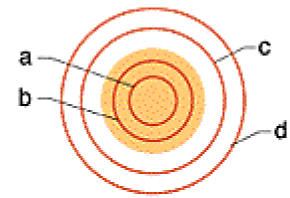
The following problems and questions have been collected from several recent examinations in PHYS 1200. They are sorted by topic. I believe that one of the best ways to learn the material in this course is to solve problems. When you encounter a conceptual issue, read the book and/or consult with a knowledgeable person (faculty, TA, Physics whiz…).

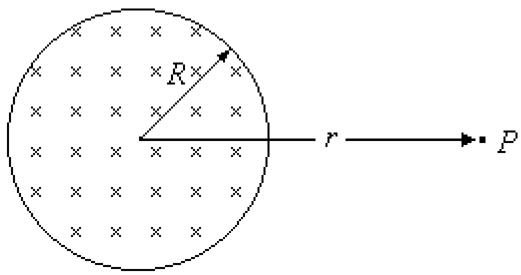
FARADAY'S AND LENZ' LAW

$EMF = -\frac{\partial \Phi_B}{\partial t}$; $\oint \vec{E} \bullet d\vec{s} = -\frac{\partial \Phi_B}{\partial t}$ Induced current creates field to oppose change.

1. (4%) The figure shows a shaded circular region in which a decreasing uniform magnetic field is directed out of the page, as well as four concentric circular paths. Rank the paths according to the magnitude of $\oint \vec{E} \cdot d\vec{s}$ evaluated along them, greatest first (use only the symbols > or =, for example a=b>c>d).



2. (15%) The sketch shows a circular region containing a uniform magnetic field that is directed into the page. The magnetic flux through the region is increasing at the rate $\frac{d\Phi_B}{dt}$ = 0.15 V.



a) (5%) Find the rate at which the magnetic field, B, is increasing. The radius of the circular region containing the flux is R = 0.30 m.

$\frac{dB}{dt}$ = ____________________
units

b) (4%) The changing magnetic field induces an electric field at point P in the sketch. The direction of the induced electric field at P is: (Circle the correct choice.)
INTO THE PAGE OUT OF THE PAGE
TO THE LEFT TO THE RIGHT
TO THE TOP OF THE PAGE TO THE BOTTOM OF THE PAGE
SOME OTHER DIRECTION

c) (6%) Find the magnitude of the induced electric field at point P. The distance from the center of the circular region containing the magnetic flux to point P is r = 0.80 m. Remember, $\frac{d\Phi_B}{dt}$ = 0.15 V

$|E|$ = ____________________

INDUCTORS AND TRANSFORMERS

$$\Phi_B = Li; \quad EMF = -\frac{dLi}{dt}; \quad U_B = \frac{1}{2}Li^2; \quad u_B = \frac{1}{2\mu_0}B^2$$

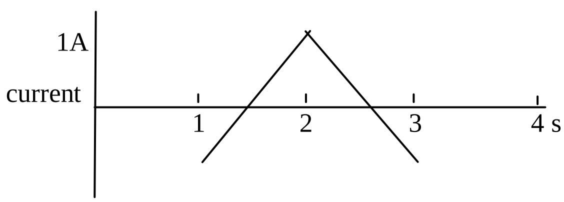
___ 3. The unit of inductance is the "henry". The unit "henry" is equivalent to:
A. volt·second/ampere
B. volt/second
C. weber/second
D. ampere·volt/second
E. ampere·second/volt

___ 4. The unit of inductance is the:
A. Hall
B. Heisenberg
C. Helmholtz
D. Henry
E. Hertz

___ 5. A current of 10 A in a certain inductor results in a stored energy of 40 J. When the current is changed to 5 A in the opposite direction, the stored energy changes by:
A. 20 J B. 30 J C. 40 J D. 50 J E. 60 J

_____6) In an inductor, energy is stored
A) in the magnetic field. B) in the electric field. C) as heat.
D) in the current. E) in the voltage.

7) (7 pts) The current plotted below is driven through an inductor with L=2 H. Sketch the induced voltage as a function of time on the axes in the box. (No vertical scale is needed.)



_____8) When a current of 1 A passes through an inductor L the energy stored is U_0. The current needed to store $2U_0$ in the same inductor is closest to:
A)0.7 A B) 1.4 A C) 2 A D) 4 A E) cannot be found.

9) Your penurious boss asks you to construct an inductor of inductance $4\text{x}10^{-4}$ H by wrapping left-over wire around a pencil that has a radius of 0.003 m. The inductor you make has a length of 0.02 m (much more than its radius). How many turns of wire do you have to wrap to make the inductor? (Assume that the permeability of the pencil is the same as vacuum.)

_____10) An energy of U_0 is stored in an inductor when the current flowing through it is I_0. If the current is doubled to $2I_0$, the energy stored is closest to:
A) zero. B) U_0 C) 2 U_0 D) 4 U_0 E) $U_0/2$

11) A solenoid is constructed by winding a thin wire 10^4 times around an insulating tube of radius

0.01 m and 0.1 m in length. The resistance of the wire is 3 ohms. Calculate its inductance.

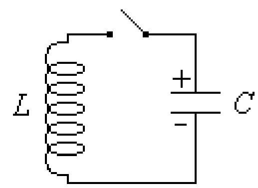
LC, RC, RL TRANSIENTS

$$Emf_L = -L\frac{di}{dt} = -L\frac{d^2q}{dt^2}; \quad Emf_R = iR = R\frac{dq}{dt}; \quad Emf_C = \frac{1}{C}\int idt = \frac{q_C}{C}$$

$$RC: \; v_C(t) = V_0 e^{-t/RC}; \quad RL: \; i_{RL}(t) = I_0 e^{-\frac{R}{L}t}; \quad LC: \; v_C(t) = V_0 \cos(\omega_{LC} t) \text{ with } \omega_{LC} - \frac{1}{\sqrt{LC}}$$

___ 12. In an oscillating LC circuit, the total stored energy is U and the maximum charge on the capacitor is Q. When the charge on the capacitor is $Q/2$, the energy stored in the inductor is:
A. $U/2$ B. $U/4$ C. $4U/3$ D. $3U/2$ E. $3U/4$

13. (20%) The sketch shows a charged capacitor, an inductor, and an open switch in series. Their values are L = 0.30 mH (0.30×10^{-3} H), C = 1.5 μF (1.5×10^{-6} F), and the charge on the capacitor is q = 40 μC (4.0×10^{-5} C). There is no current flowing in the circuit.



$L = 0.30 \times 10^{-3}$ H
$C = 1.5 \times 10^{-6}$ F
$q = 4.0 \times 10^{-5}$ C

a) (5%) How much energy is stored in the capacitor?

U_E = ____________________
units

b) (5%) Find f, the frequency of oscillation of this circuit, when the switch is closed.

f = ____________________
units

c) (5%) Find I, the maximum value of the current in the inductor, when the switch is closed and the circuit is in oscillation.

I = ____________________
units

d) (5%) How much time will elapse from the instant the switch is closed until the magnitude of the current in the inductor reaches its maximum value for the first time.

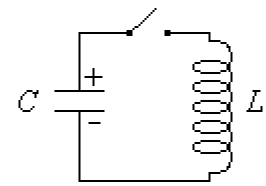
t = ____________________
units

___ 14. In an oscillating LC circuit, the charge on the capacitor is a maximum when:
A. the current in the inductor is a maximum.
B. the emf in the inductor is a maximum.
C. the emf in the inductor is zero.
D. the rate of change of current is zero.
E. none of the above.

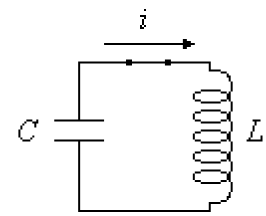
___ 15. In an oscillating LC circuit, the magnitude of the rate of change of the current in the circuit, $\left|\frac{di}{dt}\right|$, is a maximum when:
A. the magnitude of the current in the inductor is a maximum
B. the magnitude of the charge on the capacitor is a maximum
C. the energy stored in the inductor is a maximum

D. the charge on the capacitor is zero
E. none of the above

16. (8%) The sketch shows a charged capacitor *C,* in series with an inductor *L*, and an open switch. When the switch is closed, the electromagnetic oscillations begin.

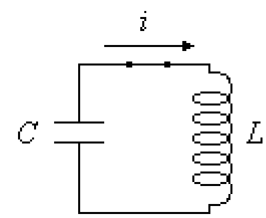


a) (4%) At some time after the switch is closed, the current is found to be flowing in the direction shown in the sketch at the right, and it is *increasing* in magnitude. The direction in which the displacement current is flowing between the plates of the capacitor is: (Circle the correct answer.)



$i_d = 0$ ↑ ↓ → ← SOME OTHER DIRECTION

b) (4%) At some time after the switch is closed, the current is found to be flowing in the direction shown in the sketch at the right, and it is *increasing* in magnitude. The direction of the emf in the inductor is: (Circle the correct answer.)



E = 0 ↑ ↓ → ← SOME OTHER DIRECTION

___ 17. A charged capacitor and an inductor are connected at time $t = 0$. In terms of the period T of the resulting oscillations, what is the first later time at which the energy stored in the electric field of the capacitor is a maximum?
A. $T/4$ B. $T/2$ C. $3T/4$ D. T E. None of the above

18. (6%) The picture shows an ideal oscillating *LC* circuit (resistance is zero)

a) (3%) At the instant shown in the picture, the current in the inductor is decreasing. What is the direction of the displacement current between the plates of the capacitor is? (Circle the correct answer)

TO THE TOP OF THE PAGE
TO THE BOTTOM OF THE PAGE
THE DISPLACEMENT CURRENT IS ZERO

b) (3%) At the instant shown in the picture, suppose the current in the inductor is at a maximum. At which point, *A* or *B*, is the voltage higher? (Circle the correct answer)
POINT *A* **POINT *B*** **VOLTAGE AT *A* = VOLTAGE AT *B***

19) (7 pts) A capacitor and an inductor are wired to make an oscillator. The capacitor has a value of 0.1 microFarads. What must the value of the inductor be in order for the circuit to oscillate at 20 kHz?

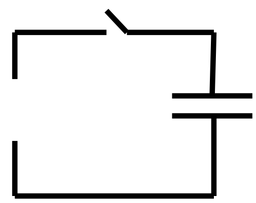
20) A capacitor *C* and resistor *R* are wired in a loop so that the capacitor can discharge through the resistor. The charge on a parallel plate capacitor is $3\text{x}10^{-6}$ C immediately after a

switch is thrown and decays exponentially to 1/10 of its initial value in $2x10^{-3}$ s. The resistance R is 1000 ohms. What is the value of the capacitance?

21) An inductor ($L=2x10^{-3}$ H) and a capacitor are wired in a loop so the charge on the capacitor varies as $q(t) = 10^{-3}\cos(2000\pi t)$ C due to the natural oscillation of the circuit. How much energy is stored in the inductor when the current is at its maximum?

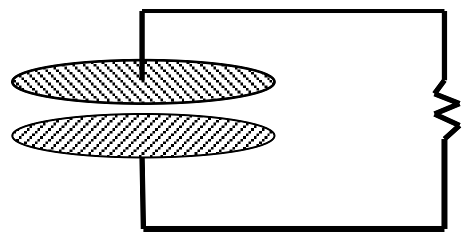
_____22) A circuit consists of an inductor and a capacitor in a closed loop. The initial energy stored in the capacitor is U_E and the initial current is zero. The circuit is then allowed to run free. The maximum energy stored in the inductor at a later time is:
A. U_E . B. $U_E/2$. C. $U_E/4$. D. zero.

23) A capacitor with $C=10^{-6}$ F and inductor with $L=10^{-3}$H are wired as shown. The capacitor is initially charged to 10V and then the switch is closed. Quantitatively describe the resulting voltage across the capacitor as a function of time. Assume that the wires have no resistance. (Does it decay or oscillate? If it decays find the time constant. If it oscillates find the period.)



24) (20 pts) You **must** show your work (relevant formulas and logic) to receive full credit

A switch is closed at t=0 to discharge a parallel plate capacitor through the resistor as shown to the right. The wires are very long and any magnetic field from them should be neglected.
The initial conditions are as follows:
Capacitor plate radius = 0.1 m.
Initial charge = 10^{-5} C. (The top plate is positive.)
Resistance= 50 kΩ .
Distance between the plates = 0.00314 m.
Capacitance = $9x10^{-11}$ F.



a) (5 pts) How long does it take for the capacitor to discharge to 1/10 of its original charge?

____

b) (5 pts) What is the initial current immediately after the switch is closed?

____

c) (5 pts) For the current in part b, find the magnetic field midway between the plates at a distance of 0.05 m from the central axis.

____

______d) (5 pts) The displacement current midway between the plates is directed:
A) up the page. B) down the page. C) circulates the axis of the capacitor.
D) left to right. E) right to left. F) is zero.

AC CIRCUITS

Driving voltage: $v_s(t) = V_0 \sin(\omega t + \phi_0)$ with resulting $i(t) = I \sin(\omega t)$.

$I = V_0 / X_{total} = V_C / X_C = V_L / X_L = V_R / X_R$

$X_R = R;\ X_C = 1/\omega C;\ X_L = \omega L$

Devices in series: $X_{total} = \sqrt{R^2 + (X_C - X_L)^2};\quad V_0 = \sqrt{V_R^2 + (V_C - V_L)^2}$

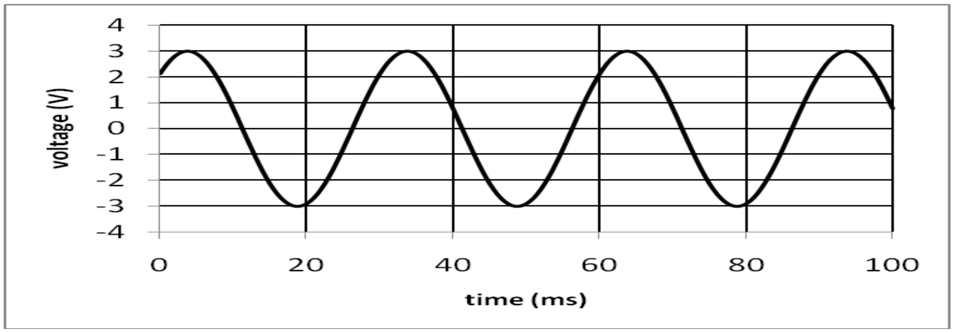
25) The reactance of a capacitor at 1000 Hz is 1000 ohms. What is the reactance at 4000 Hz?

26) A resistor of resistance 100 ohms, an inductor of inductance 2×10^{-3} H, and a capacitor of value 10^{-6} F are wired in series across a sinusoidal function generator. At what frequency will the maximum current flow through the circuit?

_____27) Two ac voltages of frequency 100 Hz and amplitude V_1=3 V and V_2= 4V are added. The phase difference between the waves is $\pi/2$. The amplitude of the combined wave is closest to
A) 1V B) 4V C) 5V D) 7V E) Can't be found.

_____28) The reactance of a capacitor at 1000 Hz is 100 ohms. The reactance at dc (zero Hz) is
A) zero ohms. B) less, but not zero. C) the same.
D) greater, but not infinite. E) infinite.

29) Use the graph below to answer questions a-d. It depicts a sinusoidal voltage $v(t) = A\sin(\omega t + \phi)$ plotted as a function of time.



_____a) The period of the voltage signal is closest to:
A) 5 ms B) 20 ms C) 30 ms D) 40 ms
E) It cannot be found from the graph.

_____b) The amplitude of the voltage signal is closest to:
A) 6V B) 4V C) 3 V D) 2V
E) It cannot be found from the graph.

_____c) If this voltage is applied across a 1 ohm resistor, the average power dissipated in the resistor is closest to:
A) 36 W B) 9 W C) 4 W D) 1 W E) 0W

_____d) If this voltage is applied across an RC circuit with a 1 F capacitor and a 1ohm resistor, the average power dissipated in the capacitor is:

A) 18 W B) 4.5 W C) 2 W D) 1 W E) 0 W

_____e) The phase shift ϕ (in radians) that best describes this signal is closest to:

A) π B) $\pi/2$ C) $\pi/4$ D) 0

____30) A harmonic voltage $v(t)=V_0\sin(\omega t+\phi)$ is applied across a capacitor. The current into the capacitor:

A) is harmonic with frequency ω and amplitude $I_0=V_0/\omega C$.
B) is harmonic with frequency 2ω and amplitude $I_0=V_0/2\omega C$.
C) is harmonic with frequency ω and amplitude $I_0=V_0\omega C$.
D) is harmonic with frequency 2ω and amplitude $I_0=2V_0\omega C$.
E) is zero.

____ 31) A harmonic voltage $v(t)=V_0\sin(\omega t+\phi)$ is applied across a capacitor. The resultant current through the capacitor is $i(t)=I_0\cos(\omega t+\phi)$. The average power dissipated in the capacitor is:

A) V_0I_0 B) $V_0I_0/2$ C) $V_0I_0/4$ D) 0
E) cannot be found with the supplied information.

32) (7 pts) A 10^{-6} F capacitor and 10^{-4} H inductor are wired in series with a 10 ohm resistor and driven with an ac voltage source. Find the driving frequency that leads to the largest voltage across the resistor.

_____33) Which of the following is a good physical reason to add an inductor in series with a speaker in an audio circuit?

A) It's cool to say you've added an inductor to the circuit.
B) It stores energy in the form of the electric field.
C) The ac field in the inductor causes emission of an electromagnetic wave.
D) The reactance of the inductor decreases with increasing frequency, cutting low frequency signal to the speaker.
E) The reactance of the inductor increases with increasing frequency, cutting high frequency signal to the speaker.

34) (15 pts) A voltage $v(t)=170\cos(2\pi ft+\phi)$ is applied across a capacitor with C=10^{-6} F and a resistor with R=100 ohms wired in series.

a) (6 pts) What is the amplitude of the current through this circuit for a source frequency of 2000 Hz?

_____________A

b) (3 pts) If the frequency is increased above 2000 Hz, how does the amplitude of the current change? (Circle one)

INCREASES DECREASES REMAINS THE SAME

c) (6 pts) At what frequency would the amplitude of the voltage across the capacitor be equal to the amplitude across the resistor?

_______________Hz

_____35) A circuit with an inductor, capacitor, and a resistor wired in series is driven by an AC signal and you measure the voltage across the resistor, V_R. If the AC driving frequency were varied from very low frequency to very high frequency:

A. V_R would be highest when the frequency is lowest – the circuit filters out high frequencies.
B. V_R would be highest when the frequency is highest – the circuit filters out low frequencies.
C. V_R would be highest at some middle frequency – the circuit serves as a band-pass.
D. V_R would be lowest at some middle frequency – the circuit serves as a notch filter.
E. None of the above.

_____36) A harmonic voltage of $v(t) = 10\cos\omega t$ (Volts) is applied across an inductor with a resultant current of $i(t) = 2\sin\omega t$ (Amps). The power dissipated in the inductor is closest to:

A) 20 W B) 14 W C) 10 W D) 7 W E) zero.

_____37) A resistor and capacitor are wired in series and the circuit is driven with a harmonic voltage of $v(t) = 10\cos(\omega t)$. The reactance of the resistor and capacitor are equal. The amplitude of the voltage across the capacitor is closest to:

A) zero volts. B) 5 V C) 7 V D) 10 V E) 14 V

_____38) When a capacitor is driven by a voltage given by $v(t) = 10\cos(\omega t)$ the reactance is 10 ohms. If the frequency were increased to 4ω the reactance would be closest to:

A) 2.5 ohms. B) 5 ohms. C) 10 ohms D) 20 ohms E) 40 ohms

39) A harmonic current of $i(t) = I_0\cos(\omega t + \phi)$ is driven through an inductor by a voltage source. The inductance is 10^{-2} H, $I_0 = 10^{-2}$ A, frequency (f)=1000 Hz, and $\phi = 30^o$. Find the amplitude of the voltage across the inductor.

WAVES

$$y(t) = y_{\max}\sin\left(\frac{2\pi}{\lambda}x - \frac{2\pi}{T}t\right) = y_{\max}\sin\left[\frac{2\pi}{\lambda}\left(x - \frac{\lambda}{T}t\right)\right] = y_{\max}\sin\left[kx - \omega t\right] = y_{\max}\sin\left[k\left(x - v_p t\right)\right]$$

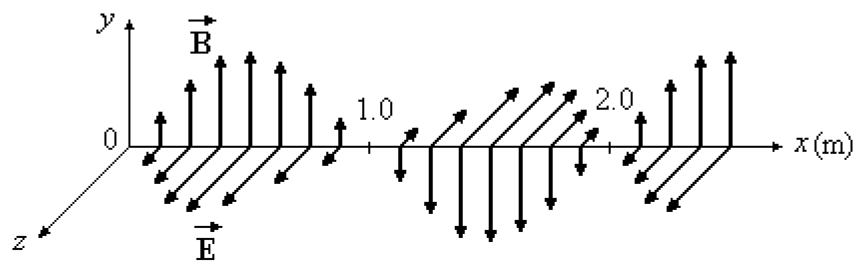
$$\vec{E}(x,t) = E_{\max}\sin\left(\frac{2\pi}{\lambda}\left(x - ct\right)\right)\hat{j}\text{(example)};\quad E = cB;\quad \vec{S} = \frac{1}{\mu_0}\vec{E}\times\vec{B}$$

$$Intensity = \frac{P}{A} = \left\langle \vec{S} \right\rangle = \frac{1}{2\mu_0}\left(\vec{E}_{\max}\times\vec{B}_{\max}\right)$$

Polarization: $I = I_{inc}\cos^2\left(\theta\right)$

___ 40. The theoretical upper limit for the frequency of electromagnetic waves is:
- A. just slightly greater than that of red light
- B. just slightly less than that of blue light
- C. the greatest x-ray frequency
- D. none of the above (there is no upper limit)
- E. none of the above (but there is an upper limit)

41. (7%) The electric and magnetic fields for a plane electromagnetic wave are shown on a set of axes in the sketch below. The *z* axis points out of the page. The electric field oscillates along the *z* direction, and the magnetic field along the *y* direction. The *x* axis is marked in meters.

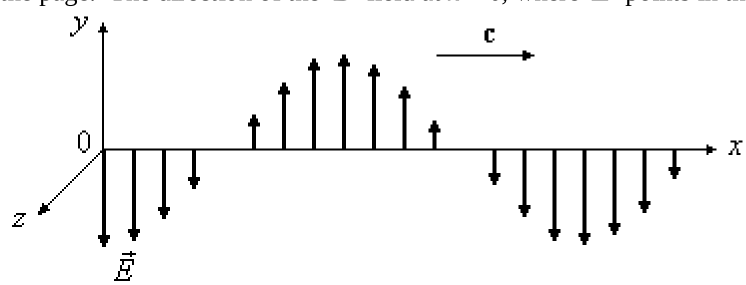


a) (3%) The direction in which the wave is moving is: (Circle the correct answer.)

POSITIVE *x* DIRECTION **NEGATIVE *x* DIRECTION**
SOME OTHER DIRECTION

b) (4%) Find the frequency of the electromagnetic wave?

___ 42. The electric field for a plane electromagnetic wave traveling in the + *x* direction is shown. The + *z* direction points out of the page. The direction of the $\vec{B}$ field at *x* = 0, where $\vec{E}$ points in the – *y* direction, is:



A. + y B. – y C. + z D. – z E. some other direction

___ 43. For a plane electromagnetic wave in vacuum, the ratio E/B of the amplitudes of the two fields in SI units is:
A. the speed of light
B. $\sqrt{2}$
C. $\frac{1}{\sqrt{2}}$
D. an increasing function of frequency
E. a decreasing function of frequency

44. (20%) The equation of the magnetic field in a plane electromagnetic wave in a vacuum as a function of x and t, is given by the equation:

$$\vec{B} = (2.0\times10^{-8}\ \mathrm{T})\cos[(0.040\pi\ \mathrm{m}^{-1})x + (1.2\pi\times10^{7}\ \mathrm{s}^{-1})t]\ \hat{z}$$

where $\hat{z}$ is a unit vector directed in the + z direction.

a) (5%) Find the wavelength of the wave.

λ = ________________ ____ units

b) (5%) Find the frequency of the wave.

f = ________________ ____ units

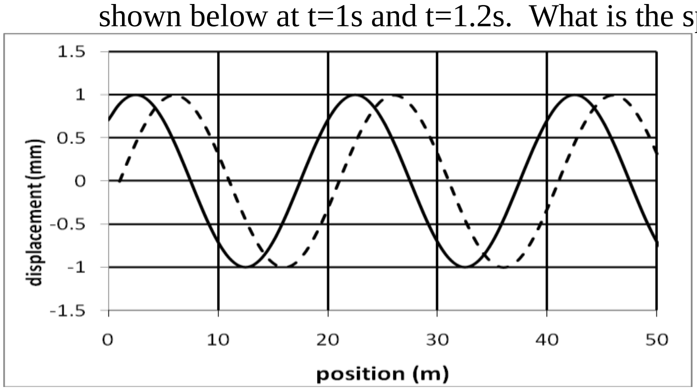
c) (3%) What is the wave speed?

v = ________________ ____ units

45) The magnetic field in an electromagnetic wave is given by $\vec{B} = B_0 \sin(10z + ct)\hat{i}$. The electric field is best represented by:

A) $\vec{E} = E_0 \cos(10z + ct)\hat{j}$
B) $\vec{E} = E_0 \sin(10z + ct)\hat{j}$
C) $\vec{E} = E_0 \sin(10z + ct)\hat{i}$
D) $\vec{E} = E_0 \sin(10x + ct)\hat{k}$
E) None of the above.

46) A wave moves in the plus x direction at a constant speed. Two snapshots of the wave are shown below at t=1s and t=1.2s. What is the speed of the wave?



_____47) The magnetic field in an electromagnetic wave is given by $\vec{B} = B_m \sin(kz - \omega t)\hat{y}$. In what direction does the wave travel?

A) +x B) +y C) +z D) -y E) Can't be determined.

____ 48) A small light bulb emits 4π W of optical power uniformly in all directions. What is the optical intensity at a distance of 10 m from the bulb?

A) 4π W/m^2 B) 40π W/m^2 C) 1 W/m^2
D) 0.1 W/m^2 E) 0.01 W/m^2

49) (7 pts) The electric field in a sinusoidal light wave of frequency 5×10^{14} Hz has an amplitude of 100 V/m. What is the intensity of the wave?

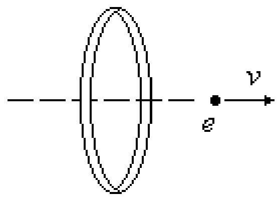
DISPLACEMENT CURRENT AND MAXWELL'S EQUATIONS

$$\oiint \vec{E}\bullet d\vec{A} = \frac{q_{enclose}}{\varepsilon_0}; \quad \oiint \vec{B}\bullet d\vec{A} = 0; \quad \oint \vec{E}\bullet d\vec{s} = -\frac{d\Phi_B}{dt}: \quad \oint \vec{B}\bullet d\vec{s} = \mu_0\left(i + i_D\right); \quad i_D = \varepsilon_0 \frac{\partial \Phi_E}{\partial t}$$

___ 50. One of Maxwell's equations is $\oint \vec{B}\cdot d\vec{s} = \mu_0\left(i + \varepsilon_0 \frac{d\Phi_E}{dt}\right)$. The "∘" symbol in the integral sign means:

A. the same as the subscript in μ_0
B. integrate clockwise around the path
C. integrate counterclockwise around the path
D. integrate around a closed path
E. integrate over a closed surface

___51. An electron has just passed through the center of a circle while moving along the axis of the circle, as shown in the sketch. At the instant shown, in the plane of the circle, directed along the axis of the circle:



A. there is only a real current
B. there is only a displacement current
C. there are both real and displacement currents
D. there is neither a real nor a displacement current
E. none of the above

___ 52. Below are Maxwell's equations for free space, where there are no charges or currents.

I. $\oint \vec{E}\cdot d\vec{A} = 0$ III. $\oint \vec{E}\cdot d\vec{s} = -\frac{d\Phi_B}{dt}$

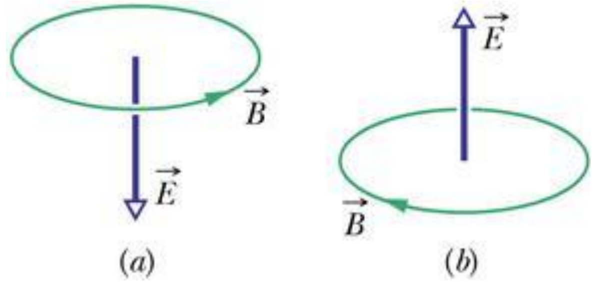
II. $\oint \vec{B}\cdot d\vec{A} = 0$ IV. $\oint \vec{B}\cdot d\vec{s} = \mu_0\varepsilon_0 \frac{d\Phi_E}{dt}$

Which equations must be modified if they are to be applied where charges and currents might be present?
A. I and II D. III and IV
B. I and III E. Some other combination.
C. I and IV

___ 53. A magnetic field exists between the plates of a capacitor:
A. always D. while the capacitor is being charged
B. never E. only if the capacitor is defective
C. when the capacitor is fully charged

___ 54. Two of Maxwell's equations contain an integral over a closed surface. For them, the infinitesimal surface area vector $d\vec{A}$ is always:
A. tangent to the surface
B. perpendicular to the surface and pointing outward
C. perpendicular to the surface and pointing inward
D. tangent to a field line
E. perpendicular to a field line

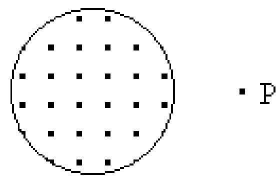
55. (6%) The figure below shows, in two situations, an electric field vector $\vec{E}$ and an induced magnetic field line. In each case, is the magnitude of $\vec{E}$ increasing, decreasing, or remaining constant? Circle the correct answers.



a) **INCREASING DECREASING REMAINING THE SAME**

b) **INCREASING DECREASING REMAINING THE SAME**

56. (3%) The diagram at the right represents a circular region where an electric field is directed out of the page, and is *constant* in time. The direction of the induced magnetic field at point *P* is: (Circle the correct answer)



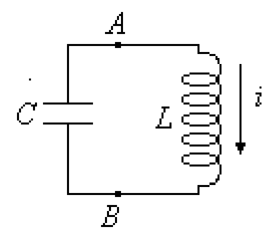
INTO THE PAGE; **OUT OF THE PAGE;**

TO THE LEFT; **TO THE RIGHT;**

TO THE TOP OF THE PAGE; **TO THE BOTTOM OF THE PAGE;**

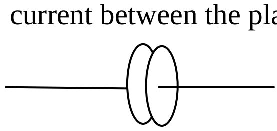
SOME OTHER DIRECTION **THERE IS NO INDUCED MAGNETIC FIELD**

_____57) The Maxwell-Ampere equation in the absence of charge and current is $\oint \vec{B} \bullet d\vec{s} = \mu_0 \varepsilon_0 \frac{\partial \Phi_E}{\partial t}$. The units of $\varepsilon_0 \frac{\partial \Phi_E}{\partial t}$ are



A) Volt/second B) Amp-meter C) Coulomb-meter^2
D) Amp E) Tesla

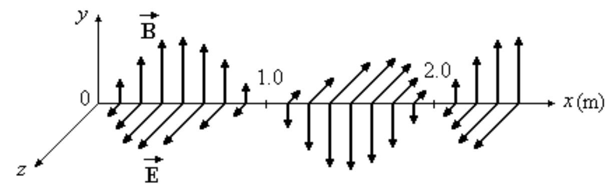
_____58) A voltage source charges a capacitor so that the positive charge on the left hand electrode is increasing as shown. What is the direction of the displacement current between the plates of the capacitor?



A) Right. B) Left C) Down
D) Circulating the capacitor (the right hand rule.)

____ 59) A circular parallel plate capacitor of radius *R* and spacing *d* is charging with constant current *i*. The magnetic field is measured midway between the plates as a function of distance *r* from the axis of the plates. The point at which the magnetic field is greatest is:
A) *r*=0 B) *r*=*R*/2 C) *r*=*R*
D) *r*=2*R* E) The field is zero.

_____60) The fields for a plane electromagnetic wave are shown to the right. The direction in which the wave travels is:
A) +x B) –x C) +z
D) –z E) cannot be found.



_____61) Is there a magnetic field between the plates of a fully charged stationary capacitor with normal conducting plates? (Assume no external sources.)
A) Yes. There is always a B field when there is an E field.
B) No. There is only field if the charge on the capacitor is changing.
C) No. There is never a B field between the plates. It can only be outside the capacitor.
D) Yes. Energy is stored in the form of the magnetic field.

62) A 100. mm-radius circular parallel plate capacitor has a plate spacing of 1.00 mm. A current of 0.100 A is charging the capacitor. Find the magnetic field 71 mm from the central axis of the capacitor.

63) The magnetic field for an electromagnetic wave traveling in vacuum is given by $\vec{B} = 0.01\cos(2\pi z + 6\pi \bullet 10^8 t)\hat{j}$ T . Write the relation for the electric field in the form $\vec{E} = a\cos(kw \pm \omega t + \phi)\hat{b}\ \ \frac{V}{m}$ where a, k, ω, ϕ are numbers you supply and w and b represent directions and direction unit vectors such as x, y, z and $\hat{i}, \hat{j}, \hat{k}$.

64) (18 pts) A point light source emits power P(W/m^2) isotropically into vacuum in the form of visible light. The frequency of the emitted light is f=5.00x10^{14} Hz.
a) (6 pts) If the power emitted by the bulb is 20W, what is the intensity at a distance of 3 m from the bulb?

___________units_____

b) (6 pts) Use your answer from part (a) to find the amplitude of the electric field at a distance of 3 m from the bulb.

__________units_____

d) (6 pts) If the amplitude of the electric field at a distance of 3 m is E_0 , what is the electric field amplitude at a distance of 1 m (in terms of E_0)?