SINGLE CORRECT OPTION TYPE

1. An electromagnetic wave in vaccum has the electric and magnetic field $\vec{E}$ and $\vec{B}$, which are perpendicular to each other. The direction of wave propagation $\vec{k}$. Then
(A) $\vec{k} \parallel \vec{B} \times \vec{E}$ (B) $\vec{k} \parallel \vec{E} \times \vec{B}$ (C) $\vec{k} \parallel \vec{E}$ (D) none

2. An electromagnetic wave of frequency $f = 3\text{MHz}$ passes from vaccum into a dielectric medium with permittivity $\varepsilon = 4$. Then
(A) wavelength is halved and frequency remains unchanged
(B) wavelength is doubled and frequency becomes half
(C) wavelength is doubled and frequency remains unchanged
(D) wavelength and frequency both remain unchanged

3. An electromagnetic wave with frequency (ω) and wavelength (λ) travels in $+y$ direction. Its magnetic field along $+x$ axis. The vector equation for the associated electric field of amplitude E_0 is
(A) $\vec{E} = -E_0 \cos\left(\omega t + \frac{2\pi}{\lambda} y\right)\hat{x}$ (B) $\vec{E} = E_0 \cos\left(\omega t - \frac{2\pi}{\lambda} y\right)\hat{x}$
(C) $\vec{E} = E_0 \cos\left(\omega t - \frac{2\pi}{\lambda} y\right)\hat{z}$ (D) $\vec{E} = -E_0 \cos\left(\omega t + \frac{2\pi}{\lambda} y\right)\hat{z}$

4. The magnetic field in a travelling electromagnetic wave has a peak value of 20 nT. The peak value of field strength is
(A) 3 v/m (B) 6 v/m (C) 9 v/m (D) 12 v/m

5. For plane electromagnetic waves propagating in the z-direction, which one of the following combination is correct possible direction for $\vec{E}$ and $\vec{B}$ respectively
(A) $\left(2\hat{i} + 3\hat{j}\right)$ and $\left(\vec{i} + 2\hat{j}\right)$ (B) $\left(-2\hat{i} - 3\hat{j}\right)$ and $\left(3\vec{i} - 2\hat{j}\right)$
(C) $\left(3\hat{i} + 4\hat{j}\right)$ and $\left(4\vec{i} - 3\hat{j}\right)$ (D) $\left(\hat{i} + 2\hat{j}\right)$ and $\left(2\vec{i} - \hat{j}\right)$

6. Magnetic field in a plane electromagnetic wave is given by $\vec{B} = B_0 \sin(kx + wt)\hat{j}\,T$. Expression for corresponding electric field will be: where C is speed of light
(A) $\vec{E} = B_0 C \sin(kx + wt)\hat{k}$ v/m (B) $\vec{E} = \frac{B_0}{c}\sin(kx + wt)\hat{k}$ v/m
(C) $\vec{E} = -B_0 C \sin(kx + wt)\hat{k}$ v/m (D) $\vec{E} = B_0 C \sin(kx - wt)\hat{k}$ v/m

7. An EM wave from air enters a medium. The electric fields are $\vec{E}_1 = E_{01}\cos\left[2\pi f\left(\frac{z}{c} - t\right)\right]\hat{x}$ in air and $\vec{E}_2 = E_{02}\cos\left[k(2z - ct)\right]\hat{x}$ in medium, where the wave number k and frequency (f) 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 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. The energy associated with electric field is (U_E) and with magnetic field is (U_B) for an electromagnetic wave in free space. Then

(A) $U_E = \frac{U_B}{2}$ (B) $U_E < U_B$ (C) $U_E = U_B$ (D) $U_E > U_B$

9. 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 $E = 6$ v/m along y-direction. Its corresponding component, B would be

(A) 6×10^{-8}T , along z-direction (B) 6×10^{-8}T along x-direction

(C) 2×10^{-8}T , along z-direction (D) 2×10^{-8}T , along y-direction

10. A plane polarized monochromatic EM wave is travelling a 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 EM wave is

(A) $\frac{3\times10^{-8}}{|z_2 - z_1|}$ (B) $\frac{6\times10^{-8}}{|z_2 - z_1|}$ (C) $\frac{1.5\times10^{8}}{|z_2 - z_1|}$ (D) $\frac{1}{t_1 + \frac{|z_2 - z_1|}{3\times10^8}}$

11. A radio transmitter transmits at 830 KHz. At a certain distance from the transmitter magnetic field has the value of 4.82×10^{-11}T . The electric field and wavelength are respectively.

(A) 0.014 N/C, 36m (B) 0.14 N/C, 36m (C) 0.14 N/C, 360m (D) 0.014 N/C, 360m

12. For sky wave propagation, the radio waves must have a frequency range in between

(A) 1 MHz to 2MHz (B) 5 MHz to 25 MHz (C) 36 MHz to 40 MHz (D) 45 MHz to 50 MHz

13. A TV transmission tower has a height of 140 m and the height of the receiving antenna is 40 m. What is the maximum distance upto which signals can be broadcasted from the tower in line of signal ($R_E\left(\text{radius of earth} = 6.4\times10^6\text{m}\right)$

(A) 80 km (B) 48 km (C) 40 km (D) 65 km

14. In a communication system operating at wavelength 800 nm, only one percent of source frequency is available as signal band width. The number of channels accommodated for transmitting TV signals of bandwidth 6 MHz are (take velocity of light $c = 3\times10^8$ m/s, $h = 6.6\times10^{-34}$J$-$s)

(A) 3.75×10^6 (B) 4.87×10^5 (C) 3.86×10^6 (D) 6.25×10^5

15. The electric field of a plane polarized electromagnetic wave in free space at time $t = 0$ is given by an expression

$\vec{E}(x\cdot y) = 10\hat{j}\cos\left[(6x + 8z)\right]$

The magnetic field $\vec{B}(x,z,t)$ m is given by (C-velocity of light)

(A) $\frac{1}{C}\left(6\hat{k} + 8\hat{i}\right)\cos\left[(6x - 8z + 10ct)\right]$ (B) $\frac{1}{C}\left(6\hat{k} - 8\hat{i}\right)\cos\left[(6x + 8z - 10ct)\right]$

(C) $\frac{1}{C}\left(6\hat{k} + 8\hat{i}\right)\cos\left[(6x + 8z - 10ct)\right]$ (D) $\frac{1}{C}\left(6\hat{k} - 8\hat{i}\right)\cos\left[(6x + 8z + 10ct)\right]$

16. An electromagnetic wave of intensity $50\,W/m^2$ enters in a medium of refractive index 'n' without any loss. The ratio of the magnitudes of electric fields, and the ratio of magnitudes of magnetic fields of the wave before and after entering into the medium are respectively, given by

(A) $\left(\frac{1}{\sqrt{n}}, \frac{1}{\sqrt{n}}\right)$ (B) $\left(\sqrt{n}, \frac{1}{\sqrt{n}}\right)$ (C) $\left(\sqrt{n}, \sqrt{n}\right)$ (D) $\left(\frac{1}{\sqrt{n}}, \sqrt{n}\right)$

17. An amplitude modulated signal is given by $v(t)=10\left(1+0.3\cos\left(2.2\times10^4\right)\right)\sin\left(5.5\times10^5 t\right)$. Here t is in seconds. The sideband frequencies (in KHz) are $\left(\pi=\frac{22}{7}\right)$

(A) 1785 and 1715 (B) 892.5 and 857.5 (C) 89.25 and 85.75 (D) 178.5 and 171.5

18. A 27 mW laser beam has a cross-sectional area of $10mm^2$. The magnitude of the maximum electric field in this EM wave is given by $\left[\varepsilon_0=9\times10^{-12}\text{SI units, } c=3\times10^8\ m/s\right]$

(A) 1 kv/m (B) 2 kv/m (C) 1.4 kv/m (D) 0.7 kv/m

19. A light wave is incident normally on a glass slab of refractive index 1.5. If 4% of light gets reflected and amplitude of the electric field of the incident light is 30 v/m. Then the amplitude of the electric field for the wave propagating in the glass medium will be

(A) 10 v/m (B) 24 v/m (C) 30 v/m (D) 6 v/m

20. The mean intensity of radiation on the surface of the sun is about $10^8\ w/m^2$. The rms value of the corresponding magnetic field is closest to

(A) $10^2 T$ (B) $10^{-4} T$ (C) 1 T (D) $10^{-2} T$

NUMERICAL BASED

21. A telephonic communication service is working at carrier frequency of 10 GHz. Only 10% of it is utilized for transmission. 2×10^x telephonic channels can be transmitted. Simultaneously if each channel requires a bandwidth of 5 KHz. Then x is _____

22. A plane electromagnetic wave of frequency 25 MHz travels in free space along positive x-direction. At a particular point in space and time $\vec{E}=6.3\hat{j}\ v/m$, then $\vec{B}$ at that point will be $2.1\times10^{-x}\hat{k}T$, then x is _____

23. The electric field associated with an EM wave in vacuum is given as $E=E_0\cos\left(kz-6\times10^8 t\right)$. The value of wave factor k in $metre^{-1}$ is _____

24. In order to cover a circular region of radius 128 km by a TV transmitter, what must the height of transmitting antenna. The height of transmitting antenna in kilometres is _____.

25. A TV tower has a height of 80 m. The maximum distance upto which TV transmission can be received is (in kilometres is _____)

KEY

1.	B	**2.**	A	**3.**	C	**4.**	B	**5.**	B
6.	A	**7.**	C	**8.**	C	**9.**	C	**10.**	C
11.	D	**12.**	B	**13.**	D	**14.**	D	**15.**	B
16.	B	**17.**	C	**18.**	C	**19.**	B	**20.**	B
21.	6	**22.**	8	**23.**	2	**24.**	1.28	**25.**	32

❇ *Wish You all the Best* ❇