Dispersive power of grating:

Dispersive power of grating is defined as the ratio of the difference in the angle of diffraction of any two neighbouring spectral lines to the difference in wavelength between the two spectral lines. It can also be defined as the difference in the angle of diffraction per unit change in wavelength. The diffraction of the n^{th} order principal maximum for a wavelength λ, is given by the equation.

$$(a+b)\sin\theta = n\lambda \quad \text{——— (i)}$$

Differentiating this equation with respect to θ and λ

$$(a+b)\cos\theta \, d\theta = n \, d\lambda$$

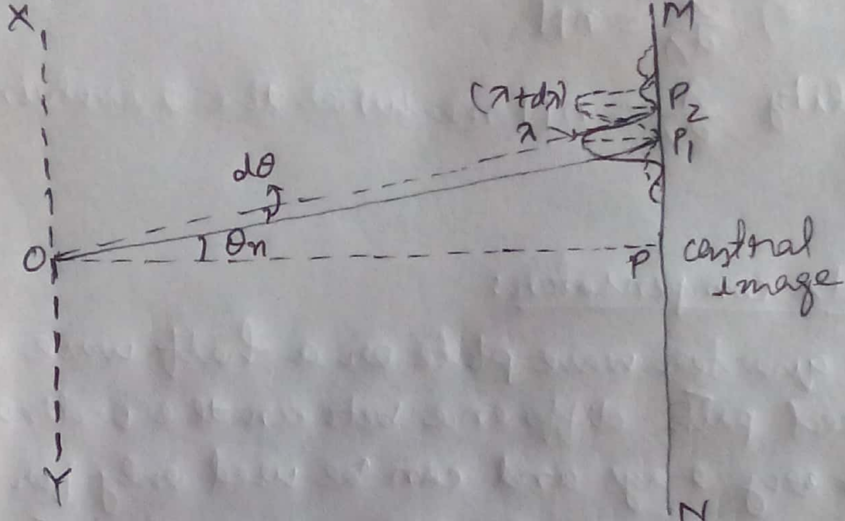
$$\Rightarrow \frac{d\theta}{d\lambda} = \frac{n}{(a+b)\cos\theta}$$

$$\Rightarrow \frac{d\theta}{d\lambda} = \frac{nN'}{\cos\theta} \quad \text{——— (ii)}$$

In the equation (ii) $d\theta/d\lambda$ is the dispersive power.

Resolving power of a plane diffraction grating:

The resolving power of a grating is ~~defind~~ defined as the ratio of the wavelength of any spectral line to the difference in wavelength between this line and a neighbouring line such that The two lines appear to be just resolved. Thus, the resolving power of a grating $\lambda/d\lambda$



XY is the grating surface and MN is the field of view of The telescope, P_1 is the n^{th} primary maximum of a spectral line of wavelength λ at an angle of diffraction θ_n. P_2 is the n^{th} primary maximum of a second spectral line of wavelength $\lambda+d\lambda$ at a diffraction ~~grating~~ angle $\theta_n+d\theta$. P_1 and P_2 are The spectral lines in the n^{th} order. These two spectral lines according to Rayleigh will appear resolved, if the position of P_2 also corresponds to the first minimum at P_1.

The direction of The n^{th} primary maximum for a wavelength λ is given by

$$(a+b)\sin\theta_n = n\lambda \qquad \text{(i)}$$

The direction of The n^{th} primary maximum of a wavelength $(\lambda+d\lambda)$ is given by

$$(a+b)\sin(\theta_n+d\theta) = n(\lambda+d\lambda) \qquad \text{(ii)}$$

The two lines ~~are~~ will appear just resolved if The angle of diffraction $(\theta_n+d\theta)$ also corresponds to the direction of The first secondary ~~maxima~~ minimum after the n^{th} primary maximum at P_1. This is possible if the extra path difference introduced is λ/N where N is the total number of lines on the grating surface

$$\therefore \quad (a+b)\sin(\theta_n + d\theta) = n\lambda + \frac{\lambda}{N} \quad \text{———} \quad (iii)$$

equating eq^n (ii) and (iii)

$$n(\lambda + d\lambda) = n\lambda + \frac{\lambda}{N}$$

$$n\,d\lambda = \frac{\lambda}{N}$$

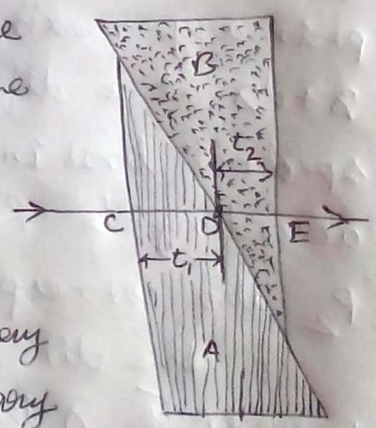
$$\Rightarrow \frac{\lambda}{d\lambda} = nN$$

The quantity $\frac{\lambda}{d\lambda} = nN$ measures the resolving power of a grating.

Babinet's compensator:

A quarter wave plate or a half wave plate produces only a fixed path difference between the ordinary and the extraordinary rays and can be used only for light of a particular wavelength. For different wavelengths, different quarter wave plates are to be used. Babinet designed a compensator by means of which a desired path difference can be introdued

It consists of two wedge-shaped sections A and B of quartz. The optic axis is lengthwise in A and transverse in B. The outer faces of the compensator are parallel to the optic axis. Therefore the ordinary and the extraordinary rays travel with different velocities along the same direction inside the compensator. Moreover, the extraordinary ray in A behaves as ordinary in B while the ordinary in A behaves as extraordinary in B.



Suppose a plane polarised parallel beam of light incident normally at the point c of the Babinet's compensator. The beam is split up into extraordinary and ordinary rays. The path difference introduced between them after they have travelled a distance CD in A is $(\mu_E - \mu_O)t_1$. The path difference introduced by B is $(\mu_O - \mu_E)t_2$. Therefore resultant path difference $= (\mu_E - \mu_O)(t_1 - t_2)$. Hence any path difference can be introduced with the help of the Babinet's compensator and it can be used for light of any wavelength.