

Q- The laser used in cornea surgery to treat corneal disease is the excimer laser, which emits ultraviolet light with a wavelength of 193 nm in air. The index of refraction of the cornea is 1.376. What are the wavelength and frequency of the light in the cornea?

The frequency n , wavelength λ and the speed of light c is related by the equation

$$c = n \lambda$$

As the speed of light in air or vacuum is $c_0 = 3 \times 10^8$ m/s the frequency of the laser is given by

$$n = \frac{c}{\lambda} = \frac{3 \times 10^8}{193 \times 10^{-9}} = 1.554 \times 10^{15} \text{ Hz}$$

As the frequency of the light is the property which does not change with the medium, it will remain **1.554×10^{15} Hz** in cornea as well.

As the speed of light changes with medium and is given in any medium by the relation

$$c = \frac{c_0}{\mu}$$

Where c_0 is the speed of light in vacuum and μ is its refractive index.

Thus, the speed of light in cornea will be

$$c = \frac{c_0}{\mu} = \frac{3 \times 10^8}{1.376} = 2.180 \times 10^8 \text{ m/s}$$

And hence the wavelength in the cornea will be

$$\lambda = \frac{c}{n} = \frac{2.180 \times 10^8}{1.554 \times 10^{15}} = 140.28 \times 10^{-9} \text{ m}$$

Thus, the wavelength of laser in the cornea will be **140.28 nm**.