

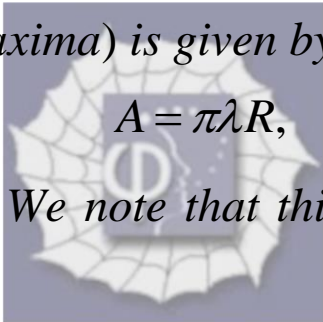
647.

**Problem 45.46 (RHK)**

We have to show that in the Newton's rings experiment that (a) the difference in the radius between adjacent rings (maxima) is given by

$$\Delta r = r_{m+1} - r_m \approx \frac{1}{2} \sqrt{\lambda R/m},$$

assuming  $m \gg 1$ , and (b) that the area between the adjacent rings (maxima) is given by


$$A = \pi \lambda R,$$

assuming  $m \gg 1$ . We note that this area is independent of  $m$ .

**Solution:**

(a)

We recall from the preceding problem that the radius of the  $m$ th bright Newton's ring is given by the relation

$$r_{m+1} = \sqrt{(m + 1/2) \lambda R}, \quad m \text{ an integer } \gg 1.$$

Therefore,

$$\begin{aligned}\Delta r = r_{m+1} - r_m &= \sqrt{(m+1/2)\lambda R} - \sqrt{(m-1/2)\lambda R} \\ &= \sqrt{\lambda R m} \left( (1+1/2m)^{1/2} - (1-1/2m)^{1/2} \right).\end{aligned}$$

Assuming that

$$\frac{1}{m} = \epsilon,$$

and using the approximation

$$(1 \pm \epsilon)^{1/2} \approx 1 \pm \frac{1}{2}\epsilon,$$

we find that

$$\Delta r = r_{m+1} - r_m \approx \frac{1}{2} \sqrt{\lambda R/m}.$$

(b)

From the above, we note that the area between the adjacent bright rings will be

$$\begin{aligned}A &= \pi(r_{m+1}^2 - r_m^2) = \pi(m+1/2 - m+1/2)\lambda R \\ &= \pi\lambda R,\end{aligned}$$

which is independent of  $m$ .