chapter 24 ELECTROMAGNETIC WAVES

☐ 2. Which one of the following will *not* generate electromagnetic waves or pulses?
(a) a steady direct current
(b) an accelerating electron
(c) a proton in simple harmonic motion
(d) an alternating current
(e) charged particles traveling in a circular path in a mass spectrometer

◘ 5. A television station broadcasts at a frequency of 86 MHz. The circuit contains an inductor with an inductance $L = 1.2 \times 10^{-6}$ H and a variable-capacitance *C*. Determine the value of *C* that allows this television station to be tuned in.
(a) 2.9×10^{-12} F
(b) 5.8×10^{-12} F
(c) 1.8×10^{-11} F
(d) 3.6×10^{-11} F
(e) 1.1×10^{-10} F

Section 24.2 The Electromagnetic Spectrum

☐ 6. Which one of the following types of wave is intrinsically different from the other four?
(a) radio waves
(b) sound waves
(c) gamma rays
(d) ultraviolet radiation
(e) visible light

◘ 8. Which one of the following statements concerning the wavelength of an electromagnetic wave in a vacuum is true?
(a) The wavelength is independent of the speed of the wave for a fixed frequency.
(b) The wavelength is inversely proportional to the speed of the wave.
(c) The wavelength is the same for all types of electromagnetic waves.
(d) The wavelength is directly proportional to the frequency of the wave.
(e) The wavelength is inversely proportional to the frequency of the wave.

◘ 9. Complete the following sentence: The various colors of visible light differ in
(a) frequency only.
(b) wavelength only.
(c) their speeds in a vacuum.
(d) frequency and wavelength.
(e) frequency and their speed in a vacuum.

Section 24.3 The Speed of Light

◘ 17. A radio wave sent from the surface of the earth reflects from the surface of the moon and returns to the

earth. The elapsed time between the generation of the wave and the detection of the reflected wave is 2.6444 s. Determine the distance from the surface of the earth to the surface of the moon. **Note**: The speed of light is 2.9979×10^8 m/s.

(a) 3.7688×10^8 m (c) 3.9638×10^8 m (e) 7.9276×10^8 m
(b) 3.8445×10^8 m (d) 4.0551×10^8 m

Section 24.4 The Energy Carried by Electromagnetic Waves

◘ 23. The peak value of the electric field component of an electromagnetic wave is E. At a particular instant, the intensity of the wave is of 0.020 W/m^2. If the electric field were increased to 5E, what would be the intensity of the wave?

(a) 0.020 W/m^2 (c) 0.25 W/m^2 (e) 1.0 W/m^2
(b) 0.10 W/m^2 (d) 0.50 W/m^2

◘ 24. An electromagnetic wave has an electric field with peak value 250 N/C. What is the average intensity of the wave?

(a) 0.66 W/m^2 (c) 83 W/m^2 (e) 170 W/m^2
(b) 0.89 W/m^2 (d) 120 W/m^2

Section 24.6 Polarization

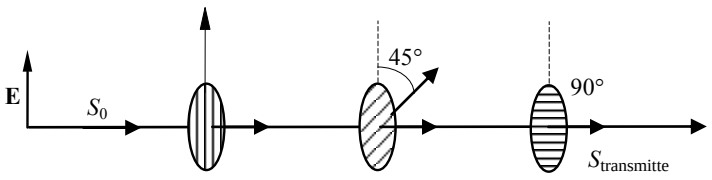
■ 35. Light emerges from a polarizer that has its transmission axis located along the x axis. The light then passes through two additional sheets of polarizing material. It is desired to orient the two sheets so that, after passing through both of them, the electromagnetic wave has the maximum possible intensity and is polarized 90° with respect to the x axis. How should the transmission axes of the sheets be oriented? **Note**: the following answers give the angles that the transmission axes make with respect to the x axis.

	First polarizing sheet	*Second polarizing sheet*
(a)	45° with respect to the x axis	45° with respect to the x axis
(b)	45° with respect to the x axis	90° with respect to the x axis
(c)	90° with respect to the x axis	45° with respect to the x axis
(d)	30° with respect to the x axis	60° with respect to the x axis
(e)	30° with respect to the x axis	90° with respect to the x axis

◘ 37. Linearly polarized light is incident of a sheet of polarizing material. The angle between the transmission axis and the incident electric field is 52°. What percentage of the incident intensity is transmitted?

(a) 38 % (c) 52 % (e) 79 %
(b) 43 % (d) 62 %

◘ 38. A linearly polarized beam of light is incident upon a group of three polarizing sheets which are arranged so that the transmission axis of each sheet is rotated by 45° with respect to the preceding sheet as shown. What fraction of the incident intensity is transmitted?

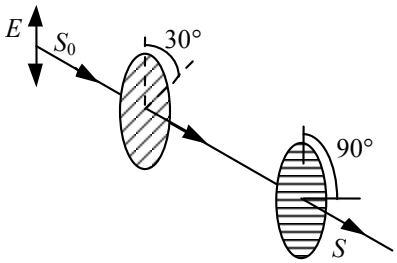


(a) 1/8 (c) 3/8 (e) 3/4

(b) 1/4 (d) 1/2

Questions 42 through 45 pertain to the situation described below:

A linearly polarized electromagnetic wave is sent through two sheets of polarizing material. The first sheet, **A**, is oriented so that its transmission axis makes an angle of 30° with respect to the incident electric field of the wave. The second sheet, **B**, is oriented so that its transmission axis makes an angle of 90° with the incident electric field of the wave. The incident beam has an electric field of peak magnitude E_0 and average intensity S_0.



■ 42. What is the peak value of the electric field amplitude after it goes through sheet **A**?
(a) $0.30E_0$ (c) $0.60E_0$ (e) $0.87E_0$
(b) $0.50E_0$ (d) $0.75E_0$

◘ 43. What is the average intensity of the wave after it passes through **A**?
(a) $0.30S_0$ (c) $0.60S_0$ (e) $0.86S_0$
(b) $0.50S_0$ (d) $0.75S_0$

◘ 44. What is the average intensity of the wave after it passes through **B**?
(a) $0.19S_0$ (c) $0.43S_0$ (e) zero
(b) $0.34S_0$ (d) $0.50S_0$

■ 45. Suppose that **A** and **B** are interchanged so that the wave is first incident upon **B**. What is the average wave intensity after passing through both polarizing sheets?
(a) $0.19S_0$ (c) $0.43S_0$ (e) zero
(b) $0.34S_0$ (d) $0.50S_0$