Optical properties of materials

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Quiz 3

Name:

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Question 1

In the lecture, we saw the motion equation for electron displacement $x(t)$ in metals in terms of Drude-Zener model:

$$m\frac{\partial^2 x}{\partial t^2} + m\Gamma\frac{\partial x}{\partial t} = |e|E_0 e^{-i\omega t}$$

A) What is the dimension of Γ?

$[\Gamma] = 1/s$

After solving the equation, we derived the expression for permittivity:

$$\varepsilon_1(\omega) = 1 - \frac{Ne^2}{\varepsilon_0 m}\frac{1}{\Gamma^2 + \omega^2}$$

B) What is the dimension of the coefficient $\frac{Ne^2}{\varepsilon_0 m}$?

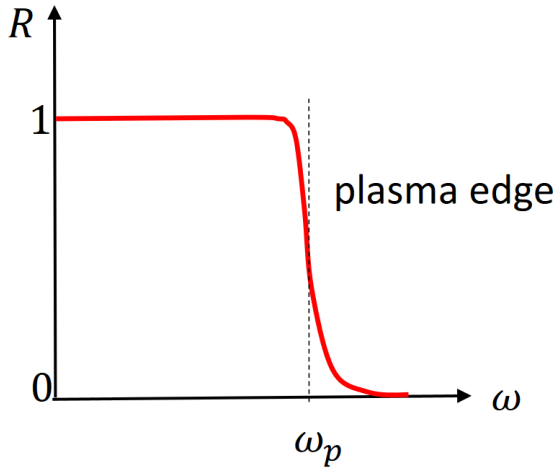
$\left[\frac{Ne^2}{\varepsilon_0 m}\right] = \frac{1}{s^2}$

C) What is the dimension of the permittivity $\varepsilon_1(\omega)$?

$[\varepsilon_1(\omega)] =$ -, it is dimensionless

Question 2

Draw the typical reflectivity of a metal vs frequency according to the Drude model.



Question 3

On which material properties does the plasma frequency depend on?

Density of free electrons.