Chapter 26: CURRENT AND RESISTANCE

1. A car battery is rated at $80\,\mathrm{A}\cdot\mathrm{h}$. An ampere-hour is a unit of:
   A. power
   B. energy
   C. current
   D. charge
   E. force

   ans: D

2. Current has units:
   A. kilowatt·hour
   B. coulomb/second
   C. coulomb
   D. volt
   E. ohm

   ans: B

3. Current has units:
   A. kilowatt·hour
   B. ampere
   C. coulomb
   D. volt
   E. ohm

   ans: B

4. The units of resistivity are:
   A. ohm
   B. ohm·meter
   C. ohm/meter
   D. ohm/meter^2
   E. none of these

   ans: B

5. The rate at which electrical energy is used may be measured in:
   A. watt/second
   B. watt·second
   C. watt
   D. joule·second
   E. kilowatt·hour

   ans: C

6. Energy may be measured in:
   A. kilowatt
   B. joule·second
   C. watt
   D. watt·second
   E. volt/ohm

   ans: D

7. Which one of the following quantities is correctly matched to its unit?
   A. Power — kW·h
   B. Energy — kW
   C. Potential difference — J/C
   D. Current — A/s
   E. Resistance — V/C

   ans: C

8. Current is a measure of:
   A. force that moves a charge past a point
   B. resistance to the movement of a charge past a point
   C. energy used to move a charge past a point
   D. amount of charge that moves past a point per unit time
   E. speed with which a charge moves past a point

   ans: D

9. 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

   ans: E

10. A 10-ohm resistor has a constant current. If 1200 C of charge flow through it in 4 minutes what is the value of the current?
   A. 3.0 A
   B. 5.0 A
   C. 11 A
   D. 15 A
   E. 20 A

   ans: D

11. Conduction electrons move to the right in a certain wire. This indicates that:
    A. the current density and electric field both point right
    B. the current density and electric field both point left
    C. the current density points right and the electric field points left
    D. the current density points left and the electric field points right
    E. the current density points left but the direction of the electric field is unknown

    ans: B

12. 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

    ans: B

13. A wire with a length of 150 m and a radius of 0.15 mm carries a current with a uniform current density of $2.8 \times 10^7\ \mathrm{A/m^2}$. The current is:
    A. $0.63\ \mathrm{A^2}$
    B. 2.0 A
    C. $5.9\ \mathrm{A^2}$
    D. 296 A
    E. $400\ \mathrm{A^2}$

    ans: B

14. In a conductor carrying a current we expect the electron drift speed to be:
    A. much greater than the average electron speed
    B. much less than the average electron speed
    C. about the same as the average electron speed
    D. less than the average electron speed at low temperature and greater than the average electron speed at high temperature
    E. less than the average electron speed at high temperature and greater than the average electron speed at low temperature

    ans: B

15. Two substances are identical except that the electron mean free time for substance A is twice the electron mean free time for substance B. If the same electric field exists in both substances the electron drift speed in A is:
    A. the same as in B
    B. twice that in B
    C. half that in B
    D. four times that in B
    E. one-fourth that in B

    ans: B

16. 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

    ans: C

17. The current density is the same in two wires. Wire A has twice the free-electron concentration of wire B. The drift speed 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

    ans: C

18. Copper contains 8.4×10^{28} free electrons/m^3. A copper wire of cross-sectional area $7.4\times10^{-7}\,\mathrm{m}^2$ carries a current of 1 A. The electron drift speed is approximately:
    A. $3\times10^{8}\,\mathrm{m/s}$
    B. $10^{3}\,\mathrm{m/s}$
    C. $1\,\mathrm{m/s}$
    D. $10^{-4}\,\mathrm{m/s}$
    E. $10^{-23}\,\mathrm{m/s}$

    ans: D

19. 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 through 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

    ans: E

20. If the potential difference across a resistor is doubled:
    A. only the current is doubled
    B. only the current is halved
    C. only the resistance is doubled
    D. only the resistance is halved
    E. both the current and resistance are doubled

    ans: A

21. Five cylindrical wires are made of the same material. Their lengths and radii are

wire 1: length ℓ, radius r
wire 2: length $\ell/4$, radius $r/2$
wire 3: length $\ell/2$, radius $r/2$
wire 4: length ℓ, radius $r/2$
wire 5: length 5ℓ, radius $2r$

Rank the wires according to their resistances, least to greatest.

A. 1, 2, 3, 4, 5
B. 5, 4, 3, 2, 1
C. 1 and 2 tie, then 5, 3, 4
D. 1, 3, 4, 2, 5
E. 1, 2, 4, 3, 5

ans: C

22. 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

ans: B

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. $R/2$

ans: C

24. The resistance of a rod does NOT depend on:

A. its temperature
B. its material
C. its length
D. its conductivity
E. the shape of its (fixed) cross-sectional area

ans: E

25. 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. $2R$
E. $4R$

ans: D

26. A nichrome wire is 1 m long and $1 \times 10^{-6}\,\mathrm{m}^2$ in cross-sectional area. When connected to a potential difference of 2 V, a current of 4 A exists in the wire. The resistivity of this nichrome is:

A. $10^{-7}\,\Omega \cdot \mathrm{m}$
B. $2 \times 10^{-7}\,\Omega \cdot \mathrm{m}$
C. $4 \times 10^{-7}\,\Omega \cdot \mathrm{m}$
D. $5 \times 10^{-7}\,\Omega \cdot \mathrm{m}$
E. $8 \times 10^{-7}\,\Omega \cdot \mathrm{m}$

ans: D

27. Two conductors are made of the same material and have the same length. Conductor A is a solid wire of diameter 1 m. Conductor B is a hollow tube of inside diameter 1 m and outside diameter 2 m. The ratio of their resistance, R_A/R_B, is:

A. 1
B. $\sqrt{2}$
C. 2
D. 3
E. 4

ans: D

28. 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

ans: D

29. 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 $0.5\,\Omega$ at 1 V
C. has a resistance of $2.5\,\Omega$ at 1 V
D. has a resistance of $2.5\,\Omega$ at 2 V
E. does not have a resistance

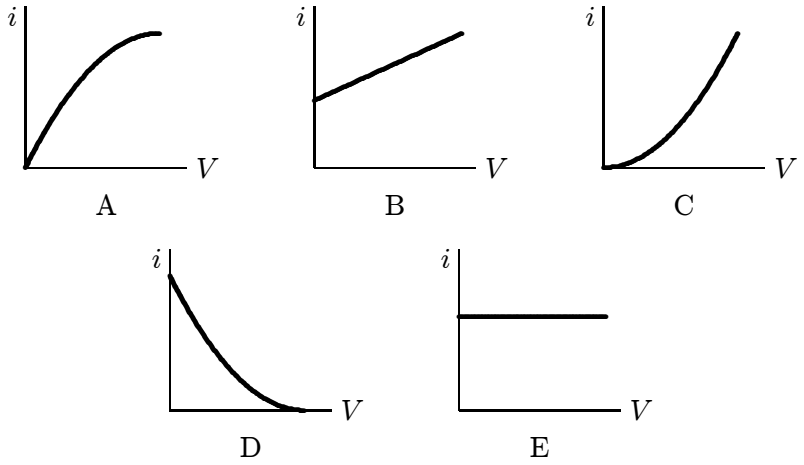
ans: B

30. A current of 0.5 A exists in a 60-ohm lamp. The applied potential difference is:

A. 15 V
B. 30 V
C. 60 V
D. 120 V
E. none of these

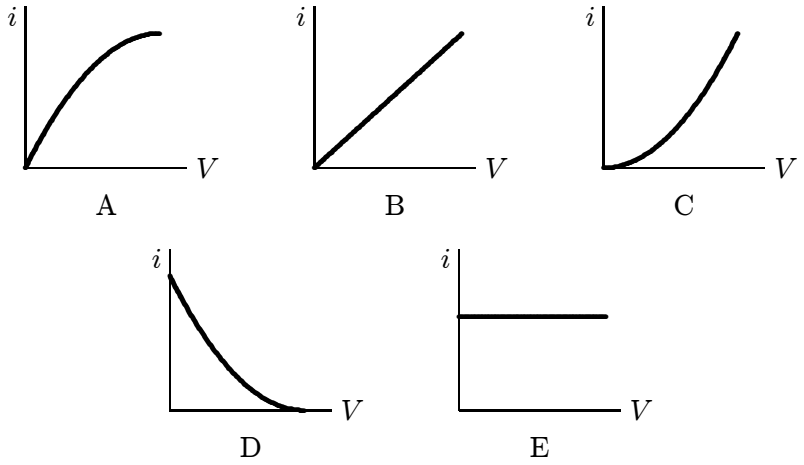
ans: B

31. Which of the following graphs best represents the current-voltage relationship of an incandescent light bulb?



ans: A

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



ans: B

33. 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. conduction electron drift speed

ans: B

34. 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

    ans: D

35. 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

    ans: E

36. For an ohmic substance, the resistivity depends on:
    A. the electric field
    B. the potential difference
    C. the current density
    D. the electron mean free time
    E. the cross-sectional area of the sample

    ans: D

37. For a cylindrical resistor made of ohmic material, the resistance does NOT depend on:
    A. the current
    B. the length
    C. the cross-sectional area
    D. the resistivity
    E. the electron drift velocity

    ans: A

38. For an ohmic substance, the electron drift velocity is proportional to:
    A. the cross-sectional area of the sample
    B. the length of the sample
    C. the mass of an electron
    D. the electric field in the sample
    E. none of the above

    ans: D

39. You wish to triple the rate of 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

ans: D

40. A student kept her 60-watt, 120-volt study lamp turned on from 2:00 PM until 2:00 AM. How many coulombs of charge went through it?

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

ans: E

41. 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

ans: C

42. An certain resistor dissipates 0.5 W when connected to a 3 V potential difference. When connected to a 1 V potential difference, this resistor will dissipate:

A. 0.5 W
B. 0.167 W
C. 1.5 W
D. 0.056 W
E. none of these

ans: D

43. An ordinary light bulb is marked "60 W, 120 V". Its resistance is:

A. 60 Ω
B. 120 Ω
C. 180 Ω
D. 240 Ω
E. 15 Ω

ans: D

44. 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 10° C to 30° C in about:

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

ans: A

45. 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

ans: A

46. Suppose the electric company charges 10 cents per kW·h. How much does it cost to use a 125 W lamp 4 hours a day for 30 days?

A. $1.20
B. $1.50
C. $1.80
D. $7.20
E. none of these

ans: B

47. A certain x-ray tube requires a current of 7 mA at a voltage of 80 kV. The rate of energy dissipation (in watts) is:

A. 560
B. 5600
C. 26
D. 11.4
E. 87.5

ans: A

48. The mechanical equivalent of heat is 1 cal = 4.18 J. A heating coil, connected to a 120-V source, provides 60,000 calories in 10 minutes. The current in the coil is:

A. 0.83 A
B. 2 A
C. 3.5 A
D. 20 A
E. 50 A

ans: C

49. You buy a "75 W" light bulb. The label means that:
    A. no matter how you use the bulb, the power will be 75 W
    B. the bulb was filled with 75 W at the factory
    C. the actual power dissipated will be much higher than 75 W since most of the power appears as heat
    D. the bulb is expected to burn out after you use up its 75 W
    E. none of the above

    ans: E

50. A current of 0.3 A is passed through a lamp for 2 minutes using a 6-V power supply. The energy dissipated by this lamp during the 2 minutes is:
    A. 1.8 J
    B. 12 J
    C. 20 J
    D. 36 J
    E. 216 J

    ans: E