Tutorial N°2: Exercises on the propagation of light, plane diopters and the prism.

Exercise 2.1 A photon of red light has a wavelength of 4.50×10^{-7} m. Calculate its frequency.

Known/Given:

speed of light, $c = 3.00\ x\ 10^{8} m/s$

wavelength, $\lambda = 4.50\ x\ 10^{-7} m$

Exercise 2.2 A photon of green light has a frequency, ν of $5.75\ x\ 10^{14} Hz$. What is its wavelength, λ?

Known/Given:

speed of light, $c = 3.00\ x\ 10^{8} m/s$

frequency, $f = 5.75\ x\ 10^{14} Hz = 5.75\ x\ 10^{14} s^{-1}$

Exercise 2.3 Find the energy of an X-ray photon with a wavelength of $1.34x10^{-11} m$.

Known/Given:

speed of light, $c = 3.00\ x\ 10^{8} m/s$

the Planck constant $h = 6.63.10^{-34} J.s$

Exercise 2.4:

One of the rays of a beam of light propagating in air enters a diamond with a refractive index of 2.43.

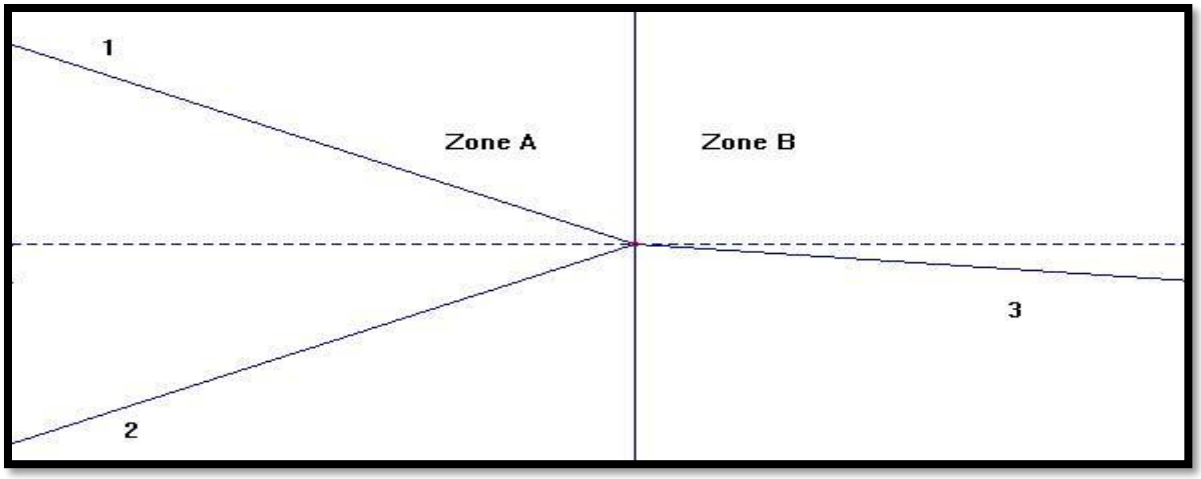
a. Schematize the situation.

b. Write Descartes' second law.

c- Calculate the angle of incidence to obtain an angle of refraction of 20°.

Exercise 2.5:

A fine luminous brush arrives on a flat diopter separating water from air. We give $n_{water} = 1.33$. We represent the rays observed in the figure below:



By justifying your answers:

1. Identify the different rays.
2. Indicate the direction of light propagation
3. In what zone is the water located.
4. Calculate the limiting angle of refraction
5. Generalize the result by specifying the zone where the limiting angle is located according to the difference in refraction of the media present and the consequences on the propagation of light from one medium to the other.

Exercise 2.6:

Rayon light consists of the superposition of three colors: violet, yellow and red. This ray propagates in a glass whose refractive indices for violet, yellow and red radiation are respectively $n_v = 1.530, n_y = 1.517 and\ n_r = 1.513$. The rayon arrives on the diopter plan separating the glass from the air.

1. Calculate the limiting angles of incidence for the color's violet, yellow and red on the diopter separating the glass from the air. The air index being equal to 1.

2. What colors are observed in the air if the ray arrives the diopter at an angle of incidence $i = 38^0$?

3. Same question if the angle of incidence $i = 41.38^0$?

4. What can this assembly be used for?

Exercise 2.7:

We want to determine the refractive index n of a glass. To do this, we use this glass to make a prism whose base is an equilateral triangle. We place it at the minimum deviation. The minimum deviation angle D measured is42^0.

Calculate its refractive index.

Exercise 2.8:

A point source S emits a monochromatic light ray, which arrives on the flat face of a half-cylindrical block, of index n, at its center O with an angle of incidence $i = 40^0$(figure below). We place a screen E at a distance D=1m from the center O. Consider H the point of impact of the ray emerging from the block on the screen E. The deviation observed is IH=0.24m.

1- Trace the path of the light ray from S until H.
2- Calculate the angle of refraction r at the point O.
3- Calculate the index n of this block