Spring '22 Dr. Drake

- 1. Jackson 11.4
- 2. Jackson 11.13
- 3. Jackson 11.20
- 4. Consider an electromagnetic wave of frequency ω propagating along the positive x direction in the laboratory reference frame with,

$$\mathbf{E} = E_0 \hat{y} \cos(kx - \omega t).$$

An ideal plane conductor moves in the laboratory frame with a velocity $\mathbf{v} = -v\hat{x}$, which may be comparable to the velocity of light.

- (a) Transform the space/time dependence of the wave in S to the space/time coordinates of the frame S' moving with the conductor (assume x = x' at t = t' = 0). Note that the sign of v is reversed from our usual convention. From the form of the wave in the S' frame, define the local wavevector k' and frequency ω' in the S' frame. How do k and ω transform under a Lorentz transformation? How does the phase of the wave kx ωt transform? Why?
- (b) Calculate the field of the right propagating wave in the S' frame.
- (c) The wave reflects from the ideal conductor. Evaluate the reflected wave in the S' frame and then transform the reflected wave back to the S frame. What happens to the wave under reflection?
- (d) Calculate the force per unit area on the conductor as a result of the reflection.