## Multiple Choice Questions  
1. According to the text, what is the primary constituent responsible for carrying current in solid conductors?  
A. Positive ions  
B. Neutrons  
C. Negatively charged electrons  
D. Positively charged nuclei  
  
2. Which of the following best describes the relationship between voltage and current in Ohm's Law?  
A. Voltage is inversely proportional to current.  
B. Voltage is equal to the square of the current.  
C. Voltage is directly proportional to current.  
D. Voltage is independent of current.  
  
3. What is the SI unit for current density?  
A. Ohm (Ω)  
B. Ampere (A)  
C. Ampere per square meter (A/m²)  
D. Volt (V)  
  
4. What is the phenomenon described in the text where electrons in a conductor move with an average velocity independent of time, despite acceleration?  
A. Acceleration  
B. Thermal Velocity  
C. Drift  
D. Collision  
  
5. What term is defined as the magnitude of the drift velocity per unit electric field?  
A. Resistivity  
B. Conductivity  
C. Mobility  
D. Current density  
  
6. Which of the following best describes the behavior of resistivity in semiconductors with increasing temperature, according to the text?  
A. Resistivity increases linearly.  
B. Resistivity remains constant.  
C. Resistivity decreases.  
D. Resistivity increases exponentially.  
  
7. In the provided text, which factor does not directly determine the resistance of a conductor?  
A. Material of the conductor  
B. Dimensions of the conductor  
C. Applied electric field  
D. Temperature  
  
8. According to the text, what supplies the power dissipated in a resistor in a simple circuit with a cell?  
A. The resistor itself  
B. The connecting wires  
C. The chemical energy of the cell  
D. The electric field outside the circuit  
  
9. What term refers to the potential difference between the positive and negative electrodes of a cell in an open circuit?  
A. Voltage drop  
B. Internal resistance  
C. Electromotive force (EMF)  
D. Current density  
  
10. Which of the following best describes Kirchhoff's junction rule?  
A. The sum of currents entering a junction equals the sum of currents leaving it.  
B. The sum of voltages around any closed loop must equal zero.  
C. Current flows from positive to negative terminals.  
D. The voltage across a resistor is proportional to the current through it.  
## Short Answer Questions  
1. What phenomenon occurs naturally where charges flow from clouds to the Earth?  
2. What physical quantity is analogous to the heat flow in the context of Ohm's Law?  
3. Define current density (j).  
4. What causes the average velocity of electrons in a conductor to be zero when no electric field is applied?  
5. What happens to an electron's speed after colliding with an ion?  
6. What is the name of the average time between successive collisions of electrons in a conductor?  
7. What is the direction of electron drift velocity compared to the electric field direction?  
8. What is the SI unit of mobility?  
9. According to the text, what is the most common deviation from Ohm's law?  
10. Name one material exhibiting non-unique relation between V and I?  
11. What characteristic do manganin and constantan possess that make them useful in standard resistors?  
12. What two factors does the resistivity of a material depend on, according to the provided text?  
  
## Long Answer Questions  
1. Explain the concept of "drift velocity" and how it relates to Ohm's Law, providing equations from the text to support your explanation.  
  
2. Describe the temperature dependence of resistivity for both metals and semiconductors, and explain the underlying reasons for these differences based on the information provided in the text.  
  
3. Explain how electrical power is transmitted from power stations to homes and factories, including the challenges and solutions discussed in the provided text. Use equations to illustrate your points.  
  
4. Describe the Wheatstone bridge circuit, state the balance condition, and explain how it is used to determine an unknown resistance.  
  
## Numerical Questions  
1. If the number density of free electrons in a copper conductor is 8.5 x 10^28 m^-3, what is the total number of free electrons in a copper wire that is 3.0 m long and has a cross-sectional area of 2.0 x 10^-6 m^2?  
  
2. Given a copper wire with a cross-sectional area of 1.0 x 10^-7 m^2 carrying a current of 1.5 A, and assuming each copper atom contributes one conduction electron, with a number density of 8.5 x 10^28 m^-3, calculate the magnitude of the drift velocity (vd) of the electrons. (e = 1.6 x 10^-19 C)  
  
3. A toaster has a resistance of 75.3 Ω at 27.0 °C. When connected to a 230 V supply, the current stabilizes at 2.68 A. What is the resistance of the toaster at its steady temperature?  
  
4. A platinum resistance thermometer has a resistance of 5 Ω at the ice point (0 °C) and 5.23 Ω at the steam point (100 °C). If the thermometer is inserted in a hot bath and reads 5.795 Ω, what is the temperature of the bath?  
5. The four arms of a Wheatstone bridge have the following resistances: AB = 100 Ω, BC = 10 Ω, CD = 5 Ω, and DA = 60 Ω. A galvanometer of 15 Ω resistance is connected across BD. A potential difference of 10 V is maintained across AC. Calculate the current through the arm BD.  
  
6. A 15 m long wire with uniform cross-section of 6.0 x 10^-7 m^2 has a resistance of 5.0 Ω. Calculate the resistivity of the material of the wire.  
  
7. A silver wire has a resistance of 2.1 Ω at 27.5 °C and 2.7 Ω at 100 °C. Find the temperature coefficient of resistance of silver.  
  
8. A Nichrome heating element connected to 230 V draws an initial current of 3.2 A, which decreases to 2.8 A when it reaches steady temperature. Determine the steady temperature of the heating element if its room temperature is 27.0 °C and the temperature coefficient of resistance of nichrome is 1.70 × 10−4 °C−1.  
  
9. A storage battery with emf 8.0 V and internal resistance 0.5 Ω is being charged by a 120 V DC supply through a 15.5 Ω series resistor. What is the terminal voltage of the battery during charging?  
  
10. Given that the number density of electrons is 8.5 x 10^28 m^-3 and the current is 3.0 A in a copper wire of cross-sectional area 2.0 x 10^-6 m^2, calculate the drift speed of electrons. Given the same parameters for copper, find the time it takes an electron to drift from one end to the other. (length is 3.0m).