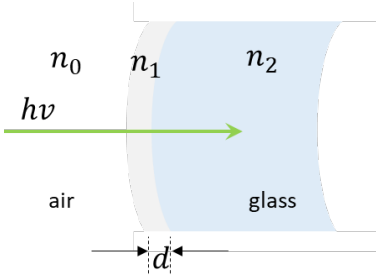
Exercise 1.1 (Photon properties)

Photons are quantum particles and therefore obey the laws of quantum mechanics $E = \hbar\omega$ and $p = \hbar k$ (k is the wavevector). For a photon with a wavelength of 500 nm, calculate its energy (J, eV), frequency ν, wavenumber $\bar{\nu}$ (cm^{-1}), momentum p and dispersion relation $\omega(k)$ in vacuum.

Exercise 1.2 (antireflective coating, interference)

An antireflective coating for a glass lens is designed in order to suppress reflections at a wavelength of 530 nm for perpendicular incidence. You can assume that there is no absorption in the glass and the coating.

a) Derive the minimum thickness *d* of this layer assuming a refractive index $n_1 = 1.38$ of the coating material and $n_2 = 1.5$ for glass.
b) Neglecting multiple reflections, estimate the percentage of the suppressed intensity of the reflected light due to the thin coating.
   Optional question: Compare your result to the exact solution including multiple reflections.
c) What happens with the light that is back reflected at the uncoated interface of the glass? Can this back reflection also be suppressed? Please provide a qualitative answer.



Note: Use $R = \left(\frac{n_1 - n_2}{n_1 + n_2}\right)^2$ to calculate the reflectance at the n_1/n_2 interface and in analogy at the n_0/n_1 interface.