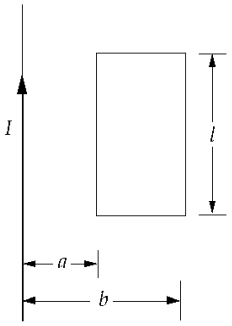
Physics 2426
Engineering Physics II
Instructor: McGraw
Review Questions - Exam 3

2. A 3.0-cm by 5.0-cm rectangular coil has 100 turns. Its axis makes an angle of 55º with a uniform magnetic field of 0.35 T. What is the magnetic flux through this coil?

A) 3.0×10^{-4} Wb
B) 4.3×10^{-4} Wb
C) 3.0×10^{-2} Wb
D) 4.3×10^{-2} Wb
E) 5.3×10^{-2} Wb

Ans: C

4.

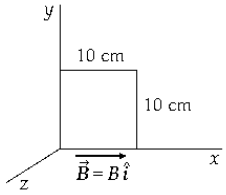


A long straight wire carries a constant current *I*. The magnitude of the magnetic flux through the illustrated rectangular loop of wire is

A) $(\mu_0/4\pi)2Il\ \ln(b/a)$
B) $(\mu_0/4\pi)4Il\ \ln(b/a)$
C) $(\mu_0/4\pi)Il\ \ln[(a+b)/(b-a)]$
D) $(\mu_0/4\pi)4Il\ \ln[(b-a)/(b+a)]$
E) $(\mu_0/4\pi)2Il\ \ln[(b-a)/(b+a)]$

Ans: A

9.



A uniform magnetic field of 0.5 T is parallel to the *x* axis. A square coil of side 10 cm has 300 turns and lies in the *xy* plane as shown. The magnetic flux through the coil is

A) 0.14 Wb B) 0.75 Wb C) 1.5 Wb D) 0.27 Wb E) zero

Ans: E

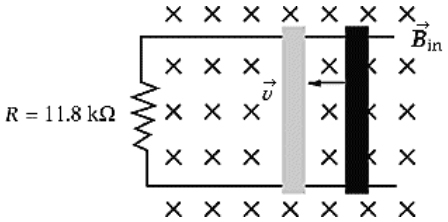
13. A circular wire coil of radius 25 cm and 20 turns is sitting in a perpendicular magnetic field of 0.2 T. If the coil is flipped over, what is the change in magnetic flux through the loop?
A) 0 Wb B) 1.6 Wb C) 0.080 Wb D) 0.80 Wb E) 0.040 Wb
Ans: B

17. A 3.0-cm by 5.0-cm rectangular coil has 100 turns. Its axis makes an angle of 55º with a uniform magnetic field of 0.35 T. It requires 0.33 s to turn the coil until its plane is perpendicular to the magnetic field. What is the (average) magnitude of the induced emf?
A) 0.16 V B) 0.13 V C) 91 mV D) 68 mV E) 29 mV
Ans: C

23. You place a coil that has 200 turns and a cross-sectional area of 0.050 m^2 so that its plane is normal to a field of 3.0 T. If the field is uniformly decreased to zero in 5.0 s, what emf is induced in the coil?
A) 0.15 kV B) 0.12 kV C) 6.0 V D) 50 mV E) 10 mV
Ans: C

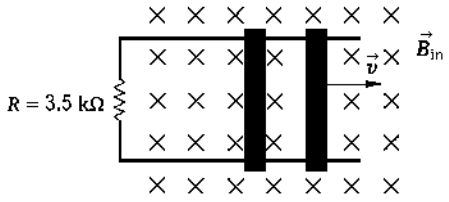
25. A square coil of wire with side 8.0 cm and 50 turns sits in a uniform magnetic field that is perpendicular to the plane of the coil. The coil is pulled quickly out of the magnetic field in 0.2 s. If the resistance of the coil is 15 ohm and a current of 12 mA is induced in the coil, calculate the value of the magnetic field.
A) 5.6 T B) 0.11 T C) 7.5×10^{-3} T D) 1.4 T E) 9.1 T
Ans: B

32.



A wire rod rolls with a speed of 20 m/s on two metallic rails, 1.0 m apart, that form a closed loop. If the magnetic field is 1.5 T into the page, the power dissipated in the resistor *R* and the current direction are, respectively,
A) 33 mW, clockwise.
B) 33 mW, counterclockwise.
C) 76 mW, counterclockwise.
D) 76 mW, clockwise.
E) 50 mW, clockwise.
Ans: D

34.



A wire rod rolls with a speed of 8.0 m/s on two metallic rails, 30 cm apart, that form a closed loop. A uniform magnetic field of magnitude 1.20 T is into the page. The magnitude and direction of the current induced in the resistor *R* are

A) 0.82 A, clockwise.
B) 0.82 A, counterclockwise.
C) 1.2 A, clockwise.
D) 1.2 A, counterclockwise.
E) 2.9 A, counterclockwise.

Ans: B

37. You place a single loop of wire 0.50 m by 0.30 m perpendicular to a field of 2.0 T. In 30 ms you turn the loop until it is parallel with the field. The average emf induced in this loop is

A) 0.30 V B) 10 V C) 5.0 V D) 67 V E) 20 V

Ans: B

40. A straight conductor 10 cm long is perpendicular to a uniform magnetic field 2.0 mT. When the conductor carries a current of 5.0 A, the force exerted on it by the field is

A) 0.25 kN B) 40 μN C) 1.0 mN D) zero E) 5.0 mN

Ans: C

42.

A 0.8-m-long pole rotates about a perpendicular axis at one end. As the pole rotates, it passes through the earth's magnetic field, which has a perpendicular component of 3×10^{-5} T to the plane of rotation. If the pole rotates with a frequency of 5 revolutions per second, calculate the induced emf across the ends of the pole.

A) 3.0×10^{-4} V
B) 1.2×10^{-5} V
C) 1.0×10^{-4} V
D) 3.8×10^{-4} V
E) 2.4×10^{-4} V

Ans: A

44. A metal disk rotates about its central axis at an angular frequency of 800 radians per second in a uniform magnetic field of 0.8 T. The diameter of the disk is 8 cm. What is the magnitude of the voltage difference between the center and edge of the disk?
A) 0 V B) 0.80 V C) 0.51 V D) 1.0 V E) 3.1 V
Ans: C

49. A coil with a self-inductance of 6.5 H carries a current that is changing at a rate of 50 A/s. What is the induced emf in the coil?
A) 0.13 V B) 7.7 V C) 32 V D) 65 V E) 0.32 kV
Ans: E

54. A region of space contains a magnetic field of 500 G and an electric field of 3×10^6 N/C. The magnetic energy density in a cubical box of side ℓ = 20 cm in this region is
A) 550 J/m^3
B) 670 J/m^3
C) 864 J/m^3
D) 995 J/m^3
E) None of these is correct.
Ans: D

58. An *LR* circuit has a resistance R = 25 Ω, an inductance L = 5.4 mH, and a battery of emf = 9.0 V. How much energy is stored in the inductance of this circuit when a steady current is achieved?
A) zero B) 0.35 J C) 0.35 mJ D) 0.70 mJ E) 0.97 mJ
Ans: C

2. A motor sometimes burns out when its load is suddenly increased because the resulting sudden decrease in its rotational frequency causes
A) an increased back emf and an increased current flow.
B) a decreased back emf and a decreased current flow.
C) a decreased back emf and zero current flow.
D) an increased back emf and a decreased current flow.
E) a decreased back emf and an increased current flow.
Ans: E

3. A 200-turn coil rotates in a magnetic field of magnitude 0.25 T at a frequency of 60 Hz. The area of the coil is 5.0 cm^2. What is the maximum emf in the coil?
A) 1.5 V B) 4.5 V C) 9.0 V D) 9.4 V E) 24 V
Ans: D

6. How much does the maximum emf produced by a generator (a rotating coil) change if the number of turns of the coil is tripled?
   A) It is the same.
   B) It is tripled.
   C) It is increased by a factor of nine.
   D) It is reduced by one-third.
   E) It is impossible to tell given the information provided.
   Ans: B

15. An ac generator supplies 22 rms volts to a 30-Ω resistor at 50 Hz. What is the maximum current in the resistor?
   A) 3.3 mA B) 21 mA C) 0.52 A D) 0.73 A E) 1.0 A
   Ans: E

16.

   As the frequency in this simple ac circuit increases, the rms current through the resistor
   A) increases.
   B) does not change.
   C) may increase or decrease depending on the magnitude of the original frequency.
   D) may increase or decrease depending on the magnitude of the resistance.
   E) decreases.
   Ans: B

18. If you double the rms voltage in an ac circuit, the peak voltage
   A) increases by a factor of 2.
   B) decreases by a factor of 2.
   C) increases by a factor of $\sqrt{2}$.
   D) decreases by a factor of $\sqrt{2}$.
   E) does not change.
   Ans: A

21. A 15-Ω resistor is connected across a sinusoidal source that has a peak value of 75 V. The average power delivered by this source is approximately
   A) 75 W B) 0.19 kW C) 0.38 kW D) 0.75 kW E) 1.2 W
   Ans: B

23. Two heaters are plugged into the same 120-V ac outlet. If one heater is rated at 1100 W, then what can be the maximum rating of the second heater in order not to exceed the 20 A trip rating on the circuit?
A) 1100 W B) 1300 W C) 1200 W D) 2400 W E) 920 W
Ans: B

25. A 500-W toaster is plugged into a 120-V ac outlet. What is the peak current in the toaster?
A) 0.24 A B) 4.2 A C) 2.9 A D) 0.34 A E) 5.9 A
Ans: E

28. The reactance of an inductor is 10 Ω at 1 kHz. The inductance of this inductor is
A) 1.00 mH B) 1.59 mH C) 2.06 mH D) 2.86 mH E) 3.45 mH
Ans: B

34. At what frequency would the reactance of a 10-μF capacitor be 100 Ω
A) 318 Hz B) 159 Hz C) 79.6 Hz D) 39.8 Hz E) 25.4 Hz
Ans: B

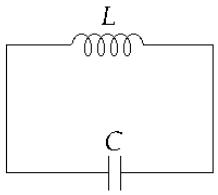
36. At what frequency would the reactance of a 1.0-mH inductor be twice that of a 10-μF capacitor?
A) 10 kHz B) 3.2 kHz C) 2.2 kHz D) 1.6 kHz E) 1.1 kHz
Ans: C

51. A 5-μF capacitor is charged to 30 V and is then connected across a 10-μH inductor. The frequency of oscillation of the energy stored in the electric field of the capacitor and the magnetic field of the inductor is
A) 1.41×10^5 Hz
B) 7.07×10^4 Hz
C) 2.25×10^4 Hz
D) 3.18×10^9 Hz
E) 2.00×10^{10} Hz
Ans: C

55. A 5-μF capacitor is charged to 30 V and is then connected in series with a 10-μH inductor and a 50-Ω resistor. The current in this circuit after a long time has passed will be
A) 0
B) 8.83 A
C) 15.4 A
D) 21.2 A
E) some value that cannot be determined from the given information.
Ans: A

57. A 5-μF capacitor is charged to 30 V and is then connected in series with a 10-μH inductor and a 50-Ω resistor. The potential difference across the inductor after a long time has passed will be
A) 0
B) 7 V
C) 15 V
D) 30 V
E) some value that cannot be determined from the given information.
Ans: A

62.



The differential equation for this circuit is

$$L\,dI/dt + Q/C = 0$$

Because $I = dQ/dt$, the solution is
A) a wave.
B) a constant current.
C) a simple harmonic oscillation.
D) an exponential decay process.
E) an exponential growth process.
Ans: C

66. You have a 30-μH inductor and want to form a 1.0-MHz parallel, resonant circuit. You need a capacitor of
A) approximately 0.84 nF.
B) approximately 1.2 nF.
C) approximately 2.1 μF.
D) approximately 33 μF.
E) None of these is correct.
Ans: A

72. A series *RLC* circuit is driven by a 1.0-kHz oscillator. The circuit parameters are V_{rms} = 12 V, L = 5.0 mH, C = 4.0 μF, and R = 10 Ω. Under steady-state conditions, the rms current in the circuit will be
A) 0.513 A B) 0.725 A C) 0.919 A D) 1.23 A E) 1.56 A
Ans: C

76. A series *RLC* circuit is driven by a 1.0-kHz oscillator. The circuit parameters are V_{rms} = 12 V, L = 5.0 mH, C = 4.0 μF, and R = 10 Ω. Under these conditions the current
A) lags the voltage by 40º.
B) leads the voltage by 40º.
C) lags the voltage by 57.1º.
D) leads the voltage by 57.1º.
E) None of these are correct.
Ans: B

86. You connect a 250-Ω resistor, a 1.20-mH inductor, and a 1.80-μF capacitor in series across a 60.0-Hz, 120-V (peak) source. The rms current in your circuit is approximately
A) 56.9 mA B) 80.5 mA C) 0.480 mA D) 37.8 mA E) 165 mA
Ans: A

92. You connect a 50.0-Ω resistor, a 2.40-mH inductor, and a 5.60-pF capacitor in series across a 60.0-Hz, 120-V (peak) source. The Q factor for this circuit is approximately
A) 181 B) 103 C) 54.6 D) 414 E) 34.5
Ans: D

21. The intensity of a laser beam is 450 W/m^2. What is the rms value of the electric field of this laser beam? (The permittivity of free space $\epsilon_0 = 8.85 \times 10^{-12}$ C^2/N · m^2 and the permeability of free space $\mu_0 = 4\pi \times 10^{-7}$ N/A^2.)
A) 1.7×10^5 V/m
B) 5.8×10^2 V/m
C) 3.4×10^5 V/m
D) 4.1×10^2 V/m
E) 1.3×10^3 V/m
Ans: D
Section: 29-6 Topic: Driven RLC Circuits Type: Numerical

95. A series *RLC* circuit with L = 5 H, C = 10 μF, and R = 10 Ω is driven by a generator with a maximum emf of 100 V and a variable frequency. The maximum current I_m at resonance is
A) 3.21 A B) 5.32 A C) 7.64 A D) 9.55 A E) 10.0 A
Ans: E

98. The 8000-turn primary of a transformer is connected to a 50-kV transmission line and the secondary has 19 turns. What is the voltage output of this transformer?
A) 21 MV B) 119 V C) 110 V D) 21 kV E) 220 V
Ans: B

1. Maxwell generalized Ampère's law to read

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 \epsilon_0 (d\phi_e/dt) + \mu_0 I$$

from which the displacement current is defined as
A) $\mu_0 \epsilon_0 (d\phi_e/dt) + \mu_0 I$ B) $\mu_0 I$ C) $\epsilon_0 \int (d\phi_e/dt)\, dt$ D) $\epsilon_0 (d\phi_e/dt)$ E) $\epsilon_0 \phi_e$
Ans: D

2. A parallel-plate capacitor has closely spaced circular plates of radius $R = 2.00$ cm. Charge is flowing onto the positive plate at the rate $I = dQ/dt = 1.36$ A. The magnetic field at a distance $r = 2.00$ cm from the axis of the plates is approximately
A) 136 mT B) 256 mT C) 16.5 mT D) 457 mT E) 88.3 mT
Ans: A

4. The electric field in a region of space varies according to

$$E = (0.25 \text{ N/C}) \sin 3000t$$

where t is in seconds. The maximum displacement current through a 1.00-m^2 area perpendicular to E is approximately
A) 3.32 nA B) 13.3 nA C) 26.6 nA D) 6.64 nA E) 11.8 nA
Ans: D

8. Which of the following statements contradicts one of Maxwell's equations?
A) A changing magnetic field produces an electric field.
B) The net magnetic flux through a closed surface depends on the current inside.
C) A changing electric field produces a magnetic field.
D) The net electric flux through a closed surface depends on the charge inside.
E) None of these statements contradict any of Maxwell's equations.
Ans: B

9. If the existence of magnetic monopoles should ever be confirmed, which of the following equations would have to be altered?
   A) A $E_n\, dA = Q_{inside}/\epsilon_0$
   B) A $B_n\, dA = 0$
   C) A $\vec{E} \cdot d\vec{l} = -d/dt(\int_S B_n\, dA)$
   D) A $\vec{B} \cdot d\vec{l} = \mu_0 I + \mu_0\epsilon_0\, d/dt(\int_S E_n\, dA)$
   E) All would still apply.
   Ans: B

21. The intensity of a laser beam is 450 W/m^2. What is the rms value of the electric field of this laser beam? (The permittivity of free space $\epsilon_0 = 8.85 \times 10^{-12}$ C^2/N · m^2 and the permeability of free space $\mu_0 = 4\pi \times 10^{-7}$ N/A^2.)
   A) 1.7×10^5 V/m
   B) 5.8×10^2 V/m
   C) 3.4×10^5 V/m
   D) 4.1×10^2 V/m
   E) 1.3×10^3 V/m
   Ans: D

10. Maxwell's equations
   A) imply that the electric field due to a point charge varies inversely as the square of the distance from the charge.
   B) describe how electric field lines diverge from a positive charge and converge on a negative charge.
   C) assert that the flux of the magnetic field vector is zero through any closed surface.
   D) describe the experimental observation that magnetic field lines do not diverge from any point space or converge to any point.
   E) All of these are correct.
   Ans: E

11. Which of the following statements is *false*?
   A) Isolated electric charges exist.
   B) Electric field lines diverge from positive charges and converge on negative charges.
   C) The flux of the magnetic field vector is zero through any closed surface.
   D) Isolated magnetic poles exist.
   E) Changing electric fields induce changing magnetic fields.
   Ans: D

13. Electromagnetic waves that have a wavelength of 300 m in free space have a frequency of
A) 1×10^{-3} Hz
B) 5×10^{5} Hz
C) 1×10^{6} Hz
D) 9×10^{6} Hz
E) 1×10^{11} Hz
Ans: C

17. Arrange the following types of electromagnetic radiation in order of increasing wavelength: gamma rays, infrared light, ultraviolet light, visible light.
A) Gamma rays are not electromagnetic radiation.
B) gamma rays, infrared, visible, ultraviolet
C) gamma rays, ultraviolet, visible, infrared
D) visible, ultraviolet, infrared, gamma rays
E) ultraviolet, visible, infrared, gamma rays
Ans: C

21. The intensity of a laser beam is 450 W/m^2. What is the rms value of the electric field of this laser beam? (The permittivity of free space $\epsilon_0 = 8.85 \times 10^{-12}$ C^2/N $\cdot$ m^2 and the permeability of free space $\mu_0 = 4\pi \times 10^{-7}$ N/A^2.)
A) 1.7×10^{5} V/m
B) 5.8×10^{2} V/m
C) 3.4×10^{5} V/m
D) 4.1×10^{2} V/m
E) 1.3×10^{3} V/m
Ans: D

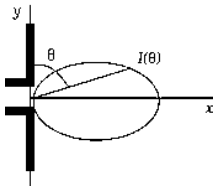
22. The detection of radio waves can be accomplished with either a dipole antenna or a loop antenna. The dipole antenna detects the _____ of the wave, and the loop antenna detects the _____ field of the wave.
A) electric field; electric
B) electric field; magnetic
C) magnetic field; magnetic
D) magnetic field; electric
E) electric and magnetic fields; electric
Ans: B

24. The nearest star to us, Alpha Centauri, is 4.30 light-years away. What is this distance in kilometers?
A) 4.1×10^{10} km
B) 4.1×10^{13} km
C) 4.1×10^{16} km
D) 6.8×10^{11} km
E) 6.8×10^{14} km
Ans: B

31. A 40-W light bulb emits spherical electromagnetic waves uniformly in all directions. If 45% of the power input to such a light bulb is emitted as electromagnetic radiation, what is the radiation pressure at a distance of 3.0 m from the light bulb?
A) 1.2 nPa B) 0.53 nPa C) 1.1 nPa D) 3.2 nPa E) 7.1 nPa
Ans: B

37. An electromagnetic wave of intensity 100 W/m^2 is incident normally on a square black card whose sides are 25 cm. If the card absorbs all of the radiation incident on it, the approximate force exerted by the wave on this card is
A) 64 nN B) 16 nN C) 42 nN D) 10 nN E) None of these is correct.
Ans: E

46. Electromagnetic waves are produced when
A) free electric charges accelerate.
B) conduction electrons move with a constant drift velocity in a conductor.
C) a conductor moves with constant velocity through a magnetic field.
D) electrons bound to atoms and molecules make transitions to higher energy states.
E) All of these are correct.
Ans: A

47.


The polar plot of the intensity of electromagnetic radiation from an electric-dipole antenna shows that the intensity is
A) a maximum at $\theta = 0^\circ$.
B) a minimum at $\theta = 90^\circ$.
C) a maximum at $\theta = 90^\circ$.
D) independent of the angle θ.
E) None of these is correct.
Ans: C

53. Which of the following statements is true?
A) Both the $\vec{B}$ and the $\vec{E}$ components of an electromagnetic wave satisfy the wave equation.
B) The phase of a wave traveling in the negative z direction is $kz + \omega t$.
C) The speed of an electromagnetic wave traveling in a vacuum is given by $\in_0 -1/2\ \mu_0 -1/2$.
D) The magnitude of $\vec{E}$ is greater than the magnitude of $\vec{B}$ by a factor of c.
E) All of these statements are true.
Ans: E