***Physics: Principle and Applications*, 7e (Giancoli)**
Chapter 22 Electromagnetic Waves

22.1 Conceptual Questions

1) Which one of the following is *not* an electromagnetic wave?
A) ultraviolet
B) infrared
C) radio waves
D) sound waves
E) gamma rays
Answer: D
Var: 1

2) Which one of the following lists gives the correct order of the electromagnetic spectrum from *low to high frequencies*?
A) radio waves, infrared, microwaves, ultraviolet, visible, x-rays, gamma rays
B) radio waves, ultraviolet, x-rays, microwaves, infrared, visible, gamma rays
C) radio waves, microwaves, infrared, visible, ultraviolet, x-rays, gamma rays
D) radio waves, microwaves, visible, x-rays, infrared, ultraviolet, gamma rays
E) radio waves, infrared, x-rays, microwaves, ultraviolet, visible, gamma rays
Answer: C
Var: 1

3) Which one of the following lists gives the correct order of the electromagnetic waves from *longer wavelength to shorter wavelength*?
A) radio waves, infrared, microwaves, ultraviolet, visible, x-rays, gamma rays
B) radio waves, ultraviolet, x-rays, microwaves, infrared, visible, gamma rays
C) radio waves, microwaves, visible, x-rays, infrared, ultraviolet, gamma rays
D) radio waves, microwaves, infrared, visible, ultraviolet, x-rays, gamma rays
E) radio waves, infrared, x-rays, microwaves, ultraviolet, visible, gamma rays
Answer: D
Var: 1

4) In an electromagnetic wave in free space, the electric and magnetic fields are
A) parallel to one another and perpendicular to the direction of wave propagation.
B) parallel to one another and parallel to the direction of wave propagation.
C) perpendicular to one another and perpendicular to the direction of wave propagation.
D) perpendicular to one another and parallel to the direction of wave propagation.
Answer: C
Var: 1

5) Which of the following statements about electromagnetic waves in free space are true? (There could be more than one correct choice.)
A) The higher-frequency travel faster than the lower-frequency waves.
B) The higher-frequency waves have shorter wavelengths than the lower-frequency waves.
C) The wavelengths of the visible waves are some of the longest electromagnetic waves.
D) The wavelengths of the visible waves are some of the shortest electromagnetic waves.
E) The electric field vector is always at right angles to the magnetic field vector.
Answer: B, E
Var: 1

6) Which one of the following types of electromagnetic wave travels through space the fastest?
A) radio waves
B) infrared
C) ultraviolet
D) microwaves
E) They all travel through space at the same speed.
Answer: E
Var: 1

7) The energy density of an electromagnetic wave in free space is
A) entirely in the electric field.
B) entirely in the magnetic field.
C) 1/4 in the electric field and 3/4 in the magnetic field.
D) 1/4 in the magnetic field and 3/4 in the electric field.
E) equally divided between the magnetic and the electric fields.
Answer: E
Var: 1

8) For an electromagnetic wave in free space having an electric field of amplitude E and a magnetic field of amplitude B, the ratio of B/E is equal to
A) c
B) c^2
C) $1/c$
D) $1/c^2$
E) $\sqrt{c}$
Answer: C
Var: 1

9) Which one of the following expressions is the correct representation for the speed of light in vacuum?
A) $\sqrt{\varepsilon_0 \mu_0}$
B) $\sqrt{\varepsilon_0 / \mu_0}$
C) $\sqrt{\mu_0 / \varepsilon_0}$
D) $1 / \sqrt{\varepsilon_0 \mu_0}$
E) $1 / \varepsilon_0 \mu_0$
Answer: D
Var: 1

10) Which of the following statements about electromagnetic waves in free space are true? (There could be more than one correct choice.)
A) The electric field carries more energy than the magnetic field.
B) The electric and magnetic fields have equal amplitudes.
C) The electric field carries the same mount of energy as the magnetic field.
D) The frequency of the magnetic field is the same as the frequency of the electric field.
E) The frequency of the electric field is higher than the frequency of the magnetic field.
Answer: C, D
Var: 1

11) Except for their color, a perfectly black (absorbing) object is identical to a perfectly white (reflecting) object. If identical light falls on both of these objects, what is true about the momentum they will receive from this light?
A) The black object will receive twice as much as the white object.
B) They will both receive the same amount.
C) The white object will receive twice as much as the black object.
D) The black object will receive four times as much as the white object.
E) The white object will receive four times as much as the black object.
Answer: C
Var: 1

12) Two light beams of different frequency but the same intensity fall on a black (totally absorbing) surface, striking perpendicular to the surface. Which of the following statements are true? (There could be more than one correct choice.)
A) The high-frequency beam exerts more pressure on the surface.
B) Both beams exert the same pressure on the surface.
C) If the surface were painted white (totally reflecting), the pressure on it would be less than when it was black.
D) Painting the surface white would not affect the pressure on it due to these beams.
E) The light beams exert no pressure on the surface because light is just energy.
Answer: B
Var: 1

22.2 Problems

1) A cordless phone operates at 900 MHz. What is the wavelength of the electromagnetic wave used by this phone? ($c = 3.0 \times 10^8$ m/s)
Answer: 0.33 m
Var: 1

2) An FM radio station broadcasts at 96.7 MHz. What is the wavelength of the radio wave used for this broadcast? ($c = 3.0 \times 10^8$ m/s)
Answer: 3.1 m
Var: 1

3) What is the wavelength used by a radio station that broadcasts at a frequency of 920 kHz? ($c = 3.00 \times 10^8$ m/s)
A) 22.6 m
B) 226 m
C) 326 m
D) 175 m
E) 276 m
Answer: C
Var: 1

4) The frequency of a microwave signal is 9.76 GHz. What is its wavelength? ($c = 3.00 \times 10^8$ m/s)
A) 3.07 cm
B) 2.07 cm
C) 1.07 cm
D) 5.07 cm
E) 4.07 cm
Answer: A
Var: 1

5) What is the frequency of 20-mm microwaves? ($c = 3.0 \times 10^8$ m/s)
A) 100 MHz
B) 400 MHz
C) 15 GHz
D) 73 GHz
Answer: C
Var: 1

6) The wavelength of an electromagnetic wave is 600 nm. What is its frequency? ($c = 3.0 \times 10^8$ m/s)
A) 200×10^{12} Hz
B) 300×10^{12} Hz
C) 400×10^{12} Hz
D) 500×10^{12} Hz
E) 600×10^{12} Hz
Answer: D
Var: 1

7) A certain part of the electromagnetic spectrum ranges from 200 nm to 400 nm. What is the *highest* frequency associated with this portion of the spectrum? ($c = 3.00 \times 10^8$ m/s)
A) 1.50×10^{14} Hz
B) 7.50×10^{13} Hz
C) 7.50×10^{14} Hz
D) 7.50×10^{15} Hz
E) 1.50×10^{15} Hz
Answer: E
Var: 1

8) A certain part of the electromagnetic spectrum ranges from 200 nm to 400 nm. What is the *lowest* frequency associated with this portion of the spectrum? ($c = 3.00 \times 10^8$ m/s)
A) 1.50×10^{14} Hz
B) 7.50×10^{13} Hz
C) 7.50×10^{14} Hz
D) 7.50×10^{15} Hz
E) 1.50×10^{15} Hz
Answer: C
Var: 1

9) A 7.55×10^{14} Hz electromagnetic wave travels in carbon tetrachloride with a speed of 2.05×10^8 m/s. What is the wavelength of the wave in this material?
A) 272 nm
B) 301 nm
C) 338 nm
D) 361 nm
E) 397 nm
Answer: A
Var: 50+

10) The distance between two asteroids is 1600 km. How much time does it take for a light signal to go from one asteroid to the other? ($c = 3.0 \times 10^8$ m/s)
A) 19 ms
B) 4.5 ms
C) 5.3 ms
D) 13 ms
E) 19 μs
Answer: C
Var: 1

11) How far does a beam of light travel in 2.0 ms? ($c = 3.0 \times 10^8$ m/s)
A) 6.0×10^5 m
B) 0.66×10^5 m
C) 90 m
D) 70 m
E) 60 m
Answer: A
Var: 1

12) How far does light travel in 1.0 μs? ($c = 3.0 \times 10^8$ m/s)
A) 3.0×10^{14} m
B) 0.30 km
C) 3.0 m
D) 30 cm
Answer: B
Var: 1

13) How long does it take light to travel 1.0 m? ($c = 3.0 \times 10^8$ m/s)
A) 3.3 ns
B) 3.3 μs
C) 3.3 ms
D) 3.3 s
Answer: A
Var: 1

14) How much time does it take a beam of light to travel 2.9 km through space. ($c = 3.0 \times 10^8$ m/s)
A) 9.7 s
B) 9.7 ms
C) 9.7 μs
D) 9.7 ns
E) 9.7 ps
Answer: C
Var: 1

15) A radio station broadcasts at 80 MHz. How long does it take for this radio signal to travel a distance of 2.0×10^7 m through space? ($c = 3.0 \times 10^8$ m/s)
A) 0.15×10^{-2} s
B) 15 ms
C) 6.7×10^{-2} s
D) 20 ms
E) 25 ms
Answer: C
Var: 1

16) How far does a beam of light travel through space in one 365-day year? ($c = 3.0 \times 10^8$ m/s)
A) 80×10^{12} m
B) 95×10^{14} m
C) 30×10^8 m
D) 20×10^{15} m
E) 36×10^{16} m
Answer: B
Var: 1

17) A radio station broadcasts at a frequency of 80 MHz. How far from the transmitter will this signal travel in 67 ms? ($c = 3.0 \times 10^8$ m/s)
A) 60×10^6 m
B) 67 m
C) 40 km
D) 80 km
E) 20×10^6 m
Answer: E
Var: 1

18) A laser beam takes 24 ms to travel from a rocket to the reflective surface of a planet and back to the rocket. How far is the rocket from this planet's surface? ($c = 3.0 \times 10^8$ m/s)
A) 2400 km
B) 1200 km
C) 1800 km
D) 3600 km
E) 4800 km
Answer: D
Var: 1

19) A radar receiver indicates that a pulse return as an echo in 20 μs after it was sent. How far away is the reflecting object? ($c = 3.0 \times 10^8$ m/s)
A) 1.5 km
B) 3.0 km
C) 6.0 km
D) 9.0 km
Answer: B
Var: 1

20) An 800-kHz radio signal is detected at a point 9.5 km distant from a transmitter tower. The electric field amplitude of the signal at that point is 0.23 V/m. Assume that the signal power is radiated uniformly in all directions and that radio waves incident upon the ground are completely absorbed. What is the average electromagnetic energy density at that point? ($c = 3.0 \times 10^8$ m/s, $\mu_0 = 4\pi \times 10^{-7}$ T · m/A, $\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N · m^2)
A) 2.3×10^{-13} J/m^3
B) 3.3×10^{-13} J/m^3
C) 4.7×10^{-13} J/m^3
D) 6.6×10^{-13} J/m^3
E) 9.4×10^{-13} J/m^3
Answer: A
Var: 1

21) A 4.4×10^{14} Hz laser emits a 2.1 μs pulse that is 5.0 mm in diameter. The energy density in the beam is 0.24 J/m^3. How many wavelengths are there in the length of the beam? ($c = 3.0 \times 10^8$ m/s, $\mu_0 = 4\pi \times 10^{-7}$ T · m/A, $\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N · m^2)
A) 9.2×10^8
B) 2.8×10^9
C) 2.8×10^8
D) 9.2×10^9
E) 2.8×10^{10}
Answer: A
Var: 50+

22) A 2.4 x 10^{14} Hz laser emits a 3.5-μs pulse that is 5.0 mm in diameter. The average energy density in the beam is 0.65 J/m^3. What average power is emitted by this laser? ($c = 3.0 \times 10^8$ m/s, $\mu_0 = 4\pi \times 10^{-7}$ T · m/A, $\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N · m^2)
A) 3.8 kW
B) 7.7 kW
C) 12 kW
D) 15 kW
E) 19 kW
Answer: A
Var: 50+

23) At a particular point and instant, the magnetic field component of an electromagnetic wave is 15.0 μT. What is the *magnetic* energy density of this wave at that point and instant? ($c = 3.00 \times 10^8$ m/s, $\mu_0 = 4\pi \times 10^{-7}$ T · m/A, $\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N · m^2)
A) 2.26×10^{-4} J/m^3
B) 8.95×10^{-5} J/m^3
C) 1.79×10^{-4} J/m^3
D) 4.47×10^{-4} J/m^3
E) 9.72×10^{-5} J/m^3
Answer: B
Var: 1

24) The maximum *magnetic* energy density of a sinusoidal electromagnetic wave is 8.95×10^{-5} J/m^3. What is the amplitude of the magnetic field component of this wave? ($c = 3.00 \times 10^8$ m/s, $\mu_0 = 4\pi \times 10^{-7}$ T · m/A, $\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N · m^2)
A) 12.0 μT
B) 13.0 μT
C) 14.0 μT
D) 15.0 μT
E) 16.0 μT
Answer: D
Var: 1

25) A sinusoidal electromagnetic wave has a peak electric field of 8.00 kV/m. What is the intensity of the wave? ($c = 3.0 \times 10^8$ m/s, $\mu_0 = 4\pi \times 10^{-7}$ T • m/A, $\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N • m^2)
A) 170 kW/m^2
B) 85 kW/m^2
C) 21 kW/m^2
D) 11 kW/m^2
Answer: B
Var: 8

26) If the magnetic field in a traveling electromagnetic wave has a maximum value of 16.5 nT, what is the maximum value of the electric field associated with this wave? ($c = 3.00 \times 10^8$ m/s)
A) 5.5×10^{-17} V/m
B) 4.95 V/m
C) 0.495 V/m
D) 55.0×10^{-16} V/m
E) 55.0×10^{-15} V/m
Answer: B
Var: 1

27) A certain electromagnetic field traveling in vacuum has a maximum electric field of 1200 V/m. What is the maximum magnetic field of this wave? ($c = 3.0 \times 10^8$ m/s)
A) 3.4×10^{-4} T
B) 4.0×10^{-6} T
C) 2.2×10^{-5} T
D) 9.6×10^{-6} T
E) 8.7×10^{-6} T
Answer: B
Var: 1

28) The amplitude of the electric field for a certain type of electromagnetic wave is 570 N/C. What is the amplitude of the magnetic field for that wave? ($c = 3.00 \times 10^8$ m/s)
A) 2.91 μT
B) 1.90 μT
C) 1.10 μT
D) 1.41 μT
E) 2.41 μT
Answer: B
Var: 5

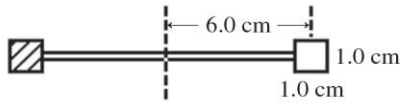
29) The maximum value of the electric field in an electromagnetic wave is 2.0 V/m. What is the maximum value of the magnetic field in that wave? ($c = 3.0 \times 10^8$ m/s)
A) 6.7 pT
B) 6.7 mT
C) 6.7 nT
D) 6.7 μT
E) 6.7 T
Answer: C
Var: 1

30) About 1350 W/m^2 of electromagnetic energy reaches the upper atmosphere of the earth from the sun, which is 1.5×10^{11} m away. Use this information to estimate the average power output of the sun.
A) 1×10^{26} W
B) 2×10^{26} W
C) 3×10^{26} W
D) 4×10^{26} W
Answer: D
Var: 1

31) A radio transmitter is operating at an average power of 4.00 kW and is radiating uniformly in all directions. What is the average intensity of the signal 8.00 km from the transmitter?
A) 4.97 μW/m^2
B) 2.49 μW/m^2
C) 0.00497 W/m^2
D) 0.00249 W/m^2
Answer: A
Var: 25

32) Radiation of a single frequency reaches the upper atmosphere of the earth with an intensity of 1350 W/m^2. What is the maximum value of the electric field associated with this radiation? (c = 3.00 × 10^8 m/s, $\mu_0 = 4\pi \times 10^{-7}$ T · m/A, $\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2/N \cdot m^2$)
A) 675.0 V/m
B) 1604 V/m
C) 1400 V/m
D) 1350 V/m
E) 1010 V/m
Answer: E
Var: 1

33) A radiometer has two square vanes (1.0 cm by 1.0 cm), attached to a light horizontal cross arm, and pivoted about a vertical axis through the center, as shown in the figure. The center of each vane is 6.0 cm from the axis. One vane is silvered and it reflects all radiant energy that falls upon it. The other vane is blackened and it absorbs all incident radiant energy. Radiant energy, having an intensity of 300 W/m^2, is incident normally upon the front surfaces of both vanes. What is the radiant power absorbed by the blackened vane?



A) 0.030 W
B) 0.040 W
C) 0.050 W
D) 0.060 W
E) 0.090 W
Answer: A
Var: 1

34) The rate of energy flow per unit area of a sinusoidal electromagnetic wave has an average value of 0.601 W/m^2. What is the maximum value of the magnetic field in the wave? (c = 3.00 × 10^8 m/s, $\mu_0 = 4\pi \times 10^{-7}$ T · m/A, $\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N · m^2)

A) 7.09 × 10^{-8} T

B) 5.02 × 10^{-8} T

C) 3.55 × 10^{-8} T

D) 9.81 × 10^{-8} T

E) 1.42 × 10^{-7} T

Answer: A
Var: 1

35) The rate of energy flow per unit area of an electromagnetic wave has an average value of 0.695 W/m^2. The wave is incident at right angles upon a rectangular area measuring 1.5 m by 2.0 m. How much total energy falls upon this rectangle each minute? ($\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N · m^2, $\mu_0 = 4\pi \times 10^{-7}$ T · m/A, c = 3.0 × 10^8 m/s)

A) 130 J
B) 160 J
C) 190 J
D) 220 J
E) 250 J
Answer: A
Var: 1

36) An 800-kHz sinusoidal radio signal is detected at a point 6.6 km from the transmitter tower. The electric field amplitude of the signal at that point is 0.780 V/m. Assume that the signal power is radiated uniformly in all directions and that radio waves incident upon the ground are completely absorbed. What is the amplitude of the magnetic field of the signal at that point? (ε_0 = 8.85 × 10^{-12} C^2/N · m^2, c = 3.0 × 10^8 m/s, $\mu_0 = 4\pi \times 10^{-7}$ T · m/A)

A) 2.6 nT
B) 2.1 nT
C) 1.6 nT
D) 3.1 nT
E) 3.6 nT
Answer: A
Var: 1

37) An 800-kHz sinusoidal radio signal is detected at a point 2.1 km distant from a transmitter tower. The electric field amplitude of the signal at that point is 0.80 V/m. Assume that the signal power is radiated uniformly in all directions and that radio waves incident upon the ground are completely absorbed. What is the intensity of the radio signal at that point? ($\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2/N \cdot m^2$, $\mu_0 = 4\pi \times 10^{-7}$ T · m/A, $c = 3.0 \times 10^8$ m/s)

A) 8.5×10^{-4} W/m^2
B) 1.2×10^{-3} W/m^2
C) 1.7×10^{-3} W/m^2
D) 6.0×10^{-4} W/m^2
E) 4.2×10^{-4} W/m^2
Answer: A
Var: 1

38) What is the maximum value of the magnetic field at a distance of 2.5 m from a light bulb that radiates 100 W of single-frequency sinusoidal electromagnetic waves uniformly in all directions? ($\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2/N \cdot m^2$, $\mu_0 = 4\pi \times 10^{-7}$ T · m/A, $c = 3.0 \times 10^8$ m/s)

A) 0.10 μT
B) 0.40 μT
C) 0.50 μT
D) 0.60 μT
E) 0.80 μT
Answer: A
Var: 1

39) A light source radiates 60.0 W of single-wavelength sinusoidal light uniformly in all directions. What is the average intensity of the light from this bulb at a distance of 0.400 m from the bulb?

A) 14.9 W/m^2
B) 37.2 W/m^2
C) 27.4 W/m^2
D) 11.9 W/m^2
E) 29.8 W/m^2
Answer: E
Var: 1

40) A light source radiates 60.0 W of single-wavelength sinusoidal light uniformly in all directions. What is the amplitude of the electric field of this light at a distance of 0.400 m from the bulb? ($\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2/N \cdot m^2$, $\mu_0 = 4\pi \times 10^{-7}$ T · m/A, $c = 3.00 \times 10^8$ m/s)

A) 162 N/C
B) 212 N/C
C) 82.1 N/C
D) 150 N/C
E) 52.9 N/C
Answer: D
Var: 1

41) A light source radiates 60.0 W of single-wavelength sinusoidal light uniformly in all directions. What is the amplitude of the magnetic field of this light at a distance of 0.700 m from the bulb?($\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N · m^2, $\mu_0 = 4\pi \times 10^{-7}$ T · m/A, $c = 3.0 \times 10^8$ m/s)

A) 1.76×10^{-7} T
B) 2.02×10^{-7} T
C) 2.22×10^{-7} T
D) 2.86×10^{-7} T
Answer: D
Var: 1

42) An 8.0-mW laser beam emits a cylindrical beam of single-wavelength sinusoidal light 0.90 mm in diameter. What is the rms value of the electric field in this laser beam? ($\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N · m^2, $\mu_0 = 4\pi \times 10^{-7}$ T · m/A, $c = 3.0 \times 10^8$ m/s)

A) 2200 N/C
B) 1000 N/C
C) 1100 N/C
D) 4100 N/C
E) 2000 N/C
Answer: A
Var: 1

43) An 8.00-mW laser beam emits a cylindrical beam of single-wavelength sinusoidal light 0.600 mm in diameter. What is the maximum value of the magnetic field in the laser beam? ($\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N · m^2, $\mu_0 = 4\pi \times 10^{-7}$ T · m/A, $c = 3.0 \times 10^8$ m/s)

A) 9.24 μT
B) 17.2 μT
C) 12.4 μT
D) 20.5 μT
E) 15.4 μT
Answer: E
Var: 1

44) How much energy is transported across a 1.00-cm^2 area per hour by a sinusoidal electromagnetic wave whose electric field has a maximum strength of 30.4 V/m? ($\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N · m^2, $\mu_0 = 4\pi \times 10^{-7}$ T · m/A, $c = 3.0 \times 10^8$ m/s)

A) 0.44 nJ
B) 0.44 μJ
C) 0.44 mJ
D) 0.44 J
Answer: D
Var: 1

45) The intensity of solar radiation near the earth is 1.4 kW/m^2. What magnitude force does this radiation exert when it strikes at right angles to a 5.0-m^2 perfectly reflecting solar panel of an artificial satellite orbiting the earth? (c = 3.0 × 10^8 m/s)
Answer: 4.7 × 10^{-5} N
Var: 1

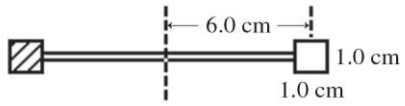
46) The total electromagnetic power emitted by the sun is 3.8 ×10^{26} W. What is the radiation pressure it exerts on the perfectly absorbing surface of a satellite near the orbit of Mercury, which is 5.8 × 10^{10} m from the sun? The radiation strikes the surface of the satellite perpendicular to the surface. (c = 3.0 × 10^8 m/s)
Answer: 30 μN/m^2
Var: 1

47) Light with an average intensity of 683 W/m^2 falls on a black surface and is completely absorbed. What is the radiation pressure that the light exerts on this surface if it strikes perpendicular to the surface? (c = 3.00 × 10^8 m/s)
A) 2280 nN/m^2
B) 205,000 N/m^2
C) 4550 nN/m^2
D) 1140 nN/m^2
Answer: A
Var: 1

48) If the average intensity of the sunlight in Miami, Florida, is 1040 W/m^2, what is the average value of the radiation pressure due to this sunlight on a black totally absorbing asphalt surface in Miami? (c = 3.00 × 10^8 m/s)
A) 2.28 × 10^{-6} N/m^2
B) 1.63 × 10^{-6} N/m^2
C) 7.83 × 10^{-6} N
D) 3.47 × 10^{-6} N/m^2
E) 9.78 × 10^{-6} N/m^2
Answer: D
Var: 1

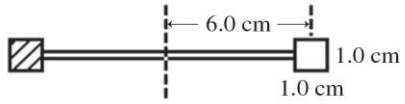
49) If the average intensity of the sunlight in Miami, Florida, is 1060 W/m^2, what is the average magnitude of the force this light exerts on a 16-m^2 surface of black asphalt that totally absorbs the light? ($c = 3.00 \times 10^8$ m/s)
A) 7.83×10^{-5} N
B) 1.63×10^{-5} N/m^2
C) 2.61×10^{-5} N
D) 5.65×10^{-5} N
E) 0.204×10^{-5} N
Answer: D
Var: 5

50) A radiometer has two square vanes (1.0 cm by 1.0 cm), attached to a light horizontal cross arm, and pivoted about a vertical axis through the center, as shown in the figure. The center of each vane is 6.0 cm from the axis. One vane is silvered and it reflects all radiant energy incident upon it. The other vane is blackened and it absorbs all incident radiant energy. Radiant energy, having an intensity of 300 W/m^2, is incident normally upon the vanes. What is the radiation pressure on the blackened vane? ($c = 3.0 \times 10^8$ m/s, $\mu_0 = 4\pi \times 10^{-7}$ T · m/A, $\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2/N \cdot m^2$)



A) 1.0×10^{-10} Pa
B) 1.0×10^{-9} Pa
C) 1.0×10^{-8} Pa
D) 1.0×10^{-7} Pa
E) 1.0×10^{-6} Pa
Answer: E
Var: 1

51) A radiometer has two square vanes (1.0 cm by 1.0 cm), attached to a light horizontal cross arm, and pivoted about a vertical axis through the center, as shown in the figure. The center of each vane is 6.0 cm from the axis. One vane is silvered and it reflects all radiant energy incident upon it. The other vane is blackened and it absorbs all incident radiant energy. Radiant energy, having an intensity of 300 W/m^2, is incident normally upon the front of both vanes. What is the net torque on the vane assembly, about the vertical axis? (c = 3.0 × 10^8 m/s, $\mu_0 = 4\pi \times 10^{-7}$ T · m/A, ε_0 = 8.85 × 10^{-12} C^2/N · m^2)



A) 0.0 N · m
B) 6.0 × 10^{-12} N · m
C) 1.2 × 10^{-11} N · m
D) 1.8 × 10^{-11} N · m
E) 2.4 × 10^{-11} N · m
Answer: B
Var: 1