Ch—08 Electromagnetic Wave

Daily Practice Problem 01

Q1. If μ_0 be the permeability and K_0 the dielectric constant of a medium, its refractive index is given by

(a) $\frac{1}{\sqrt{\mu_0 K_0}}$

(b) $\frac{1}{\mu_0 K_0}$

(c) $\sqrt{\mu_0 K_0}$

(d) $\mu_0 K_0$

Q2. A plane electromagnetic wave $E = 100\, cos(6 \times 10^8 t + 4x)$ V/m propagates in a medium of dielectric constant

(a) 1.5

(b) 2.0

(c) 2.4

(d) 4.0

Q3. Suppose that the electric field amplitude of an electromagnetic wave is $E_0 = 120\ N/C$ and that its frequency is $v = 50.0\ MHz$.

(a) Determine B_0, ω, k, and λ.

(b) Find expressions for $\vec{E}$ and $\vec{B}$.

Q4. In a plane electromagnetic wave, the electric field oscillates sinusoidally at a frequency of 2.5×10^{10} Hz and amplitude $480\ V/m$. The amplitude of the oscillating magnetic field will be

(a) $1.52 \times 10^{-8}\ Wb/m^2$

(b) $1.52 \times 10^{-7}\ Wb/m^2$

(c) $1.6 \times 10^{-6}\ Wb/m^2$

(d) $1.6 \times 10^{-7}\ Wb/m^2$

Q5. A plane electromagnetic wave propagating in the x-direction has wavelength of 60 mm. The electric field is in the y-direction and its maximum magnitude is $33\ V/m^{-1}$. The equation for the electric field as function of x and t is

(a) $11\ sin\ \pi(t - x/c)$

(b) $33\ sin\ \pi \times 10^{11}(t - x/c)$

(c) $33\ sin\ \pi\ (t - x/c)$

(d) $11\ sin\ \pi \times 10^{11}(t - x/c)$

Q6. In an electromagnetic wave, the electric field oscillated sinusoidally with amplitude $45\ Vm^{-1}$, the rms value of oscillating magnetic field will be

(a) $1.6 \times 10^{-8}\ T$

(b) $16 \times 10^{-9}\ T$

(c) $144 \times 10^{-8}\ T$

(d) $11.3 \times 10^{-8}\ T$

Q7. In an apparatus, the electric field was found to oscillate with an amplitude of 18 V/m. The magnitude of the oscillating magnetic field will be

(a) $4 \times 10^{-6} T$

(b) $6 \times 10^{-8} T$

(c) $9 \times 10^{-9} T$

(d) $11 \times 10^{11} T$

Q8. An electromagnetic wave going through vacuum is described by $E = E_0\ sin(kx - \omega t)$; $B = B_0\ sin(kx - \omega t)$. Which of the following equation is true

(a) $E_0 k = B_0 \omega$

(b) $E_0 \omega = B_0 k$

(c) $E_0 B_0 = \omega k$

(d) None of these

Q9. A plane e.m. wave is propagating in the x-direction has a wavelength of 6.0 mm. The electric field is in the y-direction and its maximum magnitude is $33\ Vm^{-1}$. Write suitable equations for the electric and magnetic fields as a function of x and t.

Q10. Electromagnetic waves travel in a medium at a speed of $2.0 \times 10^8\ ms^{-1}$. The relative permeability of the medium is 1.0. Find the relative permittivity.

Q11. The oscillating magnetic field in a plane electromagnetic wave is given by

$$B_y = (8 \times 10^{-6}) \sin\ [2 \times 10^{11} t + 300\pi x] T$$

(a) Calculate the wavelength of the electromagnetic wave.

(b) Write down the expression for the oscillating electric field. **[CBSE D 08]**

ANSWERS

1. c

2. d

3. a. $B_0 = 400\ nT$;

$\omega = 3.14 \times 10^8\ rad\ s^{-1}$;

$k = 1.05\ rad\ s^{-1}$; $c = 6m$

b. $\vec{E} = 120sin(1.05x - 3.14 \times 10^8 \times t)\hat{j}$

$\vec{B} = 400\sin(1.05x - 3.14 \times 10^8 \times t)\,\hat{k}$

4. c

5. b

6. d

7. $c = 6 \times 10^{-8}T$

8. a

9. $E = 33sin\pi \times 10^{11}\left(t - \frac{x}{c}\right)Vm^{-1}$

$B = 1.1 \times 10^{-7}sin\pi \times 10^{11}\left(t - \frac{x}{c}\right)T$

10. $\epsilon_r = 2.25$

11. a. 0.67 cm;

b. $E_z = 2400\sin[2 \times 10^{11}t + 300\,\pi x]\,Vm^{-1}$