Phys 112 HW6 Garrett Hallows

Q: 1, 4, 7, 13, 21, 23, 31, 47, 49, 54

1) $I = 5A$ $\quad t = 4\text{min}/240\text{sec}$ $\quad I = \frac{Q}{t}$ $\quad Q = I\cdot t$ $\quad e = 1.6\times10^{-19}C$

$= 5A \cdot 240$

$Q = 1.2kC$ $\quad \#_e = \frac{Q}{e} = \frac{1.2kC}{1.6e-19C}$

$= 7.49\times10^{21}$ electrons

$\boxed{\text{a) } 1.2kC \quad \text{b) } 7.49\times10^{21}\text{ electrons}}$

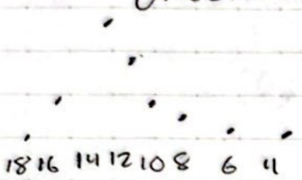
4) $J = \frac{i}{A}$

^{18} 0.04in = 0.001016m $\quad$ ^{16} 0.051in = 0.001295m

^{14} 0.064in = 0.00162m $\quad$ ^{12} 0.081in = 0.00206m

^{10} 0.102in = 0.0026m $\quad$ ^{8} 0.129 = 0.00327m

^{6} 0.162in = 0.00411m $\quad$ ^{4} 0.204in = 0.00518m



$\boxed{\text{14 gauge with current density of } 7.277\times10^{6} A/m^2}$

7) $J = 440A/cm^2$ $\quad I = 0.5A$

$A = \frac{I}{J} = \frac{0.5A}{440A/cm^2} = 0.00113cm^2 = 1.13\times10^{-7}m^2$ $\quad A = \pi r^2$

$d = 2r$ $\quad d = 190\mu m \cdot 2 = \boxed{380\mu m}$ $\quad r = \sqrt{\frac{A}{\pi}} = \sqrt{\frac{1.13\times10^{-7}m^2}{\pi}}$

$r = 1.9\times10^{-11}m$

13) $V = A\cdot L = 0.21cm^2 \cdot 0.85m$

$0.000021m^2 \cdot 0.85m = 17.8\times10^{-6}m^3 \leftarrow A\cdot L$ $\quad \times10^{-34}C$

$q = (nAL)e$ $\quad q = 8.49e28^{-3} \cdot 17.8e-6m^3 \cdot 1.6e-19C$

$q = 2.43\times10^{5}C$

$V_d = \frac{i}{nAe} = \frac{300A}{8.49e28m^{-3} \cdot 2.1e-5m^2 \cdot 1.6e-19C} = 1.05\times10^{-3}m/s$

$t = \frac{L}{V_d} = \frac{0.85m}{1.05\times10^{-3}m/s} = 809.3s = \boxed{13.5\text{ minutes}}$

21) $I = 0.3A$ $\quad V = 2.9V$ $\quad R_0 = 1.1\Omega$ $\quad \alpha = K^{-1} = 4.5e-3$

$R_T = \frac{V}{I} = \frac{2.9V}{0.3A} = 9.67\Omega$ $\quad R_T = R_0[1 + \alpha(T - T_0)]$

$9.67\Omega = 1.1\Omega[1 + 4.5e-3(T - 20)]$

$8.79 = 1 + 4.5e-3(T - 20°C)$

$7.79 = 4.5e-3(T - 20)$

$1730.6 = T - 20°C$

$1750.6°C = T$

$\boxed{1750.6°C}$

HW6 back Garrett Hallrup

23) $V = 115V$ $L = 10m$ $r = 0.3mm$ $J = 1.4 \times 10^8 A/m^2$

$p = \frac{RA}{L}$ $I = J \cdot A$ $A = \pi r^2 = \pi (0.3mm)^2 = 7.85 \times 10^{-7} m^2$

$I = 1.4 \times 10^8 A/m^2 \cdot 7.85 \times 10^{-7} m^2$

$p = \frac{1.055\Omega \cdot 7.85e{-7}m^2}{10m}$ $I = 110A$

$\boxed{\rho = 8.27 \Omega/m}$ $R = \frac{V}{I} = \frac{115}{110} = 1.055\Omega$

31) 125 strands $2.65\mu\Omega$ $I_{tot} = 0.75A$

all parallel so $I_{per\ strand} = \frac{I_{tot}}{\#} = \frac{0.75A}{125} = 6mA$

$\boxed{a)\ 6mA}$ $V = IR$ V is same for each strand so

$V_{tot} = I_s \cdot R_s = 6mA \cdot 2.65\mu\Omega = 15.9nV$

$\boxed{b)\ 15.9nV}$

$\frac{1}{R_{eq}} = \sum_{n=1}^{125} \frac{1}{2.65\mu\Omega} = 4.72 \times 10^{7} \frac{1}{\Omega}$ $R_{eq} = 21.2n\Omega$

$\boxed{c)\ 21.2n\Omega}$

47) $V_1 = 75V$ $A = 2.6 \times 10^{-6} m^2$ $\rho = 500n\Omega/m$ $p = 5000W$

$V_2 = 100V$

$P = \frac{V^2}{R} = \frac{V^2}{\frac{\rho L}{A}} = \frac{V^2 \cdot A}{\rho \cdot L}$

$L_1 = \frac{V_1^2 \cdot A}{\rho \cdot P} = \frac{75V^2 \cdot 2.6e{-6}m^2}{500n\Omega/m \cdot 5000W} = 5.85m$ $L_2 = \frac{100V^2 \cdot 2.6e{-6}m^2}{500n\Omega/m \cdot 5000W} = 10.4m$

a) 5.85m
b) 10.4m

49) $P = 100W$ $V = 120V$ cost $= 6¢/kWh$

31 day = 744 hours

Uses 74400Whr or 74.4kWh

74.4kwhr $0.06/kwhr = $4.46

$R = \frac{V^2}{P} = \frac{120^2}{100} = 144\Omega$

$I = \frac{P}{V} = \frac{100}{120} = 0.833A$

a) $4.46
b) 144Ω
c) 0.833A

54) $V = 5V$ $P = 200W$

$200 = \frac{V^2}{R} = \frac{25}{R}$ $R = 0.125\Omega$

$dR = 5x\,dx$

$\int dR = \int_0^L 5x\,dx$

$R = \frac{5}{2}x^2 \Big|_0^L$

$0.125 = \frac{5}{2}L^2 - 0$

$0.05 = L^2$

$L = 22.4cm$

$\boxed{22.4cm}$