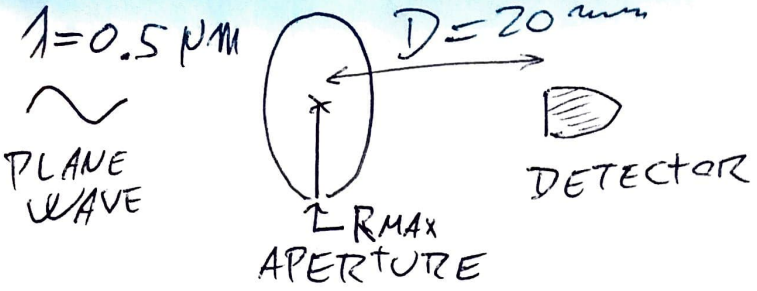
33 (I) $\lambda = 0.5\,\mu m$



(a)

$$S_1 = \sqrt{\lambda D} = \sqrt{0.5\cdot10^{-6}\cdot 20\cdot10^{-3}} = 10^{-4}\,m = 100\,\mu m$$

(b)

FOR n^{TH} ZONE: $S \le \sqrt{n\lambda D}$, WE WANT n MAX.

$$\frac{S^2}{\lambda D} \le n$$

$$\frac{S^2}{\lambda D} = \frac{10^{-3}}{0.5\cdot10^{-6}\cdot 20\cdot10^{-3}} = 100$$ HALF PERIOD ZONES

HOW MUCH D VARIES BTWN NEIGHBOURING MAX & MIN:

N ZONES ON-AXIS: $r^2 = N\lambda D$

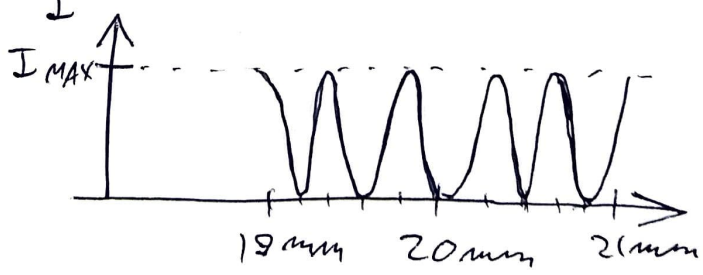
$$N = \frac{r^2}{\lambda D} = 100 \Rightarrow$$ EVEN NUMBER, A DARK SPOT

IF $N = 101$:

$$D_{101} = \frac{r^2}{N\lambda} = \frac{(10^{-3})^2}{101\cdot 0.5\cdot10^{-6}} \cong 0.0198\,m$$

OD BTWN MAX & MIN: $D_{101} - D = 0.0002\,m$

THIS ROUGHLY KEEPS CONSTANT IF WE VARY D ONLY A LITTLE. (COMPARED TO D)



LAST TIME ZERO INTENSITY: WHEN $N = 2$

$$D_2 = \left.\frac{r^2}{N\lambda}\right|_{N=2} = \frac{(10^{-3})^2}{2\cdot 0.5\cdot10^{-6}} = 1\,m$$ AWAY FROM THE APERTURE

33(II)

(c) RADIUS OF FIRST ZONE $= S_1 \Rightarrow f = 20\ mm$ AS IN a)

WE GET ANOTHER FOCI WHEN ZONES LET THROUGH AN ODD NUMBER OF FRESNEL ZONES.

WHEN $f = 20$ mm WE HAD:

(PHASOR DIAGRAM)

NEXT WE WANT

NEXT FOCI: $f_1 = \frac{S_1^2}{\lambda} = \frac{(100 \cdot 10^{-6})^2}{0.5 \cdot 10^{-6}} = 20\ mm$

$$f_2 = \frac{20}{(2 \cdot 1 + 1)} = 6.7\ mm$$

$$f_3 = \frac{20}{2 \cdot 2 + 1} = 4\ mm$$

WE ARE DIVIDING WITH ODD NUMBERS BECAUSE WE WANT ODD ZONES TO HAVE FOR A BRIGHT SPOT.

(d) FINAL CLEAR MINIMUM: WHEN FIRST EVEN NUMBERED ZONE LETS THROUGH TWO ZONES.
IE WHEN THE UNBLOCKED APERTURE LETS THROUGH 4 ZONES.

$$D_4 = \left.\frac{r^2}{N\lambda}\right|_{N=4} = \frac{(10^{-3})^2}{4 \cdot 0.5 \cdot 10^{-6}} = 0.5\ m$$ AWAY FROM APERTURE.