Answer on Question #58741, Physics / Optics |

How many lines must a grating have, used in the second order and near 550 nanometer, to resolve two lines 0.1 angstrom apart?

Solution:

For two nearly equal wavelengths λ_1 and λ_2 between which a diffraction grating can just barely distinguish, the resolving power R of the grating is defined as

$$R = \frac{\lambda}{\lambda_2 - \lambda_1} = \frac{\lambda}{\Delta\lambda}$$

If N lines of the grating are illuminated, it can be shown that the resolving power in the mth-order diffraction is

$$R = mN$$

Thus, resolving power increases with increasing order number and with increasing number of illuminated slits.

In our case,

$$\frac{\lambda}{\Delta\lambda} = mN$$

$\lambda = 550 \cdot 10^{-9}$ m, $m = 2$, $\Delta\lambda = 0.1 \cdot 10^{-10}$ m.

$$N = \frac{\lambda}{m\Delta\lambda} = \frac{550 \cdot 10^{-9}}{2 \cdot 0.1 \cdot 10^{-10}} = 27500$$

Answer: $\mathbf{27500.}$