Halliday, Resnick, and Walker, *Fundamentals of Physics 10e* Question Answers

Chapter 26 Answers

1	tie of *A*, *B*, and *C*, then tie of *A* + *B* and *B* + *C*, then *A* + *B* + *C*
2	*b*, *a*, *c*
3	(a) top-bottom, front-back, left-right; (b) top-bottom, front-back, left-right; (c) top-bottom, front-back, left-right; (d) top-bottom, front-back, left-right
4	*a*, *b*, and *c* all tie, then *d* (zero)
5	*a*, *b*, and *c* all tie, then *d*
6	(a) all tie; (b) *B*, *C*, *A*; *(c) B*, *C*, *A*
7	(a) *B*, *A*, *C*; *(b) B*, *A*, *C*
8	(a) 1 and 2 tie, then 3; (b) 1 and 2 tie, then 3; (c) 1 and 2 tie, then 3
9	(a) *C*, *B*, *A*; (b) all tie; (c) *A*, *B*, *C*; (d) all tie
10	*C*, *A*, *B*
11	(a) *a* and *c* tie, then *b* (zero); (b) *a*, *b*, *c*; (c) *a* and *b* tie, then *c*

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Classroom Response System Questions

Chapter 26 Current and Resistance

Reading Quiz Questions

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26.2.1. Which of the following corresponds to the units for current?

a) N/s

b) m/s

c) C · m/s

d) C/s

e) Two or more of the above answers are correct.

WILEY

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26.2.2. Through a certain cross-sectional area of a wire, one coulomb of electrons pass each second. In this case, the current through the wire is equal to which one of the following choices?

a) one electron volt

b) one volt

c) one ampere

d) one watt

e) one joule per second

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WILEY

26.2.3. Which one of the following statements concerning the conventional direction of current is true?

a) The conventional direction of current is the hypothetical direction of movement of positive charges through the wires of an electric circuit.

b) The conventional direction of current is the direction of movement of electrons through the wires of an electric circuit.

c) The conventional direction of current is equal to the electromotive force of the battery in an electric circuit.

d) The conventional direction of current is always a clockwise movement around a circuit.

e) The conventional current is the one that moves in a dc circuit and an unconventional current is one that moves in an ac circuit.

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WILEY

26.2.4. How is the direction of current flow defined in a conductor?

a) It is in the direction of the force on a charged particle.

b) It is in the direction that the atoms move.

c) It is in the direction that positively-charged particles would move.

d) It is in the direction that negatively-charged particles would move.

e) It is up to the person doing a given problem to decide the direction.

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WILEY

26.3.1. Complete the following statement: Current density is a measure of

a) the number of charges in a volume at a given time.

b) the amount of current flowing through a volume.

c) the amount of charges in a cross-sectional area at a given time.

d) the amount of current flowing through a cross-sectional area.

e) the total mass of the charges through a cross-sectional area.

WILEY

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WILEY

26.3.2. What is the term used to describe the net motion of electrons when an electric field is applied to a conductor and a current is established?

a) drift speed

b) random walk

c) chaotic velocity

d) Brownian acceleration

e) Einstein condensation

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26.4.1. Which pair of terms correctly fills the blanks in the following sentence? _____ is a property of an object while _____ is a property of a material.

a) resistivity, conductivity

b) current, current density

c) current, resistance

d) resistance, current

e) resistance, resistivity

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WILEY

26.4.2. In the fabrication of an electrical extension cord, the manufacturer wants to reduce the overall resistance of the wires in the extension cord. Which of the following changes would result in the lowest resistance?

a) decrease the diameter of the wires

b) increase the diameter of the wires

c) choose a metal wire with a larger value of resistivity

d) increase the length of the extension cord

e) choose a metal with a larger value for the temperature coefficient of resistivity

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WILEY

26.4.3. Two identical resistors are connected in series across the terminals of a battery with a voltage V and a current I flows through the circuit. If one of the resistors is removed from the circuit and the remaining one connected across the terminals of the battery, how much current would flow through the circuit?

a) $4I$

b) $2I$

c) I

d) $I/2$

e) $I/4$

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WILEY

26.5.1. Which one of the following statements concerning Ohm's law is true?

a) Ohm's law is true for all electronic devices.

b) Ohm's law is true when the resistivity of a material is independent of the applied electric field.

c) Ohm's law is true when the resistance varies linearly with the magnitude of the applied electric field.

d) Ohm's law is true for all conductors.

e) Ohm's law is true for all materials.

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26.5.2. By which of the following methods could the current in a given circuit be doubled?

a) Either double the resistance or double the voltage.

b) Reduce either the voltage or the resistance to half of the initial value.

c) Either double the voltage or reduce the resistance to half of its initial value.

d) Either double the resistance or reduce the voltage to half of its initial value.

e) None of the above answers are correct.

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WILEY

26.5.3. Which one of the following statements related to Ohm's law is false?

a) The ratio of the voltage applied across a wire to the current flowing through it is constant.

b) Resistance is expressed in ohms.

c) Georg Simon Ohm discovered the law named after him.

d) The resistance of all materials falls within a narrow range of values between 1 and 100 Ω.

e) One ohm is equal to one volt divided by one ampere.

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26.5.4. In most cases, Ohm's law is valid when which of the following conditions is satisfied?

a) when, for a given piece of material, the ratio V/I is the same for a wide range of voltages and currents

b) when there is a direct current passing through a given piece of material

c) when the voltage across a piece of material is constant for a wide range of currents

d) when the current through a piece of material is constant for a wide range of voltages

e) when the voltage decreases with increasing current through a piece of material

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WILEY

26.6.1. What is the name of the microscopic model that may be used to understand why some materials obey Ohm's law?

a) plum pudding model

b) Maxwell-Boltzmann model

c) standard model

d) Anderson model

e) free-electron model

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WILEY

26.7.1. The SI unit of power is the watt. Which of the following units are equivalent to the watt?

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c) C/s

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WILEY

26.7.2. In the equation, $P = i2R$, what is the meaning of the variable P?

a) It refers to total power dissipated by the circuit.

b) It refers to the transformation of electric potential energy into thermal energy.

c) It refers to the transformation of electric potential energy into mechanical energy.

d) It refers to the power of a resistor.

e) It refers to the probability that Ohm's law will be obeyed by the resistor in a circuit.

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WILEY

26.7.3. Complete the following sentence: The SI unit for electric power is

a) kilowatt-hour.

b) light-year.

c) watt.

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e) farad.

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26.7.4. Which one of the following equations is not a valid expression for electric power P? Note: I is the current in a circuit as a result of a voltage V and R is the electrical resistance of the circuit.

a) $P = I^2R$

b) $P = \frac{I^2R}{V}$

c) $P = IV$

d) $P = \frac{V^2}{R}$

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WILEY

26.8.1. Complete the following sentence: the electrical resistivity of most metal wires is

a) constant, even when the temperature of the metals varies greatly.

b) independent of the length of the wire.

c) expressed in ohms.

d) much smaller than the values for most semiconductors.

e) inversely proportional to the cross-sectional area of the wire.

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WILEY

26.8.2. Which one of the following types of materials exhibits the largest values of resistivity?

a) insulators

b) semiconductors

c) superconductors

d) metals

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26.8.3. To make silicon useful for electronic circuits, impurity atoms must be added. What is the name of this process?

a) implementation

b) superposition

c) doping

d) seeding

e) sintering

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26.9.1. What kind of materials exhibit zero resistivity when the temperature is reduced below a critical temperature for that material?

a) semiconductors

b) piezoelectrics

c) ferroelectrics

d) perovskites

e) superconductors

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26.9.2. What happened in the field of superconductivity in 1986?

a) A material that is superconducting at room temperature was discovered.

b) Ceramic materials were found that are superconducting at much higher temperatures than metals or alloys.

c) High efficiency cooling methods were found that substantially reduced the costs of cooling materials to the superconducting state.

d) Superconductivity was observed for the first time in organic materials.

e) The first superconducting magnet was invented.

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Classroom Response System Questions

Chapter 26 Current and Resistance

Interactive Lecture Questions

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26.2.1. In which one of the following situations does a conventional electric current flow due north?

a) Protons in a beam are moving due south.

b) A water molecule is moving due north.

c) Electrons in a beam are moving due south.

d) Electrons in a wire connected to a battery are moving from south to north.

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26.2.2. The battery capacity of a lithium ion battery in a digital music player is 750 mA-h. The manufacturer claims that the player can operate for eight hours if the battery is initially fully charged. Given this information, determine the number of electrons that flow through the player as you listen to your favorite songs for three hours.

a) 6.2×10^{18} electrons

b) 1.0×10^{3} electrons

c) 2.4×10^{9} electrons

d) 6.3×10^{21} electrons

e) 8.1×10^{28} electrons

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WILEY

26.2.3. When lightning strikes, the current flows from the ground upward to the clouds above. What is the direction of the electric field of the lightning?

a) upward

b) downward

c) perpendicular to the current at each location on the lightning bolt

d) parallel to the ground

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WILEY

26.3.1. Which one of the following statements concerning the electric field inside a conductor is true if electrons are moving from right to left in a conducting wire?

a) The electric field must be zero in this case.

b) The electric field is directed perpendicular to the direction the electrons are moving.

c) The electric field is directed toward the left.

d) The electric field is directed toward the right.

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26.4.1. A copper wire is fabricated that has a gradually increasing diameter along its length as shown. If an electric current is moving through the wire, which quantities vary along the length of the wire?

a) current only

b) current and current density only

c) current density and electric field only

d) resistivity and current only

e) current, resistivity, current density, and electric field

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WILEY

26.4.2. The magnitude of the electric field within a conducting wire depends on which of the following quantities?

a) potential difference, wire diameter, wire length, and wire conductivity

b) potential difference and wire conductivity only

c) potential difference, wire length, and wire conductivity only

d) wire diameter, wire length, and wire conductivity only

e) The magnitude of the electric field inside the conductor is always zero.

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26.4.3. When a potential difference V is applied to two different wires, each carries an identical current i. From this observation, what may we conclude?

a) The cross-sectional area of the two wires is the same.

b) The length of the wires is the same.

c) The wires are composed of the same material.

d) The current density in both wires is identical.

e) None of the above statements may be concluded from the observation.

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WILEY

26.4.4. Wires A and B are identical, except that the length of wire A is one-half that of wire B. If the same potential difference is applied between the two ends of each wire, how does the electric field within wire A compare to that in wire B?

a) The electric field in wire A is one fourth that in wire B.

b) The electric field in wire A is one half that in wire B.

c) The electric field in wire A is the same as that in wire B.

d) The electric field in wire A is twice that in wire B.

e) The electric field in wire A is four times that in wire B.

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WILEY

26.4.5. When a potential difference is applied to a certain copper wire, a current of 1.5 A passes through the wire. If the wire was removed from the circuit and replaced with a copper wire of twice the diameter, what current would flow through the new wire? Assume the wires are identical in all other aspects.

a) 0.38 A

b) 0.75 A

c) 1.5 A

d) 3.0 A

e) 6.0 A

WILEY

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26.4.6. When a potential difference is applied to a certain copper wire, a current of 1.5 A passes through the wire. If the wire was removed from the circuit and replaced with a copper wire of twice the cross-sectional area, what current would flow through the new wire? Assume the wires are identical in all other aspects.

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a) 0.38 A

b) 0.75 A

c) 1.5 A

d) 3.0 A

e) 6.0 A

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26.4.7. A circuit contains a battery and a resistor of resistance *R*. For which one of the following combinations of current and voltage does *R* have the smallest value?

a) $V = 9$ V and $i = 0.002$ A

b) $V = 12$ V and $i = 0.5$ A

c) $V = 1.5$ V and $i = 0.075$ A

d) $V = 6$ V and $i = 0.1$ A

e) $V = 4.5$ V and $i = 0.009$ A

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26.4.8. For which combination for the length L and radius r of a wire will the resistance have the smallest value?

a) L = 0.50 m and r = 0.03 m

b) L = 0.25 m and r = 0.08 m

c) L = 0.40 m and r = 0.2 m

d) L = 0.80 m and r = 0.1 m

e) L = 0.10 m and r = 0.05 m

WILEY

26.4.8. For which combination for the length L and radius r of a wire will the resistance have the smallest value?

a) L = 0.50 m and r = 0.03 m

b) L = 0.25 m and r = 0.08 m

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e) L = 0.10 m and r = 0.05 m

WILEY

26.4.9. The ends of a wire are connected to the terminals of a battery. For which of the following changes will the resulting current in the circuit have the largest value?

a) Replace the wire with one that has a larger resistivity.

b) Replace the wire with one that has a larger radius.

c) Replace the wire with one that has a longer length.

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26.4.9. The ends of a wire are connected to the terminals of a battery. For which of the following changes will the resulting current in the circuit have the largest value?

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26.5.1. A voltage V is applied to a device of resistance R; and the current through the device is i. If the device obeys Ohm's law, what will be the outcome if the voltage is increased to 2V?

a) The current will increase to 2i.

b) The current will decrease to i/2.

c) The resistance will increase to 2R.

d) The resistance will decrease to R/2.

e) Two or more of the above statements are correct.

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26.5.2. Wires A and B are identical except that each is made from a different material. The one end of wire A is connected to one end of wire B. The two remaining ends are connected across a battery and current flows through the two wires. Which one of the following statements concerning this situation is true?

a) The potential difference across the two wires is the same, but the current through each wire is different.

b) The potential difference across the two wires is the same; and the current through each wire is the same.

c) The potential difference across the two wires is different, but the current through each wire is the same.

d) Both the potential difference across the two wires and the current through each wire is different.

e) Too little information is given to make a determination.

WILEY

26.5.2. Wires A and B are identical except that each is made from a different material. The one end of wire A is connected to one end of wire B. The two remaining ends are connected across a battery and current flows through the two wires. Which one of the following statements concerning this situation is true?

a) The potential difference across the two wires is the same, but the current through each wire is different.

b) The potential difference across the two wires is the same; and the current through each wire is the same.

c) The potential difference across the two wires is different, but the current through each wire is the same.

d) Both the potential difference across the two wires and the current through each wire is different.

e) Too little information is given to make a determination.

WILEY

26.5.3. In a certain circuit containing a battery and a resistor, Ohm's law is obeyed. An instrument to measure the current in the circuit, an ammeter, is connected in between one of the terminals of the battery and one end of the resistor. The ammeter indicates that the current in the circuit is i. The battery is then removed and replaced with another battery. This time, the ammeter indicates the current is $2i$. Which one of the following statements concerning the resistor is true?

a) When the second battery was placed in the circuit, the resistance increased to twice its initial value.

b) When the second battery was placed in the circuit, the resistance decreased to one half its initial value.

c) When the second battery was placed in the circuit, the resistance increased to four times its initial value.

d) When the second battery was placed in the circuit, the resistance increased to one fourth its initial value.

e) When the second battery was placed in the circuit, the resistance did not change.

WILEY

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WILEY

26.5.4. A certain circuit contains a battery and a resistor. An instrument to measure the current in the circuit, an ammeter, is connected in between one of the terminals of the battery and one end of the resistor. The graph shows the current in the circuit as the voltage is increased. Which one of the following statements best describes the resistor in this circuit?

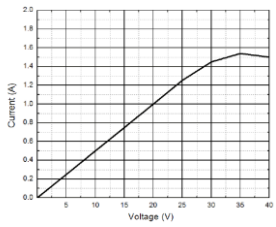
a) The resistor does not obey Ohm's law.

b) The resistor obeys Ohm's law for voltages between zero and twenty-five volts.

c) The resistor obeys Ohm's law for voltages between zero and thirty-five volts.

d) The resistor obeys Ohm's law for voltages between zero and forty volts.

e) The resistor obeys Ohm's law for voltages between thirty and forty volts.



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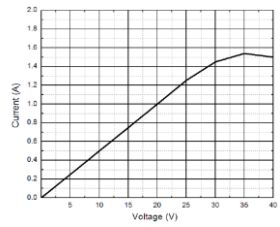

WILEY

26.6.1. The drift speed within a certain conductor is 0.10 mm/s. How many electrons move through a unit cross-sectional area in the circuit each second if the current is 2.5 A?

a) 2.5×10^4

b) 1.6×10^{15}

c) 1.6×10^{23}

d) 2.5×10^{22}

e) 6.4×10^{28}

WILEY

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WILEY

26.6.2. A copper wire is fabricated that has a gradually increasing diameter along its length as shown. If an electric current is moving through the wire, how does the drift velocity of the electrons at point A compare with that at point B?

a) The drift velocity will be greater at point A than at point B.

b) The drift velocity will be the same at both points.

c) The drift velocity will be greater at point B than at point A.

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WILEY

26.6.3. How does the resistivity of a metal wire change if either the number of electrons per unit volume increases or the mean free time increases?

a) In both cases, the resistivity will increase.

b) In both cases, the resistivity will decrease.

c) Increasing the number of electrons will increase the resistivity, but it will decrease if the mean free time increases.

d) Increasing the number of electrons will decrease the resistivity, but it will increase if the mean free time increases.

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WILEY

26.7.1. Sylvia wanted to change a burned out bulb in her lamp. When she went to the closet to get a new bulb, she saw that some were labeled "75 W" while others were labeled "100 W." What is the meaning of these labels?

a) the power emitted as visible light

b) the power emitted as light and heat

c) the power consumed by the bulb

d) Two or more of the above phrases are correct.

e) None of the above choices is correct.

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WILEY

26.7.2. An automatic coffee maker uses a resistive heating element to boil the 2.4 kg of water that was poured into it at 21 °C. The current delivered to the coffee pot is 8.5 A when it is plugged into a 120 V electrical outlet. If the specific heat capacity of water is 4186 J/kg·C°, approximately how long does it take to boil all of the water?

a) 5 minutes

b) 8 minutes

c) 10 minutes

d) 13 minutes

e) 15 minutes

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WILEY

26.7.3. The insulated wiring in a house can safely carry a maximum current of 18 A. The electrical outlets in the house provide an alternating voltage of 120 V. A space heater when plugged into the outlet operates at an average power of 1500 W. How many space heaters can safely be plugged into a single electrical outlet and turned on for an extended period of time?

a) zero

b) one

c) two

d) three

e) four

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WILEY

26.7.4. A portable CD player was recently introduced that has a "special power saving technology." The manufacturer claims that with only two standard AA batteries (together: 3.0 V, 20 kJ energy storage) that the player can be played for about 25 hours. What is the approximate resistance in the CD player's electrical circuitry?

a) 40 Ω

b) 0.010 Ω

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WILEY

26.7.5. A wire is used as a heating element that has a resistance that is fairly independent of its temperature within its operating range. When a current i flows through the wire, the energy delivered by the heater each minute is E. For what amount of current will the energy delivered by the heater each minute be $4E$?

a) $2i$

b) $4i$

c) $0.5i$

d) $0.25i$

e) $8i$

WILEY

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