

# 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,  $B_0, \omega, k$  and  $\lambda$

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

$$B_0 = 400\text{nT} \quad (1)$$

$$\omega = 3.14 \times 10^8 \text{ rad/s} \quad (2)$$

$$k = 1.05 \text{ rad/m} \quad (3)$$

$$\lambda = 6.0\text{m} \quad (4)$$

(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	$3 \times 10^8 \text{ m/s}$
$e_2, e_3$	Standard Basis vectors	

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	$B_0 = \frac{E_0}{c}$
$\omega$	Angular frequency	$\omega = 2\pi f$
$k$	Propagation constant	$k = \frac{\omega}{c}$
$\lambda$	Wavelength	$\lambda = \frac{c}{f}$

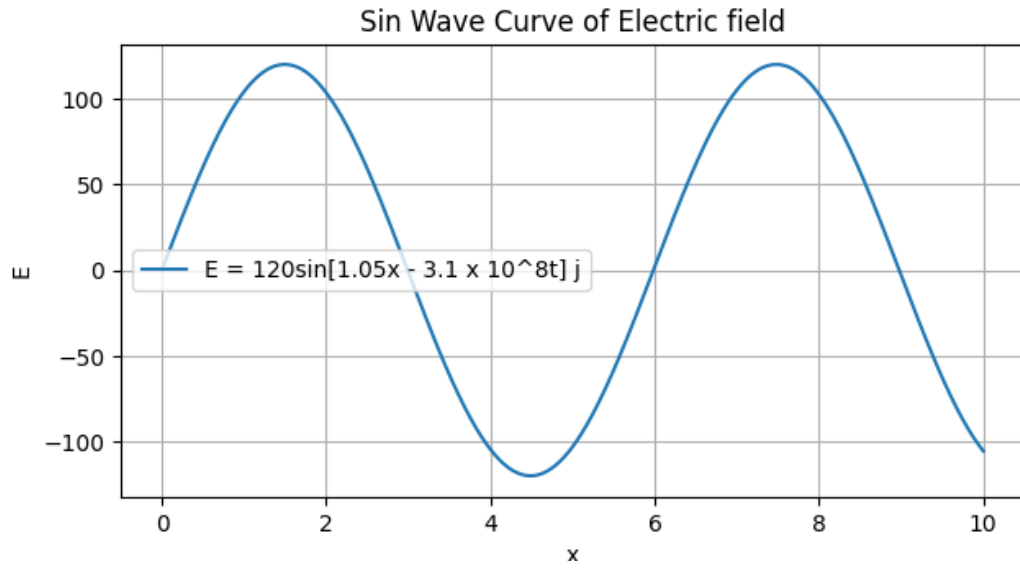
TABLE III  
OUTPUT PARAMETERS

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
$\omega$	Angular frequency	$3.14 \times 10^8 \text{ m/s}$
$k$	Propagation constant	1.05rad/s
$\lambda$	Wavelength	6.0m

$$\mathbf{E} = 120 \sin[1.05x - 3.14 \times 10^8 t] \mathbf{e}_2 \quad (5)$$

$$\mathbf{B} = (4 \times 10^{-7}) \sin[1.05x - 3.14 \times 10^8 t] \mathbf{e}_3 \quad (6)$$

(a)

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