Name: _____ Date: _____

1. The current density is the same in two wires. Wire A has twice the free-electron concentration of wire B. The magnitude of the average velocity of electrons in A is:

A) twice that of electrons in B
B) four times that of electrons in B
C) half that of electrons in B
D) one-fourth that of electrons in B
E) the same as that of electrons in B

2. Copper contains 8.4×10^{28} free electrons/m^3. A copper wire of cross-sectional area 7.4×10^{-7} m^2 carries a current of 1 A. The magnitude of the average electron velocity is approximately:

A) 3×10^8 m/s
B) 10^3 m/s
C) 1 m/s
D) 10^{-4} m/s
E) 10^{-23} m/s

3. For an ohmic resistor, resistance is the proportionality constant for:

A) potential difference and electric field
B) current and electric field
C) current and length
D) current and cross-sectional area
E) current and potential difference

4. A certain wire has resistance *R*. Another wire, of the same material, has half the length and half the diameter of the first wire. The resistance of the second wire is:

A) *R*/4
B) *R*/2
C) *R*
D) 2*R*
E) 4*R*

5. For an ohmic substance the resistivity is the proportionality constant for:

A) current and potential difference
B) current and electric field
C) current density and potential difference
D) current density and electric field
E) potential difference and electric field

6. A car battery is rated at 80 A · h. An ampere-hour is a unit of:

A) power
B) energy
C) current
D) charge
E) force

7. The current is zero in a conductor when no potential difference is applied because:

A) the electrons are not moving
B) the electrons are not moving fast enough
C) for every electron with a given velocity there is another with a velocity of equal magnitude and opposite direction.
D) equal numbers of electrons and protons are moving together
E) otherwise Ohm's law would not be valid

8. Two wires are made of the same material and have the same length but different radii. They are joined end-to-end and a potential difference is maintained across the combination. Of the following the quantity that is the same for both wires is:

A) potential difference
B) current
C) current density
D) electric field
E) average conduction electron velocity

9. Two wires made of different materials have the same uniform current density. They carry the same current only if:

A) their lengths are the same
B) their cross-sectional areas are the same
C) both their lengths and cross-sectional areas are the same
D) the potential differences across them are the same
E) the electric fields in them are the same

10. A coulomb is the same as:

A) ampere/second
B) (1/2) ampere · second^2
C) ampere/meter^2
D) ampere · second
E) newton · meter^2

11. A flat iron is marked "120 V, 600 W". In normal use, the current in it is:

A) 2 A
B) 4 A
C) 5 A
D) 7.2 A
E) 0.2 A

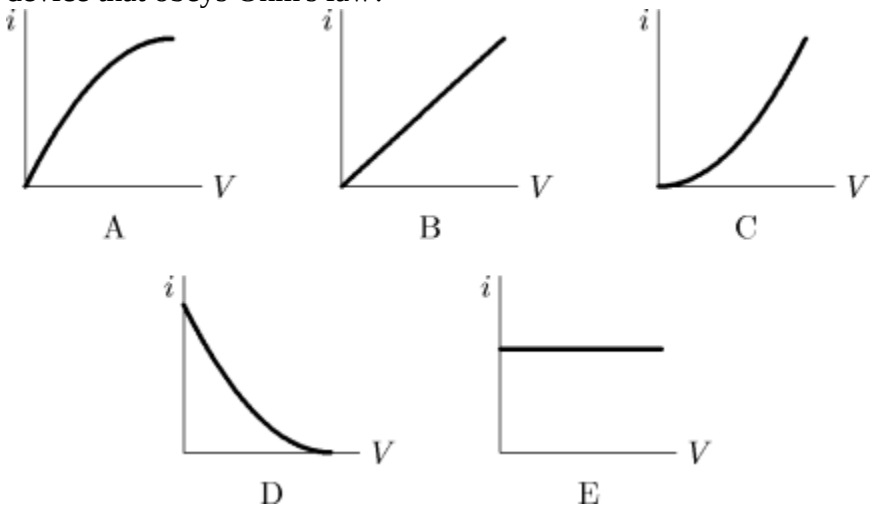
12. A certain sample carries a current of 4 A when the potential difference is 2 V and a current of 10 A when the potential difference is 4 V. This sample:

A) obeys Ohm's law
B) has a resistance of 0.5 Ω at 1 V
C) has a resistance of 2.5 Ω at 1 V
D) has a resistance of 2.5 Ω at 2 V
E) does not have a resistance

13. Of the following, the copper conductor that has the least resistance is:

A) thin, long and hot
B) thick, short and cool
C) thick, long and hot
D) thin, short and cool
E) thin, short and hot

14. Which of the following graphs best represents the current-voltage relationship for a device that obeys Ohm's law?



A) A
B) B
C) C
D) D
E) E

15. A student kept her 60-watt, 120-volt study lamp turned on from 2:00 PM until 2:00 AM. The charge that went through it was

A) 150 C
B) 3,600 C
C) 7,200 C
D) 18,000 C
E) 21,600 C

16. The rate at which electrical energy is used may be measured in the unit:

A) watt/second
B) watt · second
C) watt
D) joule · second
E) kilowatt · hour

17. You wish to triple the rate of electrical energy dissipation in a heating device. To do this you could triple:

A) the potential difference keeping the resistance the same
B) the current keeping the resistance the same
C) the resistance keeping the potential difference the same
D) the resistance keeping the current the same
E) both the potential difference and current

18. Conductivity is:

A) the same as resistivity, it is just more convenient to use for good conductors
B) expressed in Ω^{-1}
C) equal to 1/resistance
D) expressed in $(\Omega \cdot \mathrm{m})^{-1}$
E) not a meaningful quantity for an insulator

19. It is better to send 10,000 kW of electric power long distances at 10,000 V rather than at 220 V because:

A) there is less heating in the transmission wires
B) the resistance of the wires is less at high voltages
C) more current is transmitted at high voltages
D) the insulation is more effective at high voltages
E) the *iR* drop along the wires is greater at high voltage

20. Current has units:

A) kilowatt · hour
B) coulomb/second
C) coulomb
D) volt
E) ohm

21. A 60-watt light bulb carries a current of 0.5 A. The total charge passing through it in one hour is:

A) 120 C
B) 3600 C
C) 3000 C
D) 2400 C
E) 1800 C

22. If $\vec{J}$ is the current density and $d\vec{A}$ is a vector element of area then the integral $\int \vec{J} \cdot d\vec{A}$ over an area represents:

A) the electric flux at the area
B) the average current density at the position of the area
C) the resistance of the area
D) the resistivity of the area
E) the current through the area

23. A cylindrical copper rod has resistance *R*. It is reformed to twice its original length with no change of volume. Its new resistance is:

A) R
B) $2R$
C) $4R$
D) $8R$
E) $R/2$

24. The mechanical equivalent of heat is 1 cal = 4.18 J. The specific heat of water is 1 cal/g · K. An electric immersion water heater, rated at 400 W, should heat a kilogram of water from 10º C to 30º C in about:

A) 3.5 min
B) 1 min
C) 15 min
D) 45 min
E) 15 s

25. Current has units:

A) kilowatt · hour
B) ampere
C) coulomb
D) volt
E) ohm

Answer Key

1. C
2. D
3. E
4. D
5. D
6. D
7. C
8. B
9. B
10. D
11. C
12. B
13. B
14. B
15. E
16. C
17. D
18. D
19. A
20. B
21. E
22. E
23. C
24. A
25. B