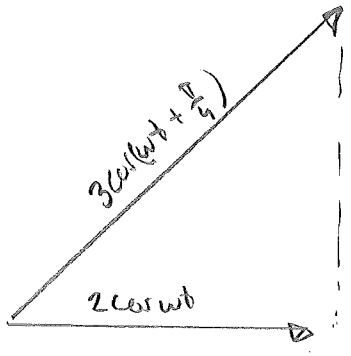
Phasor Written Homework Solutions.

1a)



A = magnitude $= \left[\left(2+\frac{3}{\sqrt{2}}\right)^2 + \left(\frac{3}{\sqrt{2}}\right)^2\right]^{1/2} = 4.6$

B = phase $= \sin^{-1}\frac{3/\sqrt{2}}{4.6} = 27.5^\circ$

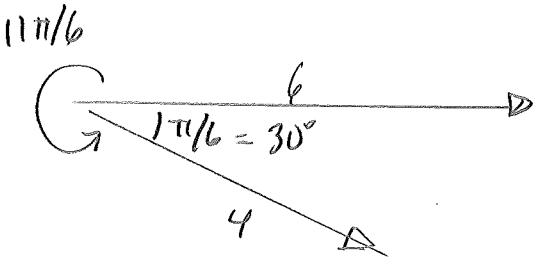
$= 0.48$ rad.

b)

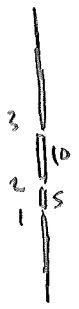
$A = \left((6 + 4\cos \pi/6)^2 + (4\sin \pi/6)^2\right)^{1/2} = 9.7$

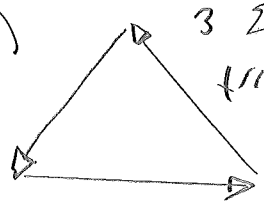
$B = -\sin^{-1}\left[\frac{(4\sin \pi/6)}{9.7}\right] = -11.9^\circ$

$= -0.21$ rad



2. a)



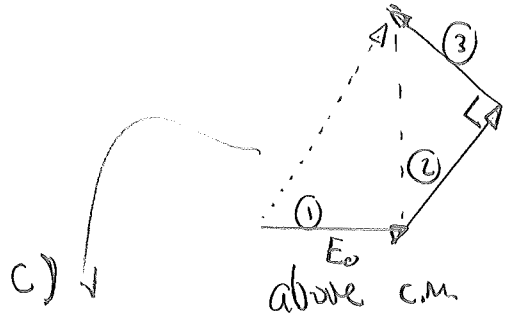


3 Equal slits can only add to zero in a equilateral triangle, which requires equal phase shifts. Since slit spacings are unequal, this cannot happen.

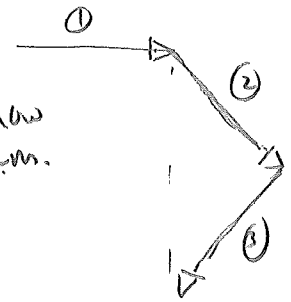
b) $\theta = \frac{1}{80}$ rad $\quad \phi_{12} = \frac{d_{12}\sin\theta}{\lambda}\cdot 2\pi = \frac{5}{0.5}\cdot\frac{1}{80}\cdot 2\pi = \frac{\pi}{4}$ ② above c.m., ② leads ①

below, ③ lags ①

$\phi_{23} = 2\phi_{12} = \frac{\pi}{2}$, $(d_{23} = 2d_{12})$

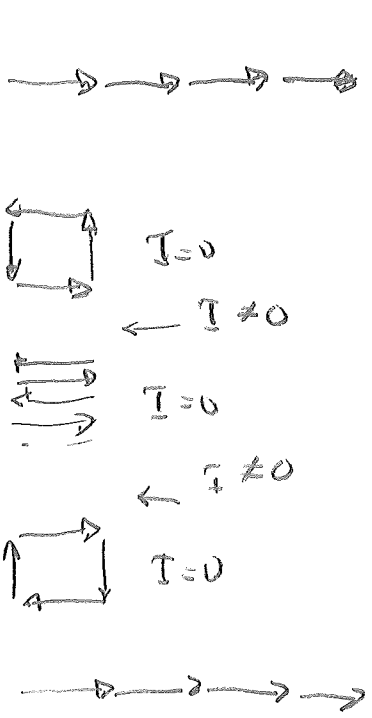


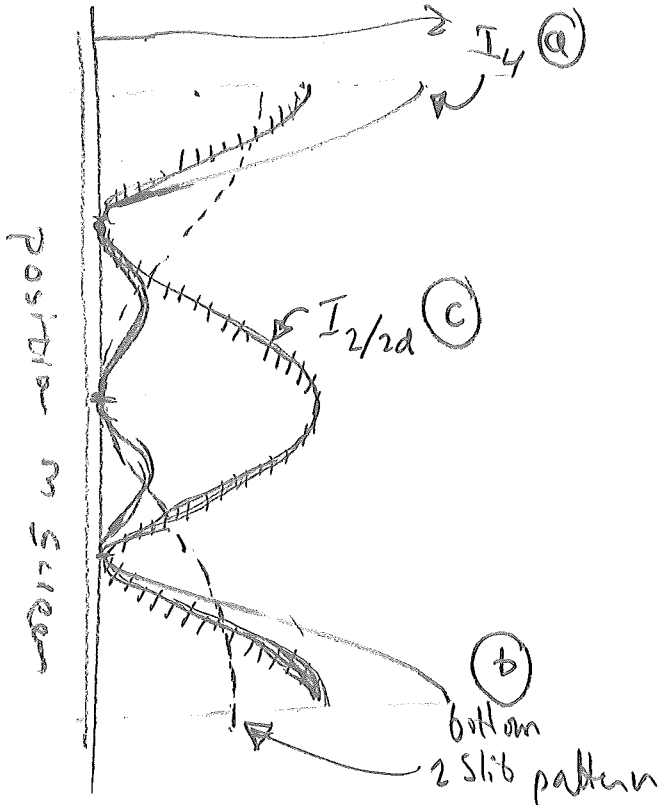
c) Sum $= \sqrt{3}\,E_0$



so $I = \left(\frac{\sqrt{3}}{3}\right)^2 I_{cm} = \frac{1}{3} I_{cm}$.

3)

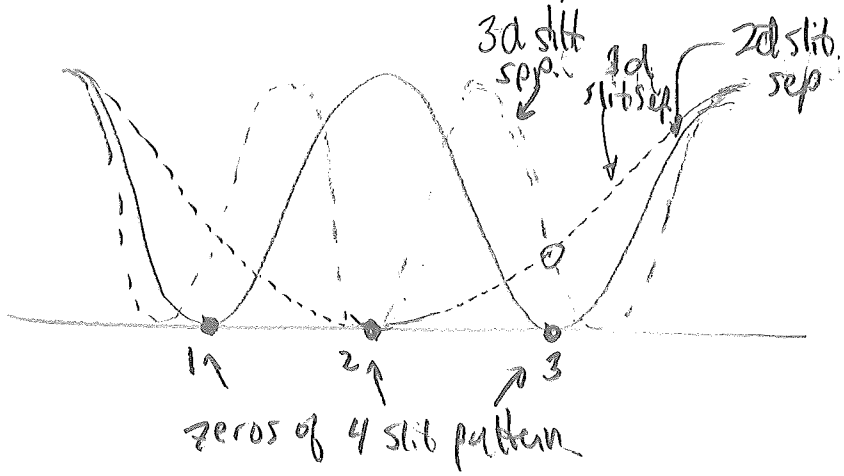




b) for only bottom two slits, only $\Longrightarrow$ give zero.

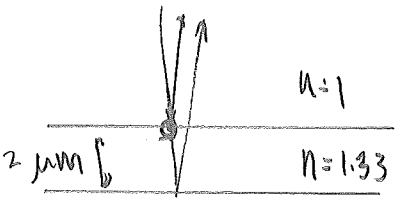
c) See fig.

a) The zeros will NOT be in the same place! $I_{2/2d}$ has zeros 1 & 3 in the same places as the 4-slit pattern, so $I_{2/3d}$ will have them closer to the principal maxima.



The 4 slit zeros (1 & 3 arise because the E field from slits 1 & 4 is out of phase with E field from slits 2 & 3. And they cancel

4.



$\phi_0 =$ π off top of film. $\Delta\phi_0 = \pm\pi$

$\phi = \frac{\Delta path}{\lambda} \cdot 2\pi + \Delta\phi_0$ $\quad \Delta path = 2d$

$\lambda = \frac{\lambda_0}{n} = \begin{matrix} 300 \text{ nm} \\ 526 \text{ nm} \end{matrix}$

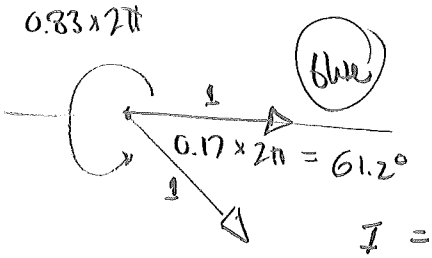
$\phi = (13.33 \pm \frac{1}{2}) \cdot 2\pi$ blue

$\phi = (7.60 \pm \frac{1}{2}) \cdot 2\pi$ red

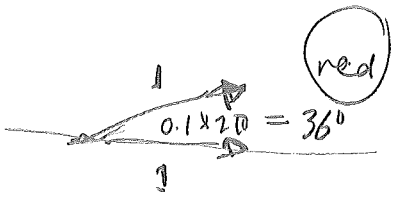
Ignore multiples of 2π

$\phi = 0.83 \times 2\pi$ blue

$\phi = 0.10 \times 2\pi$ red



$I = 0.74\ I_m$



$I = 0.90\ I_m$

} using phasor addition, divide by 2 (max. E_{refl}) and square.