

NCERT 12.8 8

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Question 8:

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

(a) Determine, B_0, ω, k and λ

(b) Find expressions for \mathbf{E} and \mathbf{B}

Solution:

TABLE I
INPUT PARAMETERS

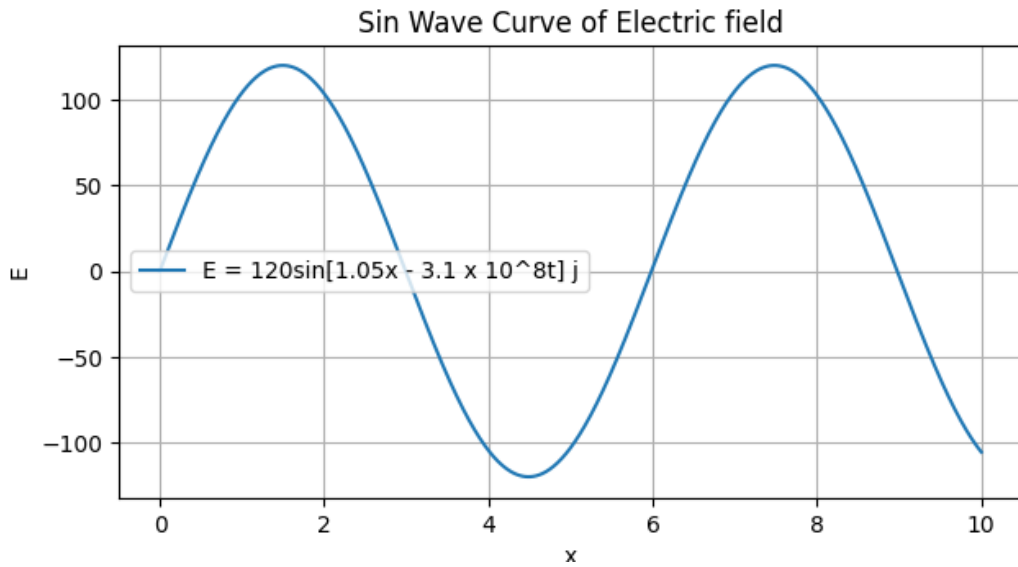
Symbol	Description	value
f	frequency of source	50.0 MHz
E_0	Electric field amplitude	120 N/C
c	speed of light	$3 \times 10^8\text{ m/s}$
$\mathbf{e}_2, \mathbf{e}_3$	Standard Basis vectors	N/A

TABLE II
FORMULAE

Symbol	Description	Formula
\mathbf{E}	Electric field vector	$E_0 \sin(kx - \omega t)\mathbf{e}_2$
\mathbf{B}	Magnetic field vector	$B_0 \sin(kx - \omega t)\mathbf{e}_3$
B_0	Magnetic field strength	$B_0 = \frac{E_0}{c}$
ω	Angular frequency	$\omega = 2\pi f$
k	Propagation constant	$k = \frac{\omega}{c}$
λ	Wavelength	$\lambda = \frac{c}{f}$

TABLE III
OUTPUT PARAMETERS

Symbol	Description	value
\mathbf{E}	Electric field vector	$120 \sin[1.05x - 3.14 \times 10^8 t]\mathbf{e}_2$
\mathbf{B}	Magnetic field vector	$(4 \times 10^{-7}) \sin[1.05x - 3.14 \times 10^8 t]\mathbf{e}_3$
B_0	Magnetic field strength	400nT
ω	Angular frequency	$3.14 \times 10^8\text{m/s}$
k	Propagation constant	1.05rad/s
λ	Wavelength	6.0m

Fig. 1. Graph of **E**Fig. 2. Graph of **B**