① $y_1 = 25\sin(\omega t - \pi/4)$

$y_2 = 15\sin(\omega t - \pi/6)$

$\therefore y = y_1 + y_2$

$\Rightarrow y = \sin\omega t\left(25\cos\frac{\pi}{4} + 15\cos\frac{\pi}{6}\right) - \cos\omega t\left(25\sin\frac{\pi}{4} + 15\sin\frac{\pi}{6}\right)$

$\Rightarrow y = A\sin(\omega t - \phi)$ where $A = 39.68$ and $\phi = 39.39^\circ$

② $\Delta L = 2.945\times10^{-2}\,m$, $\lambda = 5.896\times10^{-7}\,m$

Coherence time $\Delta t = \frac{\Delta L}{c} = \frac{2.945\times10^{-2}}{3\times10^{8}}$

$\Rightarrow \Delta t = 9.816\times10^{-11}$ sec

No. of oscillations $n = \frac{\Delta L}{\lambda} = \frac{2.945\times10^{-2}}{5.896\times10^{-7}}$

$\Rightarrow n = 4.99\times10^{4}$

③ $\frac{I_1}{I_2} = \frac{81}{1} \Rightarrow \frac{a_1^2}{a_2^2} = \frac{81}{1} \Rightarrow \frac{a_1}{a_2} = \frac{9}{1}$

$\Rightarrow a_1 = 9a_2$

$\therefore \frac{I_{max}}{I_{min}} = \frac{(a_1+a_2)^2}{(a_1-a_2)^2} = \frac{(10a_2)^2}{(8a_2)^2} = \frac{100}{64}$

$\Rightarrow I_{max} : I_{min} = 25:16$

④ Distance of 10th bright fringe from the central fringe,

$y_{10} = 10.\frac{\lambda D}{d} = \frac{10\times7000\times10^{-8}\times D}{d}$

If the xth bright fringe is formed at the same place when wavelength 5000 Å is used,

$y_x = x\times\frac{5000\times10^{-8}\times D}{d}$

But $y_{10} = y_x$

$\Rightarrow 10\times7000 = x\times5000$

$\Rightarrow x = 14$

⑤ $\lambda = 5\times10^{-5}$ cm, $\beta = 0.02$ cm, $a = 25$ cm, $b = 175$ cm, $\mu = 1.50$

$\Rightarrow D = a+b = 200$ cm

$\beta = \frac{\lambda D}{d} = \frac{\lambda D}{2(\mu-1)\alpha a}$

$\Rightarrow 0.02 = \frac{5\times10^{-5}\times200}{2(1.50-1)\alpha\times25}$

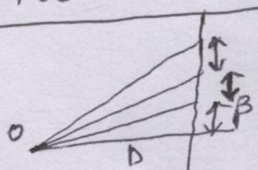
$\Rightarrow \alpha = 0.02$ Radian

$\Rightarrow \alpha = \left(0.02\times\frac{180}{\pi}\right)^\circ = 1.146^\circ$

$\therefore$ Vertex angle $\theta = (180 - 2\alpha)^\circ$

$\Rightarrow \theta = 177.708^\circ$

⑥ Angular width



$\omega = \theta_{n+1} - \theta_n$

$\omega = \frac{y_{n+1}}{D} - \frac{y_n}{D} = \frac{(y_{n+1}-y_n)}{D} = \frac{\beta}{D} = \frac{\lambda}{d}$

$\therefore d = \frac{\lambda}{\omega} = \frac{6000\times10^{-8}\,cm}{\left(0.1\times\frac{\pi}{180}\right)\text{Radian}} = 0.034$ cm

⑦ $(\mu-1)t = n\lambda$

$\Rightarrow (1.5-1)t = 3\times5800\times10^{-8}$ cm

$\Rightarrow t = 3.48\times10^{-4}$ cm

⑧ $\beta = 0.036$ cm, $\lambda = 5893\times10^{-8}$ cm

$\mu_1 = 1.59$, $\mu_2 = 1.41$, $t_1 = t_2 = 0.02$ cm

$[(\mu_1-1)t_1 - (\mu_2-1)t_2] = n\lambda$

$\Rightarrow [(1.59-1)0.02 - (1.41-1)0.02] = n\times5893\times10^{-8}$

$\Rightarrow n = 61.08 \approx 61$

Also, $y_{61} = 61\times\frac{\lambda D}{d} = 61\times\beta$

$\Rightarrow y_{61} = 61\times0.036\,cm = 2.196$ cm