\times10^{-3} m} = 6\,V$

b) $U_i = \frac{1}{2} C V_i^2$ so we have to fin C :

$C = \frac{\epsilon_0 A}{d_i} = \frac{(8.85\times10^{-12})(8.5\times10^{-4})}{8\times10^{-3}} = 9.403125\times10^{-13}$

$U_i = \frac{1}{2} C V_i^2 = \frac{1}{2}(9.403125\times10^{-13})(16)^2 = 1.2036\times10^{-10}\,J$

c) $U_f = \frac{1}{2} C V_f^2$ so we have to fin C :

$C = \frac{\epsilon_0 A}{d_f} = \frac{(8.85\times10^{-12})(8.5\times10^{-4})}{3\times10^{-3}} = 2.5075\times10^{-12}$

$U_f = \frac{1}{2} C V_f^2 = \frac{1}{2}(2.5075\times10^{-12})(6)^2 = 4.5135\times10^{-11}$

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d) $W = U_f - U_i = (4.5135\times10^{-4}) - (1.2036\times10^{-6}) = -7.5225\times10^{-4}$

Q18 $A = 5.56\,cm^2$, $d = 5.56\,mm$, $K_1 = 7$, $K_2 = 10$

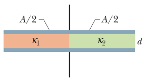
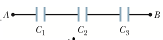


Figure 25-23 Problem 18.

هنا نعتبر الكا بسترعبارة عن 2 كا بستر مشبوكين على التوازي

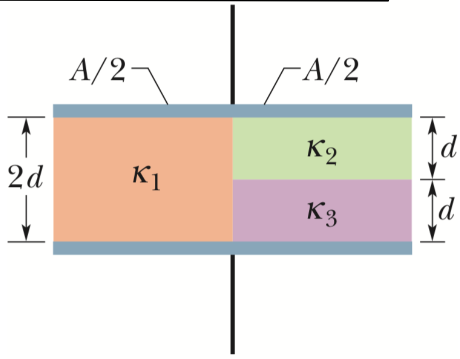
$C_1 = \frac{k_1 \epsilon_0 A/2}{d} = \frac{K_1 \epsilon_0 A}{2d} = \frac{7(8.85\times10^{-12})(\cancel{5.56}\times10^{-4})}{2(\cancel{5.56}\times10^{-3})} = 3.0975\times10^{-12}\,F$



$C_2 = \frac{k_2 \epsilon_0 A/2}{d} = \frac{1\cdot\epsilon_0 A}{2d} = \frac{10(8.85\times10^{-12})(\cancel{5.56}\times10^{-4})}{2(\cancel{5.56}\times10^{-3})} = 4.425\times10^{-12}\,F$

$C = \underbrace{C_1 + C_2}_{\text{توازي}} = 3.0975\times10^{-12} + 4.425\times10^{-12} = 7.5225\times10^{-12}\,F$

Q22 $A = 12.5\,cm^2$, $2d = 7.12\,mm$, $K_1 = 21$, $K_2 = 42$, $K_3 = 58$



$C_1 = \frac{K_1 \epsilon_0 A/2}{2d} = \frac{K_1 \epsilon_0 A}{2(2d)} = \frac{21(8.85\times10^{-12})(12.5\times10^{-4})}{2(7.12\times10^{-3})} = 1.63141\times10^{-11}\,F$

$C_2 = \frac{K_2 \epsilon_0 A/2}{d} = \frac{K_2 \epsilon_0 A}{2d} = \frac{42(8.85\times10^{-12})(12.5\times10^{-4})}{(7.12\times10^{-3})} = 6.52563\times10^{-11}\,F$

$C_3 = \frac{K_3 \epsilon_0 A/2}{d} = \frac{K_3 \epsilon_0 A}{2d} = \frac{58(8.85\times10^{-12})(12.5\times10^{-4})}{(7.12\times10^{-3})} = 9.01159\times10^{-11}\,F$

C_2 & C_3 in series:

$\frac{1}{C_{23}} = \frac{1}{C_2} + \frac{1}{C_3} \Rightarrow \frac{1}{C_{23}} = \frac{C_3 + C_2}{C_2 C_3} \Rightarrow C_{23} = \frac{C_2 C_3}{C_3 + C_2} = \frac{(6.52563\times10^{-11})(9.01159\times10^{-11})}{(9.01159\times10^{-11}) + (6.52563\times10^{-11})} \approx 3.78487\times10^{-11}\,F$

C_{23} & C_1 are in parallel:

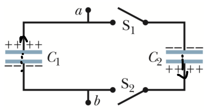
$C_{tot} = C_{23} + C_1 = 3.78487\times10^{-11} + 1.63141\times10^{-11} \approx 5.41628\times10^{-11}\,F$

Q28 $C = 50\,pf$, $A = 0.3\,m^2$

a) $C = \frac{\epsilon_0 A}{d} \Rightarrow d = \frac{\epsilon_0 A}{C} = \frac{(8.85\times10^{-12})(0.3)}{(50\times10^{-12})} = 5.31\times10^{-2}\,m^2$

b) $C = \frac{K\epsilon_0 A}{d} = \frac{(5.6)(8.85\times10^{-12})(0.3)}{(5.31\times10^{-2})} \approx 2.8\times10^{-10}\,F$

Q39



$C_1 = 1\,\mu F$, $C_2 = 3\,\mu F$, for both $(C_1, C_2) \rightarrow V = 200\,V$ (لكن متعاكسات بالقطبية كما بالصورة)

when switches S_1 and S_2 are closed, the potential differences across the capacitor are the same and the two capacitor are in parallel

a) $V_{ab} = \frac{q_{net}}{C_{eq}} \Rightarrow q = CV$ but we have to find C

$C_{eq} = C_1 + C_2 = 1 + 3 = 4\,\mu F = 4\times10^{-6}\,F$

* befor the switch was closed

$q_1 = C_1 V = (1\times10^{-6})(200) = 2\times10^{-4}\,C$

$q_2 = C_2 V = (3\times10^{-6})(200) = 6\times10^{-4}\,C$

لما V ثابتة لل capacitor

So $q_{net} = q_2 - q_1 = (6-2)\times10^{-4} = 4\times10^{-4}$ هنا بالطرح عشان الأقطاب متعاكسة

$V_{ab} = \frac{q_{net}}{C_{eq}} = \frac{4\times10^{-4}}{4\times10^{-6}} = 100\,V$

b) The charge on capacitor 1 is now $q_1 = C_1 V_{ab} = (1\times10^{-6})(100) = 1\times10^{-4}\,C$

c) The charge on capacitor 2 is now $q_2 = C_2 V_{ab} = (3\times10^{-6})(100) = 3\times10^{-4}\,C$

Q53 $C = 100\,pf$, $V_i = 80\,v$, $V_f = 35$

ومن ثم تم توصيله على التوازي مع كا باسيتر ثاني (غير مشحون في البداية) حيث انخفض فرق الجهد عبر الكابسي الكل إلى 35 v فما سعة الثاني؟

هو الشحنه ينتقل محفوظة (يعني بعض منه للثاني) الشحنة الكليه ظلت محفوظة

الشحنه قبل العمليه على C_1 $\Rightarrow q = C_1 V_0 = (100\times10^{-12})(80) = 8\times10^{-9}\,C$

q_1 بعد العمليه على C_1 $\Rightarrow q_1 = C_1 V_f = (100\times10^{-12})(35) = 35\times10^{-9}$

35 V هي نفسها فرق الجهد للكا باسيتر الثاني

الآن بما أن الشحنه محفوظة $\Rightarrow q = q_1 + q_2 \Rightarrow C_1 V_0 = (C_1 + C_2)V \Rightarrow (100\times10^{-12})(80) = ((100\times10^{-12}) + C_2)(35) \Rightarrow C_2 = 129\,pF$