52. (a) From the expression for the half-width $\Delta\theta_{\rm hw}$ (given by Eq. 37-25) and that for the resolving power R (given by Eq. 37-29), we find the product of $\Delta\theta_{\rm hw}$ and R to be

$$\Delta\theta_{\rm hw} R = \left(\frac{\lambda}{Nd\cos\theta}\right) Nm = \frac{m\lambda}{d\cos\theta} = \frac{d\sin\theta}{d\cos\theta} = \tan\theta\,,$$

where we used $m\lambda = d\sin\theta$ (see Eq. 37-22).

(b) For first order $m = 1$, so the corresponding angle θ_1 satisfies $d\sin\theta_1 = m\lambda = \lambda$. Thus the product in question is given by

$$\begin{aligned}
\tan\theta_1 &= \frac{\sin\theta_1}{\cos\theta_1} = \frac{\sin\theta_1}{\sqrt{1-\sin^2\theta_1}} \\
&= \frac{1}{\sqrt{(1/\sin\theta_1)^2 - 1}} = \frac{1}{\sqrt{(d/\lambda)^2 - 1}} \\
&= \frac{1}{\sqrt{(900\,\text{nm}/600\,\text{nm})^2 - 1}} = 0.89\ .
\end{aligned}$$