Homework 3.

1) A plane wave propagating in a medium is $\vec{E}(z,t) = \hat{a}_x 120\pi e^{-\alpha z} \cdot e^{-j\beta z + j\omega t}$ (V/m). If $\omega = 3\times 10^8$ (rad/s), and the medium is characterized by $\varepsilon_r = 2(1-j)$, $\mu_r = 1$, determine
   (a) The magnitude of the characteristic impedance $|\eta|$,
   (b) The phase angle of the characteristic impedance θ_η,
   (c) The attenuation constant α,
   (d) The propagation constant β,
   (e) The magnetic field $\vec{H}$,
   (f) The real-time expressions of the fields $\vec{E}$ and $\vec{H}$.

2) A plane wave propagating in a medium is $\vec{E}(z,t) = \hat{a}_x 120\pi e^{-\alpha z} \cdot e^{-j\beta z + j\omega t}$ (V/m). If $\omega = 3\times 10^8$ (rad/s), and the medium is characterized by $\varepsilon_r = 2$, $\mu_r = 1$, $\sigma = 32\pi$ S/m, determine
   (a) The magnitude of the characteristic impedance $|\eta|$,
   (b) The phase angle of the characteristic impedance θ_η,
   (c) The attenuation constant α,
   (d) The propagation constant β,
   (e) The magnetic field $\vec{H}$,
   (f) The real-time expressions of the fields $\vec{E}$ and $\vec{H}$.

3) A plane wave propagating in a lossy dielectric medium of characteristic impedance $\eta = 100\angle 30^0$ is described by $\vec{H}(z,t) = \hat{a}_y e^{-\alpha z} \cdot e^{-j\beta z + j\omega t}$ (V/m). If the propagation constant is given to be $\beta = 1/2$ (rad/m), determine
   (a) The attenuation constant α,
   (b) The electric field $\vec{E}$.

4) Find the skin depth at a frequency of 1.6 MHz in aluminum, where $\sigma = 38.2\times 10^6$ S/m and $\mu_r = 1$.