

Electromagnetic waves & Max. E_j^m

Q1 A parallel plate capacitor has circular plates, each of radius 5cm. It is being charged so that electric field in the gap b/w its plates rises steadily at the rate of 10^{12} V/m/s. What is the displacement-current?
 Ans: 0.07A

Q2 The voltage b/w the plates of a parallel-plate capacitor of capacitance 1 μF is changing at the rate of 5 V/s. What is the displacement-current in the capacitor.

Q3 EM waves travel in a medium at a speed of 2×10^8 m/s. The relative permeability of the medium is 1. Find relative permittivity. Ans - $\epsilon_r = 2.25$

Q4 A plane EM wave of frequency 25 MHz travels in free space along x direction. At a particular point in space and time, $\vec{E} = 6.3$ V/m \hat{j} . What is \vec{B} at this point?
 Ans $\vec{B} = 2.18 \times 10^{-8}$ T \hat{k}

Q5 The magnetic field in a plane EM wave is given by $B_y = 2 \times 10^{-7} \sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t)$. What is the wavelength & frequency of the wave? Write an expression for the electric field.
 $E_0 = 60$ V/m
 $\lambda = 1.26$ cm
 $f = 23.96$ GHz

Q6 A plane EM wave is propagating in x direction has a wavelength of 6 mm. The electric field is in y direction and its maximum magnitude is 30 V/m. Write suitable eqns for \vec{E} & \vec{B} .
 Ans: $\vec{E} = 33 \sin \pi \times 10^{11} (t - \frac{x}{c})$ V/m

$$\vec{B} = 1.1 \times 10^{-7} \sin \pi \times 10^{11} (t - \frac{x}{c})$$
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Q7 $E = 50 \sin \frac{\pi}{c} (ct - x)$ N/C of an EM wave. Find the energy contained in a cylinder of cross-section 10 cm² & length 50 cm along x axis.
 Ans: 5.5×10^{-12} J

Q8 → Paraffin has relative permittivity $k=2.1$. Find the index of refraction for paraffin and also the velocity of wave in paraffin.
Ans: 2.07×10^8 m/s

Q9 The relative magnitude of \vec{H} in a plane wave is 1 Amp/m. Find magnitude of \vec{E} for a plane wave in free space. Ans: 376 V/m