DPP 01

1. Light wave traveling in air along x-direction is given by $E_y = 540\sin\pi \times 10^4(x - ct)Vm^{-1}$. the peak value of magnetic field of wave $6x \times 10^{-7}$ T .then the value of x is _ _ _ _ _ _ _ _

2. The magnetic field of a plane electromagnetic wave is given by $\vec{B} = 2 \times 10^{-8}\sin(0.5 \times 10^3 x + 1.5 \times 10^{11}t)\hat{j}$ T. The amplitude of the electric field $(12 - 3\alpha)$ V m^{-1} along z-axis .then find vlue of α^2.

3. The oscillating magnetic field in a plane electromagnetic wave is given by $B_y = 5 \times 10^{-6}$ $\sin 1000\pi(5x - 4 \times 10^8 t)$T. amplitude of electric field is $\alpha \times 10^{\beta}$ V m^{-1}. Then value of $\alpha - \beta^2$

4. A beam of light travelling along X-axis is described by the electric field $E_y = 900\sin\omega\left(t - \frac{x}{c}\right)$. The ratio of electric force to magnetic force on a charge q moving along Y-axis with a speed of 3×10^7 m s^{-1} is $20/x$. the value of x is

5. Identify the correct statements from the following descriptions of various properties of electromagnetic waves.

(a) In a plane electromagnetic wave electric field and magnetic field must be perpendicular to each other and direction of propagation of wave should be along electric field or magnetic field.

(b) The energy in electromagnetic wave is divided equally between electric and magnetic fields.

(c) Both electric field and magnetic field are parallel to each other and perpendicular to the direction of propagation of wave.

(d) The electric field, magnetic field and direction of propagation of wave must be perpendicular to each other.

(e) The ratio of amplitude of magnetic field to the amplitude of electric field is equal to speed of light. Choose the most appropriate answer from the options given below.

(A) (D) only

(B) (B) and (D) only

(C) (B), (C) and (E) only

(D) (A), (B) and (E) only

6. As shown in the figure, after passing through the medium 1. The speed of light v_2 in medium 2 will be (Given $c = 3 \times 10^8\ m\ s^{-1}$)

Air	Medium 1	Medium 2
	$\mu_r = 1$	$\mu_r = 1$
	$\varepsilon_r = 4$	$\varepsilon_r = 9$
C	v_1	v_2

(A) $1.0 \times 10^8\ m\ s^{-1}$ (B) $0.5 \times 10^8\ m\ s^{-1}$ (C) $1.5 \times 10^8\ m\ s^{-1}$ (D) $3.0 \times 10^8\ m\ s^{-1}$

7. Sunlight falls normally on a surface of area 36 cm^2 and exerts an average force of 7.2×10^{-9} N within a time period of 20 minutes. Considering a case of complete absorption, the energy flux of incident light is

(A) $25.92 \times 10^2\ W/cm^2$ (B) $8.64 \times 10^{-6}\ W/cm^2$

(C) $6.0\ W/cm^2$ (D) $0.06\ W/cm^2$

8. A plane electromagnetic wave travels in a medium of relative permeability 1.61 and relative permittivity 6.44. If magnitude of magnetic intensity is $4.5 \times 10^{-2}\ A\ m^{-1}$ at a point, what will be the approximate magnitude of electric field intensity at that point? (Given : Permeability of free space, $\mu_0 = 4\pi \times 10^{-2}\ NA^{-2}$, speed of light in vacuum $c = 3 \times 10^8\ m\ s^{-1}$)

(A) $16.96\ V\ m^{-1}$ (B) $2.25 \times 10^{-2} Vm^{-1}$ (C) $8.48\ V\ m^{-1}$ (D) $6.75 \times 10^6\ V\ m^{-1}$

9. An electric bulb is rated as 200 W. What will be the peak magnetic field at 4 m distance produced by the radiations coming from this bulb? Consider this bulb as a point source with 3.5% efficiency.

(A) 1.19×10^{-8} T (B) 1.71×10^{-8} T (C) 0.84×10^{-8} T (D) 3.36×10^{-8} T

10. The electric field in an electromagnetic wave is given by $E = 56.5 \sin \omega(t - x/c) NC^{-1}$. Find the intensity of the wave if it is propagating along x-axis in the free space.

(Given $\varepsilon_0 = 8.85 \times 10^{-12} C^2\ N^{-1}\ m^{-2}$)

(A) $5.65\ W\ m^{-2}$ (B) $4.24\ W\ m^{-2}$

(C) $1.9 \times 10^{-7}\ W\ m^{-2}$ (D) $56.5\ W\ m^{-2}$

11. The electromagnetic waves travel in a medium at a speed of 2.0×10^8 m/s. The relative permeability of the medium is 1.0. The relative permittivity of the medium will be

(A) 2.25 (B) 4.25 (C) 6.25 (D) 8.25

12. If electric field intensity of a uniform plane electromagnetic wave is given as

$\vec{E} = -301.6\sin(kz - \omega t)\hat{a}_x + 452.4\sin(kz - \omega t)\hat{a}_y \frac{V}{m}$.

Then, magnetic intensity ' $\vec{H}$ ' of this wave in Am^{-1} will be [Given : Speed of light in vacuum $c = 3 \times 10^8\ m\ s^{-1}$, Permeability of vacuum $\mu_0 = 4\pi \times 10^{-7} NA^{-2}$]

(A) $+0.8\sin(kz-\omega t)\hat{a}_y + 0.8\sin(kz-\omega t)\hat{a}_x$

(B) $+1.0\times10^{-6}\sin(kz-\omega t)\hat{a}_y + 1.5\times10^{-6}(kz-\omega t)\hat{a}_x$

(C) $-0.8\sin(kz-\omega t)\hat{a}_y - 1.2\sin(kz-\omega t)\hat{a}_x$

(D) $-1.0\times10^{-6}\sin(kz-\omega t)\hat{a}_y - 1.5\times10^{-6}\sin(kz-\omega t)\hat{a}_x$

13. Given below are two statements :

Statement I : A time varying electric field is a source of changing magnetic field and vice-versa. Thus a disturbance in electric or magnetic field creates EM waves.

Statement II : In a material medium, the EM wave travels with speed $v = \frac{1}{\sqrt{\mu_0\varepsilon_0}}$.

In the light of the above statements, choose the correct answer from the options given below.

(A) Both statement I and statement II are true

(B) Both statement I and statement II are false

(C) Statement I is correct but statement II is false

(D) Statement I is incorrect but statement II is true

14. A radar sends an electromagnetic signal of electric field $(E_o) = 2.25$ V/m and magnetic field $(B_o) = 1.5\times10^{-8}$ T which strikes a target on line of sight at a distance of 3 km in a medium. After that, a part of signal (echo) reflects back towards the radar with same velocity and by same path. If the signal was transmitted at time $t = 0$ from radar, then after how much time echo will reach to the radar?

(A) 2.0×10^{-5} s (B) 4.0×10^{-5} s (C) 1.0×10^{-5} s (D) 8.0×10^{-5} s

15. An EM wave propagating in x-direction has a wavelength of 8 mm. The electric field vibrating y-direction has maximum magnitude of 60 V m^{-1}, Choose the correct equations for electric and magnetic fields if the EM wave is propagating in vacuum

(A) $\vec{E}_y = 60\sin\left[\frac{\pi}{4}\times10^3(x-3\times10^8t)\right]\hat{j}$ V m^{-1}

$\vec{B}_z = 2\sin\left[\frac{\pi}{4}\times10^3(x-3\times10^8t)\right]\hat{k}$ T

(B) $\vec{E}_y = 60\sin\left[\frac{\pi}{4}\times10^3(x-3\times10^8t)\right]\hat{j}Vm^{-1}$

$\vec{B}_z = 2\times10^{-7}\sin\left[\frac{\pi}{4}\times10^3(x-3\times10^8t)\right]\hat{k}$ T

(C) $\vec{E}_y = 2\times10^{-7}\sin\left[\frac{\pi}{4}\times10^3(x-3\times10^8t)\right]\hat{j}Vm^{-1}$

$\vec{B}_z = 60\sin\left[\frac{\pi}{4}\times10^3(x-3\times10^8t)\right]\hat{k}$ T

(D) $\vec{E}_y = 2\times10^{-7}\sin\left[\frac{\pi}{4}\times10^4(x-4\times10^8t)\right]\hat{j}Vm^{-1}$

$\vec{B}_z = 60\sin\left[\frac{\pi}{4}\times10^4(x-4\times10^8t)\right]\hat{k}$ T

16. Electric field of a plane electromagnetic wave propagating through a non-magnetic medium is given by $E = 20\cos(2 \times 10^{10}t - 200x)V/m$. The dielectric constant of the medium is equal to (Take $\mu_r = 1$)

(A) 2 (B) $\frac{1}{3}$ (C) 9 (D) 3

17. A light beam is described by $E = 800 \sin\omega\left(t - \frac{x}{c}\right)$. An electron is allowed to move normal to the propagation of light beam with a speed of 3×10^7 m s^{-1}. What is the maximum magnetic force exerted on the electron?

(A) 1.28×10^{-21} N (B) 12.8×10^{-18} N (C) 1.28×10^{-18} N (D) 12.8×10^{-17} N

18. Electric field in a plane electromagnetic wave is given by $E = 50\sin(500x - 10 \times 10^{10}t)V/m$.The velocity of electromagnetic wave in this medium is (Given c = speed of light in vacuum)

(A) $\frac{3}{2}c$ (B) c (C) $\frac{c}{2}$ (D) $\frac{2}{3}c$

19. AC voltage $V(t) = 20\ \sin\omega t$ of frequency 50 Hz is applied to a parallel plate capacitor. The separation between the plates is 2 mm and the area is 1 m^2. The amplitude of the oscillating displacement current for the applied AC voltage is _____. [Take $_0 = 8.85 \times 10^{-12}$ F m^{-1}]

(A) 27.29μA (B) 83.37μA (C) 55.58μA (D) 21.14μA

20. In an electromagnetic wave the electric field vector and magnetic field vector are given as $\vec{E} = E_0\hat{i}$ and $\vec{B} = B_0\hat{k}$ respectively. The direction of propagation of electromagnetic wave is along

(A) $(\hat{k})$ (B) $(-\hat{j})$ (C) $(-\hat{k})$ (D) $\hat{j}$

ANSWER KEY

1.	(3)	**2.**	(4)	**3.**	(0)	**4.**	(2)	**5.**	(B)	**6.**	(A)	**7.**	(D)
8.	(C)	**9.**	(B)	**10.**	(B)	**11.**	(A)	**12.**	(C)	**13.**	(C)	**14.**	(B)
15.	(B)	**16.**	(C)	**17.**	(B)	**18.**	(D)	**19.**	(A)	**20.**	(B)		