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

Chapter 29 Answers

1	*c*, *a*, *b*
2	1, then 3 and 4 tie, then 2 (zero)
3	*c*, *d*, then *a* and *b* tie (zero)
4	(a) into; (b) greater
5	*a*, *c*, *b*
6	(a) *c*, *a*, *d*, *b*; (b) *a*, *c*, *b*, *d*; (c) *a* and *c* tie, then *b* and *d* tie; (d) greater
7	*c* and *d* tie, then *b*, *a*
8	*b*, *d*, *c*, *a* (zero)
9	*b*, *a*, *d*, *c* (zero)
10	*d*, then *a* and *e* tie, then *b*, *c*
11	(a) 1, 3, 2; (b) less

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Halliday/Resnick/Walker Fundamentals of Physics

Classroom Response System Questions

Chapter 29 Magnetic Fields Due to Currents

Reading Quiz Questions

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29.2.1. Which of the following choices correctly indicates the relationship between the magnetic field due to a current carrying, long straight wire at a distance *R* from the wire?

a) $B \propto \frac{1}{R^2}$

b) $B \propto \frac{1}{R}$

c) $B \propto \frac{1}{R^3}$

d) $B \propto R^2$

e) $B \propto R$

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29.2.2. At a distance *R* from a current carrying wire, what is the direction of the magnetic field relative to the wire?

a) radially toward the wire

b) radially away from the wire

c) parallel to the wire

d) in the direction opposite to that of the current

e) in the direction that is perpendicular to both the wire and to the radial direction

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29.2.3. A magnetic field is generated by a current-carrying wire. Which one of the following statements concerning this situation is false?

a) The magnitude of this magnetic field decreases with increasing distance away from the wire.

b) A right-hand rule is useful for determining the direction of the magnetic field at a particular location.

c) The magnitude of the magnetic field is directly proportional to the magnitude of the current.

d) The magnetic field is parallel to the direction of the current in the wire.

WILEY

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29.2.4. Two circular loops carry identical currents, but the radius of one loop is twice that of the other. How do the magnetic fields at the centers of the loops compare?

a) In both cases, the magnetic field at the center would be zero tesla.

b) The magnetic field at the center of the larger loop is twice that at the center of the smaller loop.

c) The magnetic field at the center of the larger loop is the same as that at the center of the smaller loop.

d) The magnetic field at the center of the larger loop is one-half that at the center of the smaller loop.

e) The magnetic field at the center of the larger loop is one-fourth that at the center of the smaller loop.

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29.3.1. Consider two parallel wires carrying current in the same direction. Which one of the following statements to true concerning this situation?

a) The two wires will attract each other, even if no external magnetic field is applied to the wires.

b) The two wires will repel each other, even if no external magnetic field is applied to the wires.

c) The two wires will attract each other, only if an external magnetic field is applied to the wires.

d) The two wires will repel each other, only if an external magnetic field is applied to the wires.

e) The wires will be neither attracted nor repelled from each other when no external magnetic field is applied to the wires.

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29.3.2. Consider two parallel wires carrying current in opposite directions. Which one of the following statements to true concerning this situation?

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29.3.3. Which one of the following parameters is not used to determine the magnetic force on a current-carrying wire in a magnetic field?

a) length of the wire

b) radius of the wire

c) direction of the magnetic field with respect to the direction of the current

d) the strength of the magnetic field

e) the magnitude of the electric current

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d) the strength of the magnetic field

e) the magnitude of the electric current

29.3.4. Two long wires are parallel to each other. One wire carries a current directed due east and the other carries a current of the same magnitude, but directed due west. Which one of the following statements concerning this situation is false?

a) The magnetic field in the plane of the wires at the midpoint between the two wires is equal to zero tesla.

b) The magnetic forces due to the currents carried by the wires causes the wires to move apart.

c) If you are looking toward the west along the wire carrying the current toward the west, the magnetic field lines are directed clockwise around the wire.

d) The magnetic field produced by each wire has its greatest magnitude outside, but near the surface of the wire.

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29.4.1. Which of the following may be determined using Ampere's law?

a) electric fields due to current carrying wires

b) magnetic forces between two current carrying wires

c) magnetic fields due to current carrying wires

d) magnetic forces acting on charged particles

e) magnetic fields due to permanent magnets

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29.4.2. Under which of the following conditions is Ampere's law most easily applied?

a) the currents are all in the same direction

b) the magnetic fields are spherically symmetrical

c) no currents are present within the system

d) the magnetic fields are cylindrically symmetric

e) no charged particles are present in the system

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29.4.3. Which one of the following statement concerning Ampere's law for static magnetic fields is false?

a) The strength of the magnetic field produced by the current is not dependent on the distance from the current geometry that produces the magnetic field.

b) A closed path of arbitrary shape is constructed around the current.

c) This law may be applied to any current geometry that produces a magnetic field that does not change with time.

d) The component of the magnetic field that is parallel to the closed path is used in Ampere's law.

e) The permeability of free space is a constant that appears in Ampere's law.

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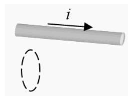
29.4.4. Ampere's law may be written as $\oint \vec{B}\cdot d\vec{s} = \mu_0 i_{enc}$. Consider the circular closed loop located near a current carrying wire as shown. What does the left side of the above equal for the closed loop if the current is directed to the right and has a magnitude of 2.0 A? The center of the loop, which has a radius of 2.5 cm, is located 4.0 cm from the wire.



a) zero

b) 3.1 T·m

c) 4.8 T·m

d) 7.2 T·m

e) This cannot be determined with only the information given.

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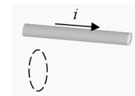

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29.5.1. What is a solenoid?

a) a single loop of wire in the shape of a circle

b) a radio antenna

c) a long coil of wire in the shape of a helix

d) a scanning mechanism inside of a television

e) a magnet that is inserted into a coil of wire

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d) a scanning mechanism inside of a television

e) a magnet that is inserted into a coil of wire

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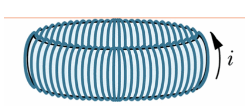
29.5.2. What is the name given to the wire object shown in the drawing?

a) D-ring

b) toroid



c) armature

d) solenoid

e) wiggler

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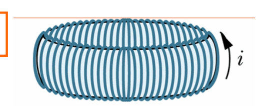

c) armature

d) solenoid

e) wiggler

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29.5.3. The coils of a solenoid are stretched so that the length of the solenoid is twice its original length. Assuming the same current is passed though the solenoid before and after it is stretched, how does the magnetic field inside the solenoid change, if at all, as a result of the stretching?

a) The magnetic field after the stretching is one-fourth the value it was before stretching.

b) The magnetic field after the stretching is one-half the value it was before stretching.

c) The magnetic field after the stretching is the same as the value it was before stretching.

d) The magnetic field after the stretching is twice the value it was before stretching.

e) The magnetic field after the stretching is four times the value it was before stretching.

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Halliday/Resnick/Walker Fundamentals of Physics

Classroom Response System Questions

Chapter 29 Magnetic Fields Due to Currents

Interactive Lecture Questions

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29.2.1. The equation for the magnetic field of a straight, current carrying wire is given by $B = \frac{\mu_0 i}{2\pi R}$, but the magnetic field at the center of a single closed circular loop is given by $B = \frac{\mu_0 i}{2R}$. Although these equations look similar, there is an important difference between these two equations, other that the factor of π. What is it?

a) The μ_0 factor is different for the two situations.

b) The variable R represents two different lengths.

c) The i represents two different types of current.

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29.2.2. Complete the following statement: The magnetic field around a current-carrying, circular loop is most like that of

a) the Earth.

b) a current-carrying, rectangular loop

c) a short bar magnet.

d) a long, straight, current-carrying wire.

e) two long, straight wires that carry currents in opposite directions.

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d) a long, straight, current-carrying wire.

e) two long, straight wires that carry currents in opposite directions.

29.3.1. Two parallel wires have currents that have the same direction, but differing magnitude. The current in wire A is *i*; and the current in wire B is 2*i*. Which one of the following statements concerning this situation is true?

a) Wire A attracts wire B with half the force that wire B attracts wire A.

b) Wire A attracts wire B with twice the force that wire B attracts wire A.

c) Both wires attract each other with the same amount of force.

d) Wire A repels wire B with half the force that wire B attracts wire A.

e) Wire A repels wire B with twice the force that wire B attracts wire A.

29.3.1. Two parallel wires have currents that have the same direction, but differing magnitude. The current in wire A is *i*; and the current in wire B is 2*i*. Which one of the following statements concerning this situation is true?

a) Wire A attracts wire B with half the force that wire B attracts wire A.

b) Wire A attracts wire B with twice the force that wire B attracts wire A.

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e) Wire A repels wire B with twice the force that wire B attracts wire A.

29.3.2. Two parallel wires have currents that are in opposite directions and have differing magnitudes. The current in wire A is *i*; and the current in wire B is 2*i*. Which one of the following statements concerning this situation is true?

a) Wire A attracts wire B with half the force that wire B attracts wire A.

b) Wire A attracts wire B with twice the force that wire B attracts wire A.

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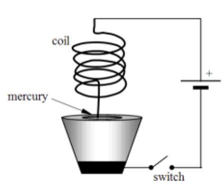
29.3.3. The drawing represents a device called Roget's Spiral. A coil of wire hangs vertically and its windings are parallel to one another. One end of the coil is connected by a wire to a terminal of a battery. The other end of the coil is slightly submerged below the surface of a cup of mercury. Mercury is a liquid metal at room temperature. The bottom of the cup is also metallic and connected by a wire to a switch. A wire from the switch to the battery completes the circuit. What is the behavior of this circuit after the switch is closed?



a) When current flows in the circuit, the coils of the wire move apart and the wire is extended further into the mercury.

b) Nothing happens to the coil because there will not be a current in this circuit.

c) A current passes through the circuit until all of the mercury is boiled away.

d) When current flows in the circuit, the coils of the wire move together, causing the circuit to break at the surface of the mercury. The coil then extends and the process begins again when the circuit is once again complete.

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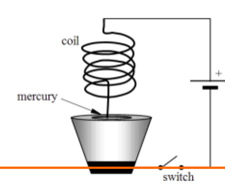

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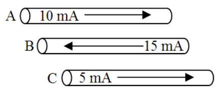
29.3.4. Three very long, parallel wires (a small portion of each is shown in the drawing) are resting on a flat surface. The distance between wire B, which has a 15 mA current to the left, and its neighbors is 0.0015 m. Wire A carries a 10 mA current toward the right; and wire C carries a 5 mA current toward the right. Rank the wires in order of the magnitude of the net magnetic force on each, with the largest value first and the lowest value last.



a) A > B > C

b) B > A > C

c) C > B > A

d) A > C > B

e) B > C > A

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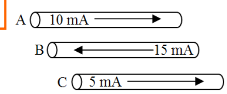


a) A > B > C

b) B > A > C

c) C > B > A

d) A > C > B

e) B > C > A

29.4.1. A copper cylinder has an outer radius 2*R* and an inner radius of *R* and carries a current *i*. Which one of the following statements concerning the magnetic field in the hollow region of the cylinder is true?

a) The magnetic field within the hollow region may be represented as concentric circles with the direction of the field being the same as that outside the cylinder.

b) The magnetic field within the hollow region may be represented as concentric circles with the direction of the field being the opposite as that outside the cylinder.

c) The magnetic field within the hollow region is parallel to the axis of the cylinder and is directed in the same direction as the current.

d) The magnetic field within the hollow region is parallel to the axis of the cylinder and is directed in the opposite direction as the current.

e) The magnetic field within the hollow region is equal to zero tesla.

29.4.1. A copper cylinder has an outer radius 2*R* and an inner radius of *R* and carries a current *i*. Which one of the following statements concerning the magnetic field in the hollow region of the cylinder is true?

a) The magnetic field within the hollow region may be represented as concentric circles with the direction of the field being the same as that outside the cylinder.

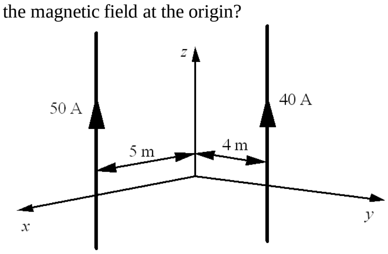
b) The magnetic field within the hollow region may be represented as concentric circles with the direction of the field being the opposite as that outside the cylinder.

c) The magnetic field within the hollow region is parallel to the axis of the cylinder and is directed in the same direction as the current.

d) The magnetic field within the hollow region is parallel to the axis of the cylinder and is directed in the opposite direction as the current.

e) The magnetic field within the hollow region is equal to zero tesla.

29.4.2. The drawing shows two long, thin wires that carry currents in the positive *z* direction. Both wires are parallel to the *z* axis. The 50-A wire is in the *x*-*z* plane and is 5 m from the *z* axis. The 40-A wire is in the *y*-*z* plane and is 4 m from the *z* axis. What is the magnitude of the magnetic field at the origin?



a) zero tesla

b) 1×10^{-6} T

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d) 5×10^{-6} T

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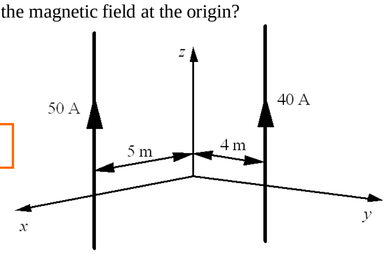

a) zero tesla

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c) 3×10^{-6} T

d) 5×10^{-6} T

e) 7×10^{-6} T

29.4.3. The drawing shows two long, straight wires that are parallel to each other and carry a current of magnitude i toward you. The wires are separated by a distance d; and the centers of the wires are a distance d from the y axis. Which one of the following expressions correctly gives the magnitude of the total magnetic field at the origin of the x, y coordinate system?

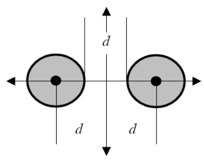
a) $\frac{\mu_0 i}{2d}$

b) $\frac{\mu_0 i}{\sqrt{2}d}$

c) $\frac{\mu_0 i}{2\pi d}$

d) $\frac{\mu_0 i}{\pi d}$

e) zero tesla



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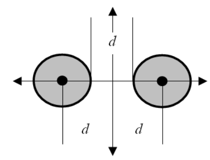
d) $\frac{\mu_0 i}{\pi d}$

e) zero tesla



29.5.1. The drawing shows a rectangular wire loop that has one side passing through the center of a solenoid. Which one of the following statements describes the force, if any, that acts on the rectangular loop when a current is passing through the solenoid.

a) The magnetic force causes the loop to move upward.

b) The magnetic force causes the loop to move downward.

c) The magnetic force causes the loop to move to the right.

d) The magnetic force causes the loop to move to the left.

e) The loop is not affected by the current passing through the solenoid or the magnetic field resulting from it.

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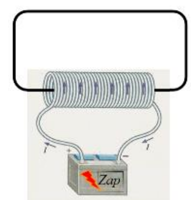
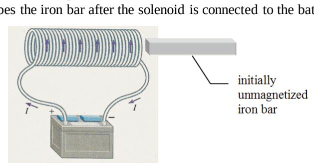


29.5.2. An initially unmagnetized iron bar is placed next to a solenoid. Which one of the following statements describes the iron bar after the solenoid is connected to the battery?



a) A magnetic force accelerates the bar to the right.

b) Since the bar is unmagnetized, there will not be any affect on the bar.

c) The magnetic field of the solenoid will cause a current to flow in a loop that extends from one end of the bar to the other and that continues until the battery is disconnected from the solenoid.

d) The magnetic field of the solenoid induces magnetism in the bar with the bar's north pole nearest to the solenoid.

e) The magnetic field of the solenoid induces magnetism in the bar with the bar's south pole nearest to the solenoid.

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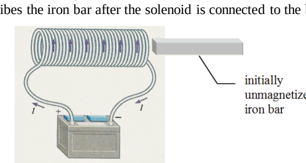

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e) The magnetic field of the solenoid induces magnetism in the bar with the bar's south pole nearest to the solenoid.

29.5.3. Which one of the following statements concerning the magnetic field inside (far from the surface) a long, current-carrying solenoid is true?

a) The magnetic field is zero.

b) The magnetic field is non-zero and nearly uniform.

c) The magnetic field is independent of the number of windings.

d) The magnetic field is independent of the current in the solenoid.

e) The magnetic field varies as $1/r$ as measured from the solenoid axis.

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29.5.4. A solenoid of length 0.250 m and radius 0.0200 m is comprised of 120 turns of wire. Determine the magnitude of the magnetic field at the center of the solenoid when it carries a current of 15.0 A.

a) 9.05×10^{-3} T

b) 7.50×10^{-3} T

c) 4.52×10^{-3} T

d) 2.26×10^{-3} T

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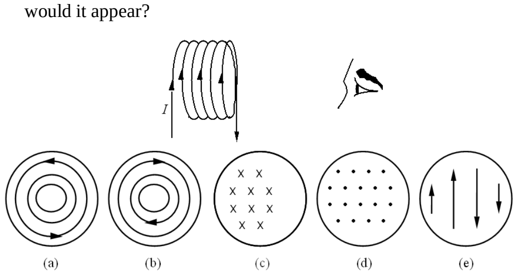
29.5.5. A solenoid carries current I as shown in the figure. If the observer could "see" the magnetic field inside the solenoid, how would it appear?



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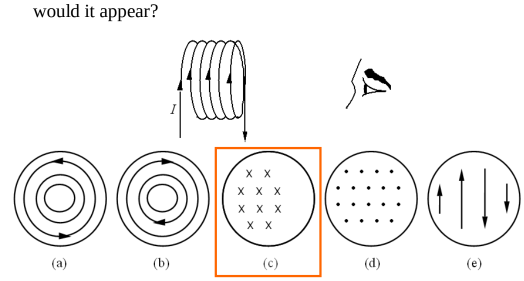

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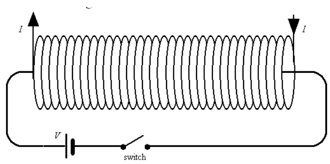
29.5.6. A wire, connected to a battery and switch, passes through the center of a long current-carrying solenoid as shown in the drawing. When the switch is closed and there is a current in the wire, what happens to the portion of the wire that runs inside of the solenoid?

a) There is no effect on the wire.

b) The wire is pushed downward.

c) The wire is pushed upward.



d) The wire is pushed toward the left.

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WILEY

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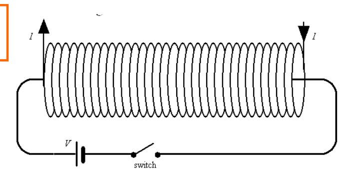

d) The wire is pushed toward the left.

e) The wire is pushed toward the right.

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29.5.7. A single circular loop of wire with radius 0.020 m carries a current of 8.0 A is placed at the center of a solenoid that has length 0.65 m, radius 0.080 m, and 1400 turns. Determine the value of the current in the solenoid so that the magnetic field at the center of the loop is zero tesla.

a) 1.4×10^{-1} A

b) 2.5×10^{-4} A

c) 4.4×10^{-2} A

d) 5.0×10^{-3} A

e) 9.3×10^{-2} A

WILEY

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WILEY

29.5.8. The drawing shows a toroid that has an inner radius of 0.040 m and an outer radius of 0.060 m. The toroid is composed of 120 turns and carries a constant current of 0.50 A. What is the magnetic field at the center of the toroid, where $r = 0$?

a) zero tesla

b) 1.2×10^{-5} T

c) 2.3×10^{-3} T

d) infinity

e) This cannot be determined without more information.

WILEY

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