Zadanie. 3.12.

DANE:

$\lambda = 633\,nm$

$k = 200$

$x = 1\,mm$

$a = 1\,m$

$b = 0{,}5\,m$

$v = 1{,}25 \cdot 10^8 \frac{m}{s}$

$c = 3 \cdot 10^8 \frac{m}{s}$

A) $q = \frac{T}{t}$

$d = \frac{10^{-3}}{200} = 0005 \cdot 10^{-3}\,m = \underline{\underline{5\,\mu m}}$

B)

$k \cdot \lambda = d \cdot \sin\alpha$

$d \cdot \sin\alpha = 1 \cdot \lambda$

$\sin\alpha = \frac{\lambda}{d}$

$tg\alpha = \frac{\Delta y}{b} \Rightarrow \Delta y = b \cdot tg\alpha$

$tg\alpha = \frac{\sin\alpha}{\cos\alpha}$

$\Delta y = b \cdot \frac{\sin\alpha}{\sqrt{1-\sin^2\alpha}}$ → wzór na 1 trygonom.

$\Delta y = b \cdot \frac{\frac{\lambda}{d}}{\sqrt{1-(\frac{\lambda}{d})^2}} = b\,\frac{\frac{\lambda}{d}}{\sqrt{1-\frac{\lambda^2}{d^2}}} = b \cdot \frac{\frac{\lambda}{d}}{\sqrt{\frac{1}{d^2}\cdot(d^2-\lambda^2)}} =$

$b \cdot \frac{\frac{\lambda}{d}}{\frac{1}{d}\cdot\sqrt{d^2-\lambda^2}} = \underline{\underline{b \cdot \frac{\lambda}{\sqrt{d^2-\lambda^2}}}}$

$\Delta y = 0{,}5m \cdot \frac{633 \cdot 10^{-9}\,m}{\sqrt{(5\cdot 10^{-6}m)^2 - (633\cdot 10^{-9}m)^2}} = \frac{316{,}5 \cdot 10^{-9}}{\sqrt{24{,}899311 \cdot 10^{-12}\,m^2}} \approx$

$\frac{316{,}5 \cdot 10^{-9}\,m^2}{4{,}96 \cdot 10^{-6}\,m} \approx 63{,}81 \cdot 10^{-3}\,m = 6{,}381\,cm \approx \underline{\underline{64\,cm}}$

c) $y = \frac{a}{2}$

$tg = \frac{y}{b} \Rightarrow \frac{\frac{a}{2}}{b} \Rightarrow \frac{a}{2b}$

$tg\alpha = \frac{1}{2\cdot 95} = \underline{\underline{1}}$

$\alpha = 45^\circ$

$n \cdot \lambda = d \cdot \sin\alpha$

$n = \frac{a}{\lambda} \cdot \sin\alpha \rightarrow \frac{5\cdot 10^{-6}}{633\cdot 10^{-9}} \cdot \sin 45^\circ \approx$

$0{,}00789 \cdot 10^3 \cdot 0{,}7071 \approx 5{,}58609 \Rightarrow \underline{\underline{n=5}}$

$\underline{\underline{m = 2\cdot n + 1 = 11}}$

e) $\lambda = \frac{f}{v} \Rightarrow f = \frac{v}{\lambda}$

$f_P = \frac{v}{c} \quad f_W = \frac{v}{\Delta w}$

$f_P = f_W$

$\frac{c}{\lambda} = \frac{v}{\Delta w}$

$c \cdot \Delta w = v \Delta$

$\Delta w = \Delta \frac{v}{c}$

$\Delta = \frac{\alpha - \sin\alpha}{n}$

E) $\lambda w = \lambda \cdot \frac{v}{c}$

$\lambda w = 633 \cdot 10^{-9} m \cdot \frac{2{,}25 \cdot 10^8 m/s}{3 \cdot 10^8 m/s} = 474{,}75 \cdot 10^{-9} m$

$\Delta y = b \cdot \frac{\Delta w}{\sqrt{a^2 - \Delta w^2}}$

$\Delta = 0{,}5m \cdot \frac{474{,}75 \cdot 10^{-9} m}{\sqrt{(5 \cdot 10^{-1} m)^2 - (474{,}75 \cdot 10^{-9} m)^2}} = \frac{237{,}375 \cdot 10^{-9} m^2}{\sqrt{241775 \cdot 10^{-12} m^2}} \approx$

$47{,}69 \cdot 10^{-3} m \approx \underline{\underline{4{,}8 cm}}$

F) $\sin\alpha = 45^0$

$n = \frac{\alpha}{\lambda w} \cdot \sin\alpha$

$n = \frac{5 \cdot 10^{-6}}{474{,}75 \cdot 10^{-9} m} \cdot \sin 45^0 = 10^4 \cdot 0{,}7071 = 7{,}071$

$\underline{\underline{n = 7}}$