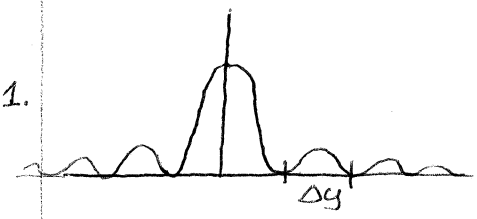
HOMEWORK # 2 SOLUTIONS

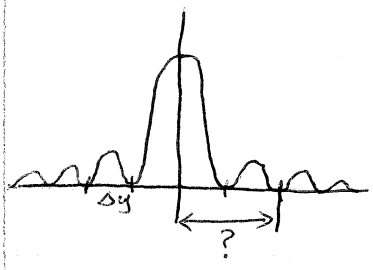
1.



$\Delta y = 1$ mm
$\lambda = 610$ nm
$D = 1.0$ m, $a = ?$

$$\Delta y = \frac{D\lambda}{a} \quad \therefore a = \frac{D\lambda}{\Delta y} = \frac{1 \times 610 \times 10^{-9}}{1 \times 10^{-3}} = \boxed{0.61 \text{ mm}}$$

2.



$\lambda = 630$ nm
$a = 0.4$ mm
$D = 2.0$ m

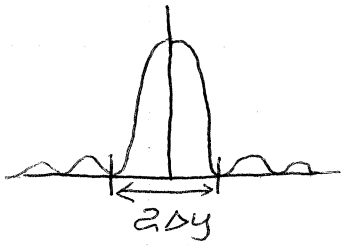
$$\Delta y = \frac{D\lambda}{a} = \frac{2 \times 630 \times 10^{-9}}{0.4 \times 10^{-3}} = \boxed{3.15 \text{ mm}}$$

DISTANCE FROM THE CENTER OF THE CENTRAL BRIGHT FRINGE TO THE 2ND MINIMUM ON ONE SIDE $= 2\Delta y = 6.3$ mm

3. a) $2\Delta y = \frac{2D\lambda}{a}$

$$(2\Delta y)_{BLUE} = \frac{2D}{a}\lambda_{BLUE}$$
$$(2\Delta y)_{RED} = \frac{2D}{a}\lambda_{RED}$$

$$\frac{(2\Delta y)_{BLUE}}{(2\Delta y)_{RED}} = \frac{\lambda_{BLUE}}{\lambda_{RED}} = \frac{430 \text{ nm}}{700 \text{ nm}} = \frac{43}{70} < 1$$



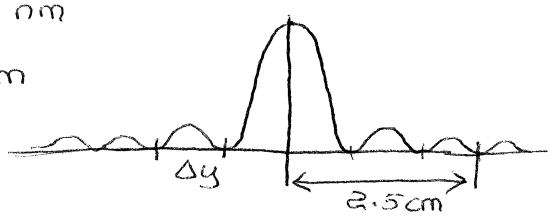
$\Rightarrow (2\Delta y)_R > (2\Delta y)_{BLUE}$

WIDER IF RED LIGHT IS USED

b) $$(2\Delta y)_{RED} = \frac{\lambda_{RED}}{\lambda_{BLUE}} \times (2\Delta y)_{BLUE} = \frac{0.7\,\mu m}{0.43\,\mu m} \times 2 \times 10^{-2} \text{ m} = \boxed{3.26 \text{ cm}}$$

4. $\lambda = 490\ nm$

$D = 3.2m$



$3\Delta y = 2.5\ cm$

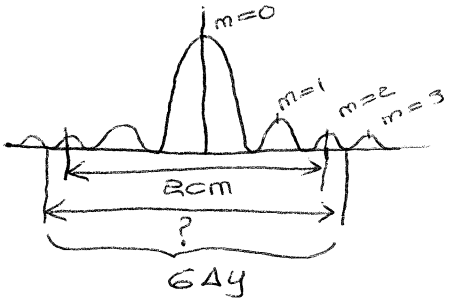
$\therefore \Delta y = \frac{2.5}{3} = 0.83cm$

$\Delta y = \frac{D\lambda}{a}$

$\therefore a = \frac{D\lambda}{\Delta y} = \frac{3.2 \times 490nm}{0.83 \times 10^{-2}}$

$\boxed{a = 0.19mm}$

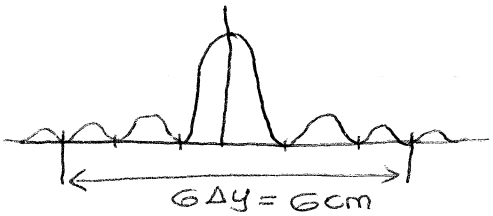
5.



$5\Delta y = 2cm \Rightarrow \Delta y = \frac{2}{5}cm$

$6\Delta y = 6 \times \frac{2}{5}cm \quad \boxed{= 2.5cm}$

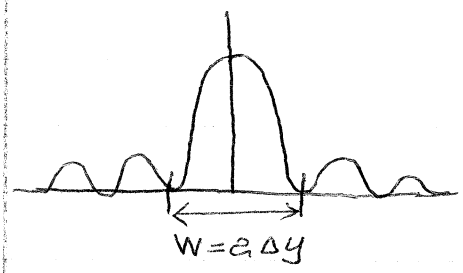
6. $\lambda = 500nm, \quad D = 4m$



$\therefore \Delta y = 1cm$

$a = \frac{D\lambda}{\Delta y} = \frac{4 \times 500nm}{1 \times 10^{-2}} = 2000 \times 10^{-7}m = \boxed{2 \times 10^{-4}m}$

7.



$W = 2\Delta y = 2\frac{D\lambda}{a}$

$a' = 2a \rightarrow W' = 2\Delta y'$

$= \frac{2D\lambda}{a'}$

$= \frac{2D\lambda}{2a}$

$= \frac{1}{2}\left(\frac{2D\lambda}{a}\right) = \frac{1}{2}W$

$\therefore W' = \frac{1}{2}W$

$\boxed{\text{IT HALVES}}$