Answer on Question #83938, Physics / Optics

Question. Describe how you would use Newton rings to determine the wavelength of a monochromatic radiation and refractive index of the medium and derive the relevant formula.

Answer.

The diameters of the dark Newton rings are proportional to the square roots of the natural numbers.

$$D_n = 2\sqrt{n\lambda R}$$

By measuring the diameter of the Newton's rings, it is possible to calculate the wavelength of light as follows. We have for the diameter of the n^{th} dark fringe

$$D_n^2 = 4n\lambda R$$

Similarly diameter for the $(n+p)^{th}$ dark fringe

$$D_{n+p}^2 = 4(n+p)\lambda R$$

$$D_{n+p}^2 - D_n^2 = 4p\lambda R$$

$$\lambda = \frac{D_{n+p}^2 - D_n^2}{4pR}.$$

λ can be calculated using this formula.

Newton's rings set up could also be used to determine the refractive index of a liquid. First the experiment is performed when there is air film between the lens and the glass plate. The diameters of the n^{th} and $(n+p)^{th}$ fringes are determined. Then we have

$$D_{n+p}^2 - D_n^2 = 4p\lambda R$$

Now the liquid whose refractive index is to be determined is poured into the container without disturbing the entire arrangement. Again the diameter of the n^{th} and $(n+p)^{th}$ dark fringes are determined. Again we have

$$D_{n+p}'^2 - D_n'^2 = \frac{4p\lambda R}{\mu}.$$

From the above equations

$$\mu = \frac{D_{n+p}^2 - D_n^2}{D_{n+p}'^2 - D_n'^2}.$$