CHAPTER REVIEW

Concept Items

19.1 Ohm's law

1. You connect a resistor across a battery. In which direction do the electrons flow?
   a. The electrons flow from the negative terminal of the battery to the positive terminal of the battery.
   b. The electrons flow from the positive terminal of the battery to the negative terminal of the battery.

2. How does current depend on resistance in Ohm's law?
   a. Current is directly proportional to the resistance.
   b. Current is inversely proportional to the resistance.
   c. Current is proportional to the square of the resistance.
   d. Current is inversely proportional to the square of the resistance.

3. In the context of electricity, what is resistance?
   a. Resistance is the property of materials to resist the passage of voltage.
   b. Resistance is the property of materials to resist the passage of electric current.
   c. Resistance is the property of materials to increase the passage of voltage.
   d. Resistance is the property of materials to increase the passage of electric current.

4. What is the mathematical formula for Ohm's law?
   a. $V = I^2R$
   b. $V = \frac{R}{I}$
   c. $V = \frac{I}{R}$
   d. $V = IR$

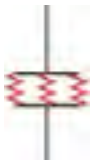
19.2 Series Circuits

5. In which circuit are all the resistors connected in series?

a. 

c. 

b. 

d. 

19.3 Parallel Circuits

7. If you remove resistance from a circuit, does the total resistance of the circuit always decrease? Explain.
   a. No, because for parallel combination of resistors, the resistance through the remaining circuit increases.
   b. Yes, because for parallel combination of resistors, the resistance through the remaining circuit increases.

8. Explain why the equivalent resistance of a parallel combination of resistors is always less than the smallest of the parallel resistors.
   a. Adding resistors in parallel gives the current a shorter path through which it can flow hence decreases the overall resistance.
   b. Adding resistors in parallel gives the current another path through which it can flow hence decreases the overall resistance.
   c. Adding resistors in parallel reduce the number of paths through which the current can flow hence decreases the overall resistance.
   d. Adding resistors in parallel gives the current longer path through which it can flow hence decreases the overall resistance.

19.4 Electric Power

9. To draw the most power from a battery, should you connect a small or a large resistance across its terminals? Explain.
   a. Small resistance, because smaller resistance will lead to the largest power
   b. Large resistance, because smaller resistance will lead to the largest power

10. If you double the current through a resistor, by what factor does the power dissipated by the resistor change?
    a. Power increases by a factor of two.
    b. Power increases by a factor of four.
    c. Power increases by a factor of eight.
    d. Power increases by a factor of 16.

Critical Thinking Items

19.1 Ohm's law

11. An accelerator accelerates He nuclei (change = $2e$) to a speed of $v = 2 \times 10^6$ m/s. What is the current if the linear density of He nuclei is $\lambda = 108\ m^{-1}$?

a. $I = 9.6 \times 10^{-5}$ A
b. $I = 3.2 \times 10^{-5}$ A
c. $I = 12.8 \times 10^{-5}$ A
d. $I = 6.4 \times 10^{-5}$ A

12. How can you verify whether a certain material is ohmic?

a. Make a resistor from this material and measure the current going through this resistor for several different voltages. If the current is proportional to the voltage, then the material is ohmic.
b. Make a resistor from this material and measure the current going through this resistor for several different voltages. If the current is inversely proportional to the voltage, then the material is ohmic.
c. Make a resistor from this material and measure the current going through this resistor for several different voltages. If the current is proportional to the square of the voltage, then the material is ohmic.
d. Make a resistor from this material and measure the current going through this resistor for several different voltages. If the current is inversely proportional to the square of the voltage, then the material is ohmic.

19.2 Series Circuits

13. Given three batteries (5V, 9V, 12V) and five resistors (10, 20, 30, 40, 50Ω) to choose from, what can you choose to form a circuit diagram with a current of 0.175A? You do not need to use all of the components.

a. Batteries (5V, 9V) and resistors (30Ω, 50Ω) connected in series
b. Batteries (5V4, 12V) and resistors (10Ω, 20Ω, 40Ω, and 50Ω) connected in series.
c. Batteries (5V, 9V, and 12V) and resistors (10Ω, 20Ω, and 30Ω) connected in series.

14. What is the maximum resistance possible given a resistor of $100\ \Omega$ and a resistor of $40\ \Omega$?

a. $100\ \Omega$
b. $140\ \Omega$
c. $180\ \Omega$
d. $240\ \Omega$

19.3 Parallel Circuits

16. Can all resistor combinations be reduced to series and parallel combinations?

a. No, all practical resistor circuits cannot be reduced to series and parallel combinations.
b. Yes, all practical resistor circuits can be reduced to series and parallel combinations.

17. What is the equivalent resistance of the circuit shown below?

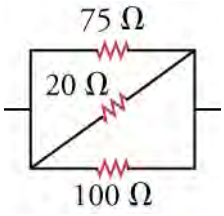


Figure 19.23

a. The equivalent resistance of the circuit 14 Ω.
b. The equivalent resistance of the circuit 16.7 Ω.
c. The equivalent resistance of the circuit 140 Ω.
d. The equivalent resistance of the circuit 195 Ω.

19.4 Electric Power

18. Two lamps have different resistances. (a) If the lamps are connected in parallel, which one is brighter, the lamp with greater resistance or the lamp with less resistance? (b) If the lamps are connected in series, which one is brighter? Note that the brighter lamp dissipates more power.

a. (a) lamp with greater resistance; (b) lamp with less resistance
b. (a) lamp with greater resistance; (b) lamp with greater resistance
c. (a) lamp with less resistance; (b) lamp with less resistance
d. (a) lamp with less resistance; (b) lamp with greater resistance

19. To measure the power consumed by your laptop computer, you place an ammeter (a device that measures electric current) in series with its DC power supply. When the screen is off, the computer draws 0.40 A of current.
When the screen is on at full brightness, it draws 0.90 A of current. Knowing the DC power supply delivers 16 V, how much power is used by the screen?

a. The power used by the screen is –8.0 W.
b. The power used by the screen is 0.3 W.
c. The power used by the screen is 3.2 W.
d. The power used by the screen is 8.0 W.

Problems

19.1 Ohm's law

20. What voltage is needed to make 6 C of charge traverse a 100-Ω resistor in 1 min?

a. The required voltage is 1×10^{-3} V.
b. The required voltage is 10 V.
c. The required voltage is 1,000 V.
d. The required voltage is 10,000 V.

22. A battery of unknown voltage V_1 is attached across a resistor R_1. You add a second battery with $V_2 = 9.0\,\text{V}$ in series with V_1 so that the voltage across R_1 is now $V_1 + V_2$ and measure $0.3\,\text{A}$ of current through resistor R_1. You add a third battery with $V_3 = 9.0\,\text{V}$ in series with the first two batteries so that the voltage across R_3 is $V_1 + V_2 + V_3$ and measure $0.4\,\text{A}$ of current through R_1. What is the resistance of R_1?

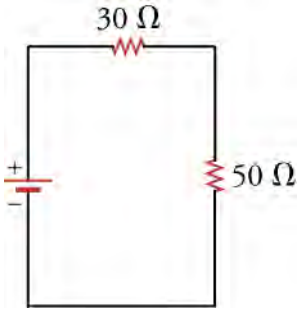
a. $23.25\,\Omega$
b. $21.75\,\Omega$
c. $31.33\,\Omega$
d. $90.0\,\Omega$

19.2 Series Circuits

23. What is the voltage drop across two 80-Ω resistors connected in series with 0.15 A flowing through them?

a. 12 V
b. 24 V
c. 36 V
d. 48 V

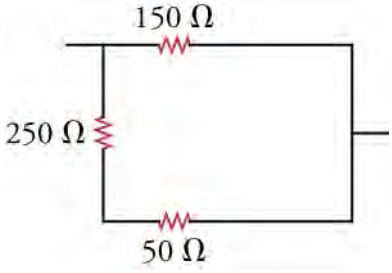
24. In this circuit, the voltage drop across the upper resistor is 4.5 V. What is the battery voltage?



a. 4.5V
b. 7.5V
c. 12V
d. 18V

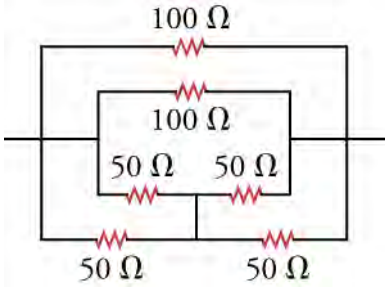
19.3 Parallel Circuits

25. What is the equivalent resistance of this circuit?



a. The equivalent resistance of the circuit is 32.7 Ω.
b. The equivalent resistance of the circuit is 100 Ω.
c. The equivalent resistance of the circuit is 327 Ω.
d. The equivalent resistance of the circuit is 450 Ω.

26. What is the equivalent resistance of the circuit shown below?



a. The equivalent resistance is 25 Ω.
b. The equivalent resistance is 50 Ω.
c. The equivalent resistance is 75 Ω.
d. The equivalent resistance is 100 Ω.

19.4 Electric Power

27. When 12 V are applied across a resistor, it dissipates 120 W of power. What is the current through the resistor?

a. The current is 1,440 A.
b. The current is 10 A.
c. The current is 0.1 A.
d. The current is 0.01 A.

TEST PREP

Multiple Choice

19.1 Ohm's law

33. You put $9.0\ \text{V}$ DC across resistor R_1 and measure the current through it. With the same voltage across resistor R_2, you measure twice the current. What is the ratio $\frac{R_1}{R_2}$?

a. 1
b. $\frac{1}{2}$
c. 4
d. 2

19.2 Series Circuits

35. How many 10-Ω resistors must be connected in series to make an equivalent resistance of 80 Ω?

a. 80
b. 8
c. 20
d. 40

37. How much current will flow through a 10-V battery with a 100-Ω resistor connected across its terminals?

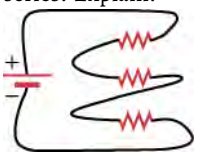
a. 0.1 A
b. 1.0 A
c. 0
d. 1,000 A

19.3 Parallel Circuits

38. A 10-Ω resistor is connected in parallel to another resistor R . The equivalent resistance of the pair is 8 Ω. What is the resistance R?

a. 10 Ω
b. 20 Ω
c. 30 Ω
d. 40 Ω

39. Are the resistors shown connected in parallel or in series? Explain.



a. The resistors are connected in parallel because the same current flows through all three resistors.
b. The resistors are connected in parallel because different current flows through all three resistors.
c. The resistors are connected in series because the same current flows through all three resistors.
d. The resistors are connected in series because different current flows through all three resistors.

19.4 Electric Power

40. Which equation below for electric power is incorrect?

a. $P = I^2R$
b. $P = \frac{V}{R^2}$
c. $P = IV$
d. $P = \frac{V^2}{R}$

41. What power is dissipated in a circuit through which $0.12\ \text{A}$ flows across a potential drop of $3.0\ \text{V}$?

a. $0.36\ \text{W}$
b. $0.011\ \text{W}$
c. Voltage drop across is $5\ \text{V}$.
d. $2.5\ \text{W}$

42. How does a resistor dissipate power?

a. A resistor dissipates power in the form of heat.
b. A resistor dissipates power in the form of sound.
c. A resistor dissipates power in the form of light.
d. A resistor dissipates power in the form of charge.

Short Answer

19.1 Ohm's law

48. What is the current through a 100-Ω resistor with 12 V across it?

a. 0
b. 0.12 A
c. 8.33 A
d. 1,200 A

49. What resistance is required to produce 0.15 A from a 9.0 V battery?

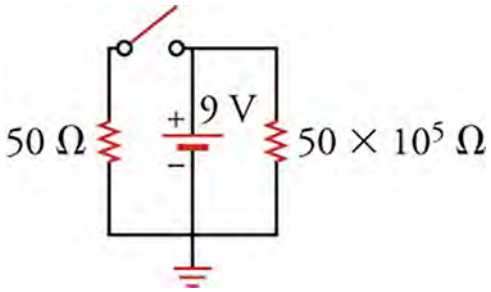
a. 0.017
b. 1
c. 60
d. 120

19.2 Series Circuits

50. Given a circuit with one 9-V battery and with its negative terminal connected to ground. The two paths are connected to ground from the positive terminal: the right path with a 20-Ω and a 100-Ω resistor and the left path with a 50-Ω resistor. How much current will flow in the right branch?

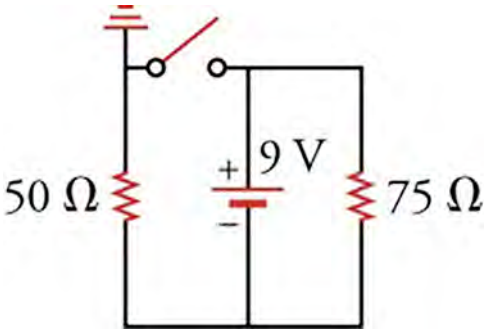
a. $\frac{9}{120}$
b. $\frac{9}{100}$
c. $\frac{9}{50}$
d. $\frac{9}{20}$

51. Through which branch in the circuit below does the most current flow?



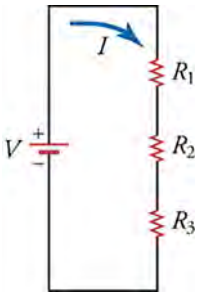
a. All of the current flows through the left branch due to the open switch.
b. All of the current flows through the right branch due to the open switch in the left branch.
c. All of the current flows through the middle branch due to the open switch in the left branch
d. There will be no current in any branch of the circuit due to the open switch.

52. What current flows through the 75-Ω resistor in the circuit below?



a. 0.072 A
b. 0.12 A
c. 0.18 A
d. 0.3 A

53. What is the equivalent resistance for the circuit below if $V = 9.0\ \text{V}$ and $I = 0.25\ \text{A}$?



a. 0.028 Ω
b. 2.25 Ω
c. 36 Ω
d. 72 Ω

19.3 Parallel Circuits

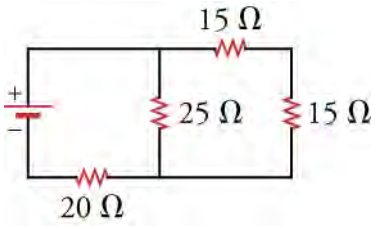
54. Ten 100-Ω resistors are connected in series. How can you increase the total resistance of the circuit by about 40 percent?

a. Adding two 10-Ω resistors increases the total resistance of the circuit by about 40 percent.
b. Removing two 10-Ω resistors increases the total resistance of the circuit by about 40 percent.
c. Adding four 10-Ω resistors increases the total resistance of the circuit by about 40 percent.
d. Removing four 10-Ω resistors increases the total resistance of the circuit by about 40 percent.

55. Two identical resistors are connected in parallel across the terminals of a battery. If you increase the resistance of one of the resistors, what happens to the current through and the voltage across the other resistor?

a. The current and the voltage remain the same.
b. The current decreases and the voltage remains the same.
c. The current and the voltage increases.
d. The current increases and the voltage remains the same.

56.



In the circuit below, through which resistor(s) does the most current flow? Through which does the least flow? Explain.

a. The most current flows through the 15-Ω resistor because all the current must pass through this resistor.
b. The most current flows through the 20-Ω resistor because all the current must pass through this resistor.
c. The most current flows through the 25-Ω resistor because it is the highest resistance.
d. The same current flows through the all the resistor because all the current must pass through each of the resistors.

19.4 Electric Power

57. You want to increase the power dissipated in a circuit. You have the choice between doubling the current or doubling the resistance, with the voltage remaining constant. Which one would you choose?

a. doubling the resistance
b. doubling the current

58. You want to increase the power dissipated in a circuit. You have the choice between reducing the voltage or reducing the resistance, with the current remaining constant. Which one would you choose?

a. reduce the voltage to increase the power
b. reduce the resistance to increase the power
c. neither, both methods reduce power

59. What power is dissipated in the circuit consisting of three 10-Ω resistors connected in series across a 9.0-V battery?

a. The power dissipated is 2430 W.
b. The power dissipated is 270 W.
c. The power dissipated is 2.7 W.
d. The power dissipated is 0.37 W.

Extended Response

19.1 Ohm's law

61. Describe the relationship between current and charge. Include an explanation of how the direction of the current is defined.

a. Electric current is the charge that passes through a conductor per unit time. The direction of the current is defined to be the direction in which positive charge would flow.
b. Electric current is the charges that move in a conductor. The direction of the current is defined to be the direction in which positive charge would flow.
c. Electric current is the charge that passes through a conductor per unit time. The direction of the current is defined to be the direction in which negative charge would flow.
d. Electric current is the charges that move in a conductor. The direction of the current is defined to be the direction in which negative charge would flow.

62. What could cause Ohm's law to break down?

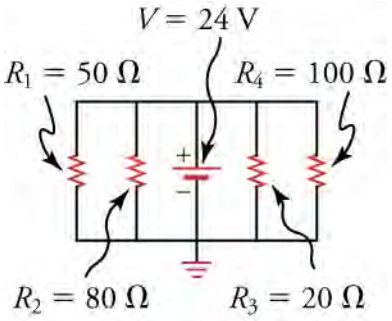
a. If small amount of current flows through a resistor, the resistor will heat up so much that it will change state, in violation of Ohm's law.
b. If excessive amount of current flows through a resistor, the resistor will heat up so much that it will change state, in violation of Ohm's law.
c. If small amount of current flows through a resistor, the resistor will not heat up so much and it will not change its state, in violation of Ohm's law.
d. If excessive amount of current flows through a resistor, the resistor will heat up so much that it will not change its state, in violation of Ohm's law.

63. You connect a single resistor R across a 10-V battery and find that $0.01\ \text{A}$ flows through the circuit. You add another resistor R after the first resistor and find that $0.005\ \text{A}$ flows through the circuit. If you have 10 resistors R connected in a line one after the other, what would be their total resistance?

a. $\frac{R}{10}$
b. $5\,\text{R}$
c. $\frac{10}{R}$
d. $10\,\text{R}$

19.2 Series Circuits

65. What is the current through each resistor in the circuit?



a. Current through resistors R_1, R_2, R_3, and R_4 is 0.48 A, 0.30 A, 1.2 A, and 0.24 A, respectively.
b. Current through resistors R_1, R_2, R_3, and R_4 is 1200 A, 1920 A, 480 A, and 2400 A, respectively.
c. Current through resistors R_1, R_2, R_3, and is R_4 2.08 A, 3.34 A, 0.833 A, and 4.17 A, respectively.
d. The same amount of current, 0.096 A, flows through all of the resistors.

19.3 Parallel Circuits

66. In a house, a single incoming wire at a high potential with respect to the ground provides electric power. How are the appliances connected between this wire and the ground, in parallel or in series? Explain.

a. The appliances are connected in parallel to provide different voltage differences across each appliance.
b. The appliances are connected in parallel to provide the same voltage difference across each appliance.

19.4 Electric Power

67. A single resistor is connected across the terminals of a battery When you attach a second resistor in parallel with the first, does the power dissipated by the system change?

a. No, the power dissipated remain same.
b. Yes, the power dissipated increases.
c. Yes, the power dissipated decreases.