1.1. What is the frequency (in Hz) and energy (in eV) of a photon with wavelength 1 m? 1 cm, 1 \( \mu m \), 1 nm?

Solution: Recall that \( E \times \lambda \approx 1.24 \times 10^{-4} \text{eV} \times \text{cm} \); hence \( E \approx 1.24 \times 10^{-4} \text{eV/\lambda (cm)} \).

Frequency, \( \nu = c/\lambda = E/h \).

For \( \lambda = 1 \text{m} \), \( E = 1.24 \times 10^{-6} \text{eV} \), \( \nu = 3 \times 10^8 \text{Hz} \)

for \( \lambda = 1 \text{cm} \), \( E = 1.24 \times 10^{-4} \text{eV} \), \( \nu = 3 \times 10^{10} \text{Hz} \)

for \( \lambda = 1 \mu m \), \( E = 1.24 \text{eV} \), \( \nu = 3 \times 10^{14} \text{Hz} \)

for \( \lambda = 1 \text{nm} \), \( E = 1.24 \times 10^3 \text{eV} \), \( \nu = 3 \times 10^{17} \text{Hz} \)

1.2. What is the refractive index of (a) an air, (b) regular glass, (c) diamond?

Rough data for \( \lambda \sim 0.59 \mu m \): air -- \( n \approx 1 + 3 \times 10^{-4} \); regular glass -- \( n \sim 1.516 \); diamond -- \( n \approx 2.42 \).

1.3. What is the reflectivity (i. e. ratio of an incident to a reflected intensity of light) of a surface air/glass under normal incidence in optical domain?

Solution: reflectivity (i. e. ratio of intensities of the reflected and incident light) is

\[
R = \left( n_2 - n_1 \right)^2 / \left( n_2 + n_1 \right)^2 .
\]

Thus, for air-glass surface it is \( R \approx 0.04 \)

1.4. In a plane EM-wave in vacuum, what is the ratio of electrical and magnetic energy density?

Answer: these two energies are equal.