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Physics - 2 (15B11PH211)

Tutorial-4

Q.1. (a) $\vec{E} = 7.5 kV/m$

$\omega = 2 \times 10^9$ rad/sec

$\lambda = CXT = \frac{2\pi C}{\omega} = \frac{2 \times 3.14 \times 3 \times 10^8}{2 \times 10^9} = 0.942 m$

(b) $\omega = 2\pi\nu$

$\nu = \frac{\omega}{2\pi} = \frac{2 \times 10^9}{2 \times 3.14} = 318.5 MHz$

(c) $T = \frac{1}{\nu} = 3.14 n sec$

(d) $H_0 = \sqrt{\frac{\epsilon_0}{\mu_0}} \times E_0 = 19.91 Amp/m$

Q.2. (a) $K = 1 rad/m$. $\vec{H} = -0.2\cos(\omega t - z)\hat{i} + 0.5\sin(\omega t - z)\hat{j}$ A/m

(b) $\frac{K}{\omega} = \sqrt{\mu_0 \epsilon_0} \Rightarrow \omega = \frac{Kc}{\sqrt{\mu_r \epsilon_r}} = 1.5 \times 10^8$ rad/sec

(c) $\eta = \sqrt{\frac{\mu}{\epsilon}} = 376.72\sqrt{\frac{1}{4}} = 188.36 \Omega$

(d) $\vec{E} = \frac{-1}{\epsilon\omega}\vec{K} \times \vec{H} = \frac{1}{\epsilon\omega}(0.5\sin(\omega t - z)\hat{i} + 0.2\cos(\omega t - z)\hat{j})$

Q.3. (a) $I = \langle S \rangle = \frac{3.8 \times 10^{26}}{4\pi(9 \times 10^{10})^2} = 3.7 \times 10^3 w/m^2$

$P = \frac{2I}{C} = 2.5 \times 10^{-5} N/m^2$

(b) The force on the chunk $F = pA = 1 MW$

The Gravitation force of the sun $F_g = \frac{GMm}{R^2} = 0.16 N$

$F_g >> F$

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Q.4. (a) $I = \frac{P}{A} = \frac{P}{\pi r^2} = 3.97 \times 10^9 \ W/m^2$

(b) $P_r = \frac{I}{c} = 13.2 \ Pa$

(c) $F_r = P_r \pi r^2 = 1.67 \times 10^{-11} N$

(d) $F_r = ma \Rightarrow a = \frac{F_r}{m} = 3.14 \times 10^3 \ m/s^2$

Q.5. $E_1 = 2a_x - 3a_y + 5a_z$ $\quad D_1 = \epsilon_0 \epsilon_r E_1 = 4\epsilon_0 a_x - 6\epsilon_0 a_y + 10\epsilon_0 a_z$

$E_2 = 2a_x - 3a_y + E_{z_2} a_z$ $\quad D_2 = D_{x_2} a_x + D_{y_2} a_y + 10\epsilon_0 a_z$

$D_{x_2} = 2\epsilon_0 \epsilon_{r_2} = 10\epsilon_0$

$D_{y_2} = -3\epsilon_0 \epsilon_{r_2} = -15\epsilon_0$

$D_{z_2} = \epsilon_0 \epsilon_r E_{z_2} = 10\epsilon_0 \Rightarrow E_{z_2} = 2$

$\vec{E_1} \cdot \hat{a_z} = |E_1| \cos(90 - \theta_1)$

$\theta_1 = \sin^{-1}\left(\frac{5}{\sqrt{38}}\right) = 54.2^\circ$ Ans

Similarly, $\theta_2 = \sin^{-1}\left(\frac{\vec{E_2} \hat{a_z}}{|\vec{E_2}|}\right)$

$= 29.0^\circ$ Ans

Q.6. $B_1 = 1.29 a_x + 0.8 a_y + 10.4 a_z$ $\quad H_1 = \frac{1}{\mu_0}(8a_x + 5.33a_y + 2.67a_z) 10^{-2}$

$B_2 = B_{x_2} a_x + B_{y_2} a_y + 0.4 a_z$ $\quad H_2 = \frac{1}{\mu_0}(8a_x + 5.33a_y + 10^2 \mu_0 H_{z_2} a_z) 10^{-2}$

$B_{x_2} = \mu_0 \mu_{r_2} H_{x_2} = 8 \times 10^{-2} \ T$

$B_{y_2} = 5.33 \times 10^{-2} \ T$

$H_{z_2} = \frac{B_{z_2}^2}{\mu_0 H_{r_2}} = \frac{0.4}{\mu_0} \ A/m$

$\theta_1 = \sin^{-1}\left(\frac{\vec{B_1} a_z}{|B_1|}\right) = 15.5^\circ$ Ans

$\theta_2 = \sin^{-1}\left(\frac{\vec{B_2} \cdot a_z}{|B_2|}\right) = 76.5^\circ$ Ans