

Poynting Theorem and Poynting Vector

Poynting Vector

- Electromagnetic waves carry energy.
- As they propagate through space, they can transfer that energy to objects in their path.
- The rate of transfer of energy by an em wave is described by a vector, \mathbf{S} , called the **Poynting vector**.

Poynting Vector, cont.

The Poynting vector is defined as:

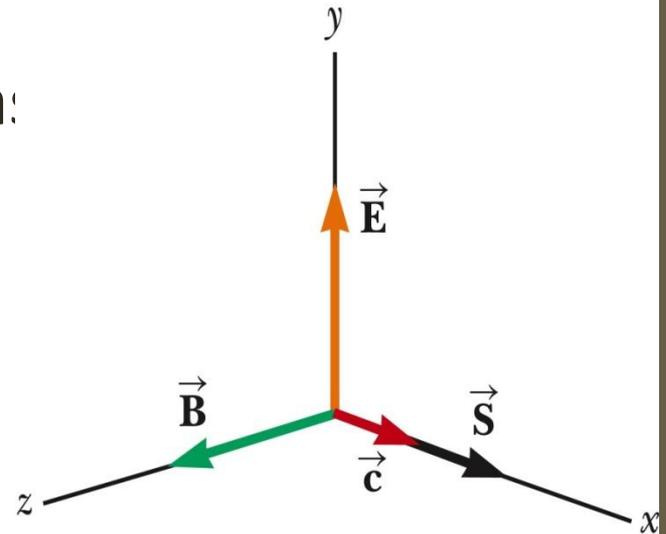
$$\vec{\mathbf{S}} \equiv \frac{1}{\mu_0} \vec{\mathbf{E}} \times \vec{\mathbf{B}}$$

Its direction is the direction of propagation.

This is time dependent.

Its magnitude varies in time.

Its magnitude reaches a maximum at the same instant as



Poynting Vector, final

The magnitude of the vector represents the rate at which energy passes through a unit surface area perpendicular to the direction of the wave propagation.

Therefore, the magnitude represents the *power per unit area*.

The SI units of the Poynting vector are $\text{J}/(\text{s}\cdot\text{m}^2) = \text{W}/\text{m}^2$.