Problem 10.3

$\vec{H} = 30\cos(10^8 t - 6x)\vec{a}_y$ mA/m

a) Direction of propagation +x direction.

b) $\lambda = \frac{2\pi}{\beta} = \frac{2\pi}{6} = 1.0472m$

c) $u = \frac{\omega}{\beta} = \frac{10^8}{6} = 1.6667 \times 10^7 \ m/s$

Problem 10.12

$\vec{E} = 5\sin(3\times10^{8}t + y)\vec{a}_z$ V/m

a) The wave is polarized in the z direction.

b) $\lambda = \dfrac{2\pi}{\beta} = 2\pi$

$T = \dfrac{2\pi}{\omega} = \dfrac{2\pi}{3\times10^{8}} = 2.094\times10^{-8}$ s

$u = c = 3\times10^{8}$ m/s

d) $\eta = \eta_0 = 377\,\Omega$

$\vec{H} = -\dfrac{5}{377}\sin(3\times10^{8}t + y)\vec{a}_x = -0.0133\sin(3\times10^{8}t + y)\vec{a}_x$ A/m

Problem 10.14

$$u = \frac{c}{\sqrt{\mu_r \varepsilon_r}} = \frac{3\times 10^8}{\sqrt{3\times 4}} = 8.66\times 10^7 \text{ m/s}$$

$$\lambda = \frac{u}{f} = \frac{8.66\times 10^7}{60\times 10^6} = 1.443\,\text{m}$$

$$\eta = \eta_0 \sqrt{\frac{\mu_r}{\varepsilon_r}} = 377\sqrt{\frac{4}{3}} = 435.32\,\Omega$$

Problem 10.17

$\vec{H} = 25\sin(2\times10^{8}t + 6x)\vec{a}_y$ mA/m

a) Direction of propagation -x direction.

b) $u = \dfrac{c}{\sqrt{\mu_r \varepsilon_r}} = \dfrac{\omega}{\beta} \quad \Rightarrow \quad \dfrac{3\times10^{8}}{\sqrt{1\times\varepsilon_r}} = \dfrac{2\times10^{8}}{6} \quad \Rightarrow \quad \sqrt{\varepsilon_r} = 9 \quad \Rightarrow \quad \varepsilon_r = 81$

$\therefore \varepsilon = 81\varepsilon_0$

c) $\eta = \eta_0\sqrt{\dfrac{\mu_r}{\varepsilon_r}} = 377\sqrt{\dfrac{1}{81}} = 41.889\,\Omega$

$\vec{E} = 41.889\times25\times10^{-3}\sin(2\times10^{8}t + 6x)\vec{a}_z$

$\vec{E} = 1.047\sin(2\times10^{8}t + 6x)\vec{a}_z$ V/m

Problem 10.23

$\vec{H} = 25\sin(\beta z + 40{,}000t)\vec{a}_y$ A/m

a) $u = c = 3\times 10^8$ m/s

$$u = \frac{\omega}{\beta} \quad \Rightarrow \quad 3\times 10^8 = \frac{4\times 10^4}{\beta} \quad \Rightarrow \quad \beta = \frac{4\times 10^4}{3\times 10^8} = 1.333\times 10^{-4} \text{ rad/m}$$

b) $$\lambda = \frac{2\pi}{\beta} = \frac{2\pi}{1.333\times 10^{-4}} = 4.7136\times 10^4 \text{ m} = 47.136 \text{ km}$$

(the wavelength is very large, because the frequency is not very high).

c) $u = c = 3\times 10^8$ m/s

d) $\eta = \eta_0 = 377\,\Omega$

$\vec{E} = -377\times 25\sin(1.333\times 10^{-4} z + 40{,}000t)\vec{a}_x$ V/m

$\vec{E} = -9.425\sin(1.333\times 10^{-4} z + 40{,}000t)\vec{a}_x$ kV/m