32.1

(a) $\Delta t = \frac{d}{c} = \frac{3.84 \times 10^{8}\ \text{m}}{3.0 \times 10^{8}\ \text{m/s}}$

$= 1.28\ \text{s}$

(b) $d = c\,\Delta t = (3.0 \times 10^{8}\ \text{m/s}) \times (8.61 \times 3.154 \times 10^{7}\ \text{s})$

$= 8.15 \times 10^{16}\ \text{m}$

$= 8.15 \times 10^{13}\ \text{km}$

32.14

(a) $v = \frac{c}{\sqrt{K_E K_B}} = \frac{3.00 \times 10^{8}\ \text{m/s}}{\sqrt{(3.64)(5.18)}}$

$= 6.91 \times 10^{7}\ \text{m/s}$

(b) $\lambda = \frac{v}{f} = \frac{6.91 \times 10^{7}\ \text{m/s}}{65.0\ \text{Hz}} = 1.06 \times 10^{6}\ \text{m}$

(c) $B = \frac{E}{v} = \frac{7.20 \times 10^{-3}\ \text{V/m}}{6.91 \times 10^{7}\ \text{m/s}} = 1.04 \times 10^{-10}\ \text{T}$

(d) $I = \frac{EB}{2K_B\mu_0} = \frac{(7.20 \times 10^{-3}\ \text{V/m})(1.04 \times 10^{-10}\ \text{T})}{2(5.18)\mu_0}$

$= 5.75 \times 10^{-8}\ \text{W/m}^2$

32.34

(a) $\Delta x = \frac{\lambda}{2} = \frac{c}{2f} = \frac{3.00 \times 10^8 \text{ m/s}}{2(75.0 \times 10^6 \text{ Hz})}$

$= 2.00 \text{ m}$

(b) The distance between the electric and magnetic nodal planes is one-quarter of a wavelength $= \frac{\lambda}{4} = \frac{\Delta x}{2} = \frac{2.00\text{m}}{2} = 1.00\text{m}.$

32.38

Assume $\vec{E} = E_{max}\,\hat{j}\,\sin(kx-\omega t)$

and $\vec{B} = B_{max}\,\hat{k}\,\sin(kx-\omega t+\phi)$,

with $-\pi < \phi < \pi$. Then Eq. (32.12) implies

$\frac{\partial E_y}{\partial x} = -\frac{\partial B_z}{\partial t} \Rightarrow k E_{max} \cos(kx-\omega t) =$

$+\omega B_{max} \cos(kx-\omega t+\phi)$

$\Rightarrow \phi = 0.$

$\Rightarrow kE_{max} = \omega B_{max}$

$\Rightarrow E_{max} = \frac{\omega}{k} B_{max} = \frac{2\pi f}{2\pi/\lambda} B_{max}$

$= f\lambda B_{max} = c B_{max}$

Similarly, for Eq. (32.14),

$-\frac{\partial B_z}{\partial x} = \epsilon_0 \mu_0 \frac{\partial E_y}{\partial t} \Rightarrow -k B_{max} \cos(kx-\omega t+\phi)$

$= -\epsilon_0\mu_0 \omega E_{max} \cos(kx-\omega t) \Rightarrow \phi = 0$

$\Rightarrow kB_{max} = \epsilon_0\mu_0\omega E_{max} \Rightarrow$

$B_{max} = \frac{1}{c} E_{max}.$