Physics 1B HW #9

24.13) $C_2 = 3\mu F$

$y = mx$

$V_2 = mV$

$V = \frac{Q}{C_{eq}}$

$\frac{Q}{C_2} = m\frac{Q}{C_{eq}}$

$\frac{1}{C_2} = 0.650\left(\frac{1}{C_1} + \frac{1}{C_2}\right)$

$\frac{0.35}{C_2} = \frac{1}{C_1}(0.650)$

$\boxed{C_1 = 5.6\times10^{-6}F}$

24.21) $\frac{1}{C_{eq1}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$

a) $C_{eq} = C_{eq1} + C_4 + C_5$

$C_{eq1} = 5.3nF$

$\boxed{C_{eq} = 17.3nF}$

b) $Q = C_{eq}V$

$Q = 17.3nF(25V)$

$\boxed{Q = 482.35nC}$

c) $Q = C_4V$

$Q = (6.5nF)(25V)$

$\boxed{Q = 162.5nC}$

d) Parallel → V is constant

$\boxed{V = 25V}$

24.44) $\ell = 12.0cm = 0.12m$

$d = 4.5mm = 0.0045m$

$K = 3.4$

$V = 18.0V$

a) $C_{eq} = C_1 + C_2$

$R = 0.0144m^2$

$C = \varepsilon_0\frac{A}{d} = \varepsilon_0\left(\frac{0.0072m^2}{0.0045m}\right)$

$C = 1.42\times10^{-11}F$

$C_2 = C_1K = 4.81\times10^{-11}F$

$\boxed{C_{eq} = 6.23\times10^{-11}F}$

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

$\boxed{U = 1\times10^{-8}J}$

c) $C = \varepsilon_0\frac{A}{d}$

$C = \varepsilon_0\left(\frac{0.0144m^2}{0.0045m}\right)$

$C = 2.87\times10^{-11}$

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

$\boxed{U = 4.59\times10^{-7}J}$

25.11) $r = 0.800mm = 8\times10^{-4}m$

$\mathcal{E} = 12V$

$I = m\left(\frac{1}{d}\right)$

$m = 600Am$

$JA = m\left(\frac{1}{d}\right)$ X

$\rho = \frac{E}{J}$

$\mathcal{E} = IR$

$R = \frac{\rho d}{A}$

$\mathcal{E} = I\left(\frac{\rho d}{A}\right)$

$I = \frac{\mathcal{E}A}{\rho}\left(\frac{1}{d}\right)$

$\frac{\mathcal{E}A}{\rho} = 600Am$

$A = 2.01\times10^{-6}m^2$

$\boxed{\rho = 4.02\times10^{-8}\Omega m}$

25.20) $R = \frac{\rho d}{A}$

$\rho_{Al} = 2.75\times10^{-8}\Omega m$

$\rho_{Cu} = 1.72\times10^{-8}\Omega m$

$d = 2.34mm = 0.00234m$

$A = 4.3\times10^{-6}m$

$R = 0.0064d$

$0.0064d = \frac{\rho_{Cu}d}{A}$

$0.0064A = \rho_{Cu}$

$A = 2.69\times10^{-6}m^2$

$\boxed{r = 1.85mm}$

25.26) $I = 4A$

$V_T = 21.2V$

a) $V_T = \mathcal{E} - Ir$

$21.2V = 24 - 4A(r)$

$\boxed{r = 0.7\Omega}$

b) $V = IR$

$21.2V = 4A(R)$

$\boxed{R = 5.3\Omega}$

25.29) $V_{reading} \to 3.08V$

$V_{reading} \to 2.97V$

$A_{reading} \to 1.68A$

a) $V_{ab,i} = 3.08V$

$V_{ab} = \mathcal{E} - I_f r$

$V_{ab,f} = 2.97V$

$I_f = 1.68A$

$I_i = 3.36A$

$V_{ab,i} = \mathcal{E} - 3.36(r)$

$V_{ab,f} = \mathcal{E} - 1.68(r)$

$\mathcal{E} = V_{ab,i} + 3.36(r)$

$r = \frac{V_{ab,f} - \mathcal{E}}{-1.68}$

$\mathcal{E} = V_{ab,i} + 3.36\left(\frac{V_{ab,f} - \mathcal{E}}{-1.68}\right)$

$-\mathcal{E} = V_{ab,i} - 2V_{ab,f}$

$I_i = 0$

$\therefore \boxed{\mathcal{E} = V_{ab} = 3.08V}$

b) $V_{ab} = \mathcal{E} - Ir$

$2.97V = 3.08V - (1.68A)r$

$\boxed{r = 0.065\Omega}$

c) $V = IR$

$2.97V = 1.68A(R)$

$\boxed{R = 1.77\Omega}$

25.42) $V = 3.70V$

$U = 3.10 \times 10^4 J$

$t = 7hr = 25200sec$

$P = V_{ab}(I)$

$\frac{U}{t} = P = V_{ab}(I)$

$\boxed{I = 0.33A}$

25.49) 1.0×10^{14} free e^-/m^3

a) $\rho = \frac{m}{ne^2\tau}$

$\rho_{Si} = 2300\Omega m$

$m = 9.1 \times 10^{-31} kg$

$e = 1.6 \times 10^{-19} C$

$2300\Omega m = \frac{9.1 \times 10^{-31} kg}{ne^2\tau}$

$\boxed{\tau = 1.55 \times 10^{-12} s}$

b) $\rho \sim \frac{1}{n}$

$\boxed{n_{Cu} >>> n_{Si}}$

$\boxed{n \uparrow, \rho \downarrow}$

25.69) $r = 5.10cm = 0.051m$

$h = 3.50cm = 0.035m$

$V = 10V = \mathcal{E}$

$R = 16\Omega$

a) $I = 484mA = 0.484A$

$R_{eq} = R_s + R$

$R_s = \frac{\rho L}{A} = \frac{s \cdot L}{sA}$, $A = 0.0082m^2$

$R_s = 26.78\frac{1}{s}$

$R_{eq} = 26.98\frac{1}{s} + 16\Omega$

$V = IR_{eq}$

$10V = 0.484A\, R_{eq}$, $R_{eq} = 20.66\Omega$

$\boxed{s = 5.79 ppt}$

b) $C = \frac{Q}{V_{ab}}$

$K = \frac{C}{C_0}$

$C_0 = \varepsilon_0 \frac{A}{d} = 2.07 \times 10^{-12} F$

$C = 1.67 \times 10^{-10} F$

$V = V_i - I_i R_i = 10V - (0.484A)(16\Omega)$

$V = 2.26\,V$

$C = \frac{Q}{V}$

$\boxed{Q = 3.76 \times 10^{-10}\,C}$

c) $P = IV$

$V = 2.26\,V$

$I = 0.484\,A$

$\boxed{P = 1.09\,W}$

d) $P_{tot} = IV = 4.84\,W$

$P_{half} = 2.42\,W$

$P = IV$

$2.42\,W = 0.484\,A\,(V)$

$V = 5\,V$

5V must be dissipated by R and R_s X

$\gamma = \frac{S_o}{S}$

$R = \frac{\gamma L}{A}$

$V = IR$

$5\,V = (0.484\,A)R$

$R = 10.33\,\Omega$

$10.33\,\Omega = \frac{S_o L}{5A}$

$S = 2.6\,ppt$ X

$V = IR$

$V = (0.484\,A)(16\,\Omega)$

$V = 7.744\,V$

$V = I\left(\frac{S_o L}{5A}\right)$

$R = 16\,\Omega$

$16\,\Omega = \frac{S_o L}{5A}$

$\boxed{S = 1.68\,ppt}$