Q. Find the skin depth for a typical metal $\sigma = 10^7\ \Omega^{-1}m^{-1}$ in visible range $\omega = 10^{15}$/sec. Assuming $\varepsilon \simeq \varepsilon_0$ & $\mu \simeq \mu_0$ & define why metals are opaque. Also find the phase diff. b/w Electric & magnetic field in this metal.

$$\sigma = 10^7\ \Omega^{-1}m^{-1}$$

$$\omega = 10^{15}/\text{sec}.$$

It is a good conductor, & for good conductor, skin depth is, $\delta_{good} = \sqrt{\frac{2}{\sigma\omega\mu}} = \sqrt{\frac{2}{10^7 \times 10^{15} \times 4\pi \times 10^{-7}}}$

$$= \sqrt{\frac{10^{-16} \times 10}{2\pi}} = \sqrt{\frac{5}{\pi}} \times 10^{-8}\ m$$

$$= 1.3 \times 10^{-8}\ m$$

$$\delta_{good} = 13\ nm$$

Now Why Metal is opaque ⇒

at every 13 nm, amp. decay by 1/e. Hence amplitude decay very fast. So electromag. wave can not pass through the metals. Hence metals are opaque. But it has some limit.

$\omega > \omega_p$ then medium is transperat.

$\omega < \omega_p$, medium is opaque.

- Reflectivity of any metal remain constant upto UV region but beyond UV region it will fall drops.
  Hence transmittance is also const. upto UV region,
  $$R + T = 1$$
  Reflectivity drops means transmitance increases.
- Hence, for X-rays & γ-rays, we can not make the mirrors. Because No metal exist which can reflect X-rays & γ-rays.
  Visible ⟶ UV ⟶ X-ray ⟶ γ-ray.
- X-rays can be reflected from an atomic plane but not by metal surface $R \simeq 1$, $T \simeq 0$