1) loss tangent $\tan\theta = \frac{\sigma}{\omega\varepsilon}$ tells U how good a conductor is

$\frac{\sigma}{\omega\varepsilon} >> 1 \therefore$ good conductor

$$\frac{\sigma}{\omega\varepsilon} = \frac{6}{2\pi \cancel{6} \varepsilon_0 3} = 5.99 \times 10^9 >> 1$$

$\omega = 2\pi f$

$\alpha \approx \beta \approx \sqrt{\frac{\mu\sigma\omega}{2}}$ $[m^{-1}]$

a) phase wave v: $v = \frac{\omega}{\beta}$

$$\beta = \sqrt{\frac{\mu_r \mu_0 \sigma 2\pi f}{2}}$$

$$v = \frac{\omega}{\beta} = \frac{\sqrt{\omega^2}}{\sqrt{\frac{\mu\sigma\omega}{2}}} = \sqrt{\frac{2\omega}{\mu_0\mu_r\sigma}} = \sqrt{\frac{2(2\pi f)}{\mu_0\mu_r\sigma}} = 1.2 \times 10^3 \text{ km/s}$$

$= 1.2 \times 10^6$ m/s

b) $\lambda = \frac{2\pi}{\beta} = 0.2$ m

c) $\vec{E} = \vec{E}_0 e^{i(\beta x - \omega t)}$

$\vec{E}_0 = 50\hat{y} e^{-\alpha x} = 50 e^{-3.15} \approx 2.14$ V/m

amplitude $\vec{E}$ field at x

d) $\frac{E_0}{H_0} = \sqrt{\frac{\mu\omega}{\sigma}} e^{-i\frac{\pi}{4}}$

$H_0 = \sqrt{\frac{\sigma}{\mu\omega}} e^{i\pi/4} E_0$

$= 0.29$ A/m

2) permitivity : ε_r [ ]

$\omega = 2\pi \cdot 10^8$ sec

freqncy : f [Hz]

$\sigma = \varepsilon\omega \simeq 27.8 \times 10^{-3}$ S/m

relative permeability : μ

$\alpha = \sqrt{\frac{\mu\sigma\omega_r}{2}} = 0.33$ m^{-1}

$\llcorner$ = unity = 1

conductivity : σ [S/m] – $\sigma = \varepsilon\omega$, $\omega = \frac{2\pi}{T} = 2\pi f$

attenuat° : α [m]
per m

3) a) $$\boxed{\frac{\langle U_{electric}\rangle}{\langle U_{magnetic}\rangle} = \frac{\langle \frac{1}{2}\vec{D}\cdot\vec{E}\rangle}{\langle \frac{1}{2}\vec{H}\cdot\vec{B}\rangle} = \frac{\varepsilon\langle \vec{E}^2\rangle}{\mu\langle \vec{H}^2\rangle} = \frac{\varepsilon}{\mu}|z|^2 = \frac{\varepsilon}{\mu}\frac{\mu}{\varepsilon} = 1}$$

• non conducting medium $Z = \sqrt{\frac{\mu}{\varepsilon}}$

• conducting med $Z = \sqrt{\frac{\mu^2\omega^2}{\mu\varepsilon\omega^2\left(1+i\frac{\mu\sigma\omega}{\mu\varepsilon\omega^2}\right)}} = \sqrt{\frac{\mu}{\varepsilon\left(1+i\frac{\sigma}{\varepsilon\omega}\right)}}$

$$\frac{\langle U_e\rangle}{\langle U_m\rangle} = \frac{1}{\sqrt{1+\left(\frac{\sigma}{\varepsilon\omega}\right)^2}} \Big] \gg 1 \implies$$ more E stored magnetic field