

Physics 391  
Lesson 5 Preflight

1. Describe in words what the terms are in Eq. 3.64, the forced oscillator equation of motion.

2. Describe in words how to get from Eq. 3.64 to Eq. 3.66.

3. Earlier we derived the wave equation from Maxwell's Equations in vacuum. Maxwell's equations in a non-magnetic, electrically neutral, non-conducting medium are shown in the figure. Derive a wave equation for the electric field from these equations. You may keep the "curl of the curl of E" term.

$$\begin{aligned}\nabla \cdot \mathbf{E} &= -\frac{1}{\epsilon_0} \nabla \cdot \mathbf{P} \\ \nabla \cdot \mathbf{H} &= 0 \\ \nabla \times \mathbf{E} &= -\mu_0 \frac{\partial \mathbf{H}}{\partial t} \\ \nabla \times \mathbf{H} &= \epsilon_0 \frac{\partial \mathbf{E}}{\partial t} + \frac{\partial \mathbf{P}}{\partial t}\end{aligned}$$

4. Explain why a plane wave propagating in a dense medium keeps going forward instead of spreading to the sides.

5. If photons always move at the speed of light,  $c$ , how come waves move slower in a medium?