Physics 606 Homework #11 Spring '19

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 direciton 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 $\mathbf{x} = \mathbf{x}'$ at $t = t' = 0$). Note that the sign of $\mathbf{v}$ 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 $kx - \omega t$ 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.