Phys 112 HWS Garrett Haldrup

No.

Date

Q: 1, 2, 5, 6, 7 P: 1, 3, 4, 9, 14, 15, 19, 20, 32, 42, 49

Qs

1: $q = C\Delta V$ $C = \frac{\epsilon_0 A}{d}$ C1 $q = \frac{\epsilon_0 A \Delta V}{d}$ C2 $q = \frac{\epsilon_0 2A \Delta V}{d}$ C3 $q = \frac{\epsilon_0 A \Delta V}{2d}$

plot a = C_2 plot b = C_1 plot c = C_3

2: a) series $\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$ b) Parallel $C_{eq} = C_1 + C_2 + C_3$

c) There is more charge on the capacitors in parallel

5: a) The potential difference across C_1 remains the same

b) The charge across C_1 remains the same.

c) The capacitance of C_{12} is more than C_1 $C_{eq} = C_1 + C_2$

d) The charges stored on C_1 and C_2 is more than C_1

6: a) The potential difference across C_1 is lower.

b) The charge across C_1 remains the same

c) The capacitance of C_{12} is less than C_1 $\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$

d) The charge stored on C_1 and C_2 is the same as C_1

7: a) Series b) Parallel c) Parallel

Ps

1: a) $C = \frac{q}{V}$ $q = 70pC$ $\Delta V = 20V$ $C = \frac{70pC}{20V} = 3.5pF$

b) stays the same because based off $\frac{\epsilon_0 A}{d}$ so 3.5pF

c) $V = \frac{q}{C}$ $q = 200pC$ $C = 3.5pF$ $V = \frac{200pC}{3.5pF} = 57.1V$

3: a) $r = 8.2cm$ $d = 1.3mm$ $A = \pi r^2 = \pi(8.2cm)^2 = 0.02m^2$

$C = \frac{\epsilon_0 \cdot 0.02m^2}{1.3mm} = 143.8pF$

b) $q = C\Delta V$ $\Delta V = 120V$ $q = 143.8pF \cdot 120V = 17.3nC$

4: $r_1 = 38mm$ $r_2 = 40mm$ $C = 4\pi\epsilon_0 \frac{r_1 \cdot r_2}{r_2 - r_1}$

$C = 4\pi\epsilon_0 \frac{38mm \cdot 40mm}{40mm - 38mm} = 84.5pF$ a)

b) $d = 2mm$ $C = \frac{\epsilon_0 A}{d}$ $A = \frac{Cd}{\epsilon_0} = \frac{84.5pF \cdot 2mm}{\epsilon_0} = 191cm^2$

9: $C_{1..3} = 25pF$ $C_{eq} = C_1 + C_2 + C_3 = 75pF$ $V = 4200V$

$q = CV = 75pF \cdot 4200V = 0.315C$

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14: all $C = 10\mu F$ $V = 10V$ $C_{eq} = C_1 + C_{2345}$ $\frac{1}{C_{2345}} = \frac{1}{C_{234}} + \frac{1}{C_5}$ $C_{234} = C_{23} + C_4$ $\frac{1}{C_{23}} = \frac{1}{C_2} + \frac{1}{C_3}$

$C_{23} = \frac{1}{\frac{1}{10\mu F} + \frac{1}{10\mu F}} = 5\mu F$ $C_{234} = 5\mu F + 10\mu F = 15\mu F$

$C_{2345} = \frac{1}{\frac{1}{15\mu F} + \frac{1}{10\mu F}} = 6\mu F$ $C_{eq} = 10\mu F + 6\mu F = 16\mu F$ $q_{eq} = CV = 16\mu F \times 10V = 160\mu C$

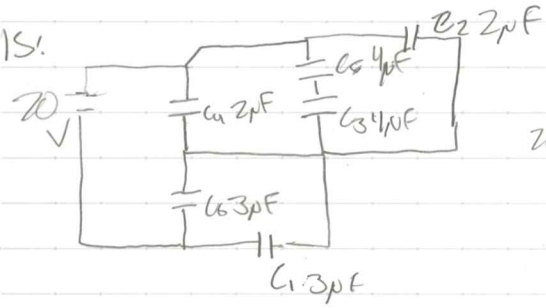
$q_{eq} = q_1 + q_{2345}$ **a)** $q_1 = CV = 10\mu F \cdot 10V = 100\mu C$

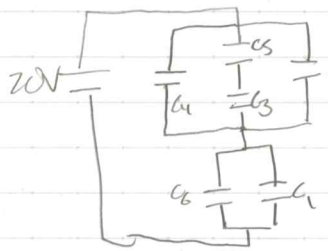
b) $q_{2345} = q_{eq} - q_1 = 160\mu C - 100\mu C = 60\mu C$ $q_{2345} = q_{234} = q_5$ $q_{234} = 60\mu C$

$V_{234} = \frac{q_{234}}{C_{234}} = \frac{60\mu C}{15\mu F} = 4V$ $q_{23} = q_{234} - q_4 = 60\mu C - 40\mu C = 20\mu C$ $q_4 = C_4 \cdot V_{234} = 10\mu F \cdot 4V = 40\mu C$

$q_2 = q_{23} = q_3$ **$q_2 = 20\mu C$**

15:





$C_{eq} = \frac{1}{\frac{1}{C_{2345}} + \frac{1}{C_{16}}}$

$C_{16} = C_1 + C_6$

$C_{2345} = C_4 + C_{35} + C_2$

$C_{35} = \frac{1}{\frac{1}{C_3} + \frac{1}{C_5}}$

$C_{35} = \frac{1}{\frac{1}{4\mu F} + \frac{1}{4\mu F}} = 2\mu F$ $C_{16} = 3\mu F + 3\mu F = 6\mu F$

$C_{2345} = 2\mu F + 2\mu F + 2\mu F = 6\mu F$

$C_{eq} = \frac{1}{\frac{1}{6\mu F} + \frac{1}{6\mu F}} = 3\mu F$ $q_{eq} = C_{eq} V = 3\mu F \cdot 20V = 60\mu C$

a: **$C_{eq} = 3\mu F$**
b: **$q_{eq} = 60\mu C$**

$q_{eq} = q_{2345} = q_{16}$ $q_{16} = q_1 + q_6$ $V_1 = \frac{q_1}{C_1}$ $q_1 = q_6$

$q_1 = \frac{q_{16}}{2} = \frac{60\mu C}{2} = 30\mu C$ $V_1 = \frac{30\mu C}{3\mu F} = 10V$

c: **10V**
d: **30nC**

$q_{2345} = q_4 + q_{35} + q_2$ $q_2 = q_{35} = q_4$ $V_2 = \frac{q_2}{C_2}$

$q_2 = \frac{q_{2345}}{3} = \frac{60\mu C}{3} = 20\mu C$ $V_2 = \frac{20\mu C}{2\mu F} = 10V$

e: **10V**
f: **20nC**

$q_{35} = q_3 = q_5 = q_2$ $V_3 = \frac{q_3}{C_3} = \frac{20\mu C}{4\mu F} = 5V$

$q_3 = 20\mu C$

g: **5V**
h: **20nC**

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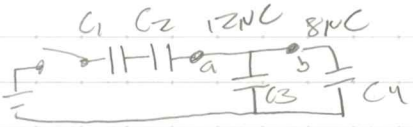

19: $V=9V$ $C_2=3\mu F$ $C_4=4\mu F$

$C_{eq}=\frac{1}{\frac{1}{C_{12}}+\frac{1}{C_{34}}}$ $C_{12}=\frac{1}{\frac{1}{C_1}+\frac{1}{C_2}}$ $C_{34}=C_3+C_4$

$V_2=\frac{q_a}{C_2}=\frac{12\mu C}{3\mu C}=4V$ $V_{eq}=V_{12}+V_{34}$ $V_3=V_4$ $V_4=\frac{q_b}{C_4}=\frac{8\mu C}{4\mu F}=2V$

$V_1=V_{12}-V_2=7-4=3V$ $V_{12}=9-2=7V$

a) $C_1=\frac{q_a}{V_1}=\frac{12\mu C}{3V}=4\mu F$

b) $C_3=\frac{q_a-q_b}{V_3}=\frac{12\mu C-8\mu C}{2V}=2\mu F$

20) $C=\frac{\epsilon_0 A}{d}$ $A=1.25cm^2$ $d=3.4mm$ $n=8$ total $C=n-1=7$

$C_{tot}=7\epsilon_0\cdot\frac{A}{d}=7\epsilon_0\cdot\frac{1.25cm^2}{3.4mm}=2.28pF$

32) $A=40cm^2$ $d=1mm$ $\Delta V=600V$

a) $C=\frac{\epsilon_0 A}{d}=\frac{\epsilon_0 40cm^2}{1mm}=35.4pF$ b) $q=CV=35.4pF\cdot 600V=21.2nC$

c) $U=\frac{1}{2}CV^2=\frac{1}{2}35.4pF\cdot 600V^2=6.37\mu J$

$\mathcal{E}=\frac{V}{d}=\frac{600V}{1mm}=600kN/C$ $u_E=\frac{1}{2}\epsilon_0\mathcal{E}^2=\frac{1}{2}\epsilon_0 600kN/C^2=1.59J/m^3$

42) a) $C=50pF$ $A=0.35m^2$

$C=\frac{\epsilon_0 A}{d}$ $d=\frac{\epsilon_0 A}{C}=\epsilon_0\frac{0.35m^2}{50pF}=6.2cm$

b) $\kappa=5.6$

$C_n=\kappa C_0=5.6\cdot 50pF=280pF$

44) $A=7.89cm^2$ $d=4.62mm$ $\kappa_1=11$ $\kappa_2=12$

$C_0=\frac{\epsilon_0 A}{d/2}=\frac{\epsilon_0 7.89cm^2}{4.62mm/2}=3.02pF$

$C_1=\kappa_1 C_0$ $C_2=\kappa_2 C_0$ $C_{eq}=\frac{1}{\frac{1}{C_1}+\frac{1}{C_2}}$

$C_1=11\cdot 3.02pF=33.3pF$ $C_2=12\cdot 3.02pF=36.3pF$

$C_{eq}=\frac{1}{\frac{1}{33.3pF}+\frac{1}{36.3pF}}=17.4pF$