An EM wave passes from air to metal, what happens to the wave in the metal?

A. It will be amplified because of free electrons
B. It will die out over some distance
C. It will be blocked right at the interface because there's no E field in a metal
D. Not sure

We found a traveling wave solution for the conductor situation,

$$\widetilde{\mathbf{E}}(\mathbf{r}, t) = \widetilde{\mathbf{E}}_0 e^{i(\widetilde{k}z - \omega t)}$$

where $\widetilde{k} = \omega^2 \mu\varepsilon + i(\omega\mu\sigma)$

True (A) or False (B): This traveling wave is transverse.

(C) I'm not sure.

The magnetic field amplitude in a metal associated with a linearly polarized electric EM wave is:

$$\widetilde{B}_0 = \left(\frac{k_R + ik_I}{\omega} \right) \widetilde{E}_0$$

True (A) or False (B): The B field is in phase with the E field.

(C) It depends!

The magnetic field amplitude in a highly conductive metal ($\sigma \gg \varepsilon\omega$) associated with a linearly polarized electric EM wave is

$$\widetilde{B}_0 = \sqrt{\frac{\mu\sigma}{\omega}}\frac{1+i}{\sqrt{2}}\widetilde{E}_0$$

$$\widetilde{B}_0 = \sqrt{\frac{\sigma}{\varepsilon_0\omega}}\frac{1+i}{\sqrt{2}}\frac{\widetilde{E}_0}{c}$$

True (A) or False (B): The B field is in phase with the E field.

(C) It depends!