

25. (a) Since $c = \lambda f$, where λ is the wavelength and f is the frequency of the wave,

$$f = \frac{c}{\lambda} = \frac{2.998 \times 10^8 \text{ m/s}}{3.0 \text{ m}} = 1.0 \times 10^8 \text{ Hz} .$$

- (b) The magnetic field amplitude is

$$B_m = \frac{E_m}{c} = \frac{300 \text{ V/m}}{2.998 \times 10^8 \text{ m/s}} = 1.00 \times 10^{-6} \text{ T} .$$

\vec{B} must be in the positive z direction when \vec{E} is in the positive y direction in order for $\vec{E} \times \vec{B}$ to be in the positive x direction (the direction of propagation).

- (c) The angular wave number is

$$k = \frac{2\pi}{\lambda} = \frac{2\pi}{3.0 \text{ m}} = 2.1 \text{ rad/m} .$$

The angular frequency is

$$\omega = 2\pi f = 2\pi(1.0 \times 10^8 \text{ Hz}) = 6.3 \times 10^8 \text{ rad/s} .$$

- (d) The intensity of the wave is

$$I = \frac{E_m^2}{2\mu_0 c} = \frac{(300 \text{ V/m})^2}{2(4\pi \times 10^{-7} \text{ H/m})(2.998 \times 10^8 \text{ m/s})} = 119 \text{ W/m}^2 .$$

- (e) Since the sheet is perfectly absorbing, the rate per unit area with which momentum is delivered to it is I/c , so

$$\frac{dp}{dt} = \frac{IA}{c} = \frac{(119 \text{ W/m}^2)(2.0 \text{ m}^2)}{2.998 \times 10^8 \text{ m/s}} = 8.0 \times 10^{-7} \text{ N} .$$

The radiation pressure is

$$p_r = \frac{dp/dt}{A} = \frac{8.0 \times 10^{-7} \text{ N}}{2.0 \text{ m}^2} = 4.0 \times 10^{-7} \text{ Pa} .$$