PRACTICE EXERCISES

SINGLE CORRECT CHOICE TYPE QUESTIONS

This section contains Single Correct Choice Type Questions. Each question has four choices (A), (B), (C) and (D), out of which ONLY ONE is correct.

1. A wave is propagating in a medium of electric dielectric constant 2 and relative magnetic permeability 50. The wave impedance of such a medium is
(A) 5 Ω (B) 376.6 Ω
(C) 1883 Ω (D) 3776 Ω

2. The electric field component of a monochromatic radiation is given by $\vec{E} = 2E_0\hat{i}\cos kz\cos\omega t$
Its magnetic field is then given by
(A) $\dfrac{2E_0}{c}\hat{j}\cos kz\cos\omega t$ (B) $\dfrac{2E_0}{c}\hat{j}\sin kz\cos\omega t$
(C) $\dfrac{2E_0}{c}\hat{j}\sin kz\sin\omega t$ (D) $-\dfrac{2E_0}{c}\hat{j}\sin kz\sin\omega t$

3. Electromagnetic waves travel in a medium which has relative permeability 1.3 and relative permittivity 2.14. Then the speed of the electromagnetic wave in the medium will be
(A) $13.6\times10^{6}\ \text{ms}^{-1}$ (B) $1.8\times10^{2}\ \text{ms}^{-1}$
(C) $3.6\times10^{8}\ \text{ms}^{-1}$ (D) $1.8\times10^{8}\ \text{ms}^{-1}$

4. To which region of electromagnetic spectrum, the frequency 1 BHz correspond?
(A) ultraviolet rays (B) radio waves
(C) visible radiation (D) X-rays

5. The oscillating electric and magnetic vectors of an electromagnetic wave are oriented along
(A) the same direction but differ in phase by 90°
(B) the same direction and are in phase
(C) mutually perpendicular directions and are in phase
(D) mutually perpendicular directions and differ in phase by 90°

6. An LC resonant circuit contains a 400 pF capacitor and a 100 μH inductor. It is sent into oscillations coupled to an antenna. The wavelength of the radiated electromagnetic wave is
(A) 377 mm (B) 377 cm
(C) 377 m (D) 3.77 cm

7. The rms value of the electric field of the light coming from the sun is $720\ \text{NC}^{-1}$. The average total energy density of the electromagnetic wave is
(A) $3.3\times10^{-3}\ \text{Jm}^{-3}$ (B) $4.58\times10^{-6}\ \text{Jm}^{-3}$
(C) $6.37\times10^{-9}\ \text{Jm}^{-3}$ (D) $81.35\times10^{-12}\ \text{Jm}^{-3}$

8. The relation between electric field E and magnetic field H in an electromagnetic wave is
(A) $E = H$ (B) $E = \dfrac{\mu_0}{\varepsilon_0}H$
(C) $E = \sqrt{\dfrac{\mu_0}{\varepsilon_0}}H$ (D) $E = \sqrt{\dfrac{\varepsilon_0}{\mu_0}}H$

9. A parallel plate capacitor of plate separation 2 mm is connected in an electric circuit having source voltage 400 V. If the plate area is 60 cm^2, then the value of displacement current for 10^{-6} s will be
(A) 1.062 A (B) 1.062×10^{-2} A
(C) 1.062×10^{-3} A (D) 1.062×10^{-4} A

10. The ratio of electric field vector E and magnetic field vector H i.e., $\left(\dfrac{E}{H}\right)$ has the dimensions of
(A) resistance
(B) inductance
(C) capacitance
(D) product of inductance and capacitance

11. A monochromatic beam of light has a frequency $\nu = \dfrac{3}{2\pi}\times10^{12}$ Hz and is propagating along the direction $\dfrac{\hat{i}+\hat{j}}{\sqrt{2}}$. It is polarized along the $\hat{k}$ direction. The acceptable form for the magnetic field is
(A) $\dfrac{E_0}{c}\dfrac{(\hat{i}+\hat{j}+\hat{k})}{\sqrt{3}}\cos\left(10^4\dfrac{(\hat{i}+\hat{j})}{\sqrt{2}}\cdot\vec{r}+(3\times10^{12})t\right)$
(B) $\dfrac{E_0}{c}\dfrac{(\hat{i}-\hat{j})}{\sqrt{2}}\cos\left(10^4\dfrac{(\hat{i}+\hat{j})}{\sqrt{2}}\cdot\vec{r}-(3\times10^{12})t\right)$
(C) $\dfrac{E_0}{c}\dfrac{(\hat{i}-\hat{j})}{\sqrt{2}}\cos\left(10^4\dfrac{(\hat{i}-\hat{j})}{\sqrt{2}}\cdot\vec{r}-(3\times10^{12})t\right)$
(D) $\dfrac{E_0}{c}\hat{k}\cos\left(10^4\dfrac{(\hat{i}+\hat{j})}{\sqrt{2}}\cdot\vec{r}+(3\times10^{12})t\right)$

12. In an electromagnetic wave, the direction of the magnetic field induction $\vec{B}$ is
(A) parallel to electric field $\vec{E}$
(B) perpendicular to electric field $\vec{E}$
(C) antiparallel to Poynting vector $\vec{S}$
(D) random

13. Electromagnetic waves are transverse in nature is evident by
(A) polarization (B) interference
(C) reflection (D) diffraction

14. The wave associated with 2.7 K belongs to
(A) radio waves (B) microwaves
(C) ultraviolet rays (D) infrared waves

15. A parallel plate capacitor consists of two circular plates each of radius 2 cm, separated by a distance of 0.1 mm. If voltage across the plates is varying at the rate of 5×10^{13} Vs^{-1}, then the value of displacement current is
(A) 5.50 A (B) 5.56×10^{2} A
(C) 5.56×10^{3} A (D) 2.28×10^{4} A

16. A radio receiver antenna that is 2 m long is oriented along the direction of the electromagnetic wave and receives a signal of intensity 5×10^{-16} Wm^{-2}. The maximum instantaneous potential difference across the two ends of the antenna is
(A) 1.23 μV (B) 1.23 mV
(C) 1.23 V (D) 12.3 mV

17. To double the covering range of a T.V. transmitter tower, its height should be made
(A) 2 times (B) 4 times
(C) $\sqrt{2}$ times (D) 8 times

18. In an electromagnetic wave, the electric and magnetising fields are 100 Vm^{-1} and 0.265 Am^{-1}. The maximum energy flow is
(A) 26.5 Wm^{-2} (B) 36.5 Wm^{-2}
(C) 46.7 Wm^{-2} (D) 765 Wm^{-2}

19. Maxwell's equation $\oint\vec{B}\cdot d\vec{A}=0$ is a statement of
(A) Faraday's Law of Induction
(B) Modified Ampere's Law
(C) Gauss's Law of Electricity
(D) Gauss's Law of Magnetism

20. In an electromagnetic wave passing through vacuum the electric and magnetic fields are described by $E=E_0\sin(kx-\omega t)$ and $B=B_0\sin(kx-\omega t)$, then
(A) $E_0k=B_0\omega$ (B) $E_0\omega=B_0k$
(C) $E_0B_0=\omega k$ (D) None of these

21. In an electromagnetic wave the electric field vector E and the magnetic field vector B are
(A) perpendicular to each other
(B) parallel to each other
(C) at 45° to each other
(D) can have any angle between them

22. An electromagnetic wave is represented by the electric field $\vec{E}=E_0\hat{n}\sin\left[\omega t+(6y-8z)\right]$. Taking unit vectors in x, y and z directions to be $\hat{i}$, $\hat{j}$, $\hat{k}$, the direction of propagation $\hat{s}$, is
(A) $\hat{s}=\left(\frac{-3\hat{j}+4\hat{k}}{5}\right)$ (B) $\hat{s}=\left(\frac{3\hat{i}-4\hat{j}}{5}\right)$
(C) $\hat{s}=\left(\frac{-4\hat{k}+3\hat{j}}{5}\right)$ (D) $\hat{s}=\left(\frac{4\hat{j}-3\hat{k}}{5}\right)$

23. The ionosphere is mainly composed of
(A) nitrogen and oxygen
(B) ozone
(C) electrons and positive ions
(D) None of the above

24. A lamp emits monochromatic green light uniformly in all directions. The lamp is 3% efficient in converting electrical power to electromagnetic waves and consumes 100 W of power. The amplitude of the electric field associated with the electromagnetic radiation at a distance of 10 m from the lamp will be
(A) 1.34 Vm^{-1} (B) 2.68 Vm^{-1}
(C) 5.36 Vm^{-1} (D) 9.37 Vm^{-1}

25. The transmitting antenna of a radio station is mounted vertically. At a point 10 km due north of the transmitter the peak electric field is 10^{-3} Vm^{-1}. The magnitude of the radiated magnetic field is
(A) 3.33×10^{-10} T (B) 3.33×10^{-12} T
(C) 10^{-3} T (D) 3×10^{5} T

26. The 21 cm radio wave emitted by hydrogen in interstellar space is due to the interaction called the hyperfine interaction is atomic hydrogen. The energy of the emitted wave (in joule) is nearly
(A) 10^{-17} (B) 1
(C) 7×10^{-8} (D) 10^{-24}

27. The energy of electromagnetic wave in vacuum is given by the relation
(A) $\frac{E^2}{2\varepsilon_0}+\frac{B^2}{2\mu_0}$ (B) $\frac{1}{2}\varepsilon_0E^2+\frac{1}{2}\mu_0B^2$
(C) $\frac{E^2+B^2}{c}$ (D) $\frac{1}{2}\varepsilon_0E^2+\frac{B^2}{2\mu_0}$

28. The magnetic field of plane electromagnetic wave is given by $\vec{B} = \vec{B}_0\hat{i}\cos(kz - \omega t) + B_1\hat{j}\cos(kz + \omega t)$

where $B_0 = 3\times10^{-5}$ T and $B_1 = 2\times10^{-6}$ T.

The rms value of the force experienced by a stationary charge $Q = 10^{-4}$ C at $z = 0$ is closest to

(A) 0.6 N (B) 0.9 N

(C) 3×10^{-2} N (D) 0.1 N

29. The law which states that the variation of electric field causes magnetic field is

(A) Faraday's Law

(B) Biot Savart Law

(C) Modified Ampere's Law

(D) Lenz's Law

30. Infrared radiation is detected by

(A) spectrometer (B) pyrometer

(C) nanometer (D) photometer

31. The average value of electric energy density in an electromagnetic wave is (E_0 is peak value)

(A) $\frac{1}{2}\varepsilon_0 E_0^2$ (B) $\frac{E_0^2}{2\varepsilon_0}$

(C) $\varepsilon_0 E_0^2$ (D) $\frac{1}{4}\varepsilon_0 E_0^2$

32. A plane electromagnetic wave of wave intensity 6 Wm^{-2} strikes a small mirror area 40 cm^2, held perpendicular to the approaching wave. The momentum transferred by the wave to the mirror each second will be

(A) 6.4×10^{-7} $kgms^{-2}$ (B) 4.8×10^{-8} $kgms^{-2}$

(C) 3.2×10^{-9} $kgms^{-2}$ (D) 1.6×10^{-10} $kgms^{-2}$

33. An electromagnetic wave is propagating along Y-axis. Then

(A) Oscillating electric field is along X-axis and oscillating magnetic field is along Y-axis

(B) Oscillating electric field is along Z-axis and oscillating magnetic field is along X-axis

(C) Both oscillating electric and magnetic fields are along Y-axis, but phase difference between them is 90°

(D) Both oscillating electric and magnetic fields are mutually perpendicular in arbitrary directions

34. The magnetic field of an electromagnetic wave is given by

$\vec{B} = 1.6\times10^{-6}\cos(2\times10^7 z + 6\times10^{15} t)(2\hat{i} + \hat{j})$ Wbm^{-2}

The associated electric field will be

(A) $\vec{E} = 4.8\times10^2\cos(2\times10^7 z + 6\times10^{15} t)(-\hat{i} + 2\hat{j})$ Vm^{-1}

(B) $\vec{E} = 4.8\times10^2\cos(2\times10^7 z - 6\times10^{15} t)(2\hat{i} + \hat{j})$ Vm^{-1}

(C) $\vec{E} = 4.8\times10^2\cos(2\times10^7 z - 6\times10^{15} t)(-2\hat{j} + \hat{i})$ Vm^{-1}

(D) $\vec{E} = 4.8\times10^2\cos(2\times10^7 z + 6\times10^{15} t)(\hat{i} - 2\hat{j})$ Vm^{-1}

35. The Maxwell's equation $\oint \vec{B}\cdot d\vec{l} = \mu_0\left(i + \varepsilon_0\frac{d\phi_E}{dt}\right)$ is a statement of

(A) Faraday's Law of Induction

(B) Modified Ampere's Law

(C) Gauss's Law of Electricity

(D) Gauss's Law of Magnetism

36. The S.I. unit of displacement current is

(A) henry (B) coulomb

(C) ampere (D) farad

37. Which of the following are not electromagnetic waves?

(A) cosmic rays (B) gamma rays

(C) β-rays (D) X-rays

38. If $\vec{E}$ and $\vec{B}$ be the electric and magnetic field vectors of an electromagnetic wave, then the propagation of the wave is along the direction of

(A) $\vec{E}$ (B) $\vec{B}$

(C) $\vec{E}\times\vec{B}$ (D) $\vec{B}\times\vec{E}$

39. If c is the speed of electromagnetic waves in vacuum, its speed in a medium of dielectric constant K and relative permeability μ_r is

(A) $v = \frac{1}{\sqrt{\mu_r K}}$ (B) $v = c\sqrt{\mu_r K}$

(C) $v = \frac{c}{\sqrt{\mu_r K}}$ (D) $v = \frac{K}{\sqrt{\mu_r C}}$

40. The speed of electromagnetic waves in vacuum is given by

(A) $\mu_0\varepsilon_0$ (B) $\sqrt{\mu_0\varepsilon_0}$

(C) $\frac{1}{\mu_0\varepsilon_0}$ (D) $\frac{1}{\sqrt{\mu_0\varepsilon_0}}$

41. An electromagnetic wave of frequency $f = 3.0$ MHz passes from vacuum into a dielectric medium with permittivity $\varepsilon = 4.0$. Then

(A) wavelength is doubled and the frequency remains unchanged

(B) wavelength is doubled and frequency becomes half

(C) wavelength is halved and frequency remains unchanged

(D) wavelength and frequency both remain unchanged

42. An electromagnetic wave travels along Z-axis. Which of the following pairs of space and time varying fields would generate such a wave?

(A) E_x, B_y (B) E_y, B_x

(C) E_z, B_x (D) E_y, B_z

43. A plane electromagnetic wave is incident on a material surface. If the wave delivers momentum p and energy E, then

(A) $p = 0$, $E = 0$ (B) $p \neq 0$, $E \neq 0$

(C) $p \neq 0$, $E = 0$ (D) $p = 0$, $E \neq 0$

44. Maxwell's equation $\oint \vec{E} \cdot d\vec{l} = -\frac{\partial \vec{B}}{\partial t}$ is a statement of

(A) Ampere's Law

(B) Faraday's Law of Induction

(C) Gauss's Law of Electricity

(D) Gauss's Law of Magnetism

45. A long straight wire of resistance R, radius a and length l carries a constant current I. The Poynting vector for the wire will be

(A) $\frac{IR}{2\pi al}$ (B) $\frac{IR^2}{al}$

(C) $\frac{I^2R}{al}$ (D) $\frac{I^2R}{2\pi al}$

46. The direction of propagation of electromagnetic waves is given by

(A) $\vec{E} \cdot \vec{E}$ (B) $\vec{E}$

(C) $\vec{B}$ (D) $\vec{E} \times \vec{B}$

47. An electromagnetic wave, going through vacuum is described by $E = E_0 \sin(kx - \omega t)$. Which of the following is independent of wavelength?

(A) k (B) ω

(C) $\frac{k}{\omega}$ (D) $k\omega$

48. If R is the radius of earth and h is height of T.V. transmitting tower, then the covering range of transmitter will be

(A) $h^2 + R^2$ (B) R

(C) $\sqrt{R^2 + h^2}$ (D) $\sqrt{2Rh}$

49. In an electromagnetic wave, the amplitude of electric field is 1 Vm^{-1}. The frequency of wave is 5×10^{14} Hz. The wave is propagating along z-axis. The average energy density of electric field, in Jm^{-3}, will be

(A) 1.1×10^{-11} (B) 2.2×10^{-12}

(C) 3.3×10^{-13} (D) 4.4×10^{-14}

50. The relation between electric field E and magnetic field induction B in an electromagnetic wave

(A) $E = \sqrt{\frac{\mu_0}{\varepsilon_0}} B$ (B) $E = cB$

(C) $E = \frac{B}{c}$ (D) $E = \frac{B}{c^2}$

51. Radiations of intensity 0.5 Wm^{-2} are striking a metal plate. The pressure on the plate is

(A) 0.166×10^{-8} Nm^{-2} (B) 0.332×10^{-8} Nm^{-2}

(C) 0.111×10^{-8} Nm^{-2} (D) 0.083×10^{-8} Nm^{-2}

52. The wave impedance of free space is

(A) ZERO (B) 376.6 Ω

(C) 33.66 Ω (D) 3.76 Ω

53. In an apparatus, the electric field was found to oscillate with an amplitude of 18 Vm^{-1}. The magnitude of the oscillating magnetic field will be

(A) 4×10^{-6} T (B) 6×10^{-8} T

(C) 9×10^{-9} T (D) 11×10^{-11} T

54. An LC current contains inductance $L = 1\ \mu H$ and capacitance $C = 0.01\ \mu F$. The wavelength of electromagnetic wave generated is nearly

(A) 0.5 m (B) 5 m

(C) 188 m (D) 30 m

55. A laser beam can be focussed on an area equal to the square of its wavelength. A He-Ne laser radiates energy at the rate of 1 mW and its wavelength is 632.8 nm. The intensity of focussed beam is

(A) 1.5×10^{13} Wm^{-2} (B) 2.5×10^{9} Wm^{-2}

(C) 3.5×10^{17} Wm^{-2} (D) None of these

56. Displacement current is same as

(A) conduction current due to flow of free electrons.

(B) conduction current due to flow of positive ions.

(C) conduction current due to flow of both positive and negative free charge carriers.

(D) is not a conduction current but is caused by time varying electric field.

57. The electromagnetic waves do not transport

(A) energy (B) charge

(C) momentum (D) information

58. A radio wave has a maximum electric field intensity of 10^{-4} Vm^{-1} on arrival at a receiving antenna. The maximum magnetic flux density of such a wave is

(A) ZERO (B) 3×10^{4} T

(C) 5.8×10^{-9} T (D) 3.3×10^{-13} T

59. TV waves have a wavelength range of 1 m to 10 m. Their frequency range in megahertz is
(A) 30 to 300 (B) 3 to 30
(C) 300 to 3000 (D) 3 to 3000

60. A lamp radiates power P_0 uniformly in all directions, the amplitude of electric field strength E_0 at a distance r from it is
(A) $E_0 = \frac{P_0}{2\pi\varepsilon_0 cr^2}$ (B) $E_0 = \sqrt{\frac{P_0}{2\pi\varepsilon_0 cr^2}}$
(C) $E_0 = \sqrt{\frac{P_0}{4\pi\varepsilon_0 cr^2}}$ (D) $E_0 = \sqrt{\frac{P_0}{8\pi\varepsilon_0 cr}}$

61. A point source of electromagnetic radiation has an average power output of 800 W. The maximum value of electric field at a distance 4 m from the source is
(A) 64.7 Vm^{-1} (B) 57.8 Vm^{-1}
(C) 56.72 Vm^{-1} (D) 54.77 Vm^{-1}

62. The expression $\sqrt{\mu_0\varepsilon_0}$ has the dimensional formula
(A) $[LT^{-1}]$ (B) $[L^{-1}T]$
(C) $[LT^{-2}]$ (D) $[L^2T^{-1}]$

63. If a source is transmitting electromagnetic wave of frequency 8.2×10^6 Hz, then wavelength of the electromagnetic waves transmitted from the source is
(A) 36.6 m (B) 40.5 m
(C) 42.3 m (D) 50.9 m

64. "Green house effect" is due to
(A) absorption of ultraviolet radiation by ozone layer
(B) transmission of visible light by atmosphere
(C) good weather
(D) reflection of infrared rays emitted by earth by atmosphere

65. If $\vec{E}$ and $\vec{B}$ are the electric and magnetic field vectors of EM waves then the direction of propagation of EM wave is along the direction of
(A) $\vec{E}$ (B) $\vec{B}$
(C) $\vec{E}\times\vec{B}$ (D) None of these

66. In electromagnetic wave the phase difference between electric and magnetic field vectors $\vec{E}$ and $\vec{B}$ is
(A) ZERO (B) $\frac{\pi}{2}$
(C) π (D) $\frac{\pi}{4}$

67. The frequency 1057 MHz of radiation arising from two close energy levels in hydrogen belongs to
(A) Radio waves (B) Infrared waves
(C) Microwaves (D) γ-rays

68. A TV tower has a height of 100 m. The average population density around the tower is 1000 per km^2. The radius of the earth is 6.4×10^6 m. The population covered by the tower is
(A) 2×10^6 (B) 3×10^6
(C) 4×10^6 (D) 6×10^6

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1. **[Online April 2019]**
The magnetic field of an electromagnetic wave is given by

$$\vec{B} = 1.6\times10^{-6}\cos(2\times10^7 z + 6\times10^{15} t)(2\hat{i}+\hat{j})\ \text{Wbm}^{-2}$$

The associated electric field will be
(A) $\vec{E} = 4.8\times10^2\cos(2\times10^7 z + 6\times10^{15} t)(-\hat{i}+2\hat{j})\ \text{Vm}^{-1}$
(B) $\vec{E} = 4.8\times10^2\cos(2\times10^7 z - 6\times10^{15} t)(2\hat{i}+\hat{j})\ \text{Vm}^{-1}$
(C) $\vec{E} = 4.8\times10^2\cos(2\times10^7 z - 6\times10^{15} t)(-2\hat{j}+\hat{i})\ \text{Vm}^{-1}$
(D) $\vec{E} = 4.8\times10^2\cos(2\times10^7 z + 6\times10^{15} t)(\hat{i}-2\hat{j})\ \text{Vm}^{-1}$

2. **[Online April 2019]**
A plane electromagnetic wave travels in free space along the x-direction. The electric field component of the wave at a particular point of space and time is $E = 6\ \text{Vm}^{-1}$ along y-direction. Its corresponding magnetic field component, B would be
(A) 2×10^{-8} T along y-direction
(B) 6×10^{-8} T along z-direction
(C) 2×10^{-8} T along z-direction
(D) 6×10^{-8} T along x-direction

3. **[Online April 2019]**
The magnetic field of plane electromagnetic wave is given by $\vec{B}=\vec{B}_0\hat{i}\cos(kz-\omega t)+B_1\hat{j}\cos(kz+\omega t)$ where $B_0=3\times10^{-5}$ T and $B_1=2\times10^{-6}$ T. The rms value of the force experienced by a stationary charge $Q=10^{-4}$ C at $z=0$ is closest to

(A) 0.6 N (B) 0.9 N
(C) 3×10^{-2} N (D) 0.1 N

4. **[Online April 2019]**
The electric field of a plane electromagnetic wave is given by $\vec{E}=E_0\hat{i}\cos(kz)\cos(\omega t)$. The corresponding magnetic field $\vec{B}$ is then given by

(A) $\vec{B}=\frac{E_0}{c}\hat{j}\sin(kz)\cos(\omega t)$

(B) $\vec{B}=\frac{E_0}{c}\hat{j}\cos(kz)\sin(\omega t)$

(C) $\vec{B}=\frac{E_0}{c}\hat{j}\sin(kz)\sin(\omega t)$

(D) $\vec{B}=\frac{E_0}{c}\hat{k}\sin(kz)\cos(\omega t)$

5. **[Online April 2019]**
An electromagnetic wave is represented by the electric field $\vec{E}=E_0\hat{n}\sin[\omega t+(6y-8z)]$. Taking unit vectors in x, y and z directions to be $\hat{i}$, $\hat{j}$, $\hat{k}$, the direction of propagation $\hat{s}$, is

(A) $\hat{s}=\left(\frac{-3\hat{j}+4\hat{k}}{5}\right)$ (B) $\hat{s}=\left(\frac{3\hat{i}-4\hat{j}}{5}\right)$

(C) $\hat{s}=\left(\frac{-4\hat{k}+3\hat{j}}{5}\right)$ (D) $\hat{s}=\left(\frac{4\hat{j}-3\hat{k}}{5}\right)$

6. **[Online April 2019]**
A plane electromagnetic wave having a frequency $\nu=23.9$ GHz propagates along the positive z-direction in free space. The peak value of the Electric field is 60 Vm^{-1}. Which among the following is the acceptable magnetic field component in the electromagnetic wave?

(A) $\vec{B}=60\sin(0.5\times10^3x+1.5\times10^{11}t)\hat{k}$

(B) $\vec{B}=2\times10^7\sin(0.5\times10^3z+1.5\times10^{11}t)\hat{i}$

(C) $\vec{B}=2\times10^{-7}\sin(0.5\times10^3z-1.5\times10^{11}t)\hat{i}$

(D) $\vec{B}=2\times10^{-7}\sin(1.5\times10^2x+0.5\times10^{11}t)\hat{j}$

7. **[2018]**
An EM wave from air enters a medium. The electric fields are $\vec{E}_1=E_{01}\hat{x}\cos\left(2\pi\nu\left(\frac{z}{c}-t\right)\right)$ in air and $\vec{E}_2=E_{02}\hat{x}\cos[k(2z-ct)]$ in medium, where the wave number k and frequency ν refer to their values in air. The medium is non-magnetic, If ε_{r_1} and ε_{r_2} refer to relative permittivities of air and medium respectively, which of the following options is correct?

(A) $\frac{\varepsilon_{r_1}}{\varepsilon_{r_2}}=4$ (B) $\frac{\varepsilon_{r_1}}{\varepsilon_{r_2}}=2$

(C) $\frac{\varepsilon_{r_1}}{\varepsilon_{r_2}}=\frac{1}{4}$ (D) $\frac{\varepsilon_{r_1}}{\varepsilon_{r_2}}=\frac{1}{2}$

8. **[Online 2018]**
A monochromatic beam of light has a frequency $\nu=\frac{3}{2\pi}\times10^{12}$ Hz and is propagating along the direction $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$. It is polarized along the $\hat{k}$ direction. The acceptable form for the magnetic field is

(A) $\frac{E_0}{c}\frac{(\hat{i}+\hat{j}+\hat{k})}{\sqrt{3}}\cos\left(10^4\frac{(\hat{i}+\hat{j})}{\sqrt{2}}\cdot\vec{r}+(3\times10^{12})t\right)$

(B) $\frac{E_0}{c}\frac{(\hat{i}-\hat{j})}{\sqrt{2}}\cos\left(10^4\frac{(\hat{i}+\hat{j})}{\sqrt{2}}\cdot\vec{r}-(3\times10^{12})t\right)$

(C) $\frac{E_0}{c}\frac{(\hat{i}-\hat{j})}{\sqrt{2}}\cos\left(10^4\frac{(\hat{i}-\hat{j})}{\sqrt{2}}\cdot\vec{r}-(3\times10^{12})t\right)$

(D) $\frac{E_0}{c}\hat{k}\cos\left(10^4\frac{(\hat{i}+\hat{j})}{\sqrt{2}}\cdot\vec{r}+(3\times10^{12})t\right)$

9. **[Online 2018]**
A plane polarized monochromatic EM wave is travelling in vacuum along z direction such that at $t=t_1$, it is found that the electric field is zero at a spatial point z_1. The next zero that occurs in its neighbourhood is at z_2. The frequency of the electromagnetic wave is

(A) $\frac{1}{t_1+\frac{|z_2-z_1|}{3\times10^8}}$ (B) $\frac{3\times10^8}{|z_2-z_1|}$

(C) $\frac{6\times10^8}{|z_2-z_1|}$ (D) $\frac{1.5\times10^8}{|z_2-z_1|}$

10. [Online 2018]

A plane electromagnetic wave of wavelength λ has an intensity I. It is propagating along the positive y-direction. The allowed expressions for the electric and magnetic fields are given by

(A) $\vec{E}=\sqrt{\frac{I}{\varepsilon_0 c}}\cos\left(\frac{2\pi}{\lambda}(y-ct)\right)\hat{i}$; $\vec{B}=\frac{1}{c}E\hat{k}$

(B) $\vec{E}=\sqrt{\frac{2I}{\varepsilon_0 c}}\cos\left(\frac{2\pi}{\lambda}(y+ct)\right)\hat{k}$; $\vec{B}=\frac{1}{c}E\hat{i}$

(C) $\vec{E}=\sqrt{\frac{2I}{\varepsilon_0 c}}\cos\left(\frac{2\pi}{\lambda}(y-ct)\right)\hat{k}$; $\vec{B}=\frac{1}{c}E\hat{i}$

(D) $\vec{E}=\sqrt{\frac{I}{\varepsilon_0 c}}\cos\left(\frac{2\pi}{\lambda}(y-ct)\right)\hat{k}$; $\vec{B}=\frac{1}{c}E\hat{i}$

11. [Online 2017]

Magnetic field in a plane electromagnetic wave is given by $\vec{B}=B_0\sin(kx+\omega t)\hat{j}$ T

Expression for corresponding electric field will be (Where c is speed of light.)

(A) $\vec{E}=-B_0 c\sin(kx+\omega t)\hat{k}$ Vm^{-1}

(B) $\vec{E}=B_0 c\sin(kx-\omega t)\hat{k}$ Vm^{-1}

(C) $\vec{E}=\frac{B_0}{c}\sin(kx+\omega t)\hat{k}$ Vm^{-1}

(D) $\vec{E}=B_0 c\sin(kx+\omega t)\hat{k}$ Vm^{-1}

12. [Online 2017]

The electric field component of a monochromatic radiation is given by $\vec{E}=2E_0\hat{i}\cos kz\cos\omega t$

Its magnetic field is then given by

(A) $\frac{2E_0}{c}\hat{j}\cos kz\cos\omega t$ (B) $\frac{2E_0}{c}\hat{j}\sin kz\cos\omega t$

(C) $\frac{2E_0}{c}\hat{j}\sin kz\sin\omega t$ (D) $-\frac{2E_0}{c}\hat{j}\sin kz\sin\omega t$

13. [2016]

Arrange the following electromagnetic radiations per quantum in the order of increasing energy

A : Blue light B : Yellow light
C : X-ray D : Radio wave

(A) D, B, A, C (B) A, B, D, C
(C) C, A, B, D (D) B, A, D, C

14. [Online 2016]

Microwave oven acts on the principle of

(A) giving rotational energy to water molecules
(B) giving translational energy to water molecules
(C) giving vibrational energy to water molecules
(D) transferring electrons from lower to higher energy levels in water molecule.

15. [Online 2016]

Consider an electromagnetic wave propagating in vacuum. Choose the correct statement.

(A) For an electromagnetic wave propagating in $+y$ direction the electric field is $\vec{E}=\frac{1}{\sqrt{2}}E_{yz}(x,t)\hat{z}$ and the magnetic field is $\vec{B}=\frac{1}{\sqrt{2}}B_z(x,t)y$

(B) For an electromagnetic wave propagating in $+y$ direction the electric fields is $\vec{E}=\frac{1}{\sqrt{2}}E_{yz}(x,t)\hat{y}$ and the magnetic field is $\vec{B}=\frac{1}{\sqrt{2}}B_{yz}(x,t)\hat{z}$

(C) For an electromagnetic wave propagating in $+x$ direction the electric field is $\vec{E}=\frac{1}{\sqrt{2}}E_{yz}(y,z,t)(\hat{y}+\hat{z})$ and the magnetic field is $\vec{B}=\frac{1}{\sqrt{2}}B_{yz}(y,z,t)(\hat{y}+\hat{z})$

(D) For an electromagnetic wave propagating in $+x$ direction the electric field is $E=\frac{1}{\sqrt{2}}E_{yz}(x,t)(\hat{y}-\hat{z})$ and the magnetic field is $\vec{B}=\frac{1}{\sqrt{2}}B_{yz}(x,t)(\hat{y}+\hat{z})$

16. [2015]

A red LED emits light at 0.1 watt uniformly around it. The amplitude of the electric field of the light at a distance of 1 m from the diode is

(A) 5.48 Vm^{-1} (B) 7.75 Vm^{-1}
(C) 1.73 Vm^{-1} (C) 2.45 Vm^{-1}

17. [Online 2015]

An electromagnetic wave travelling in the x-direction has frequency of 2×10^{14} Hz and electric field amplitude of 27 Vm^{-1}. From the options given below, which one describes the magnetic field for this wave?

(A) $\vec{B}(x,t)=(3\times10^{-8}\text{ T})\hat{j}\sin[2\pi(1.5\times10^{-8}x-2\times10^{14}t)]$

(B) $\vec{B}(x,t)=(9\times10^{-8}\text{ T})\hat{k}\sin[2\pi(1.5\times10^{-6}x-2\times10^{14}t)]$

(C) $\vec{B}(x,t)=(9\times10^{-8}\text{ T})\hat{i}\sin[2\pi(1.5\times10^{-8}x-2\times10^{14}t)]$

(D) $\vec{B}(x,t)=(9\times10^{-8}\text{ T})\hat{j}\sin(1.5\times10^{-6}x-2\times10^{14}t)$

18. [Online 2015]

For plane electromagnetic waves propagating in the z direction, which one of the following combinations gives the correct possible direction for field respectively?

(A) $(\hat{i}+2\hat{j})$ and $(2\hat{i}-\hat{j})$

(B) $(-2\hat{i}-3\hat{j})$ and $(3\hat{i}-2\hat{j})$

(C) $(2\hat{i}+3\hat{j})$ and $(\hat{i}+2\hat{j})$

(D) $(3\hat{i}+4\hat{j})$ and $(4\hat{i}-3\hat{j})$

19. [2014]

Match List-I (Electromagnetic wave type) with List-II (Its association/application) and select the correct option from the choices given below the lists:

List-I	List-II
(P) Infrared waves	(i) To treat muscular strain
(Q) Radio waves	(ii) For broadcasting
(R) X-rays	(iii) To detect fracture of bones
(S) Ultraviolet rays	(iv) Absorbed by the ozone layer of the atmosphere

	P	Q	R	S
(A)	(i)	(ii)	(iii)	(iv)
(B)	(iv)	(iii)	(ii)	(i)
(C)	(i)	(ii)	(iv)	(iii)
(D)	(iii)	(ii)	(i)	(iv)

20. [2014]

During the propagation of electromagnetic waves in a medium

(A) both electric and magnetic energy densities are zero

(B) electric energy density is double of the magnetic energy density

(C) electric energy density is half of the magnetic energy density

(D) electric energy density is equal to the magnetic energy density

21. [2013]

The magnetic field in a travelling electromagnetic wave has a peak value of $20\ \text{nT}$. The peak value of electric field strength is

(A) $12\ \text{Vm}^{-1}$ (B) $3\ \text{Vm}^{-1}$

(C) $6\ \text{Vm}^{-1}$ (D) $9\ \text{Vm}^{-1}$

22. [2012]

An electromagnetic wave in vacuum has the electric and magnetic fields $\vec{E}$ and $\vec{B}$, which are always perpendicular to each other. The direction of polarization is given by $\vec{X}$ and that of wave propagation by $\vec{k}$. Then

(A) $\vec{X} \parallel \vec{E}$ and $\vec{k} \parallel \vec{E}\times\vec{B}$

(B) $\vec{X} \parallel \vec{B}$ and $\vec{k} \parallel \vec{E}\times\vec{B}$

(C) $\vec{X} \parallel \vec{E}$ and $\vec{k} \parallel \vec{B}\times\vec{E}$

(D) $\vec{X} \parallel \vec{B}$ and $\vec{k} \parallel \vec{B}\times\vec{E}$

ANSWER KEYS–PRACTICE EXERCISES

Single Correct Choice Type Questions

1. C	**2.** C	**3.** D	**4.** B	**5.** C	**6.** C	**7.** B	**8.** C	**9.** B	**10.** A
11. B	**12.** B	**13.** A	**14.** B	**15.** C	**16.** A	**17.** B	**18.** A	**19.** D	**20.** A
21. A	**22.** A	**23.** C	**24.** A	**25.** B	**26.** D	**27.** D	**28.** A	**29.** C	**30.** B
31. D	**32.** D	**33.** B	**34.** A	**35.** B	**36.** C	**37.** C	**38.** C	**39.** C	**40.** D
41. C	**42.** A	**43.** B	**44.** B	**45.** D	**46.** D	**47.** C	**48.** D	**49.** B	**50.** B
51. A	**52.** B	**53.** B	**54.** C	**55.** B	**56.** D	**57.** B	**58.** D	**59.** A	**60.** B
61. D	**62.** B	**63.** A	**64.** D	**65.** C	**66.** A	**67.** A	**68.** C		

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1. A	**2.** C	**3.** A	**4.** C	**5.** A	**6.** C	**7.** C	**8.** B	**9.** D	**10.** C
11. D	**12.** C	**13.** A	**14.** A	**15.** D	**16.** D	**17.** *	**18.** B	**19.** A	**20.** D
21. C	**22.** A								

* No given option is correct