

NCERT 12.8 Q4

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Question: A plane electromagnetic wave travels in vacuum along the z -direction. What can you say about the directions of its electric (**E**) and magnetic (**B**) field vectors? If the frequency of the wave is 30 MHz, what can you say about its wavelength?

Solution:

Method A plane electromagnetic wave travels in vacuum along the z -direction. The electric (**E**) and magnetic ($= 30 \times 10^6$ Hz, you can plug in the values to find the wavelength:

$$\lambda = \frac{3 \times 10^8 \text{ m/s}}{30 \times 10^6 \text{ Hz}}$$

This will give you the wavelength of the electromagnetic wave. B) field vectors are perpendicular to each other and both are perpendicular to the direction of propagation. Specifically, if the wave is traveling along the z -direction, then **E** and **B** will be in the x - and y -directions.

The relationship between frequency (f), wavelength (λ), and the speed of light (c) is given by the formula:

$$c = f\lambda$$

where: c is the speed of light in a vacuum (3×10^8 m/s), f is the frequency of the wave, and λ is the wavelength.

You can rearrange this formula to solve for the wavelength:

$$\lambda = \frac{c}{f}$$

Given a frequency of 30 MHz $\lambda = 10$ m