Answer on Question #90934, Physics / Mechanics | Relativity

The wavelength of light in vacuum is 5000 A. When it travels normally through diamond the thickness of 1mm, what is the number of waves of lights in 1mm of diamond? Refractive index of diamond is 2.417.

Solution:

If λ be the wavelength of light in vacuum and f is the frequency of the wave then the velocity of light in vacuum is

$$c = f\lambda \text{ ..... (1)}$$

If v be the velocity and λ' be the wavelength of light in diamond then

$$v = f\lambda' \text{..... (2)}$$

Dividing (1) by (2) $\frac{c}{v} = \frac{\lambda}{\lambda'}$

Now refractive index of diamond, $n = \frac{c}{v}$

Then $n = \frac{\lambda}{\lambda'}$

$$\lambda' = \frac{\lambda}{n}$$

Substituting λ=5000 Å, n=2.417

$$\lambda' = \frac{5000}{2.417}$$

$$\lambda' = 2068.68\text{Å}$$

∴The wavelength of light in diamond is 2068.68Å

The number of waves in 2068.68Å is 1

∴The number of waves in 1 mm is = $\frac{1\ mm}{2068.68\ \text{Å}}$

$$= \frac{10^{-3}\ m}{2068.68 \times 10^{-10}\ m}$$

$$= \boxed{4834}$$

Answer: The number of waves in 1 mm thickness of diamond is 4834.