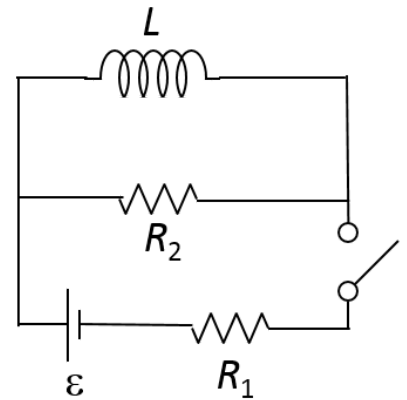


The next three questions pertain to the situation described below.

In the circuit shown in the figure below, $\varepsilon = 12 \text{ V}$, $R_1 = 25 \Omega$, $R_2 = 15 \Omega$ and $L = 0.035 \text{ H}$. The switch has been open for a long time before it is closed at $t = 0$.



1) What is the voltage across the inductor just after the switch is closed?

- a. $V_{L0} = 4.5 \text{ volts}$
- b. $V_{L0} = 0 \text{ volts}$
- c. $V_{L0} = 12 \text{ volts}$

2) What is the current through the battery after a long time?

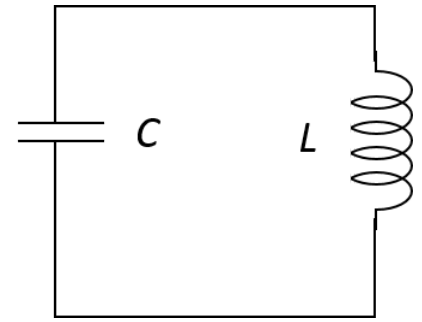
- a. $I_{\text{battery}} = 0.48 \text{ A}$
- b. $I_{\text{battery}} = 0.3 \text{ A}$
- c. $I_{\text{battery}} = 0.8 \text{ A}$
- d. $I_{\text{battery}} = 0 \text{ A}$
- e. $I_{\text{battery}} = 1.28 \text{ A}$

3) At what rate is the current in the inductor changing when the current through the battery is 0.14 A ?

- a. $dI_L/dt = 243 \text{ A/s}$
- b. $dI_L/dt = 4 \text{ A/s}$
- c. $dI_L/dt = 343 \text{ A/s}$
- d. $dI_L/dt = 0 \text{ A/s}$
- e. $dI_L/dt = 60 \text{ A/s}$

The next three questions pertain to the situation described below.

An LC oscillator consists of a 2×10^{-5} F capacitor and an inductor. The voltage across the capacitor has a maximum value of 15 V, and oscillates with a frequency $\omega = 1410$ rad/s.



4) What is the inductance of the inductor?

- a. $L = 10^{-5}$ H
- b. $L = 0.025$ H
- c. $L = 8 \times 10^{-7}$ H

5) What is the maximum energy stored in the inductor?

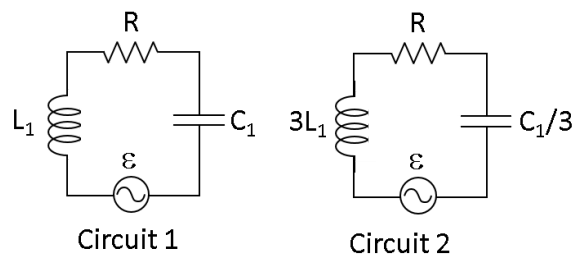
- a. $U_{L\max} = 3.21 \times 10^6$ J
- b. $U_{L\max} = 5.62 \times 10^6$ J
- c. $U_{L\max} = 0.00225$ J
- d. $U_{L\max} = 4.5 \times 10^6$ J
- e. $U_{L\max} = 4500$ J

6) What is the maximum current that flows in the circuit?

- a. $I_{\max} = 0.424$ A
- b. $I_{\max} = 0.00189$ A
- c. $I_{\max} = 600$ A

The next two questions pertain to the situation described below.

Consider the two AC circuits shown in the figure. They are identical except that the second circuit has $L_2 = 3 L_1$, and $C_2 = 1/3 C_1$. $L_2 = 0.0025$ H and $C_2 = 4 \times 10^{-6}$ F



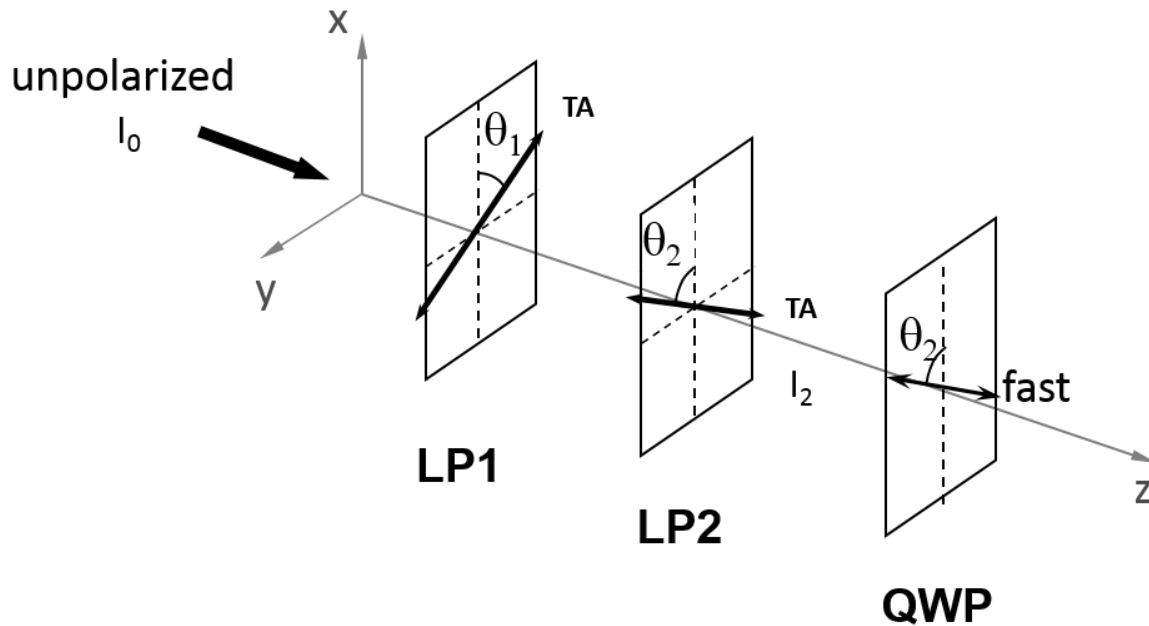
7) Compare the rate at which energy is dissipated by the resistor in the two circuits when the generator frequency $\omega = 10^4$ rad/s.

- a. $P_1 < P_2$
- b. $P_1 > P_2$
- c. $P_1 = P_2$

8) Compare the rate at which energy is dissipated by the resistor in the two circuits when the generator frequency $\omega = 9 \times 10^3$ rad/s.

- a. $P_1 < P_2$
- b. $P_1 = P_2$
- c. $P_1 > P_2$

The next two questions pertain to the situation described below.



Unpolarized light of intensity I_0 is incident on a linear polarizer (LP1) with transmission axis oriented at an angle $\theta_1 = 15^\circ$ clockwise with respect to the x axis. The light then passes through a second linear polarizer (LP2) with transmission axis oriented at an angle $\theta_2 = 40^\circ$ counterclockwise relative to the x axis as shown before passing through a quarter wave plate. The fast axis of the quarter wave plate is also at an angle $\theta_2 = 40^\circ$.

9) What is the intensity of the light after the second linear polarizer (LP2) but before the quarter wave plate?

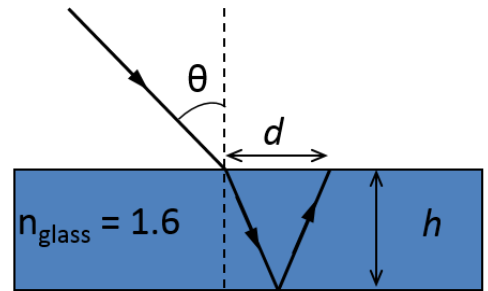
- a. $I_2 = 0.411 I_0$
- b. $I_2 = 0.307 I_0$
- c. $I_2 = 0.164 I_0$
- d. $I_2 = 0.766 I_0$
- e. $I_2 = 0.548 I_0$

10) What is the polarization after the light passes through the quarter wave plate?

- a. Left circularly polarized
- b. Right circularly polarized
- c. Linearly polarized along θ_2

The next two questions pertain to the situation described below.

A light ray passes from air ($n = 1$) into a slab of glass ($n = 1.6$) at an incident angle of $\theta = 25^\circ$. The glass has a thickness $h = 0.028$ m. At the lower boundary of the glass part of the ray is reflected and exits the glass slab a distance d away from the location of incidence.



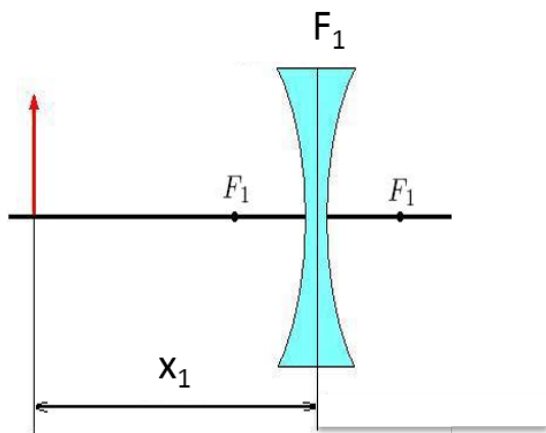
11) What is the distance d between where the incident ray enters and the reflected ray exits?

- a. $d = 0.0215$ m
- b. $d = 0.0237$ m
- c. $d = 0.0353$ m
- d. $d = 0.056$ m
- e. $d = 0.129$ m

12) If the glass slab is placed in water ($n=1.3$) and a ray of light is incident on the glass surface at the same angle $\theta = 25^\circ$, the distance d between where the incident ray enters and the reflected ray exits will be _____ when it was in air.

- a. less than
- b. larger than
- c. equal to

The next three questions pertain to the situation described below.



A diverging lens has focal length $F_1 = -7$ cm . An object is placed a distance $x_1 = 24$ cm to the left of the diverging lens as shown.

13) The image formed by the diverging lens is

- a. Virtual and inverted
- b. Virtual and upright
- c. Real and inverted

14) The location of the image formed by the diverging lens is

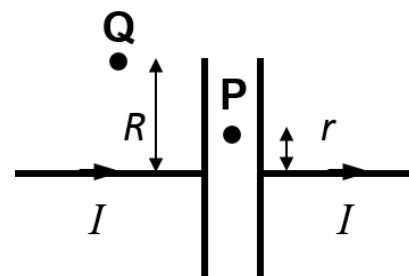
- a. 9.88 cm to the right of lens 1.
- b. -9.88 cm to the right of lens 1.
- c. -5.42 cm to the right of lens 1.

15) The magnification of the image is

- a. -0.774
- b. 4.4
- c. -0.23
- d. 0.23
- e. -4.4

The next two questions pertain to the situation described below.

Consider a capacitor having circular plates with radius $R = 0.46$ m when a current $I = 4.5$ amps is flowing into the capacitor.



16) What is the magnitude of the magnetic field at point **P** a distance $r = 0.18$ m from the center of the parallel-plate capacitor?

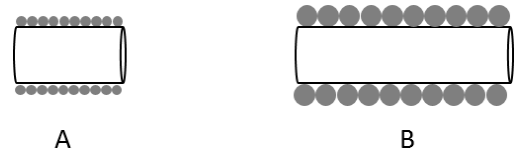
- a. $|B| = 7.66 \times 10^{-7}$ T
- b. $|B| = 1.38 \times 10^{-7}$ T
- c. $|B| = 5 \times 10^{-6}$ T

17) Compare the magnitude of the magnetic field at point **Q** a distance R above the wire, with the magnitude of the magnetic field at point **P**.

- a. $|B_Q| < |B_P|$
- b. $|B_Q| > |B_P|$
- c. $|B_Q| = |B_P|$

The next two questions pertain to the situation described below.

Two solenoids, A and B, have the same diameter and contain only one layer of copper windings, with adjacent turns touching, the insulation thickness being negligible. The two solenoids have the same total number of turns. But, Solenoid A has wire with 1/2 the thickness as solenoid B, so it is only 1/2 the length. Assume the wires have circular cross sectional area. (Recall the magnetic field inside a solenoid is given by $B = \mu_0 n I$ and the inductance of a solenoid is $L = \Phi_B / I = \mu_0 n^2 z \pi r^2$).



18) Compare the inductance of the two solenoids.

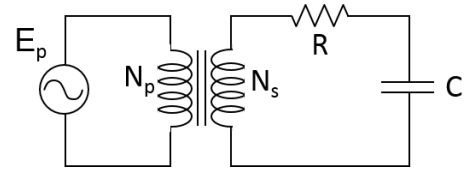
- a. $L_A < L_B$
- b. $L_A = L_B$
- c. $L_A > L_B$

19) If the wire used to create the solenoids has resistivity ρ , compare the time constants for the solenoids if they are connected directly to a battery as shown in the figure.



- a. $\tau_B = \tau_A$
- b. $\tau_B = 2 \tau_A$
- c. $\tau_B = 4 \tau_A$

20) A generator with a peak voltage of $E_p = 120$ volts oscillating at a frequency of $f = 60$ Hz is connected to a transformer with $N_p = 1350$ turns on the primary coil and $N_s = 450$ turns on the secondary coil. The secondary coil is connected in series with a resistor $R = 40 \Omega$ and capacitor $C = 8.3 \times 10^{-5}$ F as shown in the figure. What is the peak current through the resistor?

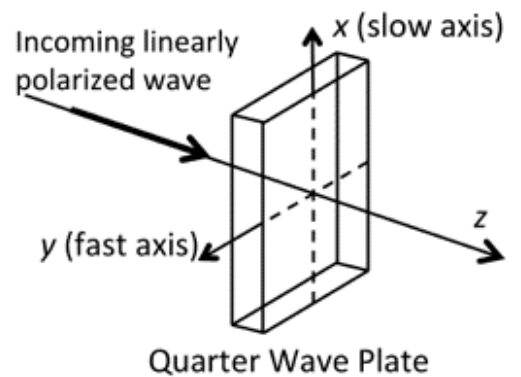


- a. $I_{\max} = 2.34$ A.
- b. $I_{\max} = 0.781$ A.
- c. $I_{\max} = 1$ A.

21) A linearly polarized monochromatic wave is incident on a quarter-wave plate, as shown in the diagram. The electric field is described by the equation

$$\vec{E}(x, t) = \frac{\hat{x} - \hat{y}}{\sqrt{2}} E_0 \cos(kz - \omega t)$$

The light that emerges is



- a. left circularly polarized.
- b. linearly polarized.
- c. right circularly polarized.