

49. The dispersion of a grating is given by $D = d\theta/d\lambda$, where θ is the angular position of a line associated with wavelength λ . The angular position and wavelength are related by $\mathbf{d} \sin \theta = m\lambda$, where \mathbf{d} is the slit separation (which we made boldfaced in order not to confuse it with the d used in the derivative, below) and m is an integer. We differentiate this expression with respect to θ to obtain

$$\frac{d\theta}{d\lambda} \mathbf{d} \cos \theta = m ,$$

or

$$D = \frac{d\theta}{d\lambda} = \frac{m}{\mathbf{d} \cos \theta} .$$

Now $m = (\mathbf{d}/\lambda) \sin \theta$, so

$$D = \frac{\mathbf{d} \sin \theta}{\mathbf{d} \lambda \cos \theta} = \frac{\tan \theta}{\lambda} .$$