

$$\text{ave.} = 8.9$$

$$\sigma = 1.5$$

**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

**E**

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

$$E = P/t$$

$$P = iV$$

$$P = Et = (iV)t$$

$$P = (0.30A)(6.0V)(120s) = 216J$$

**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**

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

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

**decrease**

$$i = V/R = V / (\rho L/A) = VA/\rho L$$

- c) decreasing A, (V and L constant)?

**remain the same**

$$v_d = \frac{i}{Ane} = \frac{(VA/\rho L)}{Ane} \Rightarrow v_d = \frac{V}{\rho Lne}$$

**Problem 3 (5 points)**

A copper wire ( $\rho = 1.69 \times 10^{-8} \Omega \cdot m$ ) of cross-sectional area  $1.5 \times 10^{-7} m^2$  and length 6.3 m is connected to a 6.0 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?

$$\rho = 1.69 \times 10^{-8} \Omega m$$

$$A = 1.5 \times 10^{-7} m^2$$

$$L = 6.3 m$$

$$V = 6.0V$$

(a)  $i = V/R = \frac{6.0V}{0.710\Omega} = \mathbf{8.45A}$

(b)  $J = i/A = \frac{8.45A}{1.5 \times 10^{-7} m^2} = \mathbf{5.64 \times 10^7 A/m^2}$

(c)  $E = V/L = \frac{6.0V}{6.3m} = \mathbf{0.952 V/m}$

$$R = \rho L/A$$

$$= \frac{(1.69 \times 10^{-8} \Omega m)(6.3m)}{1.5 \times 10^{-7} m^2}$$

$$E = \rho J = (1.69 \times 10^{-8} \Omega m)(5.64 \times 10^7 A/m^2)$$

$$= \mathbf{0.95 V/m}$$

$$R = \mathbf{0.710 \Omega}$$

(d)  $P = iV = (8.45A)(6.0V) = \mathbf{50.7W}$