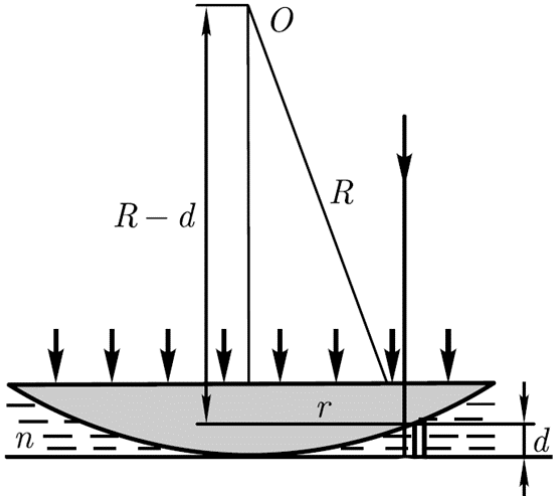
Answer on Question #77790, Physics / Optics

Question. Newton's rings are formed in reflected light of wavelength $6000\ Å$ with a liquid between the plane and curved surfaces. The diameter of $7th$ dark ring is $0.34\ cm$ and the radius of curvature of curved surface is $100\ cm$. Calculate the refractive index of liquid.

Given. $\lambda = 6000\ Å = 6000 \cdot 10^{-10}\ m; m = 7; d_m = 0.34\ cm = 0.34 \cdot 10^{-2}\ m; R = 100\ cm = 1\ m; \beta = 0.$

Find. $n-?$

Solution.



For the dark ring system:

$$2dn\cos\beta + \frac{\lambda}{2} = (2m+1)\lambda \quad \rightarrow \quad 2dn\cos\beta = m\lambda \quad \rightarrow \quad 2dn = m\lambda \quad \rightarrow \quad n = \frac{m\lambda}{2d}$$

From the figure

$$R^2 = (R-d)^2 + r^2$$

$$R^2 = R^2 - 2Rd + d^2 + r^2$$

Because d is very small, we have that

$$d = \frac{r^2}{2R}$$

Finally

$$n = \frac{4Rm\lambda}{d_m^2} = \frac{4 \cdot 1 \cdot 7 \cdot \mathbf{6000 \cdot 10^{-10}}}{(\mathbf{0.34 \cdot 10^{-2}})^2} = 1.45$$

Answer. $n = 1.45.$