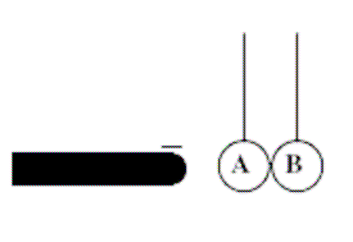
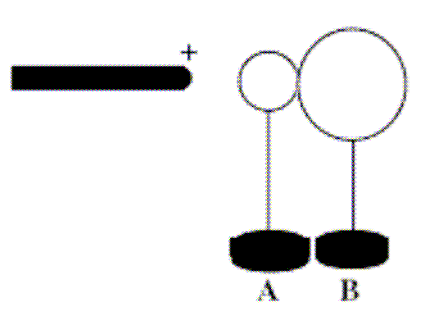
Physics 1653
Exam 3 - Review Questions

3.0 Two uncharged conducting spheres, **A** and **B**, are suspended from insulating threads so that they touch each other. While a negatively charged rod is held *near, but not touching* sphere **A**, the two spheres are separated. How will the spheres be charged, *if at all*?



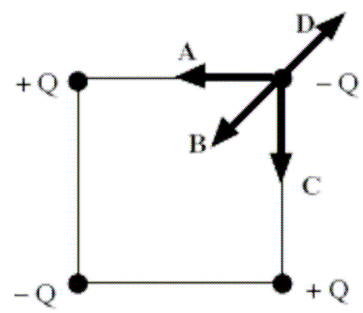
	Sphere **A**	*Sphere* **B**
(a)	0	+
(b)	−	+
(c)	0	0
(d)	−	0
(e)	**+**	**−**

10 Two uncharged, conducting spheres, A and B, are held at rest on insulating stands and are in contact. A positively charged rod is brought near sphere A as suggested in the figure. While the rod is in place, the two spheres are separated. How will the spheres be charged, if at all?



	Sphere A	Sphere B
(a)	positive	positive
(b)	positive	negative
(c)	***negative***	***positive***
(d)	negative	negative
(e)	zero	zero

13. Four point charges, each of the same magnitude, with varying signs are arranged at the corners of a square as shown. Which of the arrows labeled A, B, C, and D gives the correct direction of the net force that acts on the charge at the upper right corner?



(a) A
(b) B
(c) C
(d) D
(e) The net force on that charge is zero.

14. Two positive point charges Q and 2Q are separated by a distance R. If the charge Q experiences a force of magnitude F when the separation is R, what is the magnitude of the force on the charge 2Q when the separation is 2R ?

(a) F/4 (c) F (e) 4F
(b) F/2 (d) 2F

15. A charge Q exerts a 12 N force on another charge q. If the distance between the charges is doubled, what is the magnitude of the force exerted on Q by q?

(a) 3 N
(b) 6 N
(c) 24 N
(d) 36 N
(e) 48 N

16. At what separation will two charges, each of magnitude 6.0 μC, exert a force of 1.4 N on each other?

(a) 5.1×10^{-6} m
(b) 0.23 m
(c) 0.48 m
(d) 2.0 m
(e) 40 m

17. One mole of a substance contains 6.02×10^{23} protons and an equal number of electrons. If the protons could somehow be separated from the electrons and placed in very small, individual containers separated by 1.00×10^{3} m, what would be the magnitude of the electrostatic force exerted by one box on the other?

(a) 8.7×10^{8} N
(b) 9.5×10^{9} N
(c) 2.2×10^{10} N
(d) 8.3×10^{13} N
(e) 1.6×10^{19} N

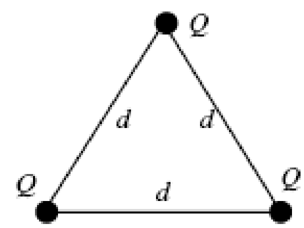
19. A −4.0-μC charge is located 0.30 m to the left of a +6.0-μC charge. What is the magnitude and direction of the electrostatic force on the positive charge?

(a) 2.4 N, to the right
(b) 2.4 N, to the left
(c) 4.8 N, to the right
(d) 4.8 N, to the left
(e) 7.2 N, to the right

20. Determine the ratio of the electrostatic force to the gravitational force between a proton and an electron, F_E/F_G. Note: $k = 8.99 \times 10^9$ N•m^2/C^2; $G = 6.672 \times 10^{-11}$ N•m^2/kg^2; $m_e = 9.109 \times 10^{-31}$ kg; and $m_p = 1.672 \times 10^{-27}$ kg.

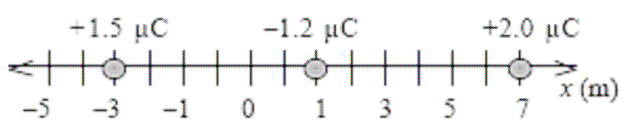
(a) 1.24×10^{23}
(b) 2.52×10^{29}
(c) 1.15×10^{31}
(d) 2.26×10^{39}
(e) 1.42×10^{58}

22. Three identical point charges, Q, are placed at the vertices of an equilateral triangle as shown in the figure. The length of each side of the triangle is d. Determine the magnitude and direction of the total electrostatic force on the charge at the top of the triangle.



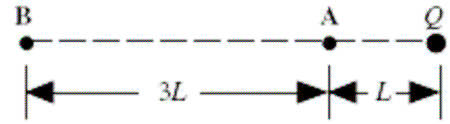
(a) $\dfrac{Q^2\sqrt{3}}{4\pi\varepsilon_0 d^2}$, directed upward

23 Three charges are located along the x axis as shown in the drawing. The mass of the -1.2 μC is 4.0×10^{-9} kg. Determine the magnitude and direction of the acceleration of the -1.2 μC charge when it is allowed to move if the other two charges remain fixed.



(a) 2×10^5 m/s^2, to the right
(b) 1×10^5 m/s^2, to the left
(c) 7×10^4 m/s^2, to the right
(d) 3×10^5 m/s^2, to the left
(e) 4×10^6 m/s^2, to the right

28. In the figure, point A is a distance L away from a point charge Q. Point B is a distance 4L away from Q. What is the ratio of the electric field at B to that at A, E_B/E_A?

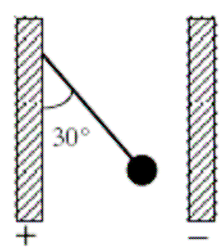


(a) 1/16
(b) 1/9
(c) 1/4 nor the length L is specified.
(d) 1/3
(e) This cannot be determined since neither the value of Q

36. What is the magnitude of the electric field due to a 4.0×10^{-9} C charge at a point 0.020 m away?

(a) 1.8×10^{3} N/C
(b) 9.0×10^{4} N/C
(c) 1.0×10^{5} N/C
(d) 3.6×10^{6} N/C
(e) 7.2×10^{7} N/C

40. A small sphere of mass 1.0×10^{-6} kg carries a total charge of 2.0×10^{-8} C. The sphere hangs from a silk thread between two large parallel conducting plates. The excess charge on each plate is equal in magnitude, but opposite in sign. If the thread makes an angle of 30° with the positive plate as shown, what is the magnitude of the charge density on each plate?



(a) 2.5×10^{-9} C/m²
(b) 5.2×10^{-9} C/m²
(c) 1.0×10^{-9} C/m²
(d) 2.1×10^{-8} C/m²
(e) 4.2×10^{-8} C/m²

46. Which one of the following statements is true concerning the spacing of the electric field lines in the vicinity of two point charges of equal magnitude and opposite sign?

(a) It indicates the direction of the electric field.
(b) It does not depend on the magnitude of the charges.
(c) It is large when the magnitude of the charges is large.
(d) It indicates the relative magnitude of the electric field.
(e) It is small when the magnitude of the charges is small.

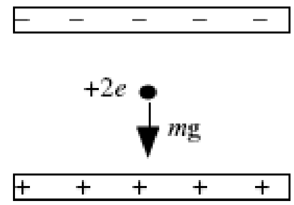
47. Which one of the following statements is true concerning the electrostatic charge on a conductor?

(a) It is uniformly distributed throughout the volume.
(b) It is confined to the surface and is uniformly distributed.
(c) Most of the charge is on the outer surface, but it is not uniformly distributed.
(d) It is entirely on the surface and it is distributed according to the shape of the object.
(e) It is dispersed throughout the volume of the object and distributed according to the object's shape.

49. What is the magnitude and direction of the electric force on a −1.2 μC charge at a point where the electric field is 2500 N/C and is directed along the +y axis.

(a) 0.15 N, −y direction
(b) 0.15 N, +y direction
(c) 0.0030 N, −y direction
(d) 0.0030 N, +y direction
(e) 4.3 N, +x direction

57. A helium nucleus is located between the plates of a parallel-plate capacitor as shown. The nucleus has a charge of +2e and a mass of 6.6×10^{-27} kg. What is the magnitude of the electric field such that the electric force exactly balances the weight of the helium nucleus so that it remains stationary?



(a) 4.0×10^{-7} N/C
(b) 6.6×10^{-26} N/C
(c) 2.0×10^{-7} N/C
(d) 5.0×10^{-3} N/C
(e) 1.4×10^{8} N/C

58. Two identical conducting spheres carry charges of +5.0 μC and –1.0 μC, respectively. The centers of the spheres are initially separated by a distance L. The two spheres are brought together so that they are in contact. The spheres are then returned to their original separation L. What is the ratio of the magnitude of the force on either charge after the spheres are touched to that before they were touched?

(a) 1/1
(b) 4/5
(c) 9/5
(d) 5/1
(e) 4/9

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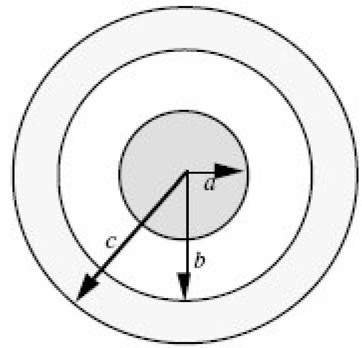
Questions 61 through 63 pertain to the situation described below: A solid, conducting sphere of radius a carries an excess charge of +6 μC. This sphere is located at the center of a hollow, conducting sphere with an inner radius of b and an outer radius of c as shown. The hollow sphere also carries a total excess charge of +6 μC.



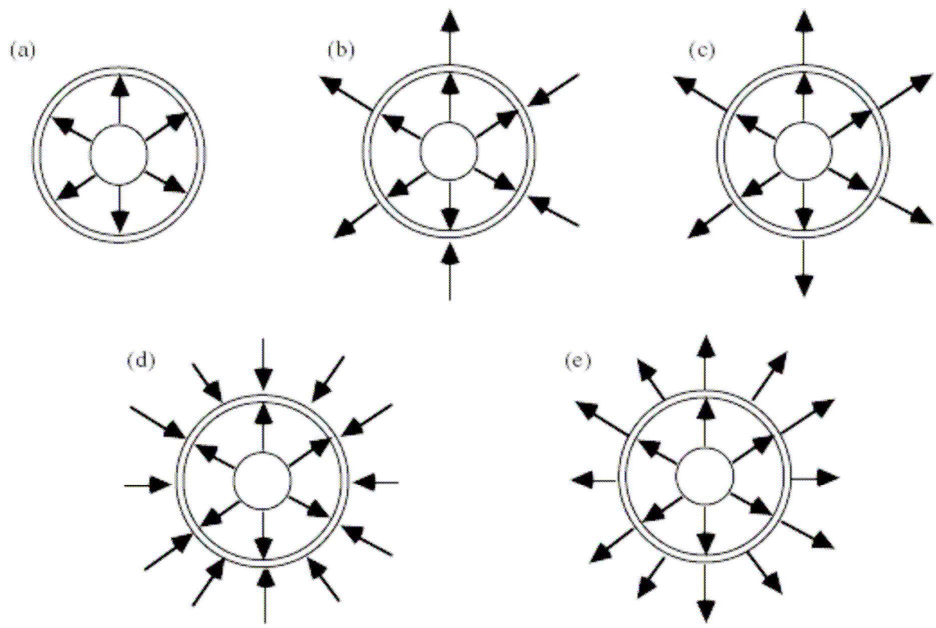
61. Determine the excess charge on the inner surface of the outer sphere (a distance b from the center of the system).

(a) zero coulombs
(b) –6 μC
(c) +6 μC
(d) +12 μC
(e) –12 μC

62. Determine the excess charge on the outer surface of the outer sphere (a distance c from the center of the system).

(a) zero coulombs
(b) –6 μC
(c) +6 μC
(d) +12 μC
(e) –12 μC

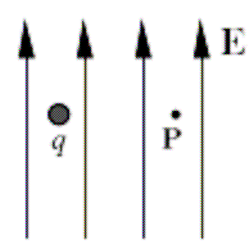
63. Which one of the following figures shows a qualitatively accurate sketch of the electric field lines in and around this system?



6. Two positive point charges are separated by a distance R. If the distance between the charges is reduced to R/2, what happens to the total electric potential energy of the system?

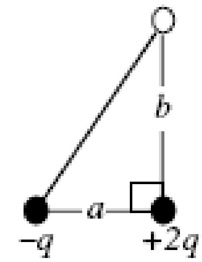
(a) It is doubled.
(b) It remains the same.
(c) It increases by a factor of 4.
(d) It is reduced to one-half of its original value.
(e) It is reduced to one-fourth of its original value.

7. A charge q = −4.0 μC is moved 0.25 m horizontally to point P in a region where an electric field is 150 V/m and directed vertically as shown. What is the change in the electric potential energy of the charge?



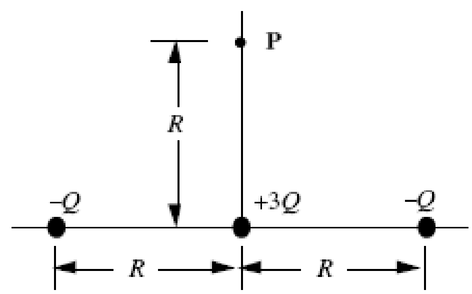
(a) -2.4×10^{-3} J (d) $+1.5 \times 10^{-4}$ J
(b) -1.5×10^{-4} J (e) $+2.4 \times 10^{-3}$ J
(c) zero joules

10. Two point charges are located at two of the vertices of a right triangle, as shown in the figure. If a third charge −2q is brought from infinity and placed at the third vertex, what will its electric potential energy be? Use the following values: a = 0.15 m; b = 0.45 m, and q = 2.0×10^{-5} C.



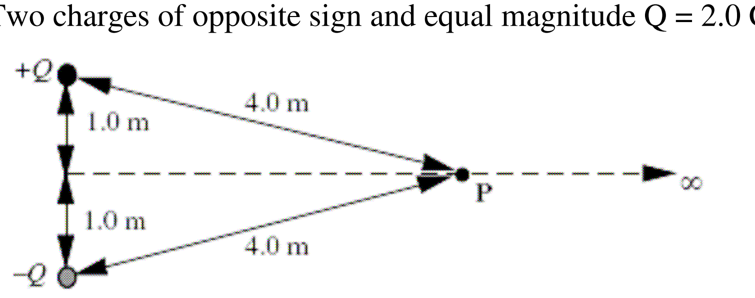
(a) −17 J
(b) −12 J
(c) −2.8 J
(d) +8.5 J
(e) +14 J

12. Three point charges –Q, –Q, and +3Q are arranged along a line as shown in the sketch. What is the electric potential at the point P?



(a) +kQ/R
(b) –2kQ/R
(c) –1.6kQ/R
(d) +1.6kQ/R
(e) +4.4kQ/R

24. Two charges of opposite sign and equal magnitude Q = 2.0 C are held 2.0 m apart



as shown in the figure. Determine the magnitude of the electric field at the point P.

(a) 2.2×10^{9} V/m
(b) 5.6×10^{8} V/m
(c) 4.4×10^{8} V/m
(d) 2.8×10^{8} V/m
(e) zero V/m

27. Which one of the following statements concerning electrostatic situations is false?

(a) E is zero everywhere inside a conductor.
(b) Equipotential surfaces are always perpendicular to E.
(c) It takes zero work to move a charge along an equipotential surface.
(d) If V is constant throughout a region of space then E must be zero in that region.
(e) No force component acts along the path of a charge as it is moved along an equipotential surface.

44. A parallel plate capacitor with plates of area A and plate separation d is charged so that the potential difference between its plates is V. If the capacitor is then isolated and its plate separation is decreased to d/2, what happens to its capacitance?

(a) The capacitance is twice its original value.
(b) The capacitance is four times its original value.
(c) The capacitance is eight times its original value.
(d) The capacitance is one half of its original value.
(e) The capacitance is unchanged.

45 A parallel plate capacitor is fully charged at a potential V. A dielectric with constant $\kappa = 4$ is inserted between the plates of the capacitor while the potential difference between the plates remains constant. Which one of the following statements is false concerning this situation?

(a) The energy density remains unchanged.
(b) The capacitance increases by a factor of four.
(c) The stored energy increases by a factor of four.
(d) The charge on the capacitor increases by a factor of four.
(e) The electric field between the plates increases by a factor of four.

48. A parallel plate capacitor has a potential difference between its plates of 1.2 V and a plate separation distance of 2.0 mm. What is the magnitude of the electric field if a material that has a dielectric constant of 3.3 is inserted between the plates?

(a) 75 V/m (c) 250 V/m (e) 500 V/m
(b) 180 V/m (d) 400 V/m

50. The effective area of each plate of a parallel plate capacitor is 2.4 m2. The capacitor is filled with neoprene rubber (κ = 6.4). When a 3.0-V potential difference exists across the plates of the capacitor, the capacitor stores 5.0 μC of charge. Determine the plate separation of the capacitor.

(a) 7.2×10^{-5} m (c) 1.7×10^{-4} m ***(e) 8.2×10^{-5} m***
(b) 3.0×10^{-4} m (d) 5.3×10^{-4} m

54. 54. A parallel plate capacitor has plates of area 2.0×10^{-3} m^2 and plate separation 1.0×10^{-4} m. Air fills the volume between the plates. What potential difference is required to establish a 3.0 μC charge on the plates?

(a) 9.3×10^2 V ***(c) 1.7×10^4 V*** (e) 3.7×10^5 V
(b) 2.4×10^4 V (d) 6.9×10^3 V

3. How many electrons flow through a battery that delivers a current of 3.0 A for 12 s?

(a) 4 (c) 4.8×10^{15} ***(e) 2.2×10^{20}***
(b) 36 (d) 6.4×10^{18}

9. When a light bulb is connected to a 4.5 V battery, a current of 0.16 A passes through the bulb filament. What is the resistance of the filament?

(a) 440 Ω (c) 9.3 Ω (e) 0.72 Ω
(b) 28 Ω (d) 1.4 Ω

12. Determine the length of a copper wire that has a resistance of 0.172 Ω and cross-sectional area of 1×10^{-4} m^2. The resistivity of copper is 1.72×10^{-8} Ω • m.

(a) 0.1 m (c) 100 m (e) 10 000 m
(b) 10 m ***(d) 1000 m***

13. The resistivity of a silver wire is 1.59×10^{-8} Ω • m. The radius of the wire is 5.04×10^{-4} m. If the length of the wire is 3.00 m, what is the resistance of the wire?

(a) 0.0598 Ω (c) 9.46 μΩ (e) 1.88 Ω
(b) 47.0 μΩ (d) 0.167 Ω

21. A 40-W and a 60-W light bulb are designed for use with the same voltage. What is the ratio of the resistance of the 60-W bulb to the resistance of the 40-W bulb?

(a) 1.5　　(c) 2.3　　(e) 3.0
(b) 0.67　　(d) 0.44

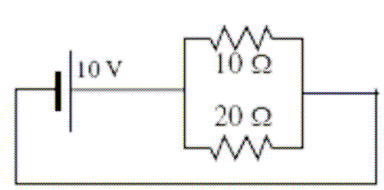
22. A 5-A current is maintained in a simple circuit that consists of a resistor between the terminals of an ideal battery. If the battery supplies energy at a rate of 20 W, how large is the resistance?

(a) 0.4 Ω　　(c) 2 Ω　　(e) 8 Ω
(b) 0.8 Ω　　(d) 4 Ω

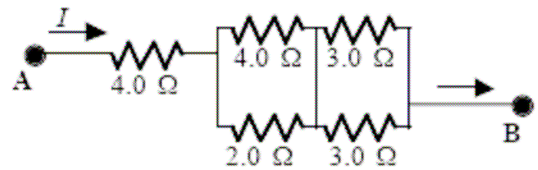
23. A computer monitor uses 2.0 A of current when it is plugged into a 120 V outlet. The monitor is never turned off. What is the yearly cost of operating the monitor if the cost of electricity is $0.12/kWh?

(a) $14　　(c) $98　　***(e) $250***
(b) $21　　(d) $170

42. What is the total power dissipated in the two resistors in the circuit shown?
(a) 10 W　　(d) 67 W
(b) 15 W　　(e) 670 W
(c) 33 W



44. Five resistors are connected as shown. What is the equivalent resistance between points A and B?

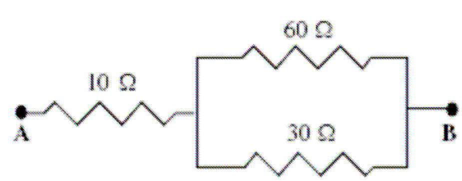


(a) 6.8 Ω (d) 2.1 Ω
(b) 9.2 Ω (e) 16 Ω
(c) 3.4 Ω

45. Jason's circuit has a 24-Ω resistor that is connected in series to two 12-Ω resistors that are connected in parallel. JoAnna's circuit has three identical resistors wired in parallel. If the equivalent resistance of Jason's circuit is the same as that of JoAnna's circuit, determine the value of JoAnna's resistors.

(a) 90 Ω (c) 30 Ω (e) 12 Ω
(b) 48 Ω (d) 24 Ω

Questions 52 through 55 pertain to the statement and diagram below:
Three resistors are placed in a circuit as shown. The potential difference between points A and B is 30 V.



52. What is the equivalent resistance between the points A and B?

(a) 10 Ω　　***(c) 30 Ω***　　(e) 100 Ω
(b) 20 Ω　　(d) 50 Ω

53. What is the potential drop across the 10-Ω resistor?

(a) 10 V　　(c) 30 V　　(e) 100 V
(b) 20 V　　(d) 60 V

54. What is the potential drop across the 30-Ω resistor?

(a) 10 V　　(c) 30 V　　(e) 100 V
(b) 20 V　　(d) 60 V

55. What is the current through the 30-Ω resistor?

(a) 0.3 A　　***(c) 0.7 A***　　(e) 2 A
(b) 0.5 A　　(d) 1 A

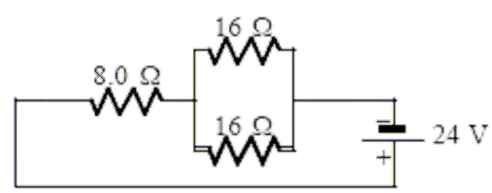
56. A non-ideal battery has a 6.0-V emf and an internal resistance of 0.6 Ω. Determine the terminal voltage when the current drawn from the battery is 1.0 A.

(a) 5.0 V
(c) 5.4 V
(e) 5.8 V
(b) 6.0 V
(d) 6.6 V

58. A battery is manufactured to have an emf of 24.0 V, but the terminal voltage is only 22.0 V when the battery is connected across a 7.5-Ω resistor. What is the internal resistance of the battery?

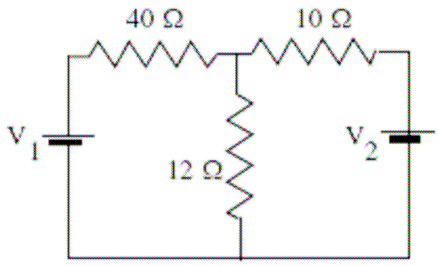
(a) 3.2 Ω
(c) 1.2 Ω
(e) 0.68 Ω
(b) 0.27 Ω
(d) 0.75 Ω

59. Three resistors are connected in a circuit as shown. Using Kirchhoff's rules, determine the current in one of the 16-Ω resistors.



(a) 0.50 A
(d) 1.3 A
(b) 0.75 A
(e) 2.0 A
(c) 1.0 A

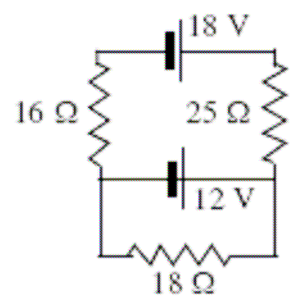
60. Three resistors and two 10.0-V batteries



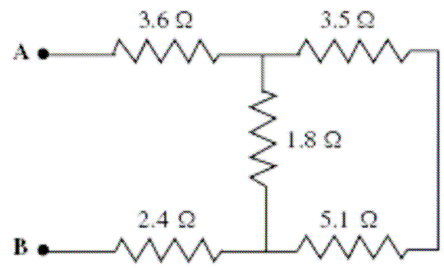
are arranged as shown in the circuit diagram. Which one of the following entries in the table is correct? Power Delivered Power Delivered by Battery 1 by Battery 2

Power Delivered by Battery 1	Power Delivered by Battery 2
(a) 2.5 W	2.5 W
(b) 4.0 W	1.0 W
(c) 1.0 W	1.0 W
(d) 1.0 W	***4.0 W***
(e) 4.0 W	4.0 W

61. Three resistors and two batteries are connected as shown in the circuit diagram. What is the magnitude of the current through the 12-V battery?
(a) 0.15 A
(b) 0.82 A
(c) 0.30 A
(d) 0.67 A
(e) 0.52 A



Questions 63 through 67 pertain to the statement and diagram below: Five resistors are connected as shown in the diagram. The potential difference between points A and B is 25 V.



63. What is the equivalent resistance between the points A and B?

(a) 1.5 Ω ***(c) 7.5 Ω*** (e) 11 Ω
(b) 4.8 Ω (d) 9.4 Ω

64. What is the current through the 3.6-Ω resistor?

(a) 1.3 A (c) 6.9 A (e) 25 A
(b) 3.3 A (d) 7.5 A

65. What is the current through the 1.8-Ω resistor?

(a) 2.8 A (c) 5.6 A (e) 14 A
(b) 3.3 A (d) 6.9 A

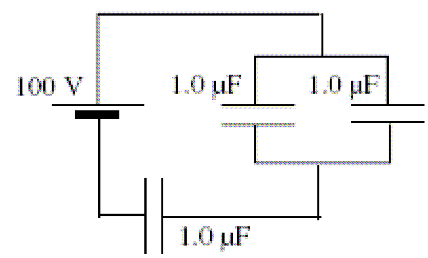
66. How much energy is dissipated in the 1.8-Ω resistor in 4.0 seconds?

(a) 18 J ***(c) 55 J*** (e) 93 J
(b) 28 J (d) 64 J

67. What is the potential drop across the 3.5-Ω resistor?

(a) 2.0 V (c) 8.0 V (e) 25 V
(b) 5.0 V (d) 17 V

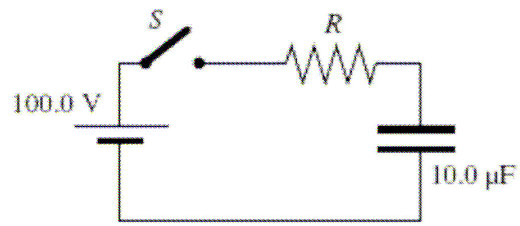
76. What is the equivalent capacitance of the combination of capacitors shown in the circuit?
(a) 0.37 μF ***(d) 0.67 μF***
(b) 3.3 μF (e) 2.1 μF
(c) 4.6 μF



79. 79. When two capacitors are connected in series, the equivalent capacitance of the combination is 100 μF. When the two are connected in parallel, however, the equivalent capacitance is 450 μF. What are the capacitances of the individual capacitors?

(a) 200 μF and 250 μF ***(d) 150 μF and 300 μF***
(b) 125 μF and 325 μF (e) 80 μF and 370 μF
(c) 175 μF and 275 μF

Questions 84 and 85 pertain to the statement and diagram below:
The figure shows a simple RC circuit consisting of a 100.0-V battery in series with a 10.0-μF capacitor and a resistor. Initially, the switch S is open and the capacitor is uncharged. Two seconds after the switch is closed, the voltage across the resistor is 37 V.



84. Determine the numerical value of the resistance R.

(a) 0.37 Ω
(b) 2.70 Ω
(c) 5.0×10^4 Ω
(d) 2.0×10^5 Ω
(e) 4.3×10^5 Ω

85. How much charge is on the capacitor 2.0 s after the switch is closed?

(a) 1.1×10^{-3} C
(b) 2.9×10^{-3} C
(c) 3.7×10^{-4} C
(d) 5.2×10^{-4} C
(e) 6.6×10^{-4} C

Questions 86 through 88 pertain to the situation described below:
An uncharged 5.0-μF capacitor and a resistor are connected in series to a 12-V battery and an open switch to form a simple RC circuit. The switch is closed at t = 0s. The time constant of the circuit is 4.0 s.

86. Determine the value of the resistance R.

(a) 15 Ω
(b) 60 Ω
(c) 8.0×10^5 Ω
(d) 8.0×10^7 Ω
(e) 8.0×10^8 Ω

87. Determine the maximum charge on the capacitor.

(a) 6.0 × 10^{-5} C (c) 1.5 × 10^{-5} C (e) 5.5 × 10^{-5} C
(b) 9.5 × 10^{-5} C (d) 4.8 × 10^{-5} C

88. What is the charge remaining on either plate after one time constant has elapsed?

(a) 7.4 × 10^{-5} C (c) 1.2 × 10^{-5} C ***(e) 2.2 × 10^{-5} C***
(b) 5.5 × 10^{-5} C (d) 3.8 × 10^{-5} C

96. Two wires A and B are made of the same material and have the same diameter. Wire A is twice as long as wire B. If each wire has the same potential difference across its ends, which one of the following statements is true concerning the current in wire A?
(a) The current is one-fourth that in B.
(b) The current is four times that in B.
(c) The current is equal to the current in B.
(d) The current is half as much as that in B.
(e) It is twice as much as that in B.

Physics 1653
Chap 19 Review Questions

8. Which one of the following statements best explains why a constant magnetic field can do no work on a moving charged particle?

(a) The magnetic field is conservative.
(b) The magnetic force is a velocity dependent force.
(c) The magnetic field is a vector and work is a scalar quantity.
(d) The magnetic force is always perpendicular to the velocity of the particle.
(e) The electric field associated with the particle cancels the effect of the magnetic field on the particle.

11. An electron is moving with a speed of 3.5×10^5 m/s when it encounters a magnetic field of 0.60 T. The direction of the magnetic field makes an angle of 60.0° with respect to the velocity of the electron.
What is the magnitude of the magnetic force on the electron?

(a) 4.9×10^{-13} N (c) 1.7×10^{-13} N **(e) 2.9×10^{-14} N**
(b) 3.2×10^{-13} N (d) 3.4×10^{-14} N

12. A proton traveling due north enters a region that contains both a magnetic field and an electric field. The electric field lines point due west. It is observed that the proton continues to travel in a straight line due north. In which direction must the magnetic field lines point?
(a) up (c) east (e) south
(b) down (d) west

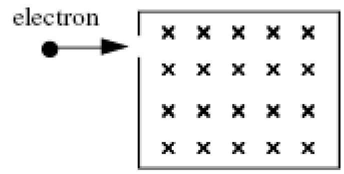
13. An electron travels through a region of space with no acceleration. Which one of the following statements is the best conclusion?

(a) Both E and B must be zero in that region.
(b) E must be zero, but B might be non-zero in that region.
(c) E and B might both be non-zero, but they must be mutually perpendicular.
(d) B must be zero, but E might be non-zero in that region.
(e) E and B might both be non-zero, but they must point in opposite directions.

14. A particle with a mass of 6.64×10^{-27} kg and a charge of $+3.20 \times 10^{-19}$ C is accelerated from rest through a potential difference of 2.45×10^{6} V. The particle then enters a uniform 1.60-T magnetic field. If the particle's velocity is perpendicular to the magnetic field at all times, what is the magnitude of the magnetic force exerted on the particle?

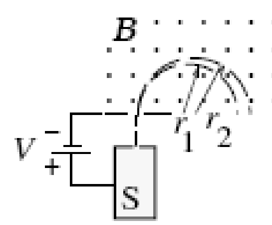
(a) zero newtons
(b) 1.14×10^{-10} N
(c) 6.55×10^{-10} N
(d) 4.09×10^{-11} N
(e) 7.87×10^{-12} N

15. An electron traveling horizontally enters a region where a uniform magnetic field is directed into the plane of the paper as shown. Which one of the following phrases most accurately describes the
motion of the electron once it has entered the field?



(a) upward and parabolic
(b) upward and circular
(c) downward and circular
(d) upward, along a straight line
(e) downward and parabolic

21. A mass spectrometer is used to separate two isotopes of uranium with masses m_1 and m_2 where $m_2 > m_1$. The two types of uranium atom exit an ion source S with the same charge of +e and are accelerated through a potential difference V. The charged atoms then enter a constant, uniform magnetic field B as shown. If r_1 = 0.5049 m and r_2 = 0.5081 m, what is the value of the ratio m_1/m_2?

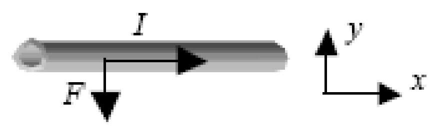


(a) 0.9984 (b) 0.9937 **(c) 0.9874** (d) 0.9812 (e) 0.9749

24. Determine the magnitude of the magnetic field if ion A travels in a semicircular path of radius 0.50 m at a speed of 5.0×10^6 m/s.

(a) 1.0 T (c) 0.42 T (e) 0.11 T
(b) 0.84 T **(d) 0.21 T**

26. A long, straight wire carries a 6.0-A current that is directed in the positive x direction. When a uniform magnetic field is applied perpendicular to a 3.0-m segment of the wire, the magnetic force on the segment is 0.36 N, directed in the negative y direction, as shown. What are the magnitude and direction of the magnetic field?



(a) 0.020 T, out of the paper
(b) 0.020 T, into the paper
(c) 0.060 T, out of the paper
(d) 0.060 T, into the paper
(e) 0.65 T, out of the paper

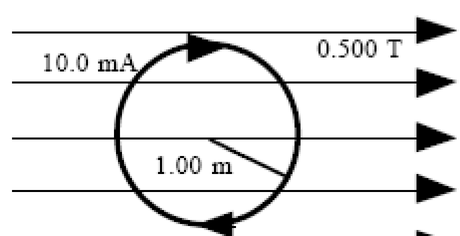
30. A current-carrying, rectangular coil of wire is placed in a magnetic field. The magnitude of the torque on the coil is not dependent upon which one of the following quantities?

(a) the magnitude of the current in the loop
(b) the direction of the current in the loop
(c) the length of the sides of the loop
(d) the area of the loop
(e) the orientation of the loop

31. A circular coil consists of 5 loops each of diameter 1.0 m. The coil is placed in an external magnetic field of 0.5 T. When the coil carries a current of 4.0 A, a torque of magnitude 3.93 N•m acts on it. Determine the angle between the normal to the plane of the coil and the direction of the magnetic field.

(a) 0° (c) 45° (e) 90°
(b) 30° (d) 60°

32. A single circular loop of radius 1.00 m carries a current of 10.0 mA. It is placed in a uniform magnetic field of magnitude 0.500 T that is directed parallel to the plane of the loop as suggested in the figure. What is the magnitude of the torque exerted on the loop by the magnetic field?



(a) 1.57 × 10–2 N•m
(b) 3.14 × 10–2 N•m
(c) 6.28 × 10–2 N•m
(d) 9.28 × 10–2 N•m
(e) zero N•m

34. A single circular loop of wire of radius 0.75 m carries a constant current of 3.0 A. The loop may be rotated about an axis that passes through the center and lies in the plane of the loop. When the orientation of the normal to the loop with respect to the direction of the magnetic field is 25°, the torque on the coil is 1.8 N•m. What is the magnitude of the uniform magnetic field exerting this torque on the loop?

(a) 0.37 T
(b) 1.7 T
(c) 3.0 T
(d) 0.46 T
(e) 0.80 T

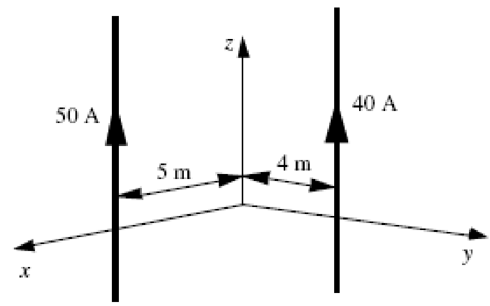
35. A coil consists of 240 circular loops, each of radius 0.044 m, and carries a current of 2.2 A. Determine the magnetic moment of the coil.

(a) 0.21 A•m2
(b) 0.65 A•m2
(c) 3.2 A•m2
(d) 15 A•m2
(e) 23 A•m2

38. 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.

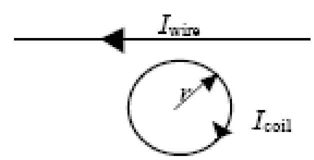
(a) 2.26×10^{-3} T
(b) 4.52×10^{-3} T
(c) 9.05×10^{-3} T
(d) 7.50×10^{-3} T
(e) zero tesla

39. 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
(c) 3×10^{-6} T
(d) 5×10^{-6} T
(e) 7×10^{-6} T

40. The radius of a coil of wire with N turns is r = 0.22 m. A current I_{coil} = 2.0 A flows clockwise in the coil, as shown. A long, straight wire carrying a current I_{wire} = 31 A toward the left is located 0.05 m from the edge of the coil. The magnetic field at the center of the coil is zero tesla. Determine N, the number of turns.



(a) 8 (c) 6 (e) 1
(b) 2 **(d) 4**

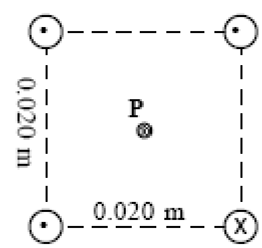
41. A long, straight wire carries a current I. If the magnetic field at a distance d from the wire has magnitude B, what is the magnitude of the magnetic field at a distance 2d from the wire?

(a) B/2 (c) 2B (e) 8B
(b) B/4 (d) 4B

42. ***An overhead electric power line carries a maximum current of 125 A. What is the magnitude of the maximum magnetic field at a point 4.50 m directly below the power line?***

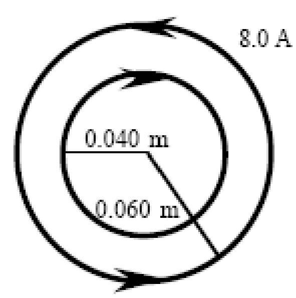
(a) 5.56×10^{-6} T
(b) 1.75×10^{-5} T
(c) 3.49×10^{-5} T
(d) 4.69×10^{-4} T
(e) 7.95×10^{-3} T

46. ***Four long, straight wires are parallel to each other; and their cross section forms a square. Each side of the square is 0.020 m as shown in the figure. If each wire carries a current of 8.0 A in the direction shown in the figure, determine the magnitude of the total magnetic field at P, the center of the square.***



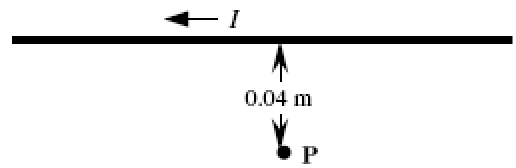
(a) 5.1×10^{-5} T
(b) 1.1×10^{-4} T
(c) 1.7×10^{-4} T
(d) 2.3×10^{-4} T
(e) zero tesla

47. The figure shows two concentric metal loops, each carrying a current. The larger loop carries a current of 8.0 A and has a radius of 0.060 m. The smaller loop has a radius of 0.040 m. What is the value of a current in the smaller loop that will result in zero total magnetic field at the center of the system?



(a) 5.3 A
(b) 6.0 A
(c) 8.8 A
(d) 12 A
(e) 24 A

Questions 50 and 51 pertain to the statement and figure below:
A long, straight wire is carrying a current of 5.0 A in the direction shown in the figure. The point P is 0.040 m from the wire.



50. What is the direction of the magnetic field at point P due to the current in the wire?

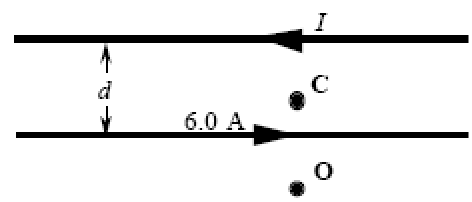
(a) to the right of page
(b) to the left of the page
(c) toward the bottom of the page
(d) into the plane of the page
(e) out of the plane of the page

51. What is the magnitude of the magnetic field at the point P?

(a) 1.3×10^{-5} T
(b) 1.9×10^{-5} T
(c) 2.5×10^{-5} T
(d) 7.9×10^{-5} T
(e) 9.4×10^{-5} T

Questions 54 and 55 pertain to the statement and figure below:

Two long, straight, parallel wires separated by a distance d carry currents in opposite directions as shown in the figure. The bottom wire carries a current of 6.0 A. Point C is at the midpoint between the wires and point O is a distance 0.50d below the 6-A wire as suggested in the figure. The total magnetic field at point O is zero tesla.



54. Determine the value of the current, I, in the top wire.

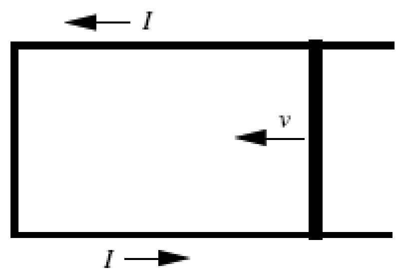
(a) 2 A
(b) 3 A
(c) 6 A
(d) 18 A
(e) This cannot be determined since the value of d is not specified.

55. Determine the magnitude of the magnetic field at point C if d = 0.10 m.

(a) 2.4×10^{-5} T
(b) 4.8×10^{-5} T
(c) 9.6×10^{-5} T
(d) 1.1×10^{-4} T
(e) 1.4×10^{-4} T

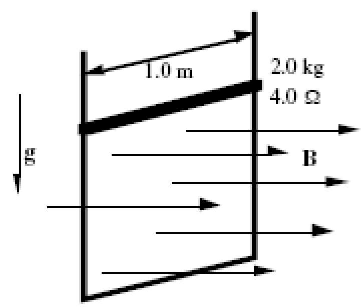
Magnetic Induction

4. A conducting bar moves to the left at a constant speed v on two conducting rails joined at the left as shown. As a result of the bar moving through a constant magnetic field, a current I induced in the indicated direction. Which one of the following directions is that of the magnetic field?



(a) toward the right
(b) toward the left
(c) parallel to the long axis of the bar
(d) into the page
(e) out of the page

6. A 2.0-kg rod has a length of 1.0 m and a resistance of 4.0 Ω. It slides with constant speed down a pair of frictionless vertical conducting rails that are joined at the bottom. Other than the rod, the rest of the circuit is resistanceless. A uniform magnetic field of magnitude 3.0 T is perpendicular to the plane formed by the rod and the rails as shown. Determine the speed of the rod.



(a) 0.38 m/s
(b) 0.90 m/s
(c) 2.6 m/s
(d) 5.6 m/s
(e) 8.7 m/s

8. The Earth's magnetic field passes through a square tabletop with a magnitude of 4.95 × 10–5 T and directed at an angle of 165° relative to the normal of the tabletop. If the tabletop has 1.50-m sides, what is the magnitude of the magnetic flux through it?

(a) 1.08×10^{-4} Wb
(b) 7.11×10^{-5} Wb
(c) 2.88×10^{-5} Wb
(d) 1.92×10^{-5} Wb
(e) 3.30×10^{-6} Wb

9. A circular copper loop is placed perpendicular to a uniform magnetic field of 0.50 T. Due to external forces, the area of the loop decreases at a rate of 1.26×10^{-3} m^2/s. Determine the induced emf in the loop.

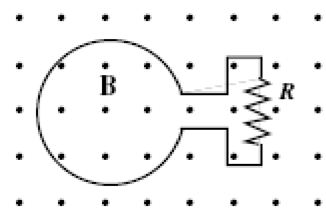
(a) 3.1×10^{-4} V (c) 1.2×10^{-3} V (e) 3.1 V
(b) 6.3 × 10^{-4} V (d) 7.9×10^{-3} V

13. A magnetic field is directed perpendicular to the plane of the 0.15-m × 0.30-m rectangular coil comprised of 120 loops of wire. To induce an average emf of −1.2 V in the coil, the magnetic field is increased from 0.1 T to 1.5 T during a time interval Δt. Determine Δt.

(a) 0.053 s (c) 1.6 s (e) 7.6 s
(b) 0.13 s **(d) 6.3 s**

Questions 16 through 19 pertain to the situation described below:

The figure shows a uniform, 3.0-T magnetic field that is normal to the plane of a conducting, circular loop with a resistance of 1.5 Ω and a radius of 0.024 m. The magnetic field is directed out of the paper as shown. Note: The area of the non-circular portion of the wire is considered negligible compared to that of the circular loop.



16. What is the magnitude of the average induced emf in the loop if the magnitude of the magnetic field is doubled in 0.4 s?

(a) 0.43 V
(b) 0.65 V
(c) 0.014 V
(d) 0.027 V
(e) 0.038 V

17. What is the average current around the loop if the magnitude of the magnetic field is doubled in 0.4 s?

(a) 2.8×10^{-3} A, clockwise
(b) 4.5×10^{-3} A, clockwise
(c) 4.5×10^{-3} A, counterclockwise
(d) 9.0×10^{-3} A, clockwise
(e) 9.0×10^{-3} A, counterclockwise

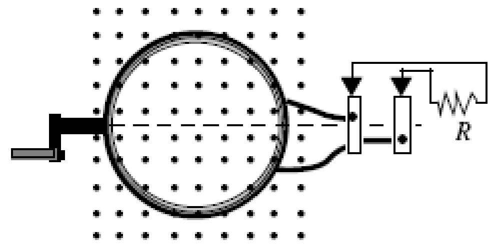
18. If the magnetic field is held constant at 3.0 T and the loop is pulled out of the region that contains the field in 0.2 s, what is the magnitude of the average induced emf in the loop?

(a) 8.6×10^{-3} V
(b) 9.8×10^{-3} V
(c) 2.7×10^{-2} V
(d) 5.4×10^{-2} V
(e) 6.4×10^{-2} V

19. If the magnetic field is held constant at 3.0 T and the loop is pulled out of the region that contains the field in 0.2 s, at what rate is energy dissipated in R?

(a) 1.8×10^{-2} W
(b) 3.6×10^{-2} W
(c) 3.8×10^{-3} W
(d) 2.7×10^{-4} W
(e) 4.9×10^{-4} W

27. A circular coil has 275 turns and a radius of 0.045 m. The coil is used as an ac generator by rotating it in a 0.500 T magnetic field, as shown in the figure. At what angular speed should the coil be rotated so that the maximum emf is 175 V?

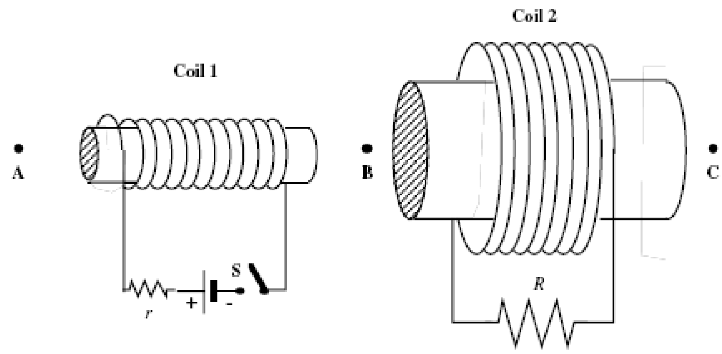


(a) 28 rad/s
(b) 50 rad/s
(c) 130 rad/s
(d) 200 rad/s
(e) 490 rad/s

28. The angular speed of a motor is 262 rad/s. The back emf generated by the motor is 89.4 V. Assuming all other factors remain the same, determine the back emf if the angular speed of the motor is reduced to 154 rad/s.

(a) 32.3 V
(b) 44.7 V
(c) 52.5 V
(d) 89.4 V
(e) 152 V

Questions 45 through 51 pertain to the situation described below:
Two coils, 1 and 2, with iron cores are positioned as shown in the figure. Coil 1 is part of a circuit with a battery and a switch.



45. Immediately after the switch S is closed, which one of the following statements is true?
(a) An induced current will flow from right to left in R.
(b) An induced current will flow from left to right in r.
(c) A magnetic field that points toward B appears inside coil 1.
(d) An induced magnetic field that points toward B appears inside coil 2.
(e) A current will pass through r, but there will be no current through R.

46. Assume the switch S has been closed for a long time. Which one of the following statements is true?
(a) An induced current will flow from right to left in R.
(b) An induced current will flow from left to right in r.
(c) A magnetic field that points toward B appears inside coil 1.
(d) An induced magnetic field that points toward B appears inside coil 2.
(e) A current will pass through r, but there will be no current through R.

47. Assume S has been closed for a long time. Which one of the following statements is true when coil 1 and its core are moved toward point B?

(a) There is no induced current in r.
(b) There is a magnetic field in coil 1 that points toward B.
(c) There is an induced current in R that flows from left to right.
(d) There is an induced current in R that flows from right to left.
(e) There is an induced magnetic field in coil 2 that points toward B.

48. Assume that S has been closed for a long time. Which one of the following changes will not result in an induced current in coil 2 that flows from left to right through R.

(a) Coil 1 and its core are moved toward A.
(b) Coil 2 and its core are moved toward B.
(c) Coil 2 and its core are moved toward C.
(d) The switch S is opened.
(e) The iron core is removed from coil 1.

49. Assume that S has been closed for a long time. Which one of the following changes will result in an induced magnetic field in coil 2 that points toward C?

(a) The switch S is opened.
(b) The iron core is removed from coil 1.
(c) Coil 1 and its core are moved toward A.
(d) Coil 1 and its core are moved toward B.
(e) Coil 2 and its core are moved toward C.

50. Assume that S has been closed for a long time. Which one of the following statements is true if S is suddenly opened?

(a) There is no induced current through R.
(b) There is no induced magnetic field in coil 2.
(c) There is an induced current in R that flows from right to left.
(d) There is an induced magnetic field in coil 2 that points toward C.
(e) There is an induced magnetic field in coil 2 that points toward B.

51. Assume that S has been closed for a long time. Which one of the following statements is true if coil 2 is moved toward C?

(a) There is an induced magnetic field in coil 2 that points toward B.
(b) There is an induced magnetic field in coil 2 that points toward C.
(c) There is an induced current in R that flows from right to left.
(d) There is an induced north pole at the right end of coil 2.
(e) There is no induced current in R.

54. The current in the secondary coil of a step-up transformer is 0.86 A when the current in the primary coil is 4.8 A. Determine the turns ratio, Ns/Np, of the transformer.

(a) 5.6 (c) 0.24 (e) 0.12
(b) 4.1 (d) 0.18

55. A transformer changes 120 V across the primary to 1200 V across the secondary. If the secondary coil has 800 turns, how many turns does the primary coil have?

(a) 40 (c) 100 (e) 4000
(b) 80 (d) 400

56. A transformer has 450 turns in its primary coil and 30 turns in its secondary coil. Which one of the following statements concerning this transformer is true?

(a) This is a step-up transformer.
(b) The turns ratio is 15 for this transformer.
(c) The ratio of the voltages Vs / Vp is 15 for this transformer.
(d) The ratio of the currents Is / Ip is 0.067 for this transformer.
(e) The power delivered to the secondary must be the same as that delivered to the primary.