

# PHYS2063 Wave Physics Homework #16 Due Thursday 20 Oct 2022

*This homework assignment is due at the start of class on the date shown. You may submit a PDF of your solutions to the Canvas page for the course, or bring a paper copy to class.*

An electromagnetic plane wave with linear polarization propagates with an electric field

$$\vec{E}(x, y, z, t) = \hat{e}E_0 \cos(\vec{k} \cdot \vec{r} - \omega t)$$

where  $\omega = |\vec{k}|c$ . Assume the wave propagates away from the origin in the direction  $x = y = z$  in the first octant, i.e.  $x$ ,  $y$ , and  $z$  all positive, and that the polarization unit vector  $\hat{e}$  lies in the  $xy$  plane.

Find the wave vector  $\vec{k}$  in terms of  $k = |\vec{k}|$  and unit vectors in the  $x$ ,  $y$ , and  $z$  directions.

Find the polarization unit vector  $\hat{e}$ .

Find the magnetic field  $\vec{B}(x, y, z, t)$  in terms of  $E_0$ ,  $k$ ,  $\omega$ , and unit vectors in the  $x$ ,  $y$ , and  $z$  directions.

Find the Poynting vector  $\vec{S}(x, y, z, t)$  in terms of  $E_0$ ,  $k$ ,  $\omega$ , and unit vectors in the  $x$ ,  $y$ , and  $z$  directions.

I encourage you to solve this problem using results that we derived in class, although you are welcome to find the solution by going back to Maxwell's Equations if you prefer.