647.

<u>Problem 45.46 (RHK)</u>

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 ? 1, *and* (b) *that the area between the adjacent rings* (*maxima*) *is given by*

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

assuming m ? 1. *We note that this area is independent of* m.

<u>Solution:</u>

(a)

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

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

Therefore,

$$\Delta r = r_{m+1} - r_m = \sqrt{\left(m+1/2\right)\lambda R} - \sqrt{\left(m-1/2\right)\lambda R}$$

$$= \sqrt{\lambda R m}\left(\left(1+1/2m\right)^{1/2} - \left(1-1/2m\right)^{1/2}\right).$$

Assuming that

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

and using the approximation

$$\left(1+1/2m\right)^{1/2} ; \ 1+1/4m,$$

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

$$A = \pi\left(r_{m+1}^2 - r_m^2\right) = \pi\left(m+1/2-m+1/2\right)\lambda R$$

$$= \pi\lambda R,$$

which is independent of *m*.