(10 pts) Consider a monochromatic electromagnetic plane wave moving along the z-axis in vacuum and described by electric and magnetic fields

$$\vec{E} = \hat{x}\, E_0\, \cos(kz - \omega t)$$
$$\vec{B} = \hat{y}\, B_0\, \cos(kz - \omega t),$$

where $\omega = ck$ and c is the speed of light.

(a). Show explicitly that these fields satisfy Maxwell equations in vacuum for a particular value of E_0/B_0, and find that value.

(b). Calculate the energy density and momentum density in the wave.

(c). Calculate the time-averaged Poynting vector. Show that its magnitude is related to the time-averaged energy density in the wave and interpret. (Time averaging should be done over the times greater than or equal to the period of the wave $T = 2\pi/\omega$.)

(d). Calculate the components of the time-averaged Maxwell stress tensor, and show that the non-zero component is again related to the time-averaged energy density, and interpret.

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