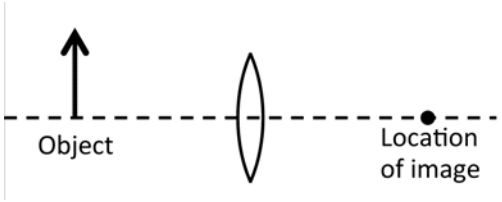
The next three questions pertain to the situation described below.



An object is placed to the left of a converging lens with focal length f = 25 cm, such that the lens is exactly the same distance from the object and the image.

1) What is the distance of the object from the lens?

a. 12.5 cm
b. 50 cm.
c. 25 cm

2) What is the magnification *m* of the image?

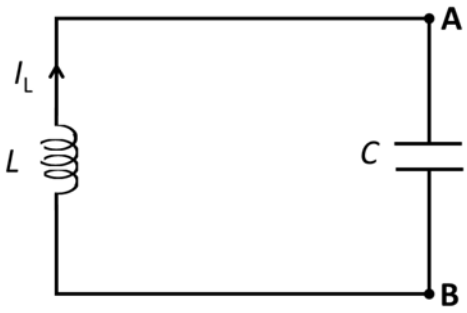
a. *m*= -1
b. *m*= +1
c. *m*= 0

3) The image is

a. virtual
b. real

The next three questions pertain to the situation described below.

Consider a circuit constructed with a capacitor and an inductor as shown below. The values for the capacitor and inductor are: $C = 1.25 \times 10^{-4}$ F and L = 0.275 H. At time t = 0, the current through the inductor has its maximum value $I_L(0) = 0.35$ A and it has the direction shown.



4) The voltage across the inductor is zero whenever the charge on the capacitor is maximum.

a. False
b. True

5) What is $U(t_1)$, the energy stored in the inductor L at $t=t_1 = 0.0115$ s?

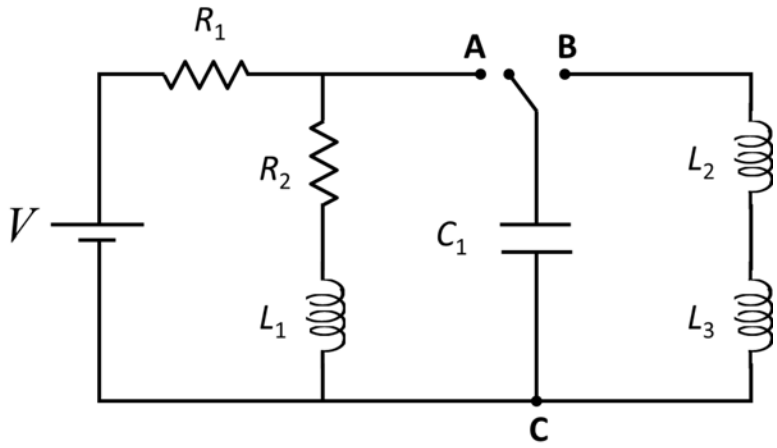
a. $U(t_1) = 0.0144$ J
b. $U(t_1) = 0.0168$ J
c. $U(t_1) = 0.00244$ J

6) What is $Q(t_2)$, the charge on the top plate of the capacitor C at time $t=t_2 = 0.0153$ s?

a. $Q(t_2) = 0.00104$ C
b. $Q(t_2) = -0.00177$ C
c. $Q(t_2) = -0.00205$ C

The next three questions pertain to the situation described below.

In the circuit shown below, the switch has been in position A for a very long time. At t = 0, it is moved to position B.



V = 9 Volts
$C_1 = 1.0 \times 10^{-4}$ F
$R_1 = 18\ \Omega$
$R_2 = 27\ \Omega$
$L_1 = 0.025$ H
$L_2 = 0.05$ H
$L_3 = 0.05$ H

7) What is I_{L1} the magnitude of the current that flows through L_1 just before the switch is moved to position B?

a. $I_{L1} = 0.2$ A
b. $I_{L1} = 0$ A
c. $I_{L1} = 0.5$ A

8) What is ω_0, the resonance frequency of the circuit consisting of C_1, L_2, and L_3 after the switch is moved to position B?

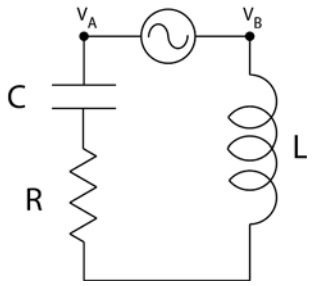
a. $\omega_0 = 632$ rad/s
b. $\omega_0 = 447$ rad/s
c. $\omega_0 = 316$ rad/s

9) What is V_{L2max}, the maximum voltage across inductor L_2 after the switch is moved to B?

a. $V_{L2max} = 5.4$ V
b. $V_{L2max} = 2.7$ V
c. $V_{L2max} = 4.5$ V

The next four questions pertain to the situation described below.

The series LRC circuit is driven by a voltage generator with V(t) = 9sin(260t) Volts. The remaining circuit elements have the following values; R = 15.5 Ω, C = 8.5×10^{-5} F and L = 0.25 H.



10) The voltage across the generator _____ the current through the generator.

a. leads
b. lags
c. is in phase with

11) Which of the following circuit elements has the largest peak voltage across it?

a. Resistor
b. Generator
c. Capacitor

12) What is the average power delivered by the generator?

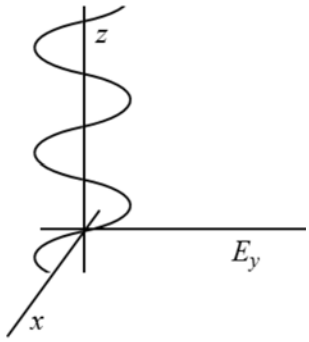
a. $P_{average}$ = 0.995 W
b. $P_{average}$ = 1.41 V
c. $P_{average}$ = 1.99 V

13) What is the Q of this circuit?

a. Q = 2.48
b. Q = 1.87
c. Q = 3.51

The next three questions pertain to the situation described below.

An electromagnetic plane wave propagates in the positive *z* direction (up) as shown in the figure, which represents the value of the wave's electric field at one instant in time as a function of *z*. Note that the electric field is parallel (or antiparallel) to the *y* axis.



14) The best description for the wave's magnetic field (note that *k*, *ω*, and B_{max} are all positive) is:

a. $\vec{B}(\vec{r},t) = -B_{\mathtt{max}}\mathtt{sin(kz+\omega t)}\hat{\mathtt{y}}$
b. $\vec{B}(\vec{r},t) = +B_{\mathtt{max}}\mathtt{cos(kz-\omega t)}\hat{\mathtt{z}}$
c. $\vec{B}(\vec{r},t) = -B_{\mathtt{max}}\mathtt{sin(kz-\omega t)}\hat{\mathtt{x}}$
d. $\vec{B}(\vec{r},t) = +B_{\mathtt{max}}\mathtt{sin(kz-\omega t)}\hat{\mathtt{x}}$
e. $\vec{B}(\vec{r},t) = +B_{\mathtt{max}}\mathtt{cos(kz-\omega t)}\hat{\mathtt{y}}$

15) An observer at rest at the origin determines that the *average* intensity of the electromagnetic wave is 8 W/m^2. What is the wave's maximum electric field?

a. E_{max} = 77.7 V/m
b. $E_{max} = 2.59 \times 10^{-7}$ V/m
c. $E_{max} = 3.66 \times 10^{-7}$ V/m
d. E_{max} = 155 V/m
e. $E_{max} = 5.18 \times 10^{-7}$ V/m

16) Compare the values of *ω* measured by two different observers. One observer is moving quickly toward the light source, the other is moving away from the light source

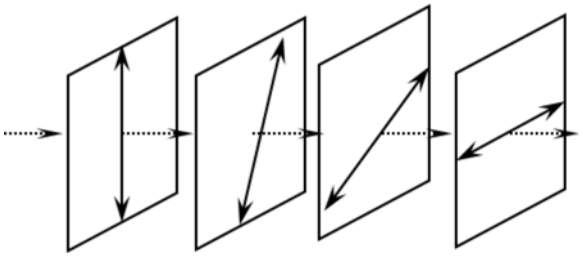
a. $\omega_{\mathtt{toward}} = \omega_{\mathtt{away}}$
b. $\omega_{\mathtt{toward}} > \omega_{\mathtt{away}}$
c. $\omega_{\mathtt{toward}} < \omega_{\mathtt{away}}$

17) Unpolarized light of initial intensity I_0 passes through a quarter wave plate. The intensity of the light after it emerges from the plate is

a. I_0
b. 0.71 x I_0
c. 0.5 x I_0

The next two questions pertain to the situation described below.

Unpolarized light of intensity I_0 and peak magnetic field B_0 strikes a stack of four linear polarizers, each with its transmission axis oriented at 30 degrees with respect to the previous filter, as shown in the figure.



18) What is the peak magnitude of the magnetic field after the light passes through the first polarizer?

a. $B_1 = B_0\sqrt{3}/2$
b. $B_1 = B_0/2$
c. $B_1 = B_0/\sqrt{2}$

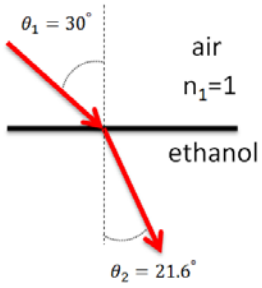
19) What is the intensity of the light after passing through all 4 polarizers?

a. $I_4 = 0.325\ I_0$
b. $I_4 = 0.316\ I_0$
c. $I_4 = 0.211\ I_0$
d. $I_4 = 0.00782\ I_0$
e. $I_4 = 0.422\ I_0$

20) The radio station WIXY broadcasts at frequency 100.3 MHz. What is the wavelength of the station's signal?

a. 0.00997 m
b. 16 m
c. 2.99 m

21) A laser beam passes from air into a container of ethanol and refracts, as shown. What is the speed of light in ethanol?

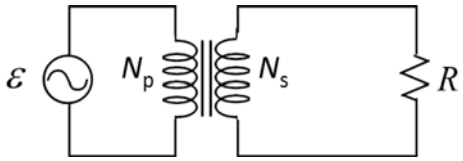


a. 2.13×10^8 m/s
b. 3.0×10^8 m/s
c. 2.21×10^8 m/s

22) The average orbital radius of the planet Mars is about 1.52 times greater than the radius of the earth's orbit around the sun. The relative magnitudes of the electric fields associated with sunlight striking the earth and Mars will satisfy the relation

a. $\langle E_{earth} \rangle / \langle E_{Mars} \rangle = 2.31$
b. $\langle E_{earth} \rangle / \langle E_{Mars} \rangle = 1.32$
c. $\langle E_{earth} \rangle / \langle E_{Mars} \rangle = 1.00$
d. $\langle E_{earth} \rangle / \langle E_{Mars} \rangle = 1.52$
e. $\langle E_{earth} \rangle / \langle E_{Mars} \rangle = 1.37$

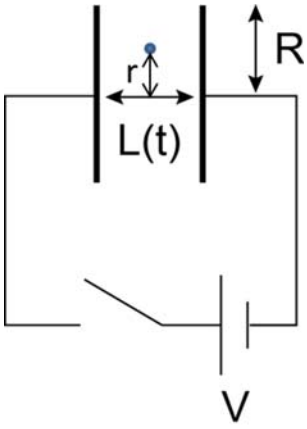
23) A transformer consists of a primary coil of N_p = 152 turns and a secondary coil of unknown turns N_s as shown. The generator voltage is given as $\epsilon = 240\sin(\omega t)$ Volts. The secondary coil is connected to a load of resistance R = 15 Ω. Assuming the coils and wires have zero resistance, what is N_s for which an average power of 30 W is delivered to the load R?



a. N_s = 19
b. N_s = 76
c. N_s = 38

The next two questions pertain to the situation described below.

A parallel plate capacitor is connected to a 14 V battery through a switch as shown. The capacitor plates are circular with radius R = 0.05 m. The separation between the plates can be externally controlled. The switch has been closed for a long time and the initial plate separation is L(t=0)= R. With the switch closed, the plate separation is made to decrease with the following functional form $L(t) = R\, e^{-t/T}$, where $T = 1.0 \times 10^{-3}$ s.



24) As the plates are coming together, there is a time when the current through the battery is measured to be 2.4×10^{-6} A. At that time, what is the magnitude of the magnetic field at the point marked between the plates of the capacitors, a distance r = 0.025 m above their center.

a. 0 T
b. 3.01×10^{-12} T
c. 4.8×10^{-12} T
d. 9.6×10^{-12} T
e. 1.92×10^{-11} T

25) Calculate the total displacement current between the capacitor plates at time t = 2T.

a. 1.44×10^{-7} A
b. 3.12×10^{-6} A
c. 1.02×10^{-7} A