NCERT 12.8 8

EE23BTECH11054 - Sai Krishna Shanigarapu

Question 8:
Suppose that the electric field amplitude of an electromagnetic wave is $E_0 = 120$N/C and that its frequency is $f = 50.0$ MHz.
(a) Determine, B_0, ω, k and λ
(b) Find expressions for **E** and **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 x 10^8 m/s
e_2, e_3	Standard Basis vectors	

TABLE II
FORMULAE

Symbol	Description	Formula
E	Electric field vector	$E_0 \sin(kx - \omega t)\mathbf{e_2}$
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	$\lambda = \frac{c}{f}$

(a)

$$B_0 = 400nT \tag{1}$$
$$\omega = 3.14x10^8 rad/s \tag{2}$$
$$k = 1.05rad/m \tag{3}$$
$$\lambda = 6.0m \tag{4}$$

(b)

$$\mathbf{E} = 120\sin[1.05x - 3.1x10^8 t]\mathbf{e_2} \tag{5}$$
$$\mathbf{B} = (4x10^{-7})\sin[1.05x - 3.14x10^8 t]\mathbf{e_3} \tag{6}$$

TABLE III
OUTPUT PARAMETERS

Symbol	Description	value
E	Electric field vector	$120\sin[1.05x - 3.1x10^8 t]\mathbf{e_2}$
B	Magnetic field vector	$(4x10^{-7})\sin[1.05x - 3.14x10^8 t]\mathbf{e_3}$
B_0	Magnetic field strength	400nT
ω	Angular frequency	3.14 x 10^8m/s
k	Propagation constant	1.05rad/s
λ	Wavelength	6.0m

Fig. 1. Graph of **E**

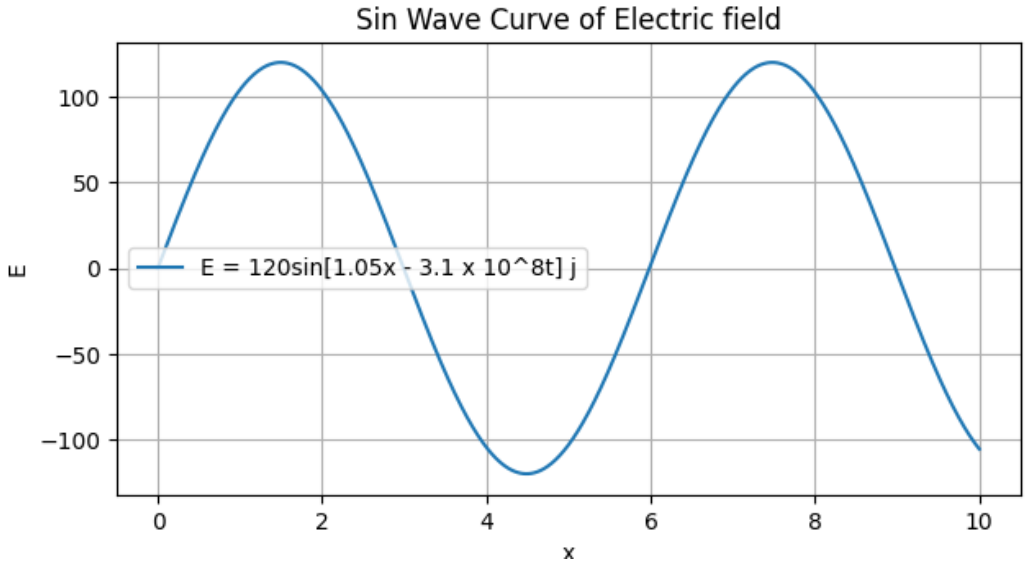

Fig. 2. Graph of **B**