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Q Cal maximum angular seperation b/w two wavelengths of values 590 nm & 420 nm. for a diffraction grating with grating spacing 1.8×10^{-6} m ?

Max. angular Seperation will always occur in the highest order

590 nm	~~420 nm~~
$\frac{n\lambda}{d} < 1$	~~$\frac{n\lambda}{d} < 1$~~
$\frac{n(590 \times 10^{-9})}{1.8 \times 10^{-6}} < 1$	~~$\frac{n(420 \times 10^{-9})}{1.8 \times 10^{-6}} < 1$~~
$n < 3.01$	~~$n < 4.3$~~
$n = 3$ ✓	~~$n = 4$~~

Suggestion :: Just do working with the longer wavelength & this answer will satisfy the other working as well

3rd order is common to both

$d \sin\theta = n\lambda$

$(1.8 \times 10^{-6}) \sin\theta = 3(590 \times 10^{-9})$

$\theta = 79.5^\circ$

$d \sin\theta = n\lambda$

$(1.8 \times 10^{-6}) \sin\theta = 3(420 \times 10^{-9})$

$\theta = 44.4^\circ$

maximum angular Seperation

$= 79.5 - 44.4^\circ$

$= 35.1$

Q:: Which wavelength in the 3rd order arrives at the same angle as a wavelength of 600 nm in the 2nd order ?

$d \sin\theta = n\lambda$

$d \sin\theta = (3)(\lambda) \rightarrow (1)$

$d \sin\theta = (2)(600 \times 10^{-9}) \rightarrow (2)$

d = same (assuming that both wavelengths are incident on the same diffraction grating)

θ = same (overlap)

Equate $3\lambda = (2)(600 \times 10^{-9})$

$\lambda = 400 \times 10^{-9}$ m (400 nm).

Q: A diffraction grating has 500 lines per mm or 500 slits per mm

(i) Show that grating spacing (d) can be written as follows

$d = 2 \times 10^{-6}$ m

Step # 1 Let's find the number of lines / number of slits per meter. I will denote this quantity as "N"

N = number of lines per meter

500 lines ⟶ 1 mm

500,000 ⟵ 1 m

$N = 500{,}000$

Step # 2 $d = \frac{1}{N}$

$d = \frac{1}{500{,}000} = 2.0 \times 10^{-6}$ m

Q:: A grating contains 550 lines per mm. find the value of grating spacing (d)

Step 1 find N (where N denotes number of lines per meter)

N = 550,000 lines per meter

Step 2 $d = \frac{1}{N}$

$d = \frac{1}{550{,}000}$

$d = 1.81 \times 10^{-6}$ m

$d \sin\theta = n\lambda$ 1st form

Since $d = \frac{1}{N}$ [N = # of lines per meter]

$\frac{1}{N} \sin\theta = n\lambda$ 2nd form