

Physics 10 HW #8

24.10) a) $C = \frac{2\pi\epsilon_0 L}{\ln(r_b/r_a)}$
 $C/L = \frac{2\pi\epsilon_0}{\ln(r_b/r_a)}$

$C/L = \frac{2\pi(8.85 \times 10^{-12})}{\ln(3.8/2.6)}$
 $C/L = 1.46 \times 10^{-10} \text{ F/m}$
 $= \boxed{146 \text{ pF/m}}$

b) $C = 3.8 \times 10^{-10} \text{ F}$
 $C = \frac{Q}{V_{ab}}$
 $3.8 \times 10^{-10} \text{ F} = \frac{Q}{370 \text{ V}}$
 $\boxed{Q = 1.41 \times 10^{-10} \text{ C}}$

c) inner q is - outer q
 $\boxed{Q = -1.41 \times 10^{-10} \text{ C}}$

24.11) a) $Q = 3.10 \text{ nC}$
 $V_{ab} = 220.0 \text{ V}$
 $C = \frac{Q}{V_{ab}}$

$\boxed{C = 14 \text{ pF}}$

b) $V_{ab} = kQ \left(\frac{1}{r_a} - \frac{1}{r_b} \right)$
 $r_b = 0.0420 \text{ m}$

$220 \text{ V} = kQ \left(\frac{1}{r_a} - \frac{1}{0.0420 \text{ m}} \right)$

$7.89(0.0420 \text{ m})r_a = 0.0420 \text{ m} - r_a$

$r_a = 0.032 \text{ m} = \boxed{3.2 \text{ cm}}$

c) $E = \frac{1}{4\pi\epsilon_0} \frac{Q}{r^2}$
 $\boxed{E = 2.81 \times 10^4 \text{ N/C}}$

24.26) $V = 7.72 \text{ J}, d = 3 \text{ nm}$

a) $U = \frac{1}{2} QV^2, U = \frac{Q^2}{2C}$

$C = \epsilon_0 \frac{A}{d}$

$U = \frac{Q^2}{2C}$

$U \sim d$

$\boxed{U_f = 3.86 \text{ J}}$

b) $U_f = \frac{1}{2} CV^2 = \frac{1}{2} (\epsilon_0 \frac{A}{d}) V^2$
 $\frac{1}{2} d \rightarrow 2U_f$

$\boxed{U_f = 15.44 \text{ J}}$

24.40) $K = 2.6, E_m = 2 \times 10^7 \text{ V/m}$

a) $u = \frac{1}{2} \epsilon_0 E^2$

$u = \frac{1}{2} (8.85 \times 10^{-12}) (2 \times 10^7)^2$

$\boxed{u = 3.09 \times 10^3 \text{ J/m}^3}$

b) $U = 0.150 \times 10^{-3} \text{ J}$

$U = \frac{1}{2} CV^2$

$C = \epsilon_0 \frac{A}{d}$

$U = \frac{1}{2} (\epsilon_0 \frac{A}{d}) V^2$

$V = Ed \rightarrow d = \frac{V}{E}$

$U = \frac{1}{2} (\epsilon_0 \frac{EA}{d}) V^2$

$U = \frac{1}{2} \epsilon_0 EA V$

~~$A = \frac{2U}{\epsilon_0 EV}$~~

$A = \frac{CQ}{\epsilon_0 V}$

$A = \frac{CQ}{\epsilon_0 EV}$

$U = \frac{1}{2} kC_0 V^2$

$C_0 = \frac{2U}{kV^2}$

$C_0 = 462 \text{ nF}$

$\boxed{A = 1.5 \times 10^{-3} \text{ m}^2}$

24.47) $A = 49.5 \text{ nm}^2, d = 0.650 \text{ nm}$

a) $C = \epsilon_0 \frac{A}{d}$

$C = \epsilon_0 (76.15 \text{ nm})$

$\boxed{C = 6.74 \times 10^{-13} \text{ F}}$

b) $C_0 = 0.674 \text{ pF}$

$C = 9.14 \text{ pF}$

$0.914 \text{ pF} = \epsilon_0 \frac{A}{d}$

$0.103 \text{ m} = \frac{A}{d}$

$49.5 \text{ nm}^2 \times \frac{1 \text{ m}^2}{1000^2 \text{ nm}^2} = 4.95 \times 10^{-5} \text{ m}^2$

$d = 4.5 \times 10^{-4} \text{ m} = 0.48 \text{ mm}$

$\boxed{\Delta d = 0.17 \text{ mm}}$