

Chapter 26: CURRENT AND RESISTANCE

1. A car battery is rated at $80\text{ A}\cdot\text{h}$. 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/meter²
- 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 $2.8 \times 10^7 \text{ A/m}^2$. The current is:
- A. 0.63 A^2
 - B. 2.0 A
 - C. 5.9 A^2
 - D. 296 A
 - E. 400 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 $7.4 \times 10^{-7} \text{ m}^2$ carries a current of 1 A. The electron drift speed is approximately:
- A. $3 \times 10^8 \text{ m/s}$
 - B. 10^3 m/s
 - C. 1 m/s
 - D. 10^{-4} m/s
 - E. 10^{-23} 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

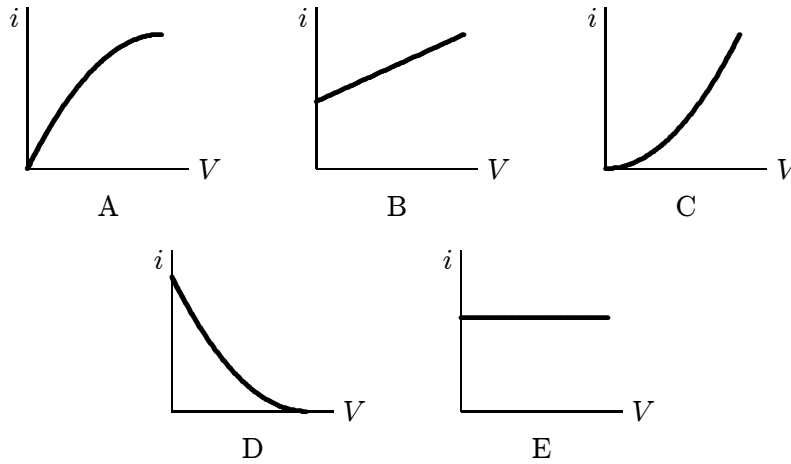
25. A certain wire has resistance R . Another wire, of the same material, has half the length and half the diameter of the first wire. The resistance of the second wire is:

- A. $R/4$
B. $R/2$
C. R
D. $2R$
E. $4R$

ans: D

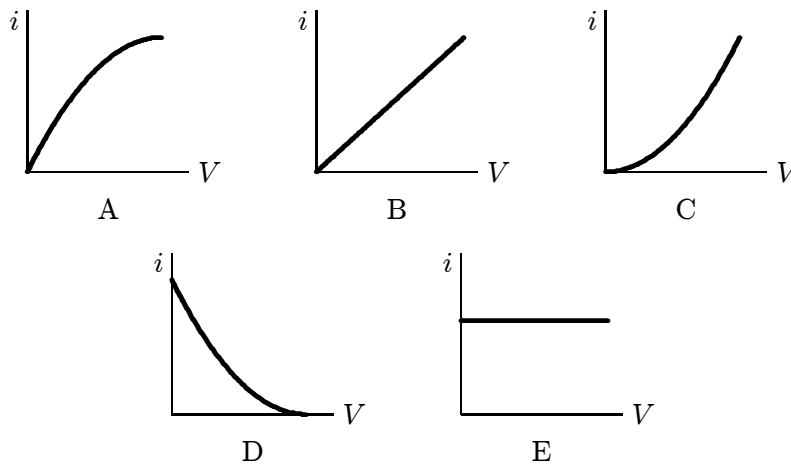
26. A nichrome wire is 1 m long and $1 \times 10^{-6} \text{ m}^2$ in cross-sectional area. When connected to a potential difference of 2 V, a current of 4 A exists in the wire. The resistivity of this nichrome is:
- $10^{-7} \Omega \cdot \text{m}$
 - $2 \times 10^{-7} \Omega \cdot \text{m}$
 - $4 \times 10^{-7} \Omega \cdot \text{m}$
 - $5 \times 10^{-7} \Omega \cdot \text{m}$
 - $8 \times 10^{-7} \Omega \cdot \text{m}$
- 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:
- 1
 - $\sqrt{2}$
 - 2
 - 3
 - 4
- ans: D
28. Conductivity is:
- the same as resistivity, it is just more convenient to use for good conductors
 - expressed in Ω^{-1}
 - equal to 1/resistance
 - expressed in $(\Omega \cdot \text{m})^{-1}$
 - 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:
- obeys Ohm's law
 - has a resistance of 0.5Ω at 1 V
 - has a resistance of 2.5Ω at 1 V
 - has a resistance of 2.5Ω at 2 V
 - 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:
- 15 V
 - 30 V
 - 60 V
 - 120 V
 - 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. $60\ \Omega$
 - B. $120\ \Omega$
 - C. $180\ \Omega$
 - D. $240\ \Omega$
 - E. $15\ \Omega$
- ans: D

44. The mechanical equivalent of heat is $1 \text{ cal} = 4.18 \text{ J}$. The specific heat of water is $1 \text{ cal/g} \cdot \text{K}$. 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 $10,000 \text{ kW}$ of electric power long distances at $10,000 \text{ V}$ 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 $\text{kW}\cdot\text{h}$. 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 $1 \text{ cal} = 4.18 \text{ J}$. 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