

P2

(a)

$$\text{Let } F(t') = \frac{2}{\pi} \int_0^{\infty} [\epsilon_1(\omega') - 1] \cos(\omega' t') d\omega' = \frac{2}{\pi} \int_0^{\infty} \epsilon_2(\omega') \sin(\omega' t') d\omega'$$

Now, in the notes we defined:

$$\begin{aligned} \epsilon_1(\omega) - 1 &= \int_0^{\infty} F(t') \cos(\omega t') dt' \\ &= \int_0^{\infty} \cos(\omega t') dt' \left\{ \frac{2}{\pi} \int_0^{\infty} \epsilon_2(\omega') \sin(\omega' t') d\omega' \right\} \\ &= \frac{2}{\pi} \int_0^{\infty} d\omega' \epsilon_2(\omega') \left\{ \int_0^{\infty} \cos(\omega t') \sin(\omega' t') dt' \right\} \end{aligned}$$

$$\text{Now, } \cos(\omega t') = \frac{e^{i\omega t'} + e^{-i\omega t'}}{2} \text{ and } \sin(\omega' t') = \frac{e^{i\omega' t'} - e^{-i\omega' t'}}{2i} \therefore$$

$$\epsilon_1(\omega) - 1 = \frac{2}{\pi} \int_0^{\infty} d\omega' \epsilon_2(\omega') \left\{ \int_0^{\infty} \frac{e^{it'(\omega+\omega')} - e^{it'(\omega-\omega')} + e^{it'(\omega'-\omega)} - e^{-it'(\omega+\omega')}}{4i} dt' \right\}$$

Now, the Laplace transform is defined as:

$$\mathcal{L}\{f(t)\} = \int_0^{\infty} e^{-st} f(t) dt \therefore$$

$$\int_0^{\infty} e^{-\alpha t'} e^{-\beta t'} dt' = \frac{1}{\alpha + \beta}$$

With this definition, we have:

$$A = \frac{1}{4i} \left( e^{it'(\omega+\omega')} - e^{it'(\omega-\omega')} + e^{it'(\omega'-\omega)} - e^{-it'(\omega+\omega')} \right)$$

$$= \frac{1}{4i} \left( \frac{1}{-i\omega' - i\omega} + \frac{1}{+i\omega' - i\omega} + \frac{1}{-i\omega' + i\omega} + \frac{1}{i\omega' + i\omega} \right)$$



So, multiplying through by  $i/i$  gives:

$$\begin{aligned}
 A &= \frac{1}{4i} \left( \frac{i}{\omega' + \omega} + \frac{i}{\omega' - \omega} - \frac{i}{\omega - \omega'} + \frac{i}{\omega' + \omega} \right) \\
 &= \frac{1}{4i} \left( \frac{2i}{\omega' + \omega} + \frac{2i}{\omega' - \omega} \right) = \frac{1}{4i} \left( \frac{2i(\omega' - \omega) + 2i(\omega' + \omega)}{\omega'^2 - \omega^2} \right) \\
 &= \frac{1}{4i} \left( \frac{2i\omega' - 2i\omega + 2i\omega' + 2i\omega}{\omega'^2 - \omega^2} \right) = \frac{1}{4i} \left( \frac{4i\omega'}{\omega'^2 - \omega^2} \right)
 \end{aligned}$$

Thus,

$$\epsilon_1(\omega) - 1 = \frac{2}{\pi} \int_0^{\infty} d\omega' \epsilon_2(\omega') \frac{\omega'}{\omega'^2 - \omega^2}$$

Similarly, for  $\epsilon_2(\omega)$ :

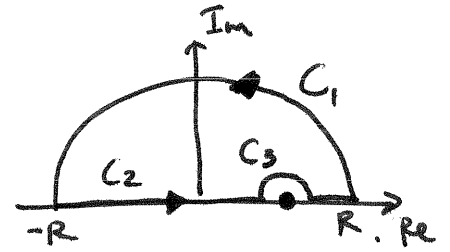
$$\begin{aligned}
 \epsilon_2(\omega) &= \int_0^{\omega} F(t') \sin(\omega t') dt' \\
 &= \int_0^{\infty} \sin(\omega t') dt' \left\{ \frac{2}{\pi} \int_0^{\infty} [\epsilon_1(\omega') - 1] \cos(\omega' t') d\omega' \right\} \\
 &= \frac{2}{\pi} \int_0^{\infty} d\omega' [\epsilon_1(\omega') - 1] \left\{ \int_0^{\infty} \sin(\omega t') \cos(\omega' t') dt' \right\} \\
 &= \frac{2}{\pi} \int_0^{\infty} d\omega' [\epsilon_1(\omega') - 1] \left\{ \frac{1}{2} (A') \right\}, \text{ where } A' \text{ has } \omega \text{ and } \omega' \\
 &\quad \text{switched. } \therefore \text{ and multiplied by a minus sign.}
 \end{aligned}$$

$$\epsilon_2(\omega) = -\frac{2}{\pi} \int_0^{\infty} d\omega' [\epsilon_1(\omega') - 1] \frac{\omega}{\omega'^2 - \omega^2}$$



(b)

$$\frac{\epsilon(\omega)}{\epsilon_0} = 1 + \frac{1}{2\pi i} \oint_C \frac{\left(\frac{\epsilon(\omega')}{\epsilon_0} - 1\right)}{\omega' - \omega} d\omega'$$



$$\rightarrow \oint_C = \oint_{C_1} + \oint_{C_2} + \oint_{C_3} = 0$$

Now, if we let  $R \rightarrow \infty$ ,  $\oint_{C_1} \rightarrow 0$ . Then:

$$\oint_C = P \int_{-\infty}^{\infty} \frac{\frac{\epsilon(\omega')}{\epsilon_0} - 1}{\omega' - \omega} d\omega' + i\pi \left(\frac{\epsilon(\omega)}{\epsilon_0} - 1\right) = 0$$

With this, we have that:

$$\frac{\epsilon(\omega)}{\epsilon_0} = 1 - \frac{1}{i\pi} P \int_{-\infty}^{\infty} \frac{\frac{\epsilon(\omega')}{\epsilon_0} - 1}{\omega' - \omega} d\omega'$$

Now,  $\epsilon(\omega) = \epsilon_1 + i\epsilon_2 \therefore$

$$\frac{\epsilon_1}{\epsilon_0} + \frac{i\epsilon_2}{\epsilon_0} = 1 - \frac{1}{i\pi} P \int_{-\infty}^{\infty} \frac{\frac{\epsilon_1}{\epsilon_0} + \frac{i\epsilon_2}{\epsilon_0} - 1}{\omega' - \omega} d\omega' \therefore$$

$\frac{\epsilon_1}{\epsilon_0}$  corresponds to real parts of RHS and

$\frac{\epsilon_2}{\epsilon_0}$  corresponds to imaginary  $\therefore$

$$\frac{\epsilon_1(\omega)}{\epsilon_0} = 1 + \frac{1}{\pi} P \int_{-\infty}^{\infty} \frac{\frac{\epsilon_2(\omega')}{\epsilon_0}}{\omega' - \omega} d\omega'$$
$$\frac{\epsilon_2(\omega)}{\epsilon_0} = -\frac{1}{\pi} P \int_{-\infty}^{\infty} \frac{\frac{\epsilon_1(\omega')}{\epsilon_0} - 1}{\omega' - \omega} d\omega'$$

$$\frac{d}{dw} \left( \frac{1}{w^{1/2} - w^2} \right)$$

$$= \frac{1}{u}$$

$$\frac{d}{du} (u^{-1}) = \frac{-1}{u^2}$$

$$\frac{-1}{u^2} \cdot (-2w) = \frac{2w}{(w^{1/2} - w^2)^2}$$

$$\frac{1}{w^{1/2} - w^2} \approx$$

$$u = w^{1/2} - w^2$$

$$\frac{du}{dw} = -2w$$

$$\frac{df}{dw} = \frac{df}{du} \frac{du}{dw}$$

( )

P3

$$\vec{S} = c\vec{E} \times \vec{H} / 4\pi$$

$$-\vec{\nabla} \cdot \vec{S} = \frac{1}{4\pi} \left( \vec{E} \cdot \frac{\partial \vec{D}}{\partial t} + \vec{H} \cdot \frac{\partial \vec{B}}{\partial t} \right)$$

Now, assume  $\vec{E} \rightarrow \frac{1}{2}\vec{E}'e^{-i\omega t} + \frac{1}{2}\vec{E}^*e^{i\omega t}$   
 $\vec{H} \rightarrow \frac{1}{2}\vec{H}'e^{-i\omega t} + \frac{1}{2}\vec{H}^*e^{i\omega t}$

Then,

$$\vec{D} = \frac{1}{2}\epsilon\vec{E}'e^{-i\omega t} + \frac{1}{2}\epsilon^*\vec{E}^*e^{i\omega t} \quad \therefore \quad \vec{E} = \frac{1}{2}\vec{E}'e^{-i\omega t} \quad \cancel{\frac{1}{2}\vec{E}^*e^{i\omega t}}$$

$$\frac{\partial \vec{D}}{\partial t} = \frac{1}{2}(-i\omega\epsilon\vec{E} + i\omega\epsilon^*\vec{E}^*)$$

$$\vec{H} = \frac{1}{2}\vec{H}'e^{-i\omega t}$$

$$\vec{B} = \frac{1}{2}\mu\vec{H}'e^{-i\omega t} + \frac{1}{2}\mu^*\vec{H}^*e^{i\omega t}$$

$$\frac{\partial \vec{B}}{\partial t} = \frac{1}{2}(-i\omega\mu\vec{H} + i\omega\mu^*\vec{H}^*)$$

$$-\vec{\nabla} \cdot \vec{S} = \frac{1}{4\pi} \left( \frac{1}{4} (-i\omega\epsilon \vec{E} \cdot \vec{E} + i\omega\epsilon^* \vec{E} \cdot \vec{E}^* - i\omega\epsilon \vec{E}^* \cdot \vec{E} + i\omega\epsilon^* \vec{E}^* \cdot \vec{E}^*) \right)$$

$$+ \frac{1}{4} (-i\omega\mu \vec{H} \cdot \vec{H} + i\omega\mu^* \vec{H} \cdot \vec{H}^* - i\omega\mu \vec{H}^* \cdot \vec{H} + i\omega\mu^* \vec{H}^* \cdot \vec{H}^*)$$

$$= \frac{i\omega}{16\pi} \left( (\epsilon^* - \epsilon) \vec{E} \cdot \vec{E}^* + (\mu^* - \mu) \vec{H} \cdot \vec{H}^* \right) + \frac{i\omega}{16\pi} \left( \epsilon \vec{E} \cdot \vec{E} + \epsilon^* \vec{E}^* \cdot \vec{E}^* \right)$$

$$+ \mu \vec{H} \cdot \vec{H} + \mu^* \vec{H}^* \cdot \vec{H}^*)$$

1. Introduction

The first part of the report discusses the background and objectives of the study.

The second part of the report describes the methodology used in the study.

The third part of the report presents the results of the study.

The fourth part of the report discusses the implications of the findings.

The fifth part of the report concludes the study and provides recommendations for future research.

The sixth part of the report provides a summary of the key findings and conclusions.

The seventh part of the report discusses the limitations of the study and the scope of the research.

The eighth part of the report provides a list of references used in the study.

The ninth part of the report provides a list of appendices.





Taking a time average of the  $-\vec{\nabla} \cdot \vec{S}$  function over one cycle gives the heat dissipation. This will eliminate the  $\vec{E}^* \cdot \vec{E}^*$  and  $\vec{H}^* \cdot \vec{H}^*$  terms because the average over the cycle is zero. Thus,

$$Q = \frac{i\omega}{16\pi} \left[ (\epsilon^* - \epsilon) \vec{E} \cdot \vec{E}^* + (\mu^* - \mu) \vec{H} \cdot \vec{H}^* \right] \therefore$$

$$Q = \frac{\omega}{8\pi} \left[ \epsilon_2 |\vec{E}|^2 + \mu_2 |\vec{H}|^2 \right] = \frac{\omega}{4\pi} \left[ \epsilon_2 \vec{E}^2 + \mu_2 \vec{H}^2 \right]$$

Now, by entropic considerations, the dissipation of energy results in the positive (always) generation of heat. Thus, given the equation for  $Q$  above, the only way to ensure  $Q > 0$  is for  $\epsilon_2 > 0$  and  $\mu_2 > 0$ .



P4

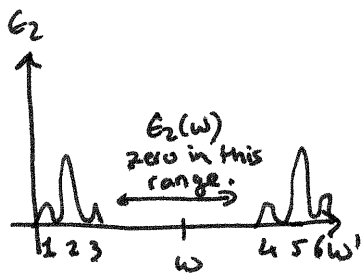
- (a) While  $\epsilon_2(\omega)$  may equal 0 at some given frequency  $\omega$ , it is not necessarily zero at all frequencies. If it were, according to the Kramers-Kronig relation:

$$\epsilon_1(\omega) = 1 + \frac{2}{\pi} P \int_0^{\infty} \frac{\epsilon_2(\omega') \omega'}{\omega'^2 - \omega^2} d\omega'$$

$\epsilon_1(\omega)$  would have to be 1 and  $d\epsilon_1/d\omega = 0$ .

So, in general,  $\epsilon_2(\omega)$  will be zero at one or more frequencies, but may have peaks at others.

For this problem, we assume that all the peaks are ~~as~~ far away from  $\omega$ . Then:



$$\epsilon_1(\omega) = 1 + \frac{2}{\pi} \left[ \int_{\text{peak 1}} \frac{\epsilon_2(\omega') \omega'}{\omega'^2 - \omega^2} d\omega' + \int_{\text{peak 2}} \frac{\epsilon_2(\omega') \omega'}{\omega'^2 - \omega^2} d\omega' + \dots \right]$$

$$+ \frac{2}{\pi} \left[ \int_{\text{peak 3}} \frac{\epsilon_2(\omega') \omega'}{\omega'^2 - \omega^2} d\omega' + \dots \right]$$

The second term on the RHS accounts for all peaks before  $\omega$ . There, we can take  $\omega^2 \gg \omega'^2$  so  $(\omega'^2 - \omega^2) \approx -\omega^2$ .

The third term on the RHS accounts for all peaks after  $\omega$ . There, we can take  $\omega'^2 \gg \omega^2$  so  $(\omega'^2 - \omega^2) \approx \omega'^2$ .



With these simplifications, the expression for  $\epsilon_1(\omega)$  becomes:

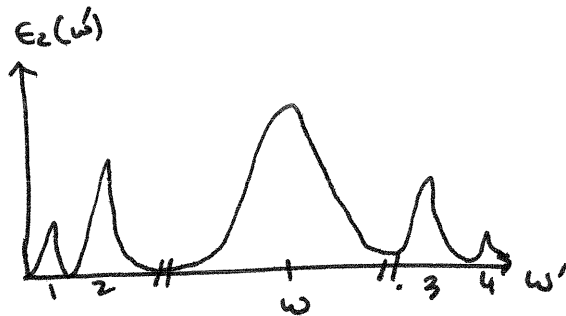
$$\epsilon_1(\omega) \approx 1 - \frac{2}{\pi \omega^2} \left[ \int_{\text{peak 1}} \epsilon_2(\omega') \omega' d\omega' + \dots \right] + \frac{2}{\pi} \left[ \int_{\text{peak 3}} \frac{\epsilon_2(\omega') \omega'}{\omega'^2} d\omega' + \dots \right] \quad \text{--- (A)}$$

Then,  $d\epsilon_1/d\omega$  is:

$$\frac{d\epsilon_1}{d\omega} = \frac{4}{\pi \omega^3} \left[ \int_{\text{peak 1}} \epsilon_2(\omega') \omega' d\omega' + \dots \right] > 0$$

↳ for positive  $\omega$

(b) Now, if  $\epsilon_2(\omega) \neq 0$ , we have an absorption that looks like:



Now, we must add a  $\frac{4}{\pi}$  term onto the RHS of equation (A) to account for the peak around  $\omega$ . Thus:

$$\epsilon_1(\omega) \approx 1 - \frac{2}{\pi \omega^2} \left[ \int_{P1} \epsilon_2(\omega') \omega' d\omega' + \dots \right] + \frac{2}{\pi} \left[ \int_{P3} \frac{\epsilon_2(\omega') \omega'}{\omega'^2} d\omega' + \dots \right] + \frac{2}{\pi} \int_{\text{peak around } \omega} \frac{\epsilon_2(\omega') \omega'}{(\omega'^2 - \omega^2)} d\omega'$$

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Now,  $d\epsilon_1/d\omega$  is:

$$\frac{d\epsilon_1}{d\omega} = \frac{4}{\pi\omega^3} \left[ \int_{PI} \epsilon_2(\omega') \omega' d\omega' + \dots \right] + \frac{8\omega}{\pi} \int \frac{\epsilon_2(\omega') \omega'}{(\omega'^2 - \omega^2)^2} d\omega'$$

peak around  
 $\omega$

Since the second term can be negative, it is possible that  $\frac{d\epsilon_1}{d\omega} < 0$  because the integral  $\int \frac{\epsilon_2(\omega') \omega'}{(\omega'^2 - \omega^2)^2} d\omega'$  can be negative (e.g.  $\epsilon_2(\omega') = 1$ ).





For simplicity, we consider s-polarization. Then,

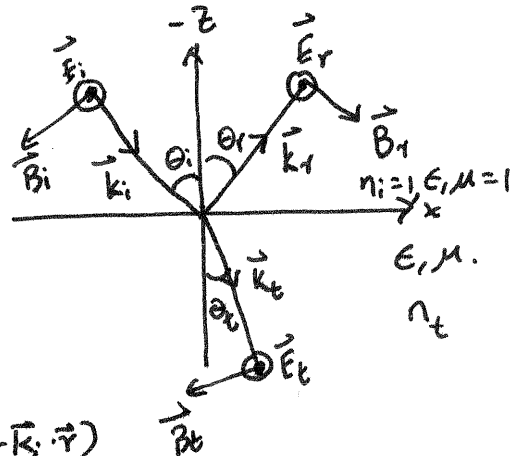
### Incident Beam

$$\vec{E}_i = \hat{j} E_i e^{i(\omega t - \vec{k}_i \cdot \vec{r})}$$

$$\vec{B}_i = \frac{1}{\omega} \vec{k}_i \times \vec{E}_i$$

$$\vec{k}_i = \frac{\omega n_i}{c} (\sin \theta_i \hat{i} + \cos \theta_i \hat{n}) \quad \therefore$$

$$\vec{B}_i = \frac{n_i}{c} (-\cos \theta_i \hat{i} + \sin \theta_i \hat{n}) E_i e^{i(\omega t - \vec{k}_i \cdot \vec{r})}$$



### Reflected Beam

$$\vec{E}_r = \hat{j} E_r e^{i(\omega t - \vec{k}_r \cdot \vec{r})}$$

$$\vec{k}_r = (\sin \theta_i \hat{i} - \cos \theta_i \hat{n}) \frac{\omega n_i}{c}$$

$$\vec{B}_r = \frac{n_i}{c} (\cos \theta_i \hat{i} + \sin \theta_i \hat{n}) E_r e^{i(\omega t - \vec{k}_r \cdot \vec{r})}$$

Now, we consider boundary conditions. The normal component of  $\vec{D}$  is continuous across the boundary, and this is satisfied because the s-polarization has no normal component. The boundary condition on the tangential component requires that  $E_i + E_r = E_t$ . Similar conditions for the normal and tangential components of the B-field lead to:

$$\frac{n_i}{c} \sin \theta_i (E_i + E_r) = \frac{n_t}{c} \sin \theta_t E_t$$

$$\frac{n_i}{\omega c} \cos \theta_i (E_i - E_r) = \frac{n_t}{\omega c} \cos \theta_t E_t$$

Here we have used the fact that the transmitted beam goes like:

$$\vec{E}_t = \hat{j} E_t e^{i(\omega t - \vec{k}_t \cdot \vec{r})} \quad \vec{k}_t = (\sin \theta_t \hat{i} + \cos \theta_t \hat{n}) \frac{\omega n_t}{c}$$

$$\vec{B}_t = (-\cos \theta_t \hat{i} + \sin \theta_t \hat{n}) \frac{n_t}{c} E_t e^{i(\omega t - \vec{k}_t \cdot \vec{r})}$$

The first part of the document discusses the importance of maintaining accurate records. It emphasizes that every transaction should be properly documented to ensure transparency and accountability. This includes recording the date, amount, and purpose of each entry.

Additionally, it highlights the need for regular audits to identify any discrepancies or errors. By conducting these audits frequently, potential issues can be caught early and corrected before they become significant problems.

The second section focuses on the role of technology in modern accounting. It notes that while traditional methods were once the standard, the integration of software has revolutionized the field. This allows for faster processing of data and the generation of detailed reports with minimal manual intervention.

However, it also cautions against over-reliance on technology. Professionals must still understand the underlying principles and be able to verify the accuracy of the software's output. A hybrid approach, combining human expertise with digital tools, is often the most effective.

Finally, the document addresses the ethical responsibilities of accountants. It states that beyond the technical aspects of the job, practitioners must adhere to a strict code of ethics. This involves being honest, objective, and maintaining the confidentiality of client information.

The conclusion reiterates that success in this profession is not just about technical skill but also about integrity and a commitment to continuous learning. As the industry evolves, staying updated on the latest trends and regulations is essential for long-term success.

We can eliminate  $E_t$  from the tangential equation using  $E_i + E_r = E_t$

$$\frac{n_i}{\mu_i c} \cos \theta_i (E_i - E_r) = \frac{n_t}{\mu_t c} \cos \theta_t (E_i + E_r) \therefore$$

$$E_i \left[ \frac{n_i}{\mu_i} \cos \theta_i - \frac{n_t}{\mu_t} \cos \theta_t \right] = E_r \left[ \frac{n_i}{\mu_i} \cos \theta_i + \frac{n_t}{\mu_t} \cos \theta_t \right] \therefore$$

$$\frac{E_r}{E_i} = \frac{\frac{n_i}{\mu_i} \cos \theta_i - \frac{n_t}{\mu_t} \cos \theta_t}{\frac{n_i}{\mu_i} \cos \theta_i + \frac{n_t}{\mu_t} \cos \theta_t} \therefore$$

$$\frac{E_r}{E_i} = \frac{\sqrt{\frac{\epsilon_i}{\mu_i}} \cos \theta_i - \sqrt{\frac{\epsilon_t}{\mu_t}} \cos \theta_t}{\sqrt{\frac{\epsilon_i}{\mu_i}} \cos \theta_i + \sqrt{\frac{\epsilon_t}{\mu_t}} \cos \theta_t}$$

For a monochromatic wave impinging on a left handed material slab, we would expect negative refraction according to Snell's law. Also, in order to conserve momentum, the "k" vector in the slab would point towards the initial interface. However, since the Poynting vector is  $\propto \vec{E} \times \vec{H}$ , the energy flow would still be in the incident  $\rightarrow$  transmitted direction as expected. This is also true for a wave packet and we would expect negative refraction according to Snell's law at the central frequency and a incident  $\rightarrow$  transmitted Poynting vector to indicate unidirectional energy flow through the slab. However due to the superposed nature of a wave packet, we would expect spatial ~~and time~~ distortion in the packet as it propagates through the slab.



P7

(\*Refractive index and reflectivity at normal incidence  
as function of frequency for Ag described by the Drude model\*)

(\*Constants\*)

$$\epsilon_0 = 8.854187817 \times 10^{-12};$$

$$e = 1.60217646 \times 10^{-19};$$

$$m = 9.10938188 \times 10^{-31};$$

$$\sigma_{Ag} = 6.30119722747322 \times 10^7;$$

$$n = 5.86 \times 10^{28}; \text{ (*Reference: Fox*)}$$

(\*Drude relaxation time for Ag,  $\gamma_{Ag} = 2.6189 \times 10^{13} \rightarrow$  from  $\sigma =$

$$ne^2 / (m(\gamma - i\omega)) \rightarrow \text{Re}[\sigma = ne^2(\gamma + i\omega) / (\gamma^2 + \omega^2)] = ne^2\gamma / (\gamma^2 + \omega^2). \text{ Let } \omega=0 \rightarrow \gamma = ne^2 / (m\sigma) *)$$

$$\gamma_{Ag} = 2.6189 \times 10^{13};$$

(\*Plasmon frequency  $\omega_{p(Ag)} = 1.3656529121249004 \times 10^{16}$  Hz, Reference: Fox\*)

$$\omega_p[n_] := \text{Sqrt}[n * e^2 / (\epsilon_0 * m)];$$

(\*electron number density for Ag\*)

$$n_{\text{density}}[\omega_] := (\omega^2 * m * \epsilon_0 / e^2);$$

(\*Drude model permittivity\*)

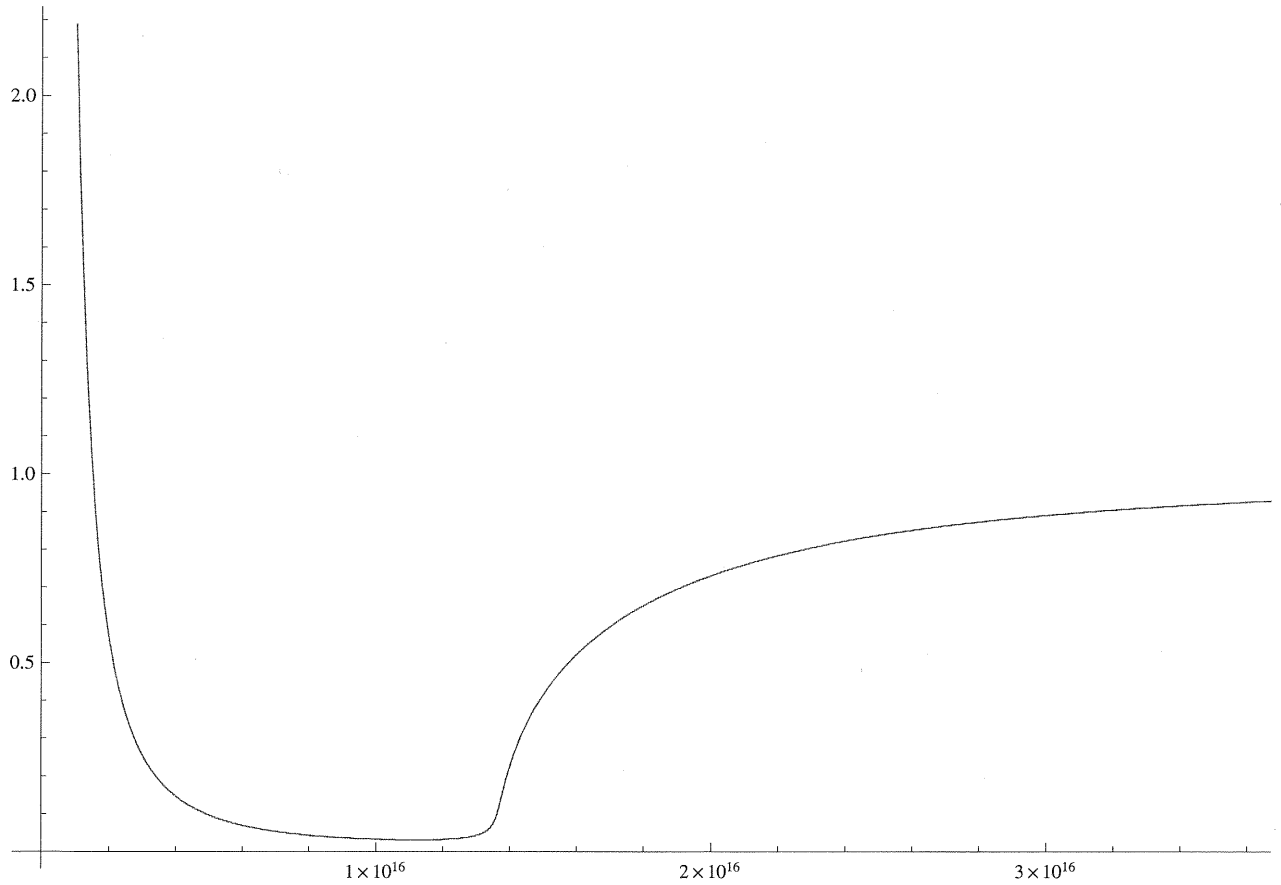
$$\epsilon_1[\omega_, \gamma_, N_] := 1 - (N * e^2 / (\epsilon_0 * m)) * (1 / (\omega^2 + \gamma^2));$$

$$\epsilon_2[\omega_, \gamma_, N_] := (4 \pi * N * e^2 / (\epsilon_0 * m)) * \gamma / (\omega * (\omega^2 + \gamma^2));$$

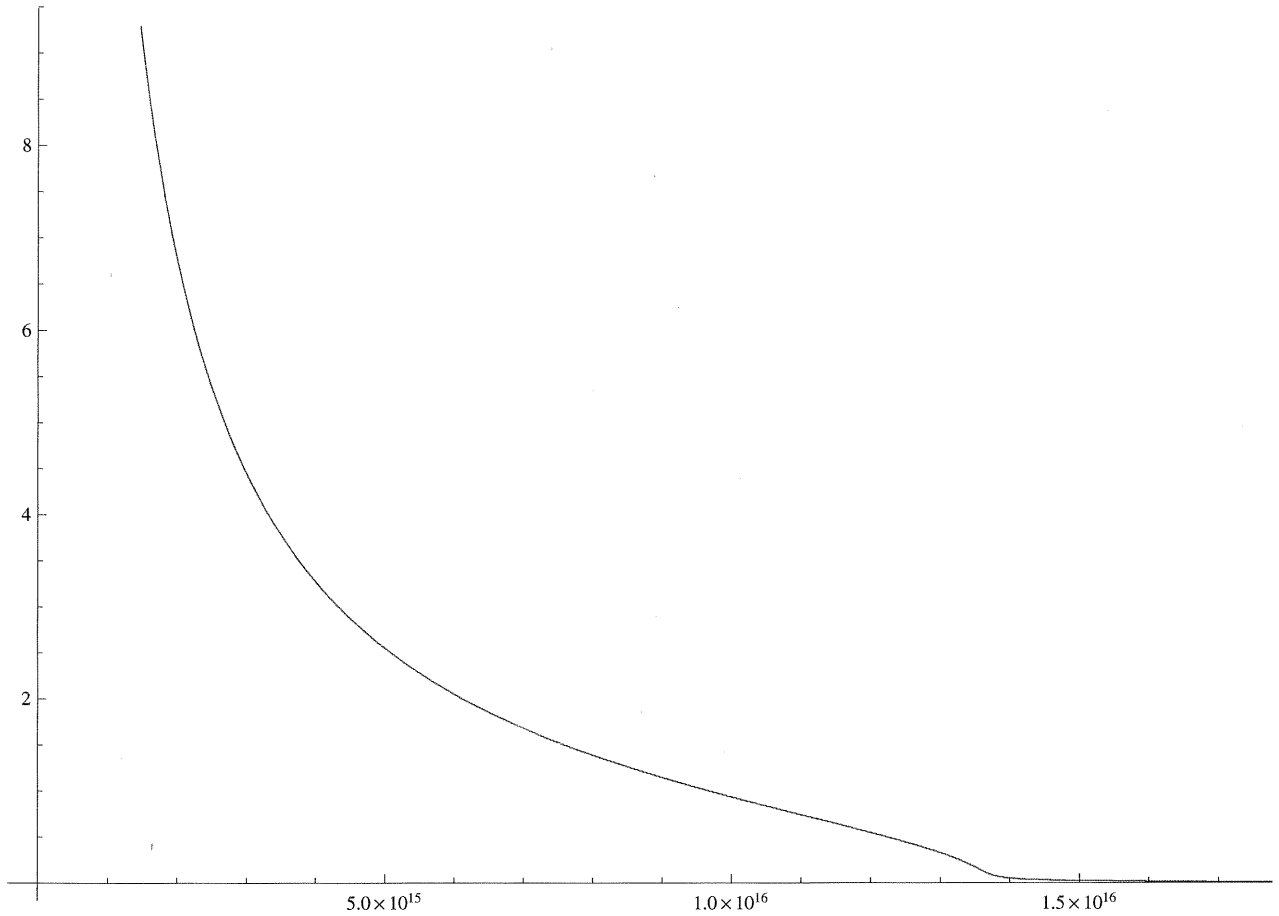
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(*Index of refraction: N[ω]=
n+κ= Sqrt[ε]=Sqrt[ε1+iε2]→ n=1/Sqrt[2]* Sqrt[Sqrt[ε12+ε22]+ε1],
κ=Sign[ε2]/Sqrt[2]*Sqrt[Sqrt[ε12+ε22]-ε1*)
(*Real part*)
nindex[ω_, γ_, N_] := 1 / Sqrt[2] * Sqrt[Sqrt[ε1[ω, γ, N]2 + ε2[ω, γ, N]2 + ε1[ω, γ, N]]
Plot[nindex[ω, γAg, n], {ω, 0, 4 * 1016}]

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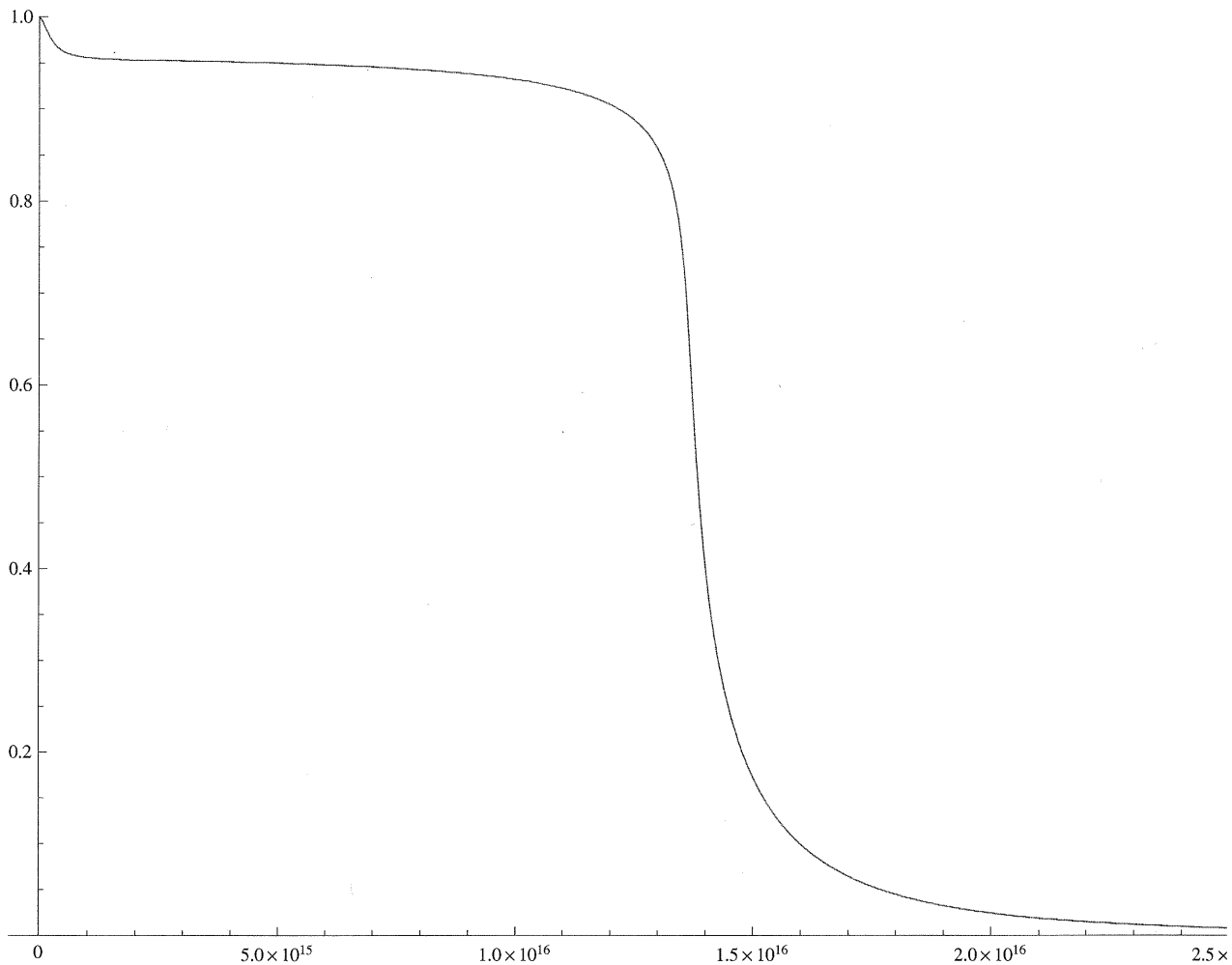


```
(*Imaginary part*)
κ[ω_, γ_, N_] :=
  (Sign[ε2[ω, γ, N]] / Sqrt[2]) * Sqrt[Sqrt[ε1[ω, γ, N]2 + ε2[ω, γ, N]2] - ε1[ω, γ, N]]
Plot[κ[ω, γAg, n], {ω, 0, 2 * 1016}]
```



```
(*Reflectivity at normal incidence --> R=|r|2, r=z-1/z+1, z=(μ/ε)0.5*)
ε[ω_, γ_, N_] := ε1[ω, γ, N] + i * ε2[ω, γ, N];
r[ω_, γ_, N_] := (1 - Sqrt[ε[ω, γ, N]]) / (1 + Sqrt[ε[ω, γ, N]]);
```

```
Plot[Abs[r[ $\omega$ ,  $\gamma_{Ag}$ , n]]2, { $\omega$ , 0, 3 * 1016}, PlotRange -> {0, 1}]
```



(\*Compare with experimental values of plasma frequency from Oats & Mucklich, Nanotechnology 16 (2005). Note that the plasma frequency obtained here is shifted from that experimentally determined. This is due to the oversimplification of the Drude model in which inter-band transitions are not accounted for.\*)



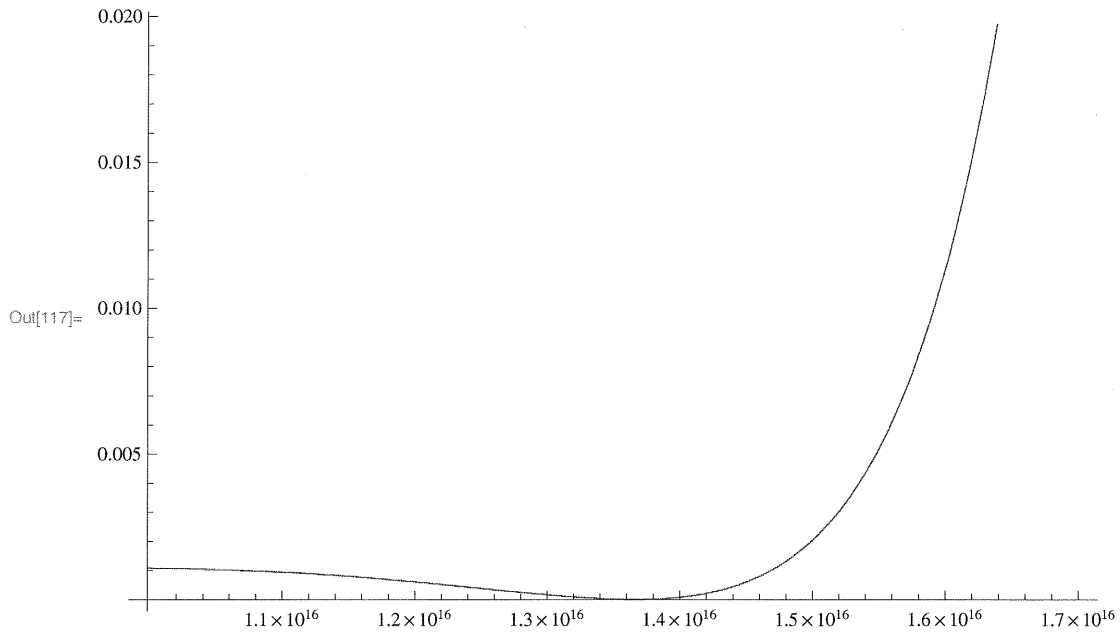
P8

(\*Transmission of P-waves through an absorptive medium,  
incident at  $\pi/4$ , with permittivity determined by the Drude model\*)

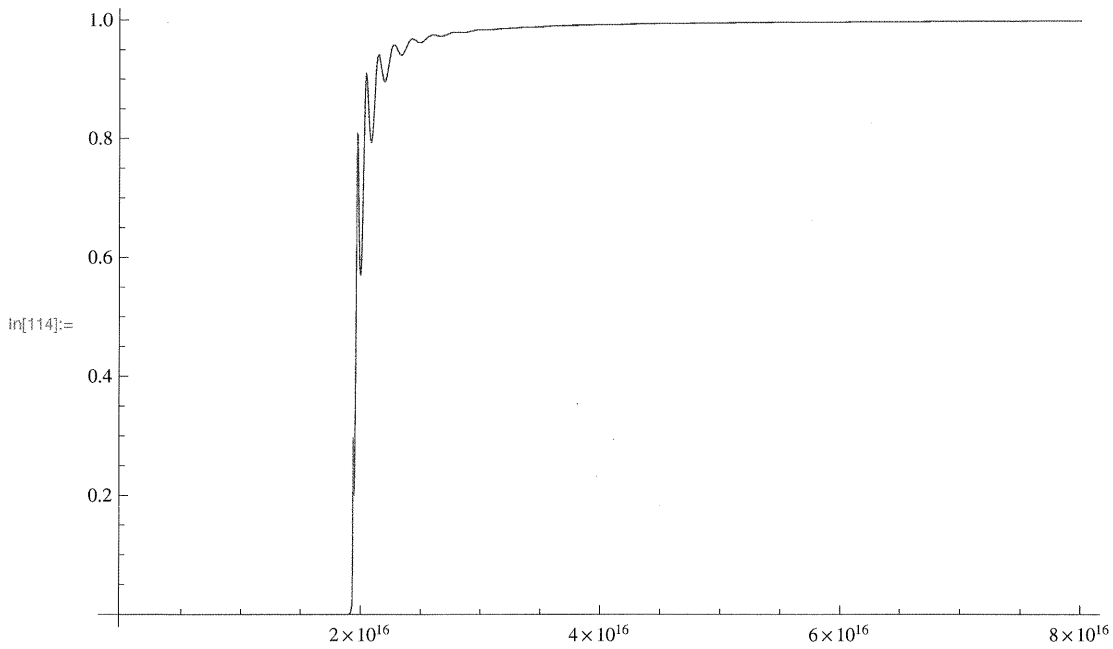
(\*Transmission  $T_p(\omega)$  for various material lengths,  $d$ , at incident angle of  $\pi/4$ \*)

$$\eta = d * \omega / (2.99 * 10^8);$$

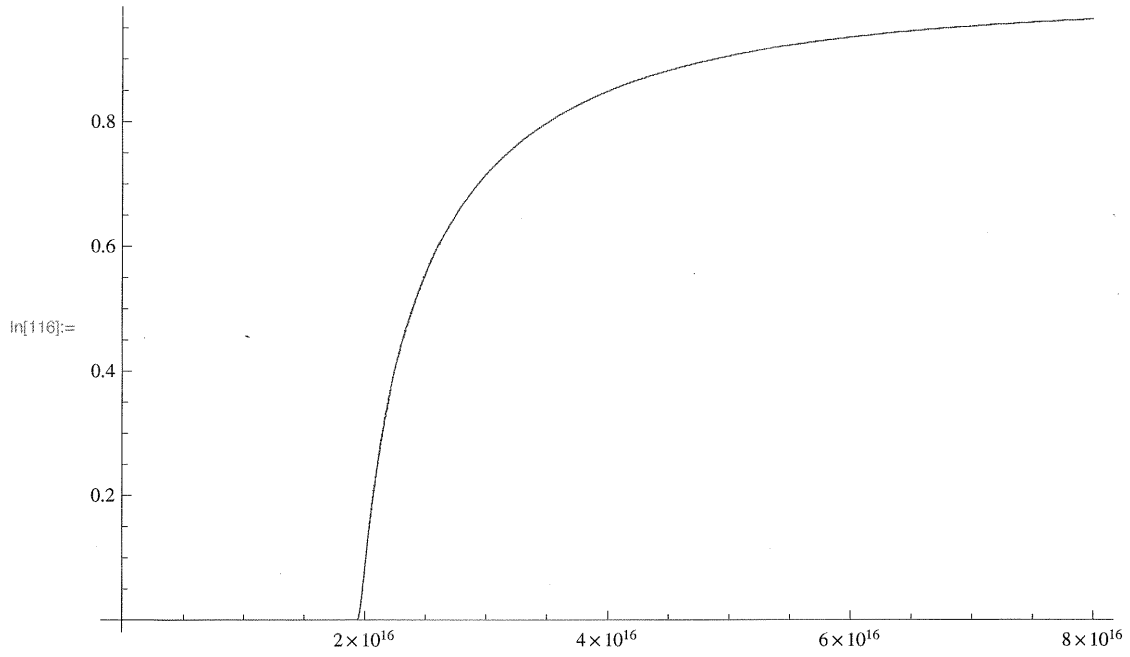
```
Plot[ $T_p[n, \kappa, 1, \pi/4, \pi/4, 1], \{\omega, 1 \cdot 10^{16}, 1.7 \cdot 10^{16}\}]$   
(*d=100nm*)
```



```
ln[113]:= (*d=500nm*)
```



```
ln[115]:= (*d=10um*)
```



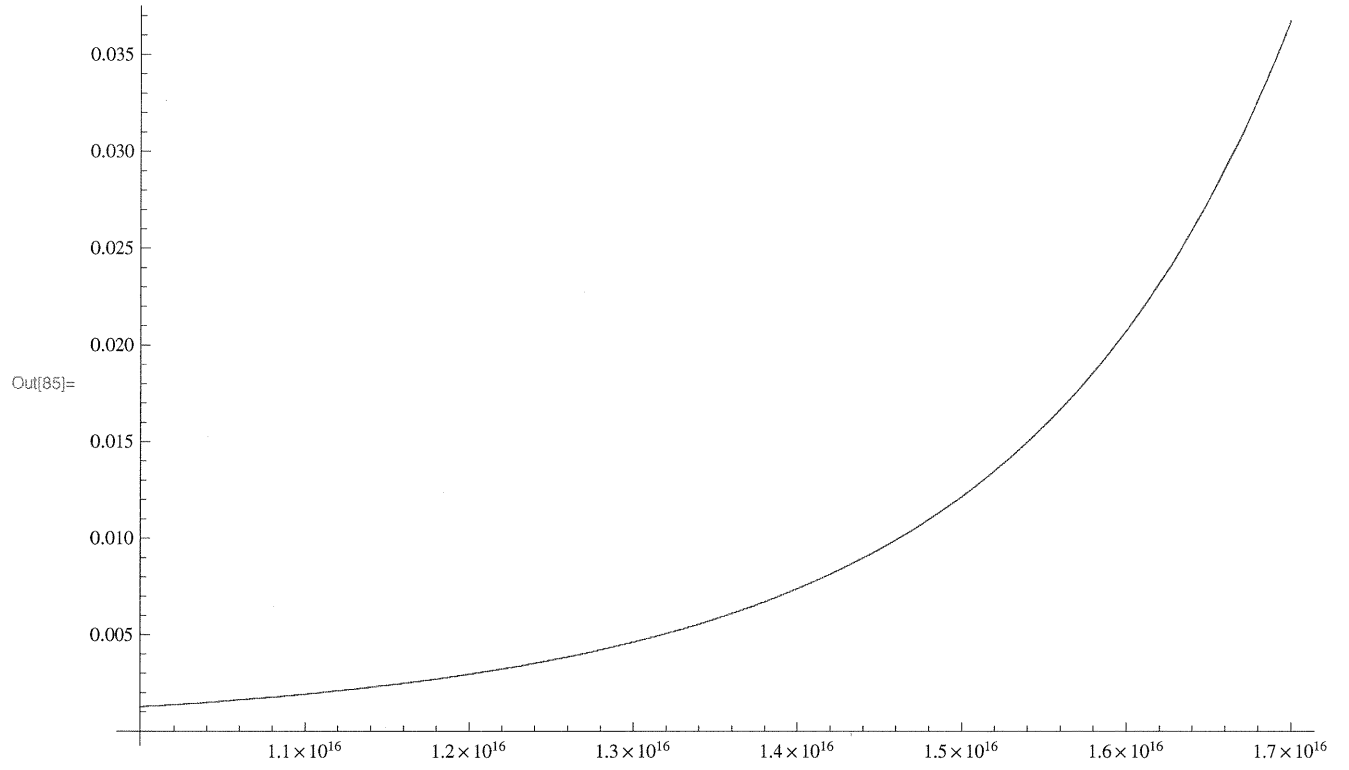


(\*Transmission of S-waves through an absorptive medium,  
incident at  $\pi/4$ , with permittivity determined by the Drude model\*)

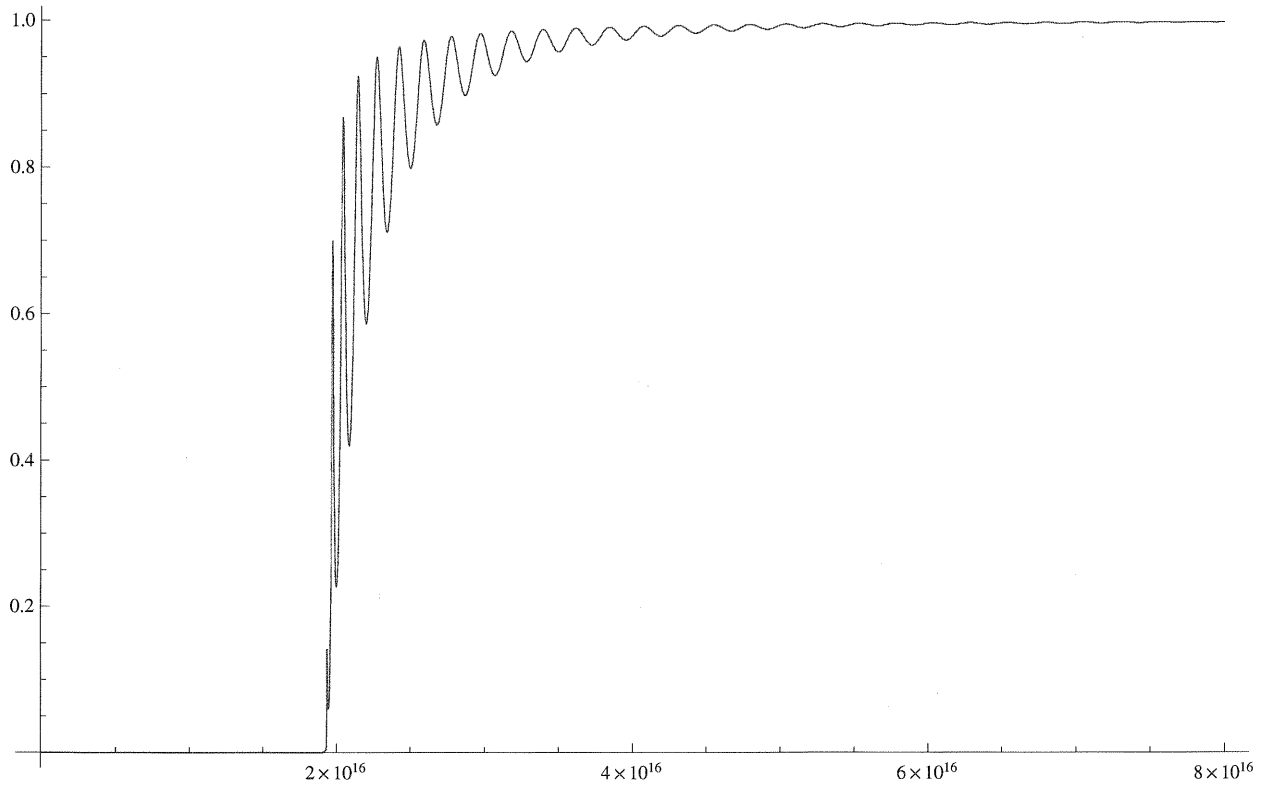
(\*Transmission  $T_s(\omega)$  for various material lengths,  $d$ , at incident angle of  $\pi/4$ \*)

```
 $\eta = d * \omega / (2.99 * 10^8);$   
Plot[Ts[n,  $\kappa$ , 1,  $\pi / 4$ ,  $\pi / 4$ , 1], { $\omega$ ,  $1 * 10^{16}$ ,  $1.7 * 10^{16}$ }]
```

(\*d=100nm\*)



(\*d=500nm\*)



(\*d=10um\*)

