Physics 4B
Fall 2017

ave. = 8.4
σ = 1.3

Name: Answer Key

Lab (circle one): 8:00 am 11:15 am 2:45 pm

Quiz #5: Current and Resistance

Problem 1 (2 points)
A current of 0.30 A is passed through a lamp for 2 minutes using a 6.0 V power supply. The energy dissipated by this lamp during the 2 minutes is

a) 1.8 J
b) 3.6 J
c) 20 J
d) 36 J
e) 216 J

E

$E = P/t$
$P = iV$

$P = Et = (iV)t$
$P = (0.30\,A)(6.0\,V)(120\,s)$
$P = 216\,J$

Problem 2 (3 points)
A potential difference V is applied across the ends of a copper wire of area A and length L. For each of the following changes, does the electron drift speed, v_d, increase, decrease, or remain the same?

a) increasing V, (A and L constant)?
increase

b) increasing L, (V and A constant)?
decrease

c) decreasing A, (V and L constant)?
remain the same

$v_d = \frac{i}{Ane}$ $R = \rho L/A$ $i = V/R$

$i = V/(\rho L/A) = \frac{VA}{\rho L}$

$v_d = \frac{i}{Ane} = \frac{\left(\frac{VA}{\rho L}\right)}{Ane} \rightarrow v_d = \frac{V}{\rho L ne}$

Problem 3 (5 points)
A copper wire ($\rho = 1.75 \times 10^{-8}\ \Omega\cdot m$) of cross-sectional area $1.35 \times 10^{-7}\ m^2$ and length 6.50 m is connected to a 10.0 V power supply. What is **(a)** the current in the wire, **(b)** the magnitude of the current density, **(c)** the magnitude of the electric field in the wire, and **(d)** the rate at which thermal energy is dissipated by the wire?

$\rho = 1.75\times10^{-8}\,\Omega\cdot m$
$L = 6.50\,m$
$V = 10.0\,V$
$A = 1.35\times10^{-7}\,m^2$

(a) $i = V/R = \frac{10.0\,V}{0.84\,\Omega} \rightarrow i = 11.9\,A$

(b) $J = i/A = \frac{11.9\,A}{1.35\times10^{-7}\,m^2} \rightarrow J = 8.81\times10^{7}\,\frac{A}{m^2}$

(c) $E = V/L = \frac{10.0\,V}{6.50\,m}$ can also use $E = \rho J$

$R = \rho L/A = \frac{(1.75\times10^{-8}\,\Omega m)(6.50\,m)}{1.35\times10^{-7}\,m^2}$

$E = 1.54\,V/m$ or $1.54\,N/C$

$R = 0.84\,\Omega$

(d) $P = iV$ (or $P = iR^2$ or $P = V^2/R$)

$P = (11.9\,A)(10.0\,V) = 119\,W$