***Physics: Principle and Applications*, 7e (Giancoli)**
Chapter 21 Electromagnetic Induction and Farady's Law

21.1 Conceptual Questions

1) A flat coil is in a uniform magnetic field. The magnetic flux through the coil is greatest when the plane of its area is
A) parallel to the magnetic field.
B) at 45° with the magnetic field.
C) perpendicular to the magnetic field.
Answer: C
Var: 1

2) According to Faraday's law, a coil in a strong magnetic field must have a greater induced emf in it than a coil in a weak magnetic field.
A) True
B) False
Answer: B
Var: 1

3) At a certain instant, coil A is in a 10-T external magnetic field and coil B is in a 1-T external magnetic field. Both coils have the same area and are oriented at right angles to the field. Which coil will have a greater emf induced in it?
A) coil A
B) coil B
C) It is impossible to know without more information about the fields.
Answer: C
Var: 1

4) A coil of wire containing N turns is in an external magnetic field that is perpendicular to the plane of the coil and it steadily changing. Under these circumstances, an emf ε is induced in the coil. If the rate of change of the magnetic field and the number of turns in the coil are now doubled (but nothing else changes), what will be the induced emf in the coil?
A) 2ε
B) $\varepsilon/2$
C) 4ε
D) $\varepsilon/4$
E) ε
Answer: C
Var: 1

5) According to Lenz's law, the induced current in a circuit always flows to oppose the external magnetic flux through the circuit.
A) True
B) False
Answer: B
Var: 1

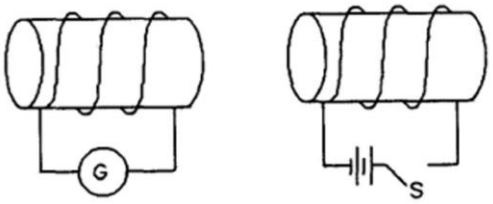
6) According to Lenz's law, the induced current in a circuit always flows to oppose the external magnetic field through the circuit.
A) True
B) False
Answer: B
Var: 1

7) A coil lies flat on a tabletop in a region where the magnetic field vector points straight up. The magnetic field vanishes suddenly. When viewed from above, what is the sense of the induced current in this coil as the field fades?
A) The induced current flows counterclockwise.
B) The induced current flows clockwise.
C) There is no induced current in this coil.
D) The current flows clockwise initially, and then it flows counterclockwise before stopping.
Answer: A
Var: 1

8) A coil lies flat on a level tabletop in a region where the magnetic field vector points straight up. The magnetic field suddenly grows stronger. When viewed from above, what is the direction of the induced current in this coil as the field increases?
A) counterclockwise
B) clockwise
C) clockwise initially, then counterclockwise before stopping
D) There is no induced current in this coil.
Answer: B
Var: 1

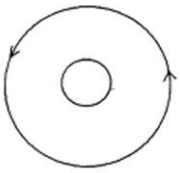
9) A coil lies flat on a horizontal tabletop in a region where the magnetic field points straight down. The magnetic field disappears suddenly. When viewed from above, what is the direction of the induced current in this coil as the field disappears?
A) counterclockwise
B) clockwise
C) clockwise initially, then counterclockwise before stopping
D) There is no induced current in this coil.
Answer: B
Var: 1

10) Two solenoids are close to each other, as shown in the figure, with the switch S open. When the switch is suddenly closed, which way will the induced current flow through the galvanometer in the left-hand solenoid?



A) from left to right
B) from right to left
C) There will be no induced current through the galvanometer.
Answer: B
Var: 1

11) An outer metal ring surrounds an inner metal ring, as shown in the figure. The current in the outer ring is counterclockwise and decreasing. What is the direction of the induced current in the inner ring?



A) clockwise
B) counterclockwise
C) There is no induced current in the inner ring.
Answer: B
Var: 1

12) A long straight wire lies on a horizontal table and carries an ever-increasing current toward the north. Two coils of wire lie flat on the table, one on either side of the wire. When viewed from above, the direction of the induced current in these coils is
A) clockwise in both coils.
B) counterclockwise in both coils.
C) clockwise in the east coil and counterclockwise in the west coil.
D) counterclockwise in the east coil and clockwise in the west coil.
Answer: D
Var: 1

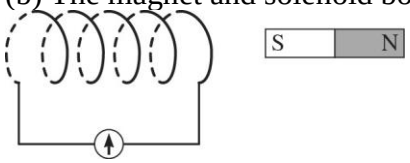
13) A circular coil lies flat on a horizontal surface. A bar magnet is held fixed above the center of the coil with its north pole pointing downward. What is the direction of the induced current in the coil, as viewed from above?
A) clockwise
B) counterclockwise
C) There is no current in the coil.
Answer: C
Var: 1

14) A circular coil of copper wire is lying flat on a horizontal table. A bar magnet is held above the center of the coil with its south pole downward. The magnet is released from rest and falls toward the coil. As viewed from above, what is the direction of the current induced in the coil as the magnet approaches the coil?
A) counterclockwise
B) clockwise
C) No current is induced in the coil.
D) An emf but no current is induced in the coil.
Answer: B
Var: 1

15) A circular coil of copper wire is lying flat on a horizontal table. A bar magnet is held above the center of the coil with its south pole downward. The magnet and the coil are now both raised upward with the same velocities. As viewed from above, what is the direction of the current induced in the coil as the magnet approaches the coil?
A) counterclockwise
B) clockwise
C) No current is induced in the coil.
D) An emf but no current is induced in the coil.
Answer: C
Var: 1

16) A circular coil lies flat on a horizontal surface. A bar magnet is held above the center of the coil with its north pole pointing down. If the magnet is dropped from this position what is the direction of the induced current in the coil, as viewed from above?
A) counterclockwise
B) clockwise
C) An emf but no current is induced in the coil.
D) There is no current in the coil.
Answer: A
Var: 1

17) A bar magnet is close to a solenoid, as shown in the figure. As viewed through the solenoid looking toward the magnet, what is the direction (clockwise or counterclockwise) of the current (if any) induced in the solenoid in each case?
(a) The magnet is pushed toward the solenoid.
(b) The magnet and solenoid both move to the right at 25 cm/s.



Answer: (a) counterclockwise (b) no induced current
Var: 1

18) A bar magnet is oriented above a copper ring, as shown in the figure. If the magnet is pulled upward, what is the direction of the current induced in the ring, as viewed from above?

A) There is no current in the ring.
B) counterclockwise
C) clockwise
Answer: B
Var: 1

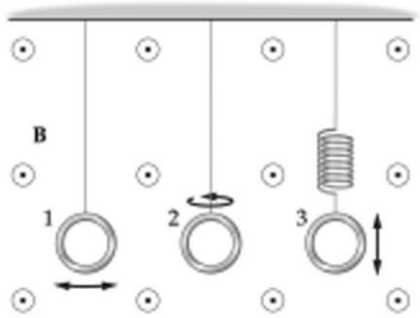
19) A bar magnet is oriented above a copper ring, as shown in the figure. If the magnet is kept fixed while the ring is dropped, what is the direction of the current induced in the ring, as viewed from *below* the ring?

A) There is no current in the ring.
B) counterclockwise
C) clockwise
Answer: C
Var: 1

20) A bar magnet is oriented above a copper ring, as shown in the figure. The magnet is dropped and passes completely through the ring. As viewed from above, what is the direction of the current induced in the ring after the magnet has completely passed through the ring and is somewhat below it?

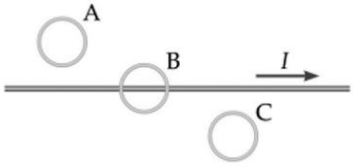
A) There is no current in the ring.
B) counterclockwise
C) clockwise
Answer: B
Var: 1

21) The three loops of wire shown in the figure are all hanging in the same uniform magnetic field $\vec{B}$ that is perpendicular to the page and does not vary with time. Loop 1 swings back and forth like the bob in a pendulum, Loop 2 rotates about a vertical axis, and Loop 3 oscillates up and down at the end of a spring. Which loop (or loops) will have an emf induced in them?



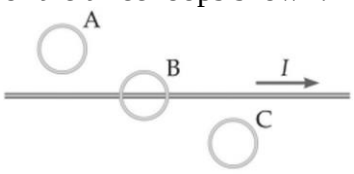
A) Loop 1
B) Loop 2
C) Loop 3
D) Loops 1 and 3
E) Loops 2 and 3
Answer: B
Var: 1

22) The wire in the figure carries a current *I* that is increasing with time at a constant rate. The wire and the three loops are all in the same plane. What is true about the currents induced in each of the three loops shown?



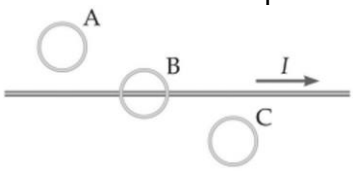
A) No current is induced in any loop.
B) The currents are counterclockwise in all three loops.
C) The currents are clockwise in all three loops.
D) Loop A has clockwise current, loop B has no induced current, and loop C has counterclockwise current.
E) Loop A has counterclockwise current, loop B has no induced current, and loop C has clockwise current.
Answer: D
Var: 1

23) The wire in the figure carries a current *I* that is decreasing with time at a constant rate. The wire and the three loops are all in the same plane. What is true about the currents induced in each of the three loops shown?



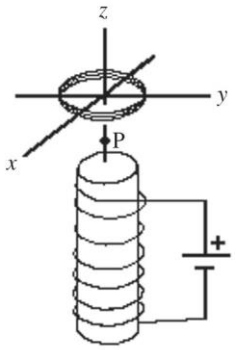
A) No current is induced in any loop.
B) The currents are counterclockwise in all three loops.
C) The currents are clockwise in all three loops.
D) Loop A has clockwise current, loop B has no induced current, and loop C has counterclockwise current.
E) Loop A has counterclockwise current, loop B has no induced current, and loop C has clockwise current.
Answer: E
Var: 1

24) The wire in the figure carries a steady current *I*. What is true about the currents induced in each of the three loops shown? The wire and the three loops are all in the same plane.



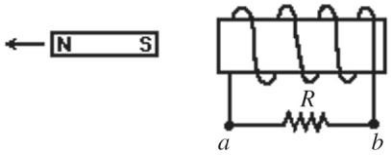
A) No current is induced in any loop.
B) The currents are counterclockwise in all three loops.
C) The currents are clockwise in all three loops.
D) Loop A has clockwise current, loop B has no induced current, and loop C has counterclockwise current.
E) Loop A has counterclockwise current, loop B has no induced current, and loop C has clockwise current.
Answer: A
Var: 1

25) As shown in the figure, a coil of wire is placed in the *xy*-plane, centered on the *z*-axis. A solenoid is centered on the *z*-axis and is carrying a steady dc current. Which one of the following actions will *not* result induce an emf in the coil?



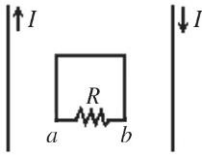
A) Rotate the coil about the *x*-axis.
B) Rotate the coil about the *y*-axis.
C) Rotate the coil about the *z*-axis.
D) Move the coil toward point P.
E) Change the current in the solenoid.
Answer: C
Var: 1

26) In the figure, a bar magnet moves away from the solenoid. The direction of the induced current through the resistor *R* is



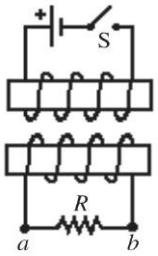
A) from *a* to *b*.
B) from *b* to *a*.
C) No current is induced.
Answer: A
Var: 1

27) As shown in the figure, two parallel wires carry a current *I* in opposite directions, and this current is decreasing. A rectangular loop is centered between the wires. The direction of the induced current through the resistor *R* is



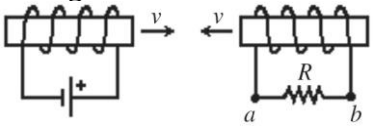
A) from *a* to *b*.
B) from *b* to *a*.
C) No current is induced.
Answer: B
Var: 1

28) As shown in the figure, two solenoids are side by side. The switch S is initially open. When S is suddenly closed, the direction of the induced current through the resistor *R* is



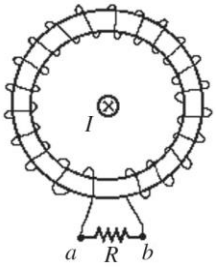
A) from *a* to *b*.
B) from *b* to *a*.
C) No current is induced.
Answer: B
Var: 1

29) As shown in the figure, a battery supplies a steady current to the solenoid on the left. The two solenoids are moving toward each other with speeds *v*. The direction of the induced current through the resistor *R* is



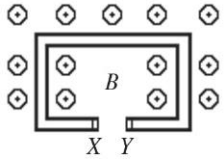
A) from *a* to *b*.
B) from *b* to *a*.
C) No current is induced.
Answer: A
Var: 1

30) As shown in the figure, a straight wire carries a current *I* into the page. The wire passes through the center of a toroidal coil. If the current *I* is quickly reduced to zero, the direction of the induced current through the resistor *R* is



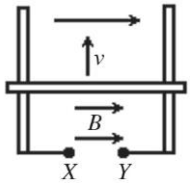
A) from *a* to *b*.
B) from *b* to *a*.
C) No current is induced.
Answer: B
Var: 1

31) As shown in the figure, a C-shaped conductor is in a uniform magnetic field *B* out of the page, and this field is increasing. What is the polarity of the induced emf in terminals X and Y?



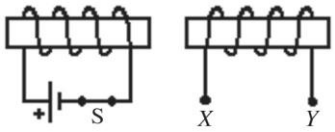
A) X and Y are at the same potential.
B) X is positive and Y is negative.
C) Y is positive and X is negative.
Answer: C
Var: 1

32) As shown in the figure, a metal bar is in contact with a pair of parallel rails. A steady, uniform, magnetic field *B* is present directed to the right. The bar is moving upward with velocity of magnitude v. What is the polarity of the induced emf in terminals X and Y?



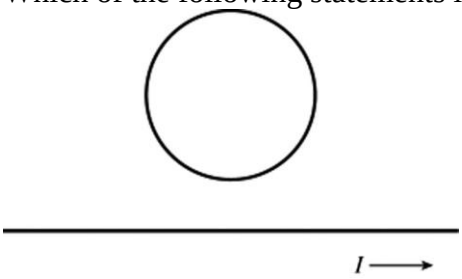
A) X and Y are at the same potential.
B) X is positive and Y is negative.
C) Y is positive and X is negative.
Answer: A
Var: 1

33) As shown in the figure, two solenoids are in line. The switch S, initially closed, is suddenly opened. Just after opening S, what is the polarity of the induced emf in terminals X and Y?



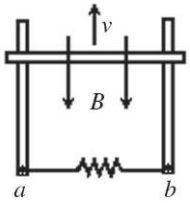
A) X and Y are at the same potential.
B) X is positive and Y is negative.
C) Y is positive and X is negative.
Answer: B
Var: 1

34) A circular wire ring is situated above a long straight wire, as shown in the figure. The straight wire has a current *I* flowing to the right, and this current is increasing at a constant rate. Which of the following statements is true?



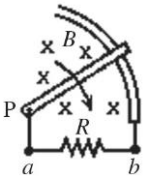
A) There is an induced current in the wire ring, directed in clockwise orientation.
B) There is an induced current in the wire ring, directed in a counterclockwise orientation.
C) There is no induced current in the wire ring.
Answer: A
Var: 1

35) As shown in the figure, a metal bar is in contact with a pair of parallel rails and is in motion with an upward velocity of magnitude *v*. A uniform magnetic field is present, directed downward as shown. The direction of the induced current through the resistor *R* is



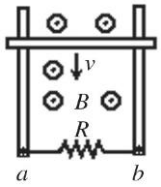
A) from *a* to *b*.
B) from *b* to *a*.
C) No current is induced.
Answer: C
Var: 1

36) As shown in the figure, one end of a metal bar is in contact with a circular rail and the other end is pivoted at P. A steady uniform, magnetic field *B* into the page is present. As the bar rotates about point P in a clockwise direction, the direction of the induced current through the resistor *R* is



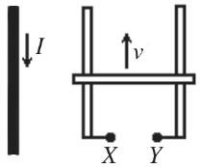
A) from *a* to *b*.
B) from *b* to *a*.
C) No current is induced.
Answer: B
Var: 1

37) As shown in the figure, a metal bar is in contact with a pair of metal parallel rails. A steady uniform magnetic field *B*, perpendicular to the plane of the rails and pointing outward from the page, is present. The bar is in downward motion with velocity of magnitude v. The direction of the induced current through the resistor *R* is



A) from *a* to *b*.
B) from *b* to *a*.
C) No current is induced.
Answer: A
Var: 1

38) As shown in the figure, a straight wire carries a steady current *I*. A metal bar is in contact with a pair of rails and is in upward motion with velocity of magnitude v. The polarity of the induced emf in terminals X and Y is



A) X and Y are at the same potential.
B) X is positive and Y is negative.
C) Y is positive and X is negative.
Answer: C
Var: 1

39) An ac generator consisting of a coil with *N* turns rotating at angular speed ω in an external magnetic field *B* produces a maximum emf ε_0.If you now decrease the number of turns in the coil to *N*/2 and at the same time cause it to rotate twice as fast, what will be the new maximum emf if you do not change any of the other quantities?
A) $4\varepsilon_0$
B) $2\varepsilon_0$
C) ε_0
D) $\varepsilon_0/2$
E) $\varepsilon_0/4$
Answer: C
Var: 1

40) A transformer is a device used to
A) transform an alternating current into a direct current.
B) transform a direct current into an alternating current.
C) increase or decrease an ac voltage.
D) increase or decrease a dc voltage.
Answer: C
Var: 1

41) A transformer is a device that normally
A) operates on either dc or ac.
B) operates only on ac.
C) operates only on dc.
Answer: B
Var: 1

42) If the secondary coil of a transformer contains more loops than the primary coil, then it is a
A) step-up transformer.
B) step-down transformer.
Answer: A
Var: 1

43) If the primary coil of a transformer contains more loops than the secondary coil then it is a
A) step-up transformer.
B) step-down transformer.
Answer: B
Var: 1

44) Coil A is close to, but not touching, coil B. If a steady counterclockwise 100-A current flows in coil A, what can you say about the induced current in coil B?
A) There will be no induced current in coil B.
B) The current in coil B will be equal to 100 A clockwise.
C) The current in coil B will be equal to 100 A counterclockwise.
D) The current in coil B will be counterclockwise and less than 100 A, but not zero.
E) The current in coil B will be clockwise and less than 100 A, but not zero.
Answer: A
Var: 1

45) An ideal solenoid has a self-inductance L. If you now double its radius and its length, but do not change the number of coils, what will its self-inductance be?
A) $4L$
B) $2L$
C) L
D) $L/2$
E) $L/4$
Answer: D
Var: 1

46) Inductors cannot store energy because they cannot store charge.
A) True
B) False
Answer: B
Var: 1

47) Inductors store energy by accumulating excess charge within their coils.
A) True
B) False
Answer: B
Var: 1

48) An inductor stores energy in its magnetic field.
A) True
B) False
Answer: A
Var: 1

49) A resistor and an inductor are connected in series to an ideal battery of constant terminal voltage. At the moment contact is made with the battery, the voltage across the resistor is
A) greater than the battery's terminal voltage.
B) equal to the battery's terminal voltage.
C) less than the battery's terminal voltage, but not zero.
D) zero.
E) equal to the voltage across the inductor.
Answer: D
Var: 1

50) A resistor and an inductor are connected in series to an ideal battery of constant terminal voltage. At the moment contact is made with the battery, the voltage across the inductor is
A) greater than the battery's terminal voltage.
B) equal to the battery's terminal voltage.
C) less than the battery's terminal voltage, but not zero.
D) zero.
E) equal to the voltage across the resistor.
Answer: B
Var: 1

51) A resistor and an inductor are connected in series to a battery. The time constant for the circuit represents the time required for the current to reach
A) 25% of the maximum current.
B) 37% of the maximum current.
C) 63% of the maximum current.
D) 75% of the maximum current.
E) 100% of the maximum current.
Answer: C
Var: 1

52) A resistor and an inductor are connected in series to a battery. The battery is suddenly removed from the circuit and replaced by a wire to complete the circuit. The time constant for of the new circuit represents the time required for the current to decrease to
A) 25% of the original value.
B) 37% of the original value.
C) 63% of the original value.
D) 75% of the original value.
E) zero.
Answer: B
Var: 1

53) A simple ac circuit is composed of a capacitor connected across the terminals of an ac power source. If the frequency of the source is doubled, what happens to the reactance of the capacitor?
A) It increases by a factor of 4.
B) It increases by a factor of 2.
C) It increases by a factor of $\sqrt{2}$
D) It decreases by a factor of 2.
E) It decreases by a factor of 4.
Answer: D
Var: 1

54) Consider a capacitor connected across the ac source. As the capacitance is increased, the current through the capacitor will
A) increase.
B) remain constant.
C) decrease.
Answer: A
Var: 1

55) A pure capacitor is connected to an ac power supply. In this circuit, the current
A) leads the voltage by 90°.
B) lags the voltage by 90°.
C) lags the voltage by 180°.
D) is in phase with the voltage.
E) None of the given answers are correct.
Answer: A
Var: 1

56) A pure inductor is connected to an ac power supply. In this circuit, the current
A) leads the voltage by 90°.
B) is in phase with the voltage.
C) lags the voltage by 45°.
D) lags the voltage by 90°.
E) leads the voltage by 45°.
Answer: D
Var: 1

57) A simple ac circuit consists of an inductor connected across the terminals of an ac power source. If the frequency of the ac source is decreased by a factor of four, what happens to the reactance of the inductor?
A) It decreases by a factor of four.
B) It decreases by a factor of eight.
C) It increases by a factor of two.
D) It increases by a factor of four.
E) It increases by a factor of eight.
Answer: A
Var: 1

58) As the frequency of the ac voltage across an inductor approaches zero, the inductive reactance of that coil
A) approaches zero.
B) approaches one.
C) approaches infinity.
D) becomes negative.
Answer: A
Var: 1

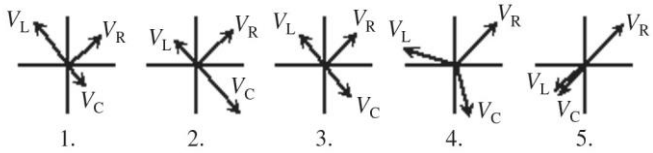
59) In a series *RLC* ac circuit, a second resistor is connected in series with the resistor previously in the circuit. As a result of this change, what happens to the impedance of the circuit?
A) It increases.
B) It decreases.
C) It does not change.
D) It increases for frequencies below resonance and decreases for frequencies above resonance.
E) It decreases for frequencies below resonance and increases for frequencies above resonance.
Answer: A
Var: 1

60) In a series *RLC* ac circuit, a second resistor is connected in parallel with the resistor previously in the circuit. As a result of this change, what happens to the impedance of the circuit?
A) It increases.
B) It decreases.
C) It does not change.
D) It increases for frequencies below resonance and decreases for frequencies above resonance.
E) It decreases for frequencies below resonance and increases for frequencies above resonance.
Answer: B
Var: 1

61) What is the phase angle between the voltages of the inductor and capacitor in a RLC series circuit?
A) 0°
B) 45°
C) 90°
D) 180°
E) 270°
Answer: D
Var: 1

62) Which of the following statements is true for a series *RLC* ac circuit in resonance? (There could be more than one correct choice).
A) The inductive reactance and the capacitive reactance are both equal to zero.
B) The inductive reactance is equal to the capacitive reactance.
C) The current in the circuit is a minimum.
D) The current in the circuit is a maximum.
E) The rms current is equal to the peak current.
Answer: B, D
Var: 1

63) In the figure, which of the phasor diagrams represents a series *RLC* circuit driven at resonance?



A) 1
B) 2
C) 3
D) 4
E) 5
Answer: C
Var: 1

64) In an *RLC* ac circuit, the values of the inductance and capacitance are both doubled. As a result of this change, the resonance frequency of the circuit is
A) the same as before.
B) reduced to one-half the original value.
C) reduced to one-fourth the original value.
D) twice the original value.
E) four times the original value.
Answer: B
Var: 1

65) In a *RLC* circuit, the values of the inductance and capacitance are both halved. As a result of this change, the resonance frequency of the circuit is
A) the same as before.
B) reduced to one-half the original value.
C) reduced to one-fourth the original value.
D) twice the original value.
E) four times the original value.
Answer: D
Var: 1

66) Consider a series circuit in which the capacitive reactance equals the inductive reactance. What is the phase angle between current and voltage for this circuit?
A) +180°
B) +90°
C) -180°
D) -90°
E) 0°
Answer: E
Var: 1

21.2 Problems

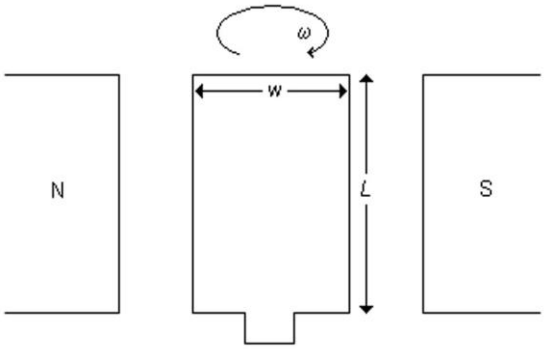
1) A flat circular loop of radius 0.10 m is rotating in a uniform magnetic field of 0.20 T. Find the magnetic flux through the loop when the plane of the loop and the magnetic field vector are parallel.
A) 0 $T \cdot m^2$
B) 3.1×10^{-3} $T \cdot m^2$
C) 5.5×10^{-3} $T \cdot m^2$
D) 6.3×10^{-3} $T \cdot m^2$
Answer: A
Var: 1

2) A flat circular loop of radius 0.10 m is rotating in a uniform magnetic field of 0.20 T. Find the magnetic flux through the loop when the plane of the loop and the magnetic field vector are perpendicular.
A) 0 $T \cdot m^2$
B) 3.1×10^{-3} $T \cdot m^2$
C) 5.5×10^{-3} $T \cdot m^2$
D) 6.3×10^{-3} $T \cdot m^2$
Answer: D
Var: 1

3) A flat circular loop of radius 0.10 m is rotating in a uniform magnetic field of 0.20 T. Find the magnetic flux through the loop when the plane of the loop and the magnetic field vector are at an angle of 30°.
A) 0 T · m^2
B) 3.1×10^{-3} T · m^2
C) 5.5×10^{-3} T · m^2
D) 6.3×10^{-3} T · m^2
Answer: B
Var: 1

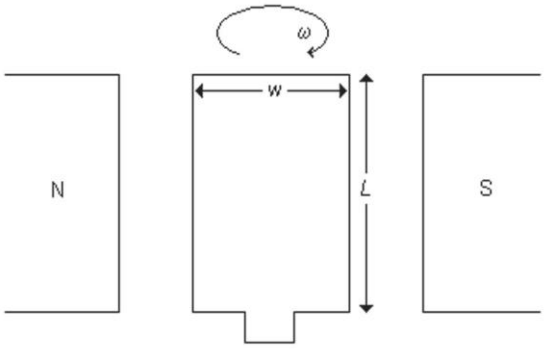
4) A 2.00-m long metal wire is formed into a square and placed in the horizontal *xy*-plane. A uniform magnetic field is oriented at 30° above the horizontal with a strength of 0.344 T. What is the magnetic flux through the square due to this field?
A) 0.0745 T · m^2
B) 0.172 T · m^2
C) 0.0430 T · m^2
D) 0.298 T · m^2
Answer: C
Var: 1

5) A rectangular loop of wire that can rotate about an axis through its center is placed between the poles of a magnet in a magnetic field with a strength of 0.40 T, as shown in the figure. The length of the loop *L* is 0.16 m and its width *w* is 0.040 m. What is the magnetic flux through the loop when the plane of the loop is perpendicular to the magnetic field?



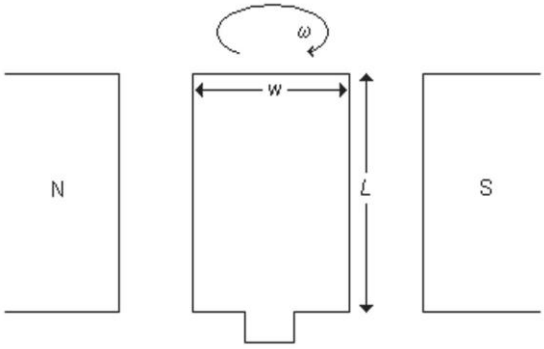
A) 13×10^{-3} T · m^2
B) 2.6×10^{3} T · m^2
C) 0.80 T · m^2
D) 2.6×10^{-3} T · m^2
E) 0 T · m^2
Answer: D
Var: 1

6) A rectangular loop of wire that can rotate about an axis through its center is placed between the poles of a magnet in a magnetic field with a strength of 0.40 T, as shown in the figure. The length of the loop *L* is 0.16 m and its width *w* is 0.040 m. What is the magnetic flux through the loop when the plane of the loop is parallel to the magnetic field?



A) 13×10^{-3} T · m^2
B) 2.6×10^{3} T · m^2
C) 0.80 T · m^2
D) 2.6×10^{-3} T · m^2
E) 0 T · m^2
Answer: E
Var: 1

7) A rectangular loop of wire that can rotate about an axis through its center is placed between the poles of a magnet in a magnetic field with a strength of 0.40 T, as shown in the figure. The length of the loop *L* is 0.16 m and its width *w* is 0.040 m. What is the magnetic flux through the loop when the plane of the loop makes an angle of 60° with the magnetic field?



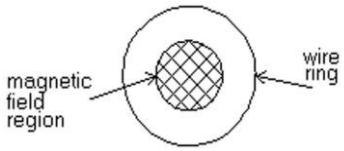
A) 2.6×10^{-3} T · m^2
B) 1.3×10^{-3} T · m^2
C) 0 T · m^2
D) 2.2×10^{-3} T · m^2
E) 0.80 T · m^2
Answer: D
Var: 1

8) A flat circular loop having one turn and radius 5.0 cm is positioned with its plane perpendicular to a uniform 0.60-T magnetic field. The area of the loop is suddenly reduced to essentially zero in 0.50 ms. What emf is induced in the loop?
Answer: 9.4 V
Var: 1

9) A flat coil having 40 turns, each one of cross-sectional area 12.0 cm^2, is oriented with its plane perpendicular to a uniform magnetic field. The field varies steadily from 0.00 T to 1.20 T in 20.0 ms. What emf is induced in the coil during this time?
Answer: 2.88 V
Var: 1

10) A flat circular coil having 16 turns, each of diameter 20 cm, is in a uniform and steady 0.13-T magnetic field.
(a) Find the total magnetic flux through the coil when the field is perpendicular to the plane of the coil.
(b) If the coil is rotated in 10 ms so its plane is parallel to the field, find the average induced emf in the coil.
Answer: (a) 0.065 $T \cdot m^2$ (b) 6.5 V
Var: 1

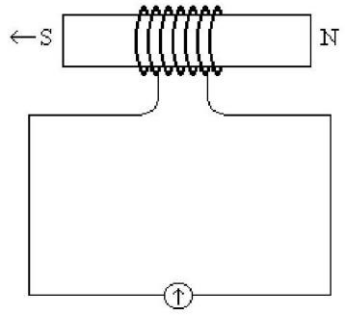
11) As shown in the figure, a uniform magnetic field *B* is confined to a cylindrical volume of radius 0.050 m. This field is directed into the plane of the page and is increasing at a constant rate of 0.900 T/s. Calculate the magnitude and direction (clockwise or counterclockwise) of the current induced in a circular wire ring of radius 0.16 m and resistance 7.1 Ω that encircles the magnetic field region.



Answer: 1.0×10^{-3} A, counterclockwise
Var: 50+

12) A flux of 4.0×10^{-5} $T \cdot m^2$ is maintained through a coil of area 7.5 cm^2 for 0.50 s. What emf is induced in this coil during this time by this flux?
A) 8.0×10^{-5} V
B) 4.0×10^{-5} V
C) 3.0×10^{-5} V
D) 2.0×10^{-5} V
E) No emf is induced in this coil.
Answer: E
Var: 1

13) A bar magnet is pushed through a coil of wire of cross-sectional area 0.020 m^2 as shown in the figure. The coil has seven turns, and the rate of change of the strength of the magnetic field in it due to the motion of the bar magnet is 0.040 T/s. What is the magnitude of the induced emf in that coil of wire?



A) 5.6×10^{-3} V
B) 5.6×10^{-2} V
C) 5.6×10^{-1} V
D) 5.6×10^{-4} V
E) 5.6×10^{-5} V
Answer: A
Var: 1

14) A circular conducting loop with a radius of 0.50 m and a small gap filled with a 10.0-Ω resistor is oriented in the xy-plane. If a uniform magnetic field of 1.0 T, making an angle of 30° with the z-axis, increases to 10.0 T, in 4.0 s, what is the magnitude of the current that will be caused to flow in the loop if it has negligible resistance?
A) 0.01530393 A
B) 0.08835729 A
C) 0.15303932 A
D) 0 A
Answer: C
Var: 50+

15) A closed flat loop conductor with radius 2.0 m is located in a changing uniform magnetic field. If the emf induced in the loop is 2.0 V, what is the rate at which the magnetic field strength is changing if the magnetic field is oriented perpendicular to the plane in which the loop lies?
A) 0.16 T/s
B) 1.0 T/s
C) 0.080 T/s
D) 2.0 T/s
Answer: A
Var: 9

16) A conductor is formed into a flat loop that encloses an area of $1.0\ m^2$. The plane of the loop is oriented at a 30.0° angle with the *xy*-plane. A uniform time-varying magnetic field is oriented parallel to the *z*-axis. If the emf induced in the loop is $25.0\ V$, what is the rate at which the magnetic field strength is changing?
A) 29 T/s
B) 22 T/s
C) 50 T/s
D) 13 T/s
Answer: A
Var: 50+

17) A circular coil of 20 turns and radius 5.0 cm is placed with its plane oriented at 90° to a uniform magnetic field of $0.10\ T$. The field is now increased at a steady rate, reaching a value of $0.50\ T$ after 4.0 seconds. What emf is induced in the coil?
A) 0.016 V
B) 0.021 V
C) 0.026 V
D) 0.031 V
E) 0.036 V
Answer: A
Var: 50+

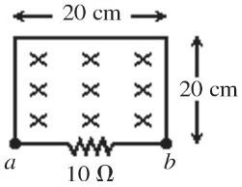
18) The magnetic flux through a coil changes steadily from $4.0 \times 10^{-5}\ T \cdot m^2$ to $5.0 \times 10^{-5}\ T \cdot m^2$ in 0.10 s. What emf is induced in this coil?
A) 5.0×10^{-4} V
B) 4.0×10^{-4} V
C) 1.0×10^{-4} V
D) None of the given answers are correct.
Answer: C
Var: 3

19) A flat coil is wrapped with 200 turns of very thin wire on a square frame with sides 18 cm long. A uniform magnetic field is applied perpendicular to the plane of the coil. If the field changes uniformly from 0.50 T to 0.00 T in 8.0 s, find the emf induced in the coil.
A) 2.1 mV
B) 4.1 mV
C) 0.21 V
D) 0.41 V
Answer: D
Var: 1

20) A flat square coil of wire with 15 turns and an area of 0.40 m^2 is placed with the plane of its area parallel to a magnetic field of 0.75 T. The coil is flipped so its plane is perpendicular to the magnetic field in a time of 0.050 s. What is the magnitude of the average induced emf in the coil?
A) 6.0 V
B) 36 V
C) 45 V
D) 90 V
Answer: D
Var: 1

21) A flat coil having 160 turns, each with an area of 0.20 m^2, is placed with the plane of its area perpendicular to a magnetic field of 0.40 T. The magnetic field changes uniformly from 0.40 T in the $+x$ direction to 0.40 T in the $-x$ direction in 2.0 s. If the resistance of the coil is 16 Ω, at what rate is power generated in the coil during this change?
A) 5.0 W
B) 10 W
C) 15 W
D) 20 W
Answer: B
Var: 1

22) As shown in the figure, a wire and a 10-Ω resistor are used to form a circuit in the shape of a square with dimensions 20 cm by 20 cm. A uniform but non-steady magnetic field is directed into the plane of the circuit. The magnitude of the magnetic field is steadily decreased from 2.70 T to 0.90 T in a time interval of 96 ms. What is the induced current in the circuit, and what is its direction through the resistor?



A) 75 mA, from *b* to *a*
B) 45 mA, from *b* to *a*
C) 75 mA, from *a* to *b*
D) 45 mA, from *a* to *b*
E) 110 mA, from *a* to *b*
Answer: A
Var: 50+

23) A round flat conducting loop is placed perpendicular to a uniform 0.50 T magnetic field. If the area of the loop increases at a rate of $3.0 \times 10^{-3}\ \text{m}^2/\text{s}$, what is the induced emf in the loop?
A) 4.3 mV
B) 0 mV
C) 1.5 mV
D) 1.7 mV
E) 5.5 mV
Answer: C
Var: 5

24) The area of a rectangular loop of wire is $3.6 \times 10^{-3}\ \text{m}^2$. The loop is placed in a uniform magnetic field that changes steadily from 0.20 T to 1.4 T in 1.6 s. The plane of the loop is perpendicular to the direction of the magnetic field. What is the magnitude of the induced emf in that loop?
A) 2.8×10^{-3} V
B) 2.7×10^{-3} V
C) 0 V
D) 1.8×10^{-3} V
E) 3.0×10^{-3} V
Answer: B
Var: 5

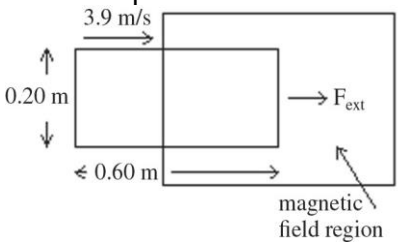
25) A constant uniform magnetic field of 0.50 T is applied at right angles to the plane of a flat rectangular loop of area $3.0 \times 10^{-3}\ \text{m}^2$. If the area of this loop changes steadily from its original value to a new value of $1.6 \times 10^{-3}\ \text{m}^2$ in 1.6 s, what is the emf induced in the loop?
A) 1.6×10^{-2} V
B) 0 V
C) 7.5×10^{-2} V
D) 4.4×10^{-4} V
E) 9.0×10^{-2} V
Answer: D
Var: 5

26) A flat rectangular coil with dimensions of 8.0 cm × 10 cm is dropped from a zero magnetic field position into a 1.4-T magnetic field in 0.10 s. The coil has 60 turns and is perpendicular to the magnetic field. What is the average induced emf in the coil as a result of this action?
A) 8.6 V
B) 2.4 V
C) 6.7 V
D) 3.6 V
E) 0 V
Answer: C
Var: 5

27) A single-turn loop of wire, having a resistance of 8.00 Ω and a cross-sectional area 200 cm^2, is perpendicular to a uniform magnetic field that increases steadily from 0.200 T to 2.800 T in 2.20 seconds. What is the magnitude of the induced current in the loop?
A) 2.95 A
B) 3.18 A
C) 0 A
D) 3.18 mA
E) 2.95 mA
Answer: E
Var: 1

28) A round flat metal coil has 180 turns and negligible resistance. It is connected in a series circuit with a 17-Ω resistor, with nothing else in the circuit. You measure that a 6.0-A current flows through the resistor when a magnetic field through the coil, perpendicular to its area, is changing at 3.0 T/s. What is the radius of the coil?
A) 0.25 m
B) 0.014 m
C) 0.54 m
D) 0.043 m
Answer: A
Var: 50+

29) As shown in the figure, a region of space contains a uniform magnetic field. The magnitude of this field is 2.8 T, and it is directed straight into the plane of the page in the region shown. Outside this region the magnetic field is zero. A rectangular loop measuring 0.20 m by 0.60 m and having a resistance of 2 Ω is being pulled into the magnetic field by an external force, as shown.
(a) What is the direction (clockwise or counterclockwise) of the current induced in the loop?
(b) Calculate the magnitude of the external force F_{ext} that is required to move the loop at a constant speed of 3.9 m/s.

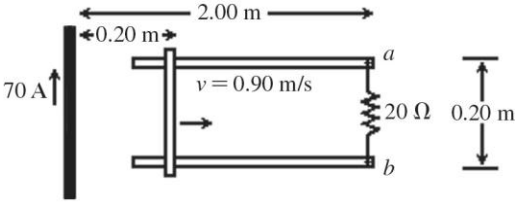


Answer: (a) counterclockwise (b) 6×10^{-1} N
Var: 50+

30) A airplane having a metal surface and a wingspan of 25.0 m flies horizontally at 200. m/s where the earth's magnetic field is vertical with magnitude 45.0 μT.
(a) What emf is induced across the wings?
(b) What wingspan would the plane need to produce 1.00-V emf across its wings?
(c) The plane now reverses direction. Does the polarity of the wingtip emf change? That is, if the left wing was positive before, does it now become negative?
Answer: (a) 0.225 V (b) 111. m (c) no polarity change
Var: 5

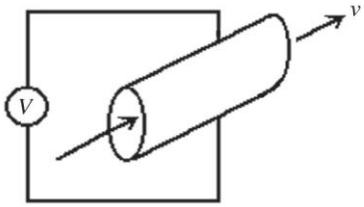
31) An eagle, with a wingspread of 2.0 m, flies toward the north at 8.0 m/s in a region where the vertical component of the earth's magnetic field is 0.20×10^{-4} T. What emf would be developed between the eagle's wing tips? (It has been speculated that this phenomenon could play a role in the navigation of birds, but the effect is too small, in all likelihood.)
Answer: 0.32 mV
Var: 1

32) A long vertical wire carries a steady 70 A current. As shown in the figure, a pair of horizontal rails are 0.20 m apart. A 20-Ω resistor connects points *a* and *b*, at the end of the rails. A bar is in contact with the rails, and is moved by an external force with a constant horizontal velocity of 0.90 m/s to the right, as shown. The bar and the rails have negligible resistance. At the instant that the bar is 0.20 m from the wire, what are the induced current in the resistor and its direction through the resistor? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)



A) 0.63 μA, from *a* to *b*
B) 0.63 μA, from *b* to *a*
C) 0.32 μA, from *a* to *b*
D) 0.32 μA, from *b* to *a*
E) 1.9 μA, from *b* to *a*
Answer: A
Var: 1

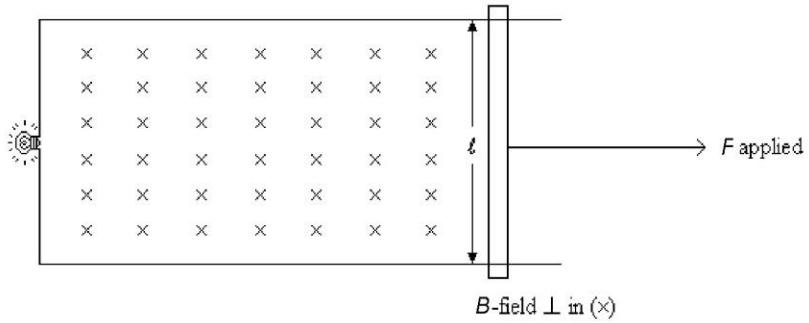
33) An electromagnetic flowmeter is useful when it is desirable not to interrupt the system in which the fluid is flowing (such as the blood in an artery during heart surgery). Such a device is illustrated in the figure. The conducting fluid moves with speed *v* in a tube of diameter *d*. Perpendicular to this tube is a magnetic field *B*. A voltage *V* is induced between opposite sides of the tube due to the motion of the conducting fluid in the magnetic field. For a certain case, *B* = 0.120 T, *d* = 1.2 cm, and the measured voltage is $V = 2.88\ \text{mV}$. Determine the speed of the fluid.



A) 2.0 m/s
B) 11 m/s
C) 0.075 m/s
D) 1.1 m/s
E) 750 m/s
Answer: A
Var: 50+

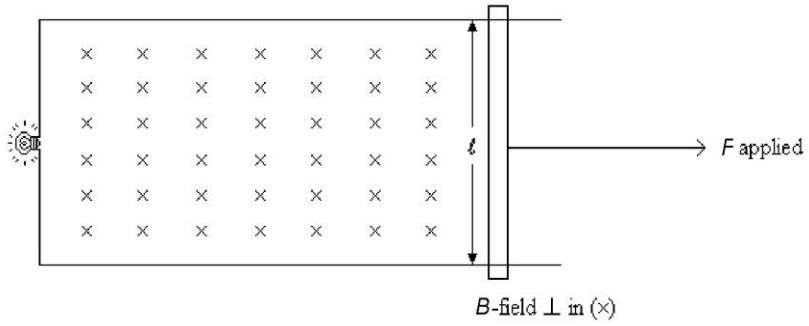
34) It is known that birds can detect the earth's magnetic field, but the mechanism of how they do this is not known. It has been suggested that perhaps they detect a motional emf as they fly north to south, but it turns out that the induced voltages are small compared to the voltages normally encountered in cells, so this is probably not the mechanism involved. To check this out, calculate the induced voltage across the wingtips of a wild goose with a wingspan of $1.2\ \text{m}$ if it is flying directly south at $13\ \text{m/s}$ at a point where the earth's magnetic field is 5.0×10^{-5} T directed downward from the horizontal by $40°$.
A) 0.50 mV
B) 0.60 mV
C) 0.78 mV
D) 0.060 mV
E) 0.25 mV
Answer: A
Var: 50+

35) A conducting rod of length ℓ= 25 cm is placed on a U-shaped metal wire that is connected to a lightbulb having a resistance of 8.0 Ω, as shown in the figure. The wire and the rod are in the plane of the page. A constant uniform magnetic field of strength 0.40 T is applied perpendicular to and into the paper. An applied external force pulls the rod to the right with a constant speed of 6.0 m/s. What is the magnitude of the emf induced in the rod?



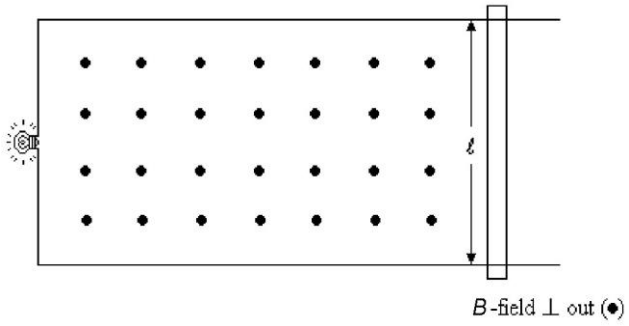
A) 0.20 V
B) 0.30 V
C) 0.40 V
D) 0.50 V
E) 0.60 V
Answer: E
Var: 1

36) A conducting rod with a length ℓ = 25 cm is placed on a U-shaped metal wire that is connected to a lightbulb having a resistance of 8.0 Ω as shown in the figure. The wire and the rod are in the plane of the page. A constant uniform magnetic field of strength 0.40 T is applied perpendicular to and into the paper. An external applied force moves the rod to the right with a constant speed of 6.0 m/s. What are the magnitude and direction of the induced current in the circuit?



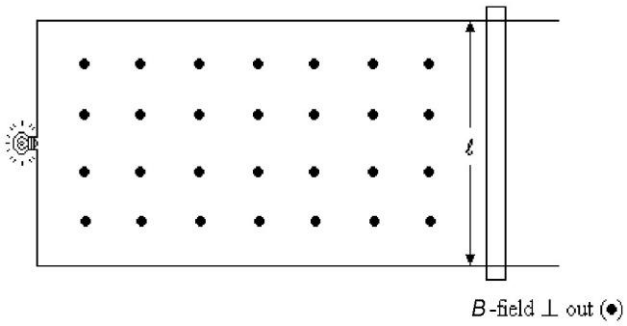
A) 17 mA clockwise
B) 17 mA counterclockwise
C) 75 mA counterclockwise
D) 75 mA clockwise
E) 52 mA clockwise
Answer: C
Var: 1

37) A conducting rod whose length is ℓ = 25 cm is placed on a U-shaped metal wire that is connected to a lightbulb having a resistance of 8.0 Ω as shown in the figure. The wire and the rod are in the plane of the page. A constant uniform magnetic field of strength 0.40 T is applied perpendicular to and out of the paper. An external applied force moves the rod to the left with a constant speed of 12 m/s. What are the magnitude and direction of the induced current in the



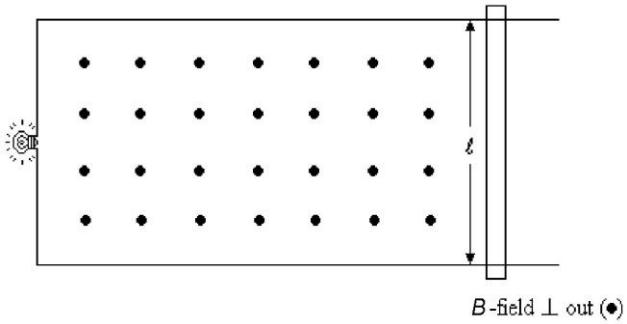
circuit?
A) 150 mA clockwise
B) 150 mA counterclockwise
C) 34 mA counterclockwise
D) 34 mA clockwise
E) 100 mA clockwise
Answer: B
Var: 1

38) A conducting rod whose length is ℓ = 1.60 m is placed on frictionless U-shaped metal rails that is connected to a lightbulb having a resistance of 4.00 Ω as shown in the figure. The rails and the rod are in the plane of the page. A constant uniform magnetic field of strength 2.20 T is applied perpendicular to and out of the paper. What is the magnitude of the external applied force needed to move the rod to the right with a constant speed of 6.00 m/s?



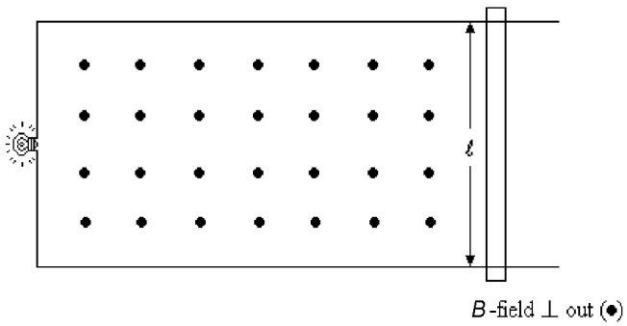
A) 8.60 N
B) 9.30 N
C) 10.6 N
D) 12.6 N
E) 18.6 N
Answer: E
Var: 1

39) A conducting rod whose length is ℓ = 1.60 m is placed on frictionless U-shaped metal rails that is connected to a lightbulb having a resistance of 4.00 Ω as shown in the figure. The rails and the rod are in the plane of the page. A constant uniform magnetic field of strength 2.20 T is applied perpendicular to and out of the paper. An external applied force moves the rod to the right with a constant speed of 6.00 m/s. At what rate is energy dissipated in the lightbulb?



A) 60.0 W
B) 121 W
C) 21.2 W
D) 112 W
E) 11.5 W
Answer: D
Var: 1

40) A conducting rod whose length is ℓ = 27.0 cm is placed on frictionless U-shaped metal rails that is connected to a lightbulb having a resistance of 5.00 Ω as shown in the figure. The rails and the rod are in the plane of the page. A constant uniform magnetic field of strength 1.20 T is applied perpendicular to and out of the paper. An external applied force moves the rod to the right with a constant speed. At what speed should the rod be pulled so that the lightbulb will consume energy at a rate of 1.10 W?



A) 2.00 m/s
B) 3.50 m/s
C) 4.26 m/s
D) 6.00 m/s
E) 7.24 m/s
Answer: E
Var: 1

41) You wish to construct a simple ac generator with a maximum output of 12 V when rotated at 60 Hz. A magnetic field of 0.050 T is available. If the area of the rotating coil is 100 cm^2, how many turns are needed?
Answer: 64
Var: 1

42) You are designing an ac generator with a maximum emf of 8.0 V. If the generator coil has 200 turns, each with a cross-sectional area of 0.030 m^2, what should be the frequency of the generator in a magnetic field of 0.030 T?
A) 7.1 Hz
B) 7.5 Hz
C) 8.0 Hz
D) 44 Hz
Answer: A
Var: 1

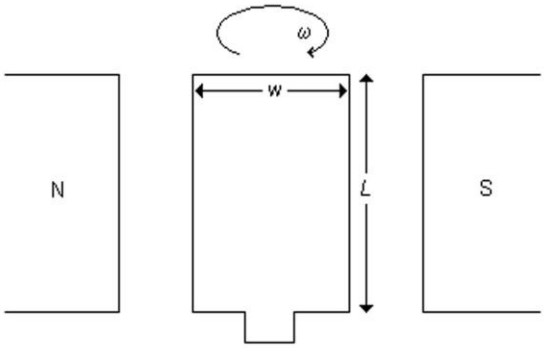
43) The coil of an ac generator has 50 loops and a cross-sectional area of 0.25 m^2. What is the maximum emf that can be generated by this generator if it is spinning with an angular speed of 4.0 rad/s in a 2.0-T magnetic field?
A) 50 V
B) 100 V
C) 200 V
D) 400 V
Answer: B
Var: 3

44) An ac generator consists of 100 loops of wire, each of area 0.090 m^2, and has a *total* resistance 12 Ω. The loops rotate about a diameter in a magnetic field of 0.50 T at a constant angular speed of 60 revolutions per second. Find the maximum induced emf in the generator.
A) 0.27 kV
B) 0.54 kV
C) 1.7 kV
D) 3.4 kV
Answer: C
Var: 1

45) An ac generator contains 80 flat rectangular loops of wire, each of which is 12 cm long and 8 cm wide. The loops rotate at 1200 rpm about an axis through the center and parallel to the long side. If the magnetic field in which the loop rotates is uniform, has magnitude 0.30 T, and is perpendicular to the axis of rotation, what will be the maximum output voltage of this generator?
A) 20 V
B) 27 V
C) 29 V
D) 35 V
Answer: C
Var: 1

46) An ac generator with a *total* resistance of 12 Ω contains 100 flat loops of wire, each with an area of 0.090 m^2. The loops rotate at 60 rev/s in a magnetic field of magnitude 0.50 T. What is the maximum possible induced current?
A) 23 A
B) 46 A
C) 0.14 kA
D) 0.28 kA
Answer: C
Var: 1

47) A rectangular coil of *N* turns, length *L* = 25 cm, and width *w* = 15 cm, as shown in the figure, is rotating in a magnetic field of 1.6 T with a frequency of 75 Hz. If the coil develops a maximum emf 56.9 V, what is the value of *N*?



A) 2
B) 4
C) 6
D) 8
E) 10
Answer: A
Var: 1

48) A circular coil with 600 turns has a radius of 15 cm. The coil is rotating about an axis perpendicular to a magnetic field of 0.020 T. If the maximum induced emf in the coil is 1.6 V, at what angular frequency is the coil rotating?
A) 0.30 rad/s
B) 0.60 rad/s
C) 0.90 rad/s
D) 1.4 rad/sec
E) 1.9 rad/s
Answer: E
Var: 1

49) The primary coil of an ideal transformer has 100 turns and its secondary coil has 400 turns. If the ac voltage applied to the primary coil is 120 V, what voltage is present in its secondary coil?
A) 100 V
B) 30 V
C) 70 V
D) 480 V
E) 400 V
Answer: D
Var: 1

50) An ideal transformer has 60 turns on its primary coil and 300 turns on its secondary coil. If 120 V at 2.0 A is applied to the primary,
(a) what voltage is present in the secondary?
(b) what current is present in the secondary?
Answer: (a) 240 V (b) 0.40 A
Var: 1

51) An ideal step-up transformer doubles a primary voltage of 110 V. What is the ratio of the number of turns in its primary coil to the number of turns in the secondary coil?
A) 1:4
B) 4:1
C) 2:1
D) 1:2
E) 1:8
Answer: D
Var: 1

52) When 5.0 A at 110 V flows in the primary of an ideal transformer, how many amps at 24 V can flow in the secondary?
A) 1.1 A
B) 4.6 A
C) 5.0 A
D) 23 A
Answer: D
Var: 1

53) The secondary coil of an ideal neon sign transformer provides 7500 V at 10.0 mA. The primary coil operates on 120 V. What current does the primary draw?
A) 0.625 A
B) 0.625 mA
C) 0.160 A
D) 1.66 A
Answer: A
Var: 1

54) The primary coil of an ideal transformer has 100 turns and its secondary coil has 400 turns. If the ac current in the secondary coil is 2 A, what is the current in its primary coil?
A) 2 A
B) 8 A
C) 1/2 A
D) 1/4 A
E) 4 A
Answer: B
Var: 1

55) The primary coil of an ideal transformer has 600 turns and its secondary coil has 150 turns. If the current in the primary coil is 2 A, what is the current in its secondary coil?
A) 8 A
B) 1/2 A
C) 1/4 A
D) 2 A
E) 4 A
Answer: A
Var: 1

56) A current of 2.0 A in the 100-turn primary of an ideal transformer causes 14 A to flow in the secondary. How many turns are in the secondary?
A) 700
B) 114
C) 14
D) 4
Answer: C
Var: 1

57) In an ideal transformer, how many turns are necessary in a 110-V primary if the 24-V secondary has 100 turns?
A) 458
B) 240
C) 110
D) 22
Answer: A
Var: 1

58) An ideal transformer consists of a 500-turn primary coil and a 2000-turn secondary coil. If the current in the secondary is 3.0 A, what is the current in the primary?
A) 0.75 A
B) 1.3 A
C) 12 A
D) 48 A
Answer: C
Var: 1

59) An ideal step-down transformer is needed to reduce a primary voltage of 120 V to 6.0 V. What must be the ratio of the number of turns in the secondary to the number of turns in the primary?
Answer: 1 to 20
Var: 1

60) An ideal transformer steps down 120 V to 12. V and the 2630.-turn secondary supplies 12. A.
(a) Determine the current in the primary.
(b) Determine the turns ratio.
(c) What is the ratio of output power to input power?
Answer: (a) 1.2 A (b) 1.0:10. (c) 1:1 for ideal transformer
Var: 5

61) An ideal transformer with 120 turns in its secondary supplies 12 V at 220 mA to a toy train. The primary is connected across a 120-V wall outlet.
(a) How many turns are in the primary?
(b) What is the primary current?
(c) What power is delivered by the wall outlet?
Answer: (a) 1200 (b) 22 Ma (c) 2.6 W
Var: 1

62) An ideal transformer has 60 turns on its primary coil and 300 turns on its secondary coil. If 120 V at 2.0 A is applied to the primary, what voltage and current are present in the secondary?
Answer: 600 V, 0.40 A
Var: 1

63) You need an ideal transformer to reduce a voltage of 150 V in the primary circuit to 25 V in the secondary circuit. The primary circuit has 130 windings and the secondary circuit is completed through a 55-Ω resistor. How many windings should the secondary circuit contain?
Answer: 22
Var: 1

64) The primary of an ideal transformer has 100 turns and its secondary has 200 turns. If the input current at the primary is 100 A, we can expect the output current at the secondary to be
A) 50 A.
B) 100 A.
C) 200 A.
D) none of the given answers.
Answer: A
Var: 1

65) The primary of an ideal transformer has 100 turns and its secondary has 200 turns. If the input voltage to the primary is 100 V, we can expect the output voltage of the secondary to be
A) 50 V.
B) 100 V.
C) 200 V.
D) none of the given answers.
Answer: C
Var: 1

66) The primary of an ideal transformer has 100 turns and its secondary has 200 turns. Neglecting frictional losses, if the power input to the primary is 100 W, we can expect the power output of the secondary to be
A) 50 W.
B) 100 W.
C) 200 W.
D) none of the given answers.
Answer: B
Var: 1

67) A generator produces 60 A of current at 120 V. The voltage is usually stepped up to 4500 V by an ideal transformer and transmitted through a power line of total resistance 1.0 Ω. Find the number of turns in the secondary if the primary has 200 turns.
A) 5
B) 200
C) 4500
D) 7500
Answer: D
Var: 1

68) The mutual inductance between two coils is 10 mH. The current in the first coil changes uniformly from 2.7 A to 5.0 A in 160 ms. If the second coil has a resistance of 0.60 Ω, what is the magnitude of the induced current in the second coil?
Answer: 0.24 A
Var: 1

69) A 73-mH solenoid inductor is wound on a form that is 0.80 m long and 0.10 m in diameter. A coil having a resistance of 7.7 Ω is tightly wound around the solenoid at its center. The mutual inductance of the coil and solenoid is 19 μH. At a given instant, the current in the solenoid is 820 mA and is decreasing at the rate of 2.5 A/s. At the given instant, what is the induced current in the coil?
A) 6.2 μA
B) 4.9 μA
C) 7.4 μA
D) 8.6 μA
E) 9.9 μA
Answer: A
Var: 50+

70) What is the self-inductance of an ideal solenoid that is 300 cm long with a cross-sectional area of 1.00×10^{-4} m^2 and has 1000 turns of wire? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 4.19 nH
B) 4.19 pH
C) 4.19 μH
D) 41.9 nH
E) 41.9 μH
Answer: E
Var: 1

71) A coil with a self-inductance of 6.0 H has a constant current of 2.0 A flowing through it for 2.0 s. What is the emf induced in this coil?
A) 6.0 V
B) 12 V
C) 0.0 V
D) 4.0 V
E) 8.0 V
Answer: C
Var: 1

72) A coil with a self-inductance of 6.0 H is connected to a dc battery through a switch. As soon as the switch is closed, the rate of change of current is 2.0 A/s. What is the emf induced in this coil at this instant?
A) 6.0 V
B) 3.0 V
C) 12 V
D) 0.33 V
E) 0.0 V
Answer: C
Var: 1

73) The inductance of a solenoid that is 16.0 cm long and has a cross-sectional area of 1.00×10^{-4} m^2 is 1.00 mH. How many turns of wire does this solenoid have? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 318,000
B) 159,000
C) 1130
D) 282
E) 150
Answer: C
Var: 5

74) The figure shows a solenoid having no appreciable resistance. When the current in this solenoid is decreasing at a rate of 5.5 A/s, the self-induced emf in the solenoid is measured to be 9.5 V.
((a) What is the self-inductance of this solenoid?
(b) If the current is in the direction from *b* to *a* in the figure, which point, *a* or *b*, is at higher potential?

Answer: (a) 1.7 H (b) point *b*
Var: 50+

75) The current flowing through a circuit is changing at a rate of 6.0 A/s. If the circuit contains a 190-H inductor, what is the emf across the inductor?
A) 1100 V
B) 11 mV
C) 32 mV
D) 32 V
Answer: A
Var: 1

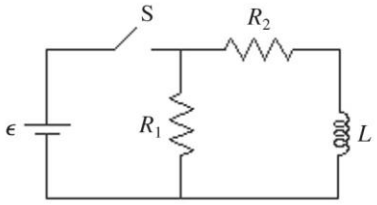
76) An ideal solenoid with 3000 turns is 70.0 cm long. If its self-inductance is 25.0 mH, what is its radius? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 0.0222 m
B) 0.00199 m
C) 327 m
D) 52.0 m
Answer: A
Var: 1

77) You need an inductor that will store 20 J of energy when a 3.0-A current flows through it. What should be its self-inductance?
A) 4.4 H
B) 90 H
C) 60 H
D) 3.7 H
Answer: A
Var: 1

78) A 4.0-mH coil carries a current of 5.0 A. How much energy is stored in its magnetic field?
A) 2.0 mJ
B) 10 mJ
C) 20 mJ
D) none of the given answers
Answer: D
Var: 1

79) A large electromagnet has a 22 T magnetic field between its poles. What is the magnetic energy density in that region of space? ($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)
A) 190 J/cm^3
B) 88 J/cm^3
C) 240 J/cm^3
D) 30,000 J/cm^3
Answer: A
Var: 11

80) The figure shows a circuit. The ideal battery has a constant terminal voltage of ε = 27 V, the inductance is $L = 0.40$ H, and the resistances are $R_1 = 12\ \Omega$ and $R_2 = 9.0\ \Omega$. Initially the switch S is open with no currents flowing. Then the switch is suddenly closed.
(a) What is the current in the resistor R_1 the instant after the switch is closed?
(b) After leaving the switch has been closed for a very long time, it is opened again. Just after it is opened, what is the current in R_1?



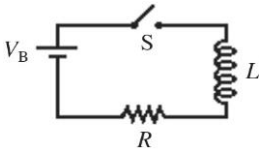
Answer: (a) 2.3 A (b) 3.0 A
Var: 50+

81) A series circuit contains a 1.0-k Ω resistor, a 5.0-mH inductor, and an ideal 25-V power supply. What is the time constant for the circuit?
A) 5.0 μs
B) 5.0 s
C) 1.6 μs
D) 1.6 s
Answer: A
Var: 1

82) A simple series circuit contains a 6.0-Ω resistor, an ideal 15-V DC power supply, and an 18-H inductor. What the time constant of this circuit?
A) 110 s
B) 3.0 s
C) 0.33 s
D) None of the given answers are correct.
Answer: B
Var: 1

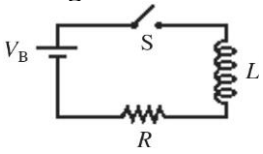
83) What resistance should be added in series with a 6.0 H inductor to give a circuit with a time constant of $3.0\,\text{ms}$?
A) 2.0 kΩ
B) 18 Ω
C) 2.0 Ω
D) 2.9 Ω
Answer: A
Var: 28

84) The series circuit shown in the figure contains an ideal battery with a constant terminal voltage $V_B = 60\,\text{V}$, an ideal inductor $L = 50\,\text{H}$, a resistor $R = 11\,\text{ohm}$ resistor, and a switch S. Initially, the switch is open, and there is no current in the inductor. At time $t = 0\,\text{s}$, the switch is suddenly closed. What is the current in the circuit $4.09\,\text{s}$ after closing the switch?



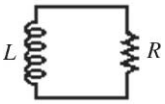
A) 3.2 A
B) 2.7 A
C) 2.2 A
D) 4.3 A
E) 5.5 A
Answer: A
Var: 50+

85) The series circuit shown in the figure contains an ideal battery with a constant terminal voltage $V_B = 60\,\text{V}$, an ideal inductor $L = 42\,\text{H}$, a resistor $R = 24\,\text{ohm}$ resistor, and a switch S.Initially, the switch is open, and there is no current in the inductor. At time $t = 0\,\text{s}$, the switch is suddenly closed. What is the current in the circuit when the voltage across the resistor is equal to the voltage across the inductor?



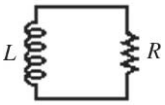
A) 1.3 A
B) 0.50 A
C) 1.0 A
D) 0.75 A
E) 1.5 A
Answer: A
Var: 50+

86) As shown in the figure, a circuit consists of a resistor $R = 17\,\Omega$ in series with an ideal inductor $L = 49\,\text{H}$ having no resistance. At time t = 0 s, there is a 12-A current in the circuit. At that instant, what is the rate of change of the current?



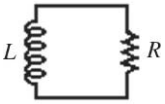
A) -4.2 A/s
B) -12 A/s
C) -19 A/s
D) -27 A/s
E) -35 A/s
Answer: A
Var: 50+

87) As shown in the figure, a circuit consists of a resistor $R = 18\,\Omega$ in series with an ideal inductor $L = 33\,\text{H}$ having no resistance. At time t = 0 s, there is a 12-A current in the circuit. When the magnetic energy of the inductor is 1600 J, what is the rate of dissipation of energy in the resistor?



A) 1700 W
B) 440 W
C) 870 W
D) 1300 W
E) 2200 W
Answer: A
Var: 50+

88) As shown in the figure, a circuit consists of a resistor $R = 22\,\Omega$ in series with an ideal inductor $L = 31\,\text{H}$ having no resistance. At time $t = 0\,\text{s}$, there is a 12-A current in the circuit. At time $t = 5.0\,\text{s}$, what is the emf across the inductor?



A) 7.6 V
B) 7.0 V
C) 6.3 V
D) 8.2 V
E) 8.9 V
Answer: A
Var: 50+

89) A 25-mH inductor is connected in series with a 20-Ω resistor through an ideal 15-V dc power supply and a switch. If the switch is closed at time $t = 0$ s, what is the current when $t = 2.0$ ms?
A) 0.40 A
B) 0.50 A
C) 0.60 A
D) 0.70 A
E) 0.80 A
Answer: C
Var: 1

90) A 45-mH inductor is connected in series with a 60-Ω resistor through an ideal 15-V dc power supply and an open switch. What is the current 7.0 ms after closing the switch?
A) 250 mA
B) 650 mA
C) 550 mA
D) 280 mA
E) 850 mA
Answer: A
Var: 5

91) In a series circuit containing a resistor and an inductor connected to an ideal dc source and a switch, the inductor gets 40% of its maximum current 1.8 s after the switch is closed. What is the time constant of this circuit?
A) 0.80 s
B) 1.5 s
C) 2.5 s
D) 3.5 s
E) 5.5 s
Answer: D
Var: 1

92) A 1.50-H inductor is connected in series with a 200-Ω resistor through an ideal 15.0-V dc power supply and an open switch. How much energy is contained in the inductor 20.0 ms after closing the switch?
A) 0.910 mJ
B) 1.83 mJ
C) 3.65 mJ
D) 7.31 mJ
E) 5.48 mJ
Answer: C
Var: 1

93) A 1.5-H inductor is connected in series with a 200-Ω resistor through an ideal 15-V dc power supply and an open switch. After closing the, what is the maximum energy that will be contained in the inductor?
A) 1.2 mJ
B) 2.2 mJ
C) 3.2 mJ
D) 4.2 mJ
E) 5.2 mJ
Answer: D
Var: 1

94) A series circuit consists of an open switch, an ideal emf source $\varepsilon 0$, a $5.0\text{-k}\Omega$ resistor, and a 4.0-H inductor. If the potential across the resistor is 65.0 V at 2.0 ms after the switch is closed, find the source emf, $\varepsilon 0$.
A) 71 V
B) 36 V
C) 76 V
D) 56 V
Answer: A
Var: 50+

95) American power plants usually supply 120 V ac.
(a) At what frequency is this voltage supplied?
(b) What is the maximum voltage?
Answer: (a) 60 Hz (b) 170 V (120 V is the rms voltage)
Var: 1

96) A 100-W light bulb is powered by 120 V ac 60.0-Hz household connection. Determine the rms current and the current amplitude.
Answer: 0.833 A rms, 1.18 A amplitude
Var: 1

97) The peak current and voltage outputs of a generator are 20 A and 240 V, respectively. What average power is provided by the generator?
Answer: 2.4 kW
Var: 1

98) The potential applied to a 20-Ω resistor is $v = (60\text{ V})\cos(33t)$. What is the rms current through this resistor?
Answer: 2.1 A
Var: 1

99) The current through a 50-Ω resistor is $I = (0.80\text{ A})\sin(240t)$. What are (a) the current amplitude and (b) the rms current?
Answer: (a) 0.80 A (b) 0.57 A
Var: 1

100) A 0.150-kW lamp is plugged into a 120-V ac wall outlet. What are (a) the peak current through the lamp, (b) the rms current through the lamp, and (c) the resistance of the lamp?
Answer: (a) 1.77 A (b) 1.25 A (c) 96.0 Ω
Var: 1

101) The potential applied to a 20-Ω resistor is (60 V) cos(33*t*). What is the average power consumed in the resistor?
Answer: 90 W
Var: 1

102) If the maximum voltage of an ac signal is 8.0 V, what is the rms value of this voltage?
A) 2.8 V
B) 5.7 V
C) 6.2 V
D) 4.0 V
E) 16.0 V
Answer: B
Var: 1

103) A 120-V rms voltage at 60.0 Hz is applied across an inductor, capacitor and a 100-Ω resistor in series. If the maximum value of the current in this circuit is 1.60 A, what is the rms value of the current in this circuit?
A) 1.13 A
B) 2.26 A
C) 1.82 A
D) 1.60 A
E) 2.66 A
Answer: A
Var: 1

104) An alternating current is supplied to an electronic component with a rating that the voltage across it can *never*, even for an instant, exceed 16 V. What is the highest rms voltage that can be supplied to this component while staying below the voltage limit?
A) $8\sqrt{2}$ V
B) $16\sqrt{2}$ V
C) 256 V
D) 8 V
Answer: A
Var: 11

105) What is the peak voltage in an ac circuit where the rms voltage is 120 V?
A) 84.8 V
B) 120 V
C) 170 V
D) 240 V
Answer: C
Var: 1

106) A 150-W lamp is placed into a 120-V ac outlet. What is the peak current?
A) 0.80 A
B) 0.88 A
C) 1.2 A
D) 1.8 A
Answer: D
Var: 1

107) A 10-Ω resistor is connected to a 120-V ac power supply. What is the peak current through the resistor?
A) 12 A
B) 17 A
C) 0.083 A
D) 0.12 A
Answer: B
Var: 1

108) The current through a 50-Ω resistor is $I = (0.80\text{ A})\sin(240t)$, where t is measured in seconds. What is the rms current?
A) 0.57 A
B) 0.80 A
C) 1.1 A
D) 1.6 A
Answer: A
Var: 1

109) The current through a 50-Ω resistor is $I = (0.80\text{ A})\sin(240t)$, where t is measured in seconds. How much power on average is dissipated in the resistor?
A) 16 W
B) 32 W
C) 45 W
D) 64 W
Answer: A
Var: 1

110) At what frequency does a 10-μF capacitor have a reactance of 0.12 kΩ?
Answer: 0.13 kHz
Var: 1

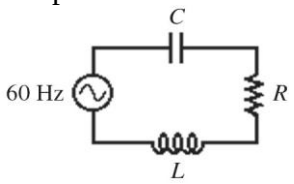
111) At what frequency will the inductive reactance of a 44-mH inductor be equal to the capacitive reactance of a 27-pF capacitor?
Answer: 0.15 MHz
Var: 1

112) A 0.10-μF capacitor is connected to a 120-V rms 60-Hz source.
(a) What is its capacitive reactance?
(b) What is the rms current to the capacitor?
(c) If both the capacitance and the frequency were doubled, what would be the rms current?
Answer: (a) 27 kΩ (b) 4.5 mA (c) 18 mA
Var: 1

113) A 0.200-H inductor is connected to a 60.0-Hz 120-V rms source.
(a) What is the inductive reactance?
(b) What is the rms current to the inductor?
(c) If both the inductance and the frequency were doubled, what would be the rms current?
Answer: (a) 75.4 Ω (b) 1.59 A (c) 0.398 A
Var: 1

114) What capacitance will have the same reactance as a 100-mH inductance of both of them are in a 120-V 60-Hz circuit?
Answer: 70 μF
Var: 1

115) In the circuit shown in the figure, the 60-Hz ac source has a voltage amplitude of 120 V, the capacitive reactance is $820\ \Omega$, the inductive reactance is $330\ \Omega$, and the resistance is $550\ \Omega$. What is the capacitance *C* of the capacitor?



A) 3.2 μF
B) 6.3 μF
C) 9.4 μF
D) 13 μF
E) 20 μF
Answer: A
Var: 50+

116) The reactance of a capacitor is $4.0\ \text{k}\Omega$ at a frequency of $0.60\ \text{kHz}$. What is the capacitance?
A) 0.066 μF
B) 0.42 μF
C) 2.6 μF
D) 0.093 μF
Answer: A
Var: 50+

117) A 6.0-μF capacitor is connected to an ac signal with a frequency of 60 Hz. If the maximum voltage applied to the capacitor is 8.0 V, what is its capacitive reactance?
A) 6.0 Ω
B) 440 Ω
C) 7.5×10^{-6} Ω
D) 740 Ω
E) 160 Ω
Answer: B
Var: 5

118) The capacitive reactance of a 44-μF capacitor in an ac circuit is 6.0×10^{2} Ω. What is the frequency of the applied signal?
A) 80 Hz
B) 17 Hz
C) 800 Hz
D) 6.0 Hz
E) 2.2 Hz
Answer: D
Var: 5

119) A 120-V rms voltage is applied across a 6.0-μF capacitor. If the frequency of the generator is 60 Hz, what is the rms value of the current in the circuit?
A) 0.47 A
B) 0.37 A
C) 0.071 A
D) 0.17 A
E) 0.27 A
Answer: E
Var: 1

120) At what frequency does a 10-μF capacitor have a reactance of 1200 Ω?
A) 13 Hz
B) 42 Hz
C) 60 Hz
D) 83 Hz
Answer: A
Var: 1

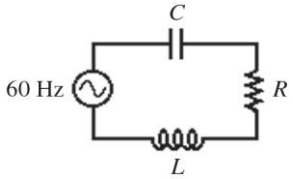
121) At what frequency will the capacitive reactance of a 0.010-μF capacitor be 100 Ω?
A) 1.0 kHz
B) 16 kHz
C) 0.16 MHz
D) 0.31 MHz
Answer: C
Var: 1

122) What is the rms current through a 0.0010-μF capacitor at 1000 Hz and 5.0 V?
A) 5.4 μA
B) 31 μA
C) 3.1 mA
D) 10 mA
Answer: B
Var: 1

123) What is the reactance of a 20-mH inductor at a frequency of 60 Hz?
A) 7.5 Ω
B) 0.13 Ω
C) 1.2 Ω
D) 1.2 mΩ
E) 7.5 mΩ
Answer: A
Var: 1

124) At what frequency is the reactance of a 20.0-mH inductor equal to 120 Ω?
A) 318 Hz
B) 637 Hz
C) 796 Hz
D) 955 Hz
E) 1110 Hz
Answer: D
Var: 1

125) In the circuit shown in the figure, the 60-Hz ac source has a voltage amplitude of 120 V, the capacitive reactance is $750\ \Omega$, the inductive reactance is $290\ \Omega$, and the resistance is $500\ \Omega$. What is the inductance L of the inductor?



A) 770 mH
B) 1700 mH
C) 2900 mH
D) 3700 mH
E) 4800 mH
Answer: A
Var: 50+

126) What is the reactance of a 1.0-mH inductor at 60 Hz?
A) 0.19 Ω
B) 0.38 Ω
C) 2.7 Ω
D) 5.3 Ω
Answer: B
Var: 1

127) What is the inductive reactance of a 2.50-mH coil at 1000 Hz?
A) 2500 Ω
B) 796 Ω
C) 15.7 Ω
D) 2.50 Ω
Answer: C
Var: 1

128) At what frequency will a 14.0-mH coil have 14.0 Ω of inductive reactance?
A) 1000 Hz
B) 505 Hz
C) 257 Hz
D) 159 Hz
Answer: D
Var: 1

129) The inductor in a radio receiver carries a current of amplitude 0.200 A when an ac voltage of amplitude 2.40 V is across it at a frequency of 1400 Hz. What is the value of the inductance?
A) 1.43 mH
B) 1.36 mH
C) 9.20 mH
D) 4.42 mH
E) 1.97 mH
Answer: B
Var: 1

130) At what frequency will a 20.0-mH inductor have an inductive reactance of 100 Ω?
A) 225 Hz
B) 655 Hz
C) 796 Hz
D) 457 Hz
E) None of the other answers is correct.
Answer: C
Var: 1

131) What rms current flows in a 60-mH inductor when 120-V rms ac at a frequency of 20 kHz is applied to it?
A) 8.0 mA
B) 16 mA
C) 24 mA
D) 32 mA
Answer: B
Var: 1

132) What is the rms current through a 2.50-mH coil due to a 110-V rms, 60-Hz source?
A) 0.94 A
B) 2.5 A
C) 104 A
D) 117 A
Answer: D
Var: 1

133) A series ac circuit has a resistance of 4.0 Ω, a capacitive reactance of $26\,\Omega$, and an inductive reactance of $17\,\Omega$. Find the impedance of the circuit.
A) 9.8 Ω
B) 31 Ω
C) 13 Ω
D) 47 Ω
Answer: A
Var: 50+

134) For a series ac circuit consisting of a resistance of $13.0\,\text{k}\Omega$, a capacitance of $7.0\,\mu\text{F}$, and an inductance of $35.0\,\text{H}$, what frequency is needed to minimize the impedance if the voltage amplitude is 110 V?
A) 0.010 kHz
B) 0.064 kHz
C) 12 kHz
D) 2.1 kHz
Answer: A
Var: 50+

135) A 120-V rms voltage is applied across a 6.00-μF capacitor and a 100-Ω resistor. If the frequency of the generator is 60.0 Hz, what is the impedance of this circuit?
A) 153 Ω
B) 453 Ω
C) 353 Ω
D) 253 Ω
E) 553 Ω
Answer: B
Var: 1

136) A 10-Ω resistor is connected in series with a 20-μF capacitor. What is the impedance at 1.0 kHz?
A) 8.0 Ω
B) 10 Ω
C) 13 Ω
D) 15 Ω
Answer: C
Var: 1

137) What is the impedance of an ac series circuit with 12.0 Ω of resistance, 15.0 Ω of inductive reactance, and 10.0 Ω of capacitive reactance?
A) 11.6 Ω
B) 13.0 Ω
C) 21.9 Ω
D) 27.7 Ω
Answer: B
Var: 1

138) What is the impedance at 1500 Hz if a 100-Ω resistor, 20-mH coil, and 1.0-μF capacitor are connected in series?
A) 0.19 kΩ
B) 0.13 kΩ
C) 0.11 kΩ
D) 82 Ω
Answer: B
Var: 1

139) If a 1.0-kΩ resistor is connected in series with a 20-mH inductor, what is the impedance at 1.0 kHz?
A) 0.13 kΩ
B) 1.0 kΩ
C) 1.1 kΩ
D) 0.13 MΩ
Answer: B
Var: 1

140) What resistance is needed in a series circuit with a 20-mH coil and 1.0-μF capacitor for a total impedance of 100 Ω at 1.5 kHz?
A) 0.16 kΩ
B) 82 Ω
C) 57 Ω
D) 18 Ω
Answer: C
Var: 1

141) Which one of the following capacitances in series with a 100-Ω resistor and 15-mH coil will give a total impedance of 110 Ω at 2.0 kHz?
A) 0.14 mF
B) 46 μF
C) 10 μF
D) 0.56 μF
Answer: D
Var: 1

142) What resistance must be put in series with a 450-mH inductor at 5000 Hz for a total impedance of 40000 Ω?
A) 45 kΩ
B) 40 kΩ
C) 37 kΩ
D) 26 kΩ
Answer: C
Var: 1

143) What inductance must be put in series with a 100-kΩ resistor at 1.0-MHz for a total impedance of 150 kΩ?
A) 18 mH
B) 0.15 H
C) 0.17 H
D) 1.5 H
Answer: A
Var: 1

144) What resistance is needed in series with a 10-μF capacitor at 1.0 kHz for a total impedance of 45 Ω?
A) 29 Ω
B) 42 Ω
C) 61 Ω
D) 1.8 Ω
Answer: B
Var: 1

145) The impedance of an *RC* circuit containing a 40.0-μF capacitor is 800 Ω. If the frequency of the applied ac voltage is 18.0 Hz, what is the resistance of the resistor?
A) 569 Ω
B) 669 Ω
C) 769 Ω
D) 869 Ω
E) 800 Ω
Answer: C
Var: 5

146) The impedance of an *RC* circuit with a 200-Ω iresistor s 1060 Ω. If the frequency of the applied ac voltage is 20.0 Hz, what is the capacitance of the capacitor?
A) 6.64 μF
B) 7.64 μF
C) 8.64 μF
D) 9.64 μF
E) 200 μF
Answer: B
Var: 5

147) A 120-V rms voltage at 1.00 kHz is applied to a resistor and an inductor in series. If the impedance of this circuit is 110 Ω, what is the maximum value of the current?
A) 1.54 A
B) 1.09 A
C) 1.84 A
D) 1.04 A
Answer: A
Var: 1

148) A 200-Ω resistor, a 25-mH inductor, and a capacitor are connected in series across an ac voltage source at 1000 Hz. If the impedance of this circuit is 240 Ω, which one of the following quantities could be the capacitance of the capacitor?
A) 5.5 μF
B) 3.2 μF
C) 4.2 μF
D) 6.5 μF
E) 7.5 μF
Answer: D
Var: 1

149) A 25.0-mH inductor, a 2.00-μF capacitor, and a certain resistor are connected in series across an ac voltage source at 1.00 kHz. If the impedance of this circuit is 200 Ω, what is the value of the resistor?
A) 100 Ω
B) 184 Ω
C) 552 Ω
D) 579 Ω
E) 200 Ω
Answer: B
Var: 1

150) A 120-V rms voltage at 1000 Hz is applied to a series *RLC* circuit with an equal value of inductive and capacitive reactance and a 200-Ω resistance. What is the impedance of this circuit?
A) 100 Ω
B) 0 Ω
C) 240 Ω
D) 120 Ω
E) 200 Ω
Answer: E
Var: 1

151) A 120-V rms voltage at 60 Hz is applied across an inductor and a 200-Ω resistor. If the impedance of this circuit is 216 Ω, what is the rms value of the current?
A) 0.336 A
B) 0.446 A
C) 0.556 A
D) 0.667 A
E) 0.767 A
Answer: C
Var: 1

152) A 100-Ω resistor is connected in series with a 10.0-mH inductor across an ac source operating at 1.00 kHz. What is the impedance of this circuit?
A) 100 Ω
B) 118 Ω
C) 200 Ω
D) 236 Ω
E) 1000 Ω
Answer: B
Var: 1

153) What resistance must be put in series with a 30-mH inductor at 4000 Hz to have a total impedance of $8.0 \times 10^4\ \Omega$?
A) $30 \times 10^4\ \Omega$
B) $5.0 \times 10^4\ \Omega$
C) $6.0 \times 10^4\ \Omega$
D) $7.0 \times 10^4\ \Omega$
E) $8.0 \times 10^4\ \Omega$
Answer: E
Var: 5

154) What inductance must be put in series with a 200-Ω resistor at 4.00 kHz to have a total impedance of 240 Ω?
A) 3.28 mH
B) 4.28 mH
C) 5.28 mH
D) 6.28 mH
E) 12 mH
Answer: C
Var: 1

155) A 120-V rms signal at 60.0 Hz is applied across a series combination of a 30.0-mH inductor and a resistor. If the rms value of the current in this circuit is 0.600 A, what is the resistance of the resistor?
A) 80.0 Ω
B) 268 Ω
C) 143 Ω
D) 200 Ω
E) 30.0 Ω
Answer: D
Var: 5

156) A 120-V rms signal at 60 Hz is applied across a series combination of a 30-mH inductor and a 100-Ω resistor. What is the rms value of the current in this circuit?
A) 0.80 A
B) 1.2 A
C) 1.4 A
D) 1.6 A
E) 1.8 A
Answer: B
Var: 1

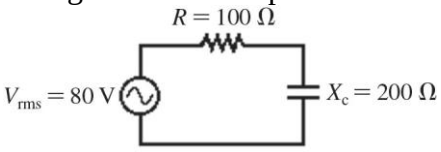
157) A 120-V rms signal at 60 Hz is applied across a series combination of a 30-mH inductor and a 100-Ω resistor. What is the rms value of the voltage across the resistor?
A) 120 V
B) 60 V
C) 100 V
D) 150 V
E) 0.70 V
Answer: A
Var: 1

158) A 120-V rms voltage is applied across a 6.0-μF capacitor and a series combination of a 100-Ω resistor. If the frequency of the power source is 60 Hz, what is the rms value of the current in the circuit?
A) 0.26 A
B) 0.36 A
C) 0.46 A
D) 0.56 A
E) 0.76 A
Answer: A
Var: 1

159) A 120-V rms voltage at 60 Hz is applied across a series combination of a 20-μF capacitor and an unknown resistor. If the rms value of the current in the circuit is 0.60 A, what is the resistance of the resistor?
A) 60 Ω
B) 120 Ω
C) 180 Ω
D) 150 Ω
E) 200 Ω
Answer: D
Var: 1

160) A 120-V rms signal at 60.0 Hz is applied across a series combination of a 30.0-mH inductor and a 100-Ω resistor. What is the rms value of the voltage across the inductor?
A) 0.700 V
B) 119 V
C) 100 V
D) 13.5 V
E) 120 V
Answer: D
Var: 5

161) As shown in the figure, an ac source whose rms voltage is 80 V is in series with a 100-Ω resistor and a capacitor whose reactance is 200 Ω at the frequency of the source. What is the rms voltage across the capacitor?



A) 66 V
B) 68 V
C) 70 V
D) 72 V
E) 74 V
Answer: D
Var: 1

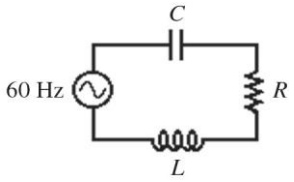
162) A 120-V rms voltage at 2000 Hz is applied to a 6.0-mH inductor, a 2.0-μF capacitor, and a 200-Ω resistor. What is the rms value of the current in this circuit?
A) 1.5 A
B) 0.48 A
C) 2.5 A
D) 3.5 A
E) 0.59 A
Answer: E
Var: 5

163) A 120-V rms voltage at 1000 Hz is applied to an inductor, a 2.00-μF capacitor and a 100-Ω resistor. If the rms value of the current in this circuit is 0.680 A, what is the inductance of the inductor?
A) 34.2 mH
B) 35.8 mH
C) 11.4 mH
D) 17.9 mH
E) 22.8 mH
Answer: B
Var: 1

164) A 120-V rms voltage at 1.0 kHz is applied to a 2.0-mH inductor, a 4.0-μF capacitor and a resistor. If the rms value of the current in this circuit is 0.40 A, what is the value of the resistor?
A) 300 Ω
B) 95 Ω
C) 420 Ω
D) 120 Ω
E) 240 Ω
Answer: A
Var: 1

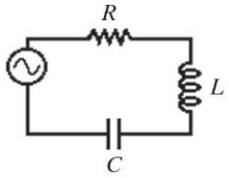
165) A series circuit has a sinusoidal voltage supplied to it at 632 kHz with a peak voltage of 748 V. It also contains a 25-kΩ resistance, a 16-μF capacitance, and a 30-H inductance. What is the peak current for this circuit?
A) 6.3 μA
B) 11 μA
C) 26 μA
D) 30 μA
Answer: A
Var: 50+

166) In the circuit shown in the figure, the 60-Hz ac source has a voltage amplitude of 120 V, the capacitive reactance is 920 Ω, the inductive reactance is 290 Ω, and the resistance is 420 Ω. What is the rms current in the circuit?



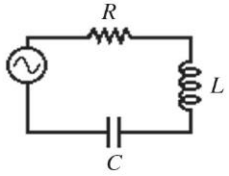
A) 0.11 A
B) 0.13 A
C) 0.14 A
D) 0.17 A
E) 0.20 A
Answer: A
Var: 50+

167) The figure shows a series ac circuit. The inductor has a reactance of 60 Ω and an inductance of 150 mH. A 50-Ω *R* and a capacitor *C* whose reactance is 90 Ω are also in the circuit, and the rms current in the circuit is 1.5 A. What is the rms voltage of the source?



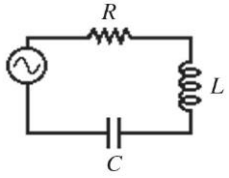
A) 87 V
B) 84 V
C) 81 V
D) 78 V
E) 75 V
Answer: A
Var: 50+

168) The figure shows a series ac circuit. The inductor has a reactance of 80 Ω and an inductance of 220 mH. A 30-Ω resistor and a capacitor whose reactance is 80 Ω are also in the circuit, and the rms current in the circuit is 2.0 A. What is the capacitance of the capacitor?



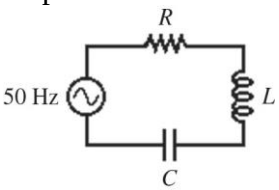
A) 34 μF
B) 37 μF
C) 32 μF
D) 30 μF
E) 27 μF
Answer: A
Var: 50+

169) The figure shows a series ac circuit. The inductor has a reactance of 50 Ω and an inductance of 220 mH. An 80-Ω resistor and a capacitor whose reactance is 160 Ω are also in the circuit, and the rms current in the circuit is 2.2 A. What is the voltage amplitude across the capacitor?



A) 500 V
B) 350 V
C) 630 V
D) 770 V
E) 210 V
Answer: A
Var: 50+

170) A series circuit has a 50-Hz ac source, a 40-Ω resistor, a 0.70-H inductor, and a 60-μF capacitor, as shown in the figure. The rms current in the circuit is 1.6 A. What is the voltage amplitude of the source?



A) 390 V
B) 330 V
C) 270 V
D) 220 V
E) 190 V
Answer: A
Var: 50+

171) A series circuit has a 100-Ω resistor, a 0.100-μF capacitor, and a 2.00-mH inductor connected across a 120 V rms ac source operating at resonant frequency. What is the rms value of the voltage across the inductor?
A) 170 V
B) 150 V
C) 120 V
D) 54.0 V
E) 533 V
Answer: A
Var: 1

172) A series circuit has a 100-Ω resistor, a 0.100-μF capacitor, and a 2.00-mH inductor connected across a 120-V rms ac source operating at resonant frequency. What is the rms value of the voltage across the capacitor?
A) 54.0 V
B) 120 V
C) 150 V
D) 533 V
E) 170 V
Answer: E
Var: 1

173) A series circuit has a 100-Ω resistor, a 0.100-μF capacitor, and a 2.00-mH inductor connected across a 120-V rms ac source operating at 1000/π Hz. What is the rms voltage across the inductor?
A) 120 mV
B) 87.1 mV
C) 302 mV
D) 96.1 mV
E) 200 mV
Answer: D
Var: 1

174) A series circuit consists of a 100-Ω resistor, a 10.0-μF capacitor, and a 0.350-H inductor. The circuit is connected to a 120-V rms, 60-Hz power supply. What is the rms current in the circuit?
A) 0.42 A
B) 0.52 A
C) 0.62 A
D) 0.72 A
Answer: D
Var: 1

175) A resistance of 55 Ω, a capacitor of capacitive reactance 30 Ω, and an inductor of inductive reactance 30 Ω are connected in series to a 110-V rms, 60-Hz power source. What rms current flows in this circuit?
A) 2.0 A
B) less than 2.0 A
C) more than 2.0 A
D) none of the given answers
Answer: A
Var: 1

176) A resistance of 55 Ω, a capacitor of capacitive reactance 30 Ω, and an inductor of inductive reactance 30 Ω are connected in series to a 110-V rms 60-Hz power source. What rms current flows in this circuit?
A) more than 4.0 A
B) 2.0 A
C) more than 2.0 A but less than 4.0 A
D) 4.0 A
E) less than 2.0 A
Answer: B
Var: 1

177) A series circuit consists of a 0.440-H inductor, a 380.0-Ω resistor, a 5.70-μF capacitor, and an ac voltage source of amplitude 250.0 V. Find the rms voltage across the capacitor when the circuit operates at resonance.
Answer: 129 V
Var: 50+

178) A 120-mH inductor is in series with a 20-Ω resistor and a variable capacitor that can range from 0.110 μF to 0.400 μF.
(a) What is the range of possible resonance frequencies?
(b) If the power supply is a 24-V rms source, what rms current flows at resonance?
Answer: (a) 0.726 kHz to 1.39 kHz (b) 1.20 A
Var: 1

179) What is the resonance frequency of a series ac circuit consisting of a 40.0 μF capacitor, a 55-Ω resistor, and a 0.030 H inductor?
A) 0.15 kHz
B) 0.9 kHz
C) 6.9 kHz
D) 6 kHz
Answer: A
Var: 1

180) A series ac circuit has a resonance frequency of 9.0 kHz. If the inductor in the circuit has a value of 2.0 H, and the resistance is 75 Ω, what is the capacitance of the circuit?
A) 0.16 pF
B) 156 pF
C) 6.2 pF
D) 17.7 pF
Answer: A
Var: 1

181) An ac circuit has a 100-Ω resistor in series with a 4.9-μF capacitor and a 700-mH inductor. At what frequency does the circuit act like a pure resistance?
A) 0.29 MHz
B) 1.9 MHz
C) 12 MHz
D) 0.54 kHz
E) 86 Hz
Answer: E
Var: 1

182) A series *RLC* circuit has a 100-Ω resistor, a 0.100-μF capacitor and a 2.00-mH inductor connected across a 120-V rms ac voltage source operating at 1000/π Hz. What is the resonant frequency of this circuit?
A) 70.7 kHz
B) 17.9 kHz
C) 22.5 kHz
D) 35.3 kHz
E) 11.3 kHz
Answer: E
Var: 1

183) What size capacitor should be placed in series with a 30-Ω resistor and a 40-mH inductive coil if the resonant frequency of the circuit is to be 1.0 kHz?
A) 2.0 μF
B) 0.63 μF
C) 3.3 μF
D) 6.0 μF
E) 4.5 μF
Answer: B
Var: 1

184) A 50-Ω resistor is placed in series with a 40-mH inductor. At what frequency will the current in this circuit lag the applied voltage by exactly 45°?
Answer: 0.20 kHz
Var: 1

185) A series circuit containing an inductor and a resistor is driven by a 120-V 60-Hz voltage source. The resistance is equal to 20.0 Ω and the inductance is 160 mH. What is the phase angle between the current the the applied voltage?
Answer: The current lags by 72°
Var: 1

186) An series circuit consists of an ac voltage source, a resistor of resistance 810 Ω, and an inductor. (There is no capacitance in the circuit.) The current amplitude is 0.40 A, and the phase angle between the source voltage and the current has magnitude $11°$.
(a) Does the source voltage lag or lead the current?
(b) What is the voltage amplitude of the source?
Answer: (a) The source voltage leads the current. (b) 330 V
Var: 50+

187) A series circuit consists of an ac voltage source of frequency 60 Hz and source voltage amplitude 345 V, a resistor of resistance $393\ \Omega$, a capacitor of capacitance 2.7×10^{-6} F, and an inductor of inductance *L*.
(a) What must be the value of *L* for the phase angle of the circuit to be zero?
(b) When *L* has the value calculated in part (a), what is the current amplitude in the circuit?
Answer: (a) 2.6 H (b) 0.878 A
Var: 50+

188) A 10-Ω resistor is in series with a 100-μF capacitor at 120 Hz. What is the phase angle?
A) -82°
B) -53°
C) -37°
D) -4.7°
E) +37°
Answer: B
Var: 1

189) A 50.0-mH inductor is connected in series with a 2500-Ω resistor in an ac circuit. What is the phase angle at 3000 Hz?
A) 20.7°
B) -20.7°
C) -75.9°
D) 75.9°
E) 90.0°
Answer: A
Var: 5

190) The phase angle of a series *RL* ac circuit with a 100-Ω resistor and a 20.0-mH inductor is 70.0°. What is the inductive reactance of this circuit?
A) 100 Ω
B) 150 Ω
C) 200 Ω
D) 175 Ω
E) 275 Ω
Answer: E
Var: 1

191) The phase angle of a series *RL* ac circuit with a 20.0-mH inductor and a certain resistor at 1000 Hz is 20.0°. What is the resistance in this circuit?
A) 145 Ω
B) 100 Ω
C) 245 Ω
D) 200 Ω
E) 345 Ω
Answer: E
Var: 1

192) The phase angle in a series *RL* circuit at 1.0 kHz with a 0.20-kΩ resistor and a certain inductor is 40°. What is the inductance in this circuit?
A) 84 mH
B) 74 mH
C) 27 mH
D) 37 mH
E) 58 mH
Answer: C
Var: 1

193) A 20.0-mH inductor is connected in series with a 100-Ω resistor at 1.00 kHz in an ac circuit. What is the phase angle of this circuit?
A) 90.0°
B) 51.5°
C) 38.5°
D) 0°
E) 45°
Answer: B
Var: 1

194) A 200-Ω resistor, a 40-mH inductor, and a 2.0-μF capacitor are connected in series with a 120-V rms source at 1.0 kHz. What is the phase angle of this circuit?
A) 49°
B) 90°
C) 41°
D) 0°
E) 45°
Answer: C
Var: 1

195) The phase angle of an *RLC* series ac circuit with an inductive reactance of 200 Ω and a capacitive reactance of 100 Ω is 40.0°. What is the resistance of the resistor in this circuit?
A) 100 Ω
B) 119 Ω
C) 156 Ω
D) 200 Ω
E) 265 Ω
Answer: B
Var: 1

196) At 1.00 kHz, the phase angle of an *RLC* series circuit with an inductive reactance of 200 Ω, a resistance of 200 Ω and a certain capacitor is 40.0°. What is the capacitance of the capacitor in this circuit?
A) 1.95 μF
B) 2.95 μF
C) 3.95 μF
D) 4.95 μF
E) 5.95 μF
Answer: D
Var: 1

197) At 1.0 kHz, the phase angle of an *RLC* series circuit with a capacitive reactance of 40 Ω, a resistance of 100 Ω, and a certain inductor is 40°. What is the inductance in this circuit?
A) 12 mH
B) 120 mH
C) 210 mH
D) 62 mH
E) 20 mH
Answer: E
Var: 1

198) A series ac circuit has a resistance of 2.0 kΩ, a capacitance of 8.0 μF, and an inductance of 9.0 H. If the frequency of the alternating current is 4.0/π kHz, by what angle does the voltage lead the current?
A) +1.5 rad
B) -1.8 rad
C) +36 rad
D) +3.1 rad
E) -3.1 rad
Answer: A
Var: 1

199) A series ac circuit has voltage supplied to it at a frequency of $25.0\ \text{kHz}$ with a phase difference between the current and the voltage of magnitude $0.80\ \text{rad}$. If the circuit has a capacitance of $2.0\ \mu\text{F}$ and an inductance of $0.030\ \text{H}$, find the resistance of the circuit.
A) 4.6 kΩ
B) 0.00 kΩ
C) 0 kΩ
D) 0 kΩ
Answer: A
Var: 50+

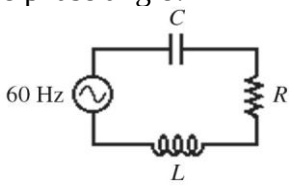
200) A 60.0-μF capacitor is in series with a 100-Ω resistor connected across an ac source of frequency 120 Hz. What is the phase angle?
A) -12.5°
B) +12.5°
C) -77.6°
D) +77.6°
E) 90.0°
Answer: A
Var: 1

201) A capacitor with a capacitive reactance of 40.0 Ω is connected in series with a 100-Ω resistor across an ac source of frequency 60.0 Hz. What is the phase angle?
A) +68.2°
B) -68.2°
C) -21.8°
D) +21.8°
E) 90.0°
Answer: C
Var: 1

202) A 120-V rms voltage at 60 Hz is applied across an *RC* circuit. The rms value of the current in the circuit is 0.60 A, and it leads the voltage by 60°. What is the resistance in this circuit?
A) 100 Ω
B) 150 Ω
C) 120 Ω
D) 60 Ω
E) 200 Ω
Answer: A
Var: 1

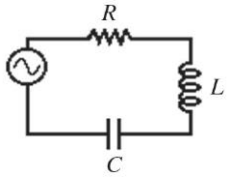
203) A 120-V rms voltage at 60 Hz is applied across an *RC* circuit. The rms value of the current in the circuit is 0.60 A, and it leads the voltage by 60°. What is the capacitance in this circuit?
A) 13 μF
B) 14 μF
C) 15 μF
D) 16 μF
E) 17 μF
Answer: C
Var: 1

204) In the circuit shown in the figure, the 60-Hz ac source has a voltage amplitude of 120 V, the capacitive reactance is 800 Ω, the inductive reactance is 300 Ω, and the resistance is 560 Ω. What is the phase angle?



A) -42°
B) +42°
C) -69°
D) +69°
E) -21°
Answer: A
Var: 50+

205) The figure shows a series ac circuit. The inductor has a reactance of 60 Ω and an inductance of 210 mH. A 30-Ω resistor and a capacitor whose reactance is 80 Ω are also in the circuit, and the rms current in the circuit is 2.2 A. What is the phase angle of the circuit?



A) -34°
B) 34°
C) +90°
D) -56°
E) 56°
Answer: A
Var: 50+

206) A series circuit consists of an ac voltage source of voltage amplitude *V* and frequency 60 Hz, a resistor of resistance $163\ \Omega$, and a capacitor of capacitance 6.2×10^{-6} F. What must the source voltage amplitude *V* be for the average electrical power consumed in the resistor to be 529 watts? (There is no inductance in the circuit.)
Answer: 1200 V
Var: 50+

207) A series circuit contains a 20-Ω resistor, a 200-mH inductor, a 10-μF capacitor, and an ac power source. At what frequency should the power source drive the circuit in order to have maximum power transferred from the driving source?
A) 0.45 kHz
B) 0.17 kHz
C) 0.28 kHz
D) 0.96 kHz
E) 0.11 kHz
Answer: E
Var: 1

208) A series ac circuit containing a resistor, inductor, and a capacitor has a peak voltage of $116\ \text{V}$ and a peak current of $2.00\ \text{A}$. If the current lags the voltage by $52.0°$, what is the average power of the circuit?
A) 71 W
B) 142 W
C) 148 W
D) 296 W
Answer: A
Var: 50+

209) A series ac circuit has a reactance of $11\ \text{k}\Omega$ due to its capacitance, a reactance of $3\ \text{k}\Omega$ due to its inductance, and a resistance of $29\ \text{k}\Omega$. What is the power factor of this circuit?
A) 0.96
B) 0.27
C) 1.04
D) 0.48
Answer: A
Var: 50+

210) A series ac circuit has a peak current of $1.0\ \text{A}$ with a frequency of $7\ \text{kHz}$. If the resistance of the circuit is $55\ \text{k}\Omega$, the capacitance of the circuit is $20\ \mu\text{F}$, and the inductance of the circuit is $26\ \text{H}$, determine the average power of the circuit over one cycle.
A) 0 W
B) 0 W
C) 0 W
D) 0 W
Answer: A
Var: 50+

211) A 120-V rms voltage at 60.0 Hz is applied across a capacitor and a 100-Ω resistor. If the impedance of this circuit is 200 Ω, what is the average power of this circuit?
A) 278 W
B) 72.0 W
C) 36.0 W
D) 100 W
E) 200 W
Answer: C
Var: 1

212) The circuit power factor of an *RC* circuit is 0.620. The rms value of the ac voltage applied to this signal is 120 V and the impedance is 200 Ω. What is the average power of this circuit?
A) 44.6 W
B) 89.2 W
C) 60.0 W
D) 0.620 W
E) 124 W
Answer: A
Var: 1

213) A series circuit has a 100-Ω resistor, 2.00-mH inductor and a 4.00-μF capacitor connected across a 120-V rms ac source at 1000/π Hz. What is the power dissipated by the circuit?
A) 184 W
B) 18.6 W
C) 58.4 W
D) 91.8 W
E) 180 W
Answer: C
Var: 1

214) A series circuit has a 100-Ω resistor, 4.00-mH inductor and a 0.100-μF capacitor connected across a 120-V rms ac source at the resonance frequency. What is the power dissipated by the circuit?
A) 100 W
B) 120 W
C) 144 W
D) 160 W
E) 45.8 W
Answer: C
Var: 1

215) What is the power output in an ac series circuit with 12.0 Ω of resistance, 15.0 Ω of inductive reactance, and 10.0 Ω of capacitive reactance, when the circuit is connected to a 120-V rms power supply?
A) 6.00 kW
B) 3.21 kW
C) 1.02 kW
D) 4.49 kW
Answer: C
Var: 1

216) The phase angle of an ac circuit is 63°. What is the power factor?
A) 0.89
B) 0.55
C) 0.45
D) 0.11
Answer: C
Var: 1

217) An ac series circuit has an impedance of 60 Ω and a resistance of 30 Ω. What is the power factor of this circuit?
A) 0.50
B) 0.71
C) 1.0
D) 1.4
Answer: A
Var: 1

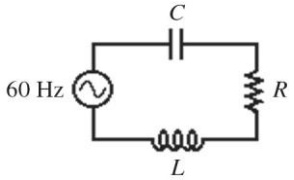
218) What is the power factor for a series ac circuit containing a 50-Ω resistor, a 10-μF capacitor, and a 0.45-H inductor, when connected to a 60-Hz power supply?
A) 0.00
B) 0.46
C) 0.79
D) 1.0
Answer: B
Var: 1

219) A series *RLC* circuit has a 100-Ω resistor, 2.0-mH inductor and a 4.0-μF capacitor connected across a 120-V rms ac source at 1000/π Hz. What is the power factor of this circuit?
A) 0.54
B) 0.64
C) 0.74
D) 0.84
E) 0.94
Answer: B
Var: 1

220) An ac signal is applied across a 40-mH inductor and a 100-Ω resistor. If the power factor of this circuit is 0.40, what is the frequency of the ac signal?
A) 160 Hz
B) 200 Hz
C) 410 Hz
D) 600 Hz
E) 910 Hz
Answer: E
Var: 1

221) The power factor of an ac *RL* circuit with a 100-Ω resistor and a certain inductor is 0.60. What is the impedance of the circuit?
A) 170 Ω
B) 85 Ω
C) 340 Ω
D) 100 Ω
E) 60 Ω
Answer: A
Var: 1

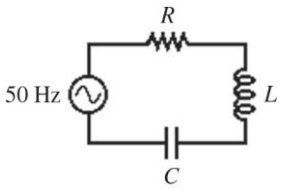
222) In the circuit shown in the figure, the 60-Hz ac source has a voltage amplitude of 120 V, the capacitive reactance is 850 Ω, and the inductive reactance is 340 Ω. What is the resistance *R* if the power factor is 0.80?



A) 680 Ω
B) 610 Ω
C) 540 Ω
D) 460 Ω
E) 380 Ω
Answer: A
Var: 50+

223) What is the power factor of an *RLC* ac series circuit with an inductive reactance of 174 Ω, a capacitive reactance of 60 Ω and a resistance of 0.10 kΩ?
A) 0.29
B) 0.46
C) 0.56
D) 0.66
E) 0.76
Answer: D
Var: 1

224) A series circuit has a 50-Hz ac source, a 60-Ω resistor, a 0.50-H inductor, and a 10-μF capacitor, as shown in the figure. The rms current in the circuit is 2.2 A. What is the power factor of the circuit?



A) 0.35
B) 0.33
C) 0.31
D) 0.30
E) 0.28
Answer: A
Var: 50+

225) A certain ac signal at 1000 Hz is applied across an inductor and a 100-Ω resistor. If the power factor of the circuit is 0.400, what is the impedance of this circuit?
A) 150 Ω
B) 200 Ω
C) 250 Ω
D) 100 Ω
E) 300 Ω
Answer: C
Var: 1