PHYSICS III
Dr. Joenathan – Winter 2001

Homework VII
Chapter 25 and 26
25-9, 25, 41, 47 and 26-13, 27, 46

25-9.

$$\Delta V = \frac{Q}{4\pi\varepsilon_0}\left(\frac{1}{R} - \frac{1}{r_\infty}\right) = \frac{Q}{4\pi\varepsilon_0 R}$$

$$C = \frac{Q}{\Delta V} = 4\pi\varepsilon_0 R$$

$$C_{earth} = 4\pi\varepsilon_0\ (6.37 \times 10^6\, m) = 7.08 \times 10^{-4}\, F$$

$$= 708\mu F$$

25-25.

$$C_{23} = C_2 + C_3 = 12.0\mu F + 4.00\mu F = 16.0\mu F$$

$$C_{123} = \frac{C_1 C_{23}}{C_1 + C_{23}} = \frac{(6.00\mu F)(16.0\mu F)}{22.0\mu F} = 4.36\mu F$$

$$Q_{tot} = C_{123}(\Delta V) = (4.36 \times 10^{-6}\, F)\ (240.\, V)$$

$$= 1.05 \times 10^{-3} C = Q_1 = Q_{23}$$

$$\Delta V_{23} = \frac{Q_{23}}{C_{23}} = \frac{1.05 \times 10^{-3} C}{16.0 \times 10^{-6} F} = 65.5V$$

$$Q_2 = C_2\ (\Delta V_{23}) = (12.0 \times 10^{-6} F)\ (65.5V)$$

$$= 7.85 \times 10^{-4} C$$

$$Q_3 = C_3(\Delta V_{23}) = Q_{23} - Q_2 = 2.62 \times 10^{-4} C$$

$25-41$. *Dielectric strength for pyrex* $= E_{\max}$

$$= 15.0 \times 10^6\, V/m$$

$$\Delta V_{max} = E_{max}\ d = (15.0\times10^{6}\,V/m)\ (5.00\times10^{-3}\,m)$$

$$= 7.50\times10^{4}\,V$$

25-47.

$$A = (0.305m)(18.3m) = 5.57m^2$$

$$C = \frac{\kappa\varepsilon_0 A}{d} = \frac{(3.5)\ (8.85\times10^{-12}C^2/N\cdot m^2)\ (5.57m^2)}{(0.125\times10^{-3}m)}$$

$$= 1.38\times10^{-6}F = 1.38\mu F$$

26-13. (a)

$$R_a = \frac{\rho_a L}{\pi d^2/4} = \frac{4\rho_a L}{\pi d^2}$$

$$= \frac{4(2.8\times10^{-8}\Omega\cdot m)(50.0m)}{\pi\ (0.163\times10^{-2}m)^2} = 0.671\Omega$$

$$R_t = \frac{4\rho_t L}{\pi d^2} = \frac{4(5.6\times10^{-8}\Omega\cdot m)(50.0m)}{\pi\ (0.163\times10^{-2}m)^2}$$

$$= 1.34\Omega$$

(b)

$$V = V_a + V_t = IR_a + IR_t = I(R_a + R_t)$$

$$I = \frac{V}{R_a + R_t} = \frac{12.0V}{2.01\Omega} = 5.96A$$

(c)

$$V_a = IR_a = (5.96\,A)\ (0.671\Omega) = 4.00V$$

$$Vt = IR_t = (5.96\,A)\ (1.34\Omega) = 8.00V$$

26-13. (d)

$$E_a = \frac{V_a}{L} = \frac{4.00V}{50.0m} = 0.080V/m$$

$$E_t = \frac{V_t}{L} = \frac{8.00V}{50.0m} = 0.160V/m$$

(e)

$$J_a = \frac{E_a}{\rho_a} = \frac{0.080V/m}{2.8\times10^{-8}\,\Omega\cdot m} = 2.86 \times 10^6\ A/m^2$$

$$= J_t$$

26-27.

$$P = I^2R = \frac{Q}{t}$$

$$Q = I^2Rt = (2.00\ A)^2\ (500.\ \Omega)\ (3600\ s)$$

$$= 7.20 \times 10^6\ J$$

26-46.

$$I = \frac{\Delta V}{R} = \frac{\Delta V}{\rho}(2\pi L)\left(\frac{1}{\ln(R_2/R_1)}\right)$$

$$= \frac{2\pi L(\Delta V)}{\rho \ln(R_2/R_1)} = \frac{2\pi L(\Delta V)}{\rho \ln(D_2/D_1)}$$

$$= \frac{2\pi\,(1.00m)(1900.V)}{(2.00\times10^{11}\,\Omega\ \cdot m)\ln\left(\frac{0.116in}{0.0320in}\right)} = 4.63\times10^{-8}\,A$$