Tutorial 4, Physics-2 (15B11PH211), 2022

1.[CO3] The electric field intensity of a uniform plane electromagnetic wave in air is 7.5 kV/m in the y-direction. The wave is propagating in the x-direction at a frequency of 2×10^9 rad/sec. Determine; (a) wavelength of electromagnetic wave, (b) frequency, (c) time period, and (d) the amplitude of magnetic field intensity. ($\mu_o=4\pi\times10^{-7}$ N/A^{2}m and $\varepsilon_o=8.854\times10^{-12}$ C^2/N-m^2)

2.[CO3] A perfect dielectric medium has σ = o, μr = 1 and εr = 4. An electromagnetic wave has magnetic field components represented as

$$\vec{H} = -0.2\cos(\omega t - z)\hat{i} + 0.5\sin(\omega t - z)\hat{j}\ A/m$$

Determine: (a) propagation constant, (b) angular velocity, (c) wave impedance, and (d) the component of electric field intensity associated with the wave.

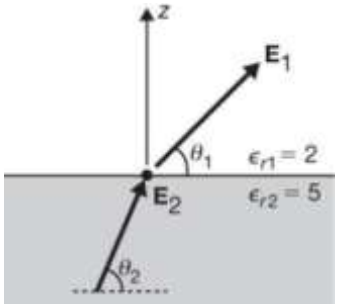
3.[CO4] On February 9, 1986, Comet Halley was at its closest point to the Sun, about 9×10^{10} m from the center of the Sun. The average power output of the Sun is 3.8×10^{26}W

(a) Calculate the radiation pressure on the comet at this point in its orbit. Assume that the comet reflects the entire incident light.

(b) Suppose that a 10-kg chunk of material of cross-sectional area 4×10^{-2} m^2 breaks loose from the comet. Calculate the force on this chunk due to the solar radiation. Compare this force with the gravitational force of the Sun.[G = 6.67×10^{-11} N.m^2/kg^2; $m_s = 2\times10^{30}$ kg]

4.[CO4] A small laser emits light at power 5.00 mW and wavelength 633 nm. The laser beam is focused (narrowed) until its diameter matches the 1266 nm diameter of a sphere placed in its path. The sphere is perfectly absorbing and has density 5.00×10^3 kg/m^3. What are (a) the beam intensity at the sphere's location, (b) the radiation pressure on the sphere, (c) the magnitude of the corresponding force, and (d) the magnitude of the acceleration that force alone would give the sphere?

5.[CO3] Given that $E_1 = 2a_x - 3a_y + 5a_z$ (V/m) at the charge-free dielectric interface, find D_2 and the angles θ_1 and θ_2.



6.[CO3] In region 1, $B_1 = 1.2a_x + 0.8a_y + 0.4a_z$ (T). Find H_2 (i.e., H at z = + 0) and the angles between the field vectors and a tangent to the interface.