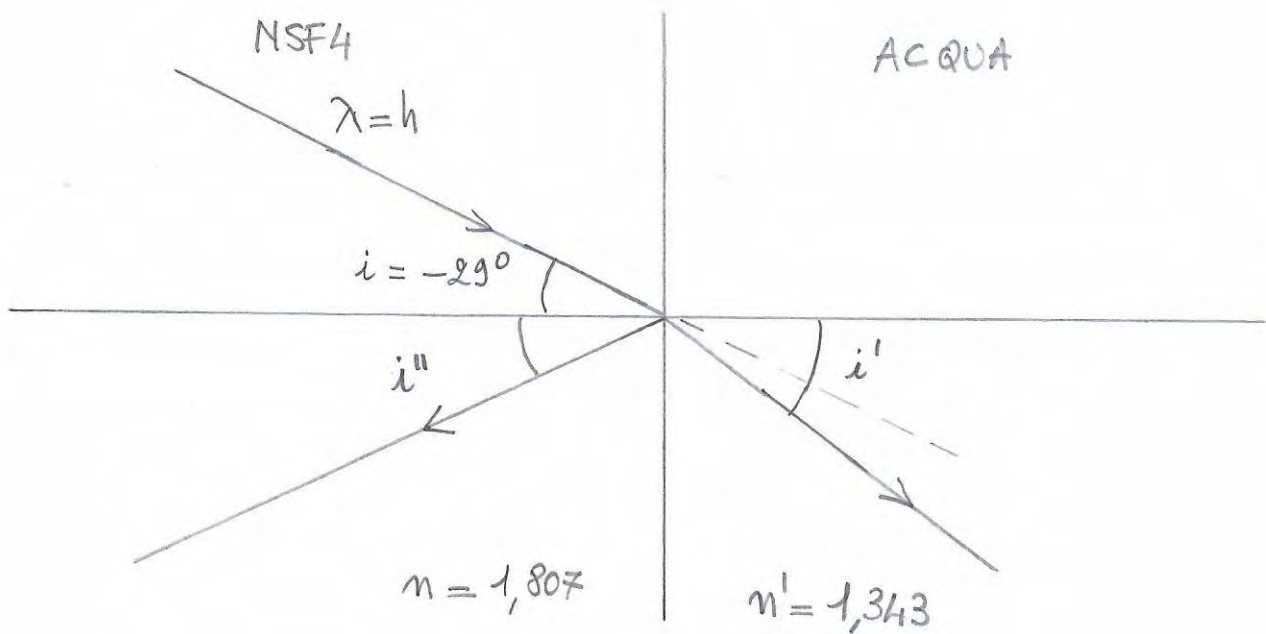


ESERCIZIO 1/1



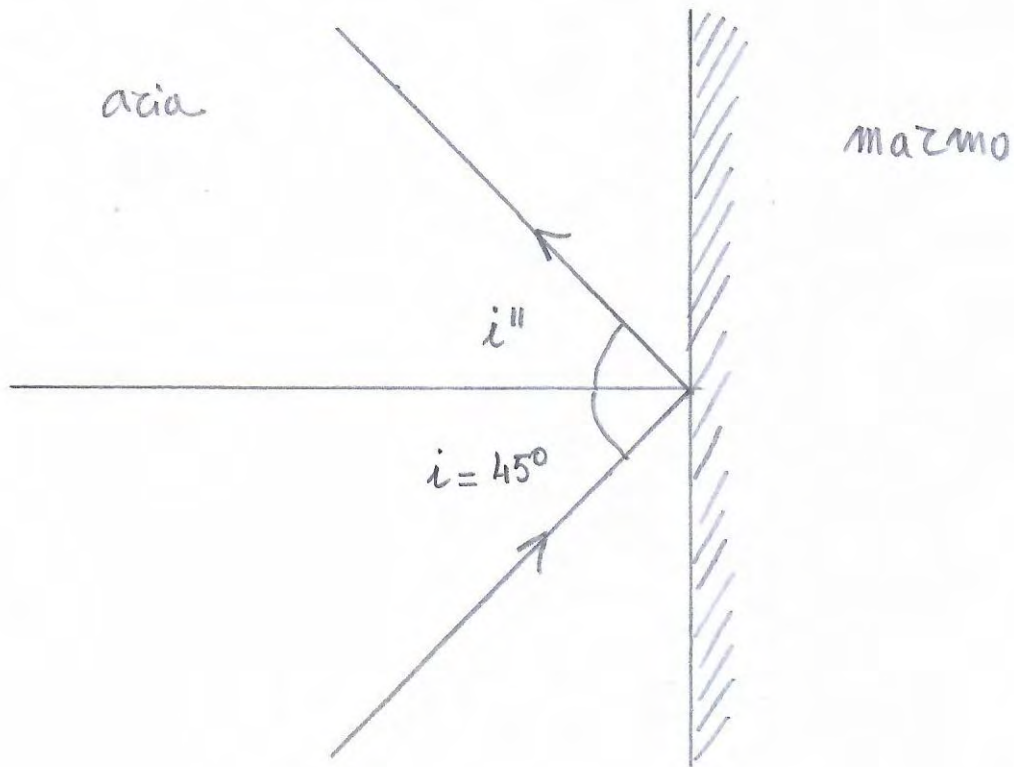
$$i'' = -i' \Rightarrow \boxed{i'' = 29^\circ}$$

$$n' \sin i' = n \sin i \Rightarrow \sin i' = \frac{1,807}{1,343} \sin(-29^\circ)$$

$$i' = \sin^{-1} \left[\frac{1,807}{1,343} \sin(-29^\circ) \right] \Rightarrow$$

$$\boxed{i' = -40,72}$$

ESERCIZIO 1/2

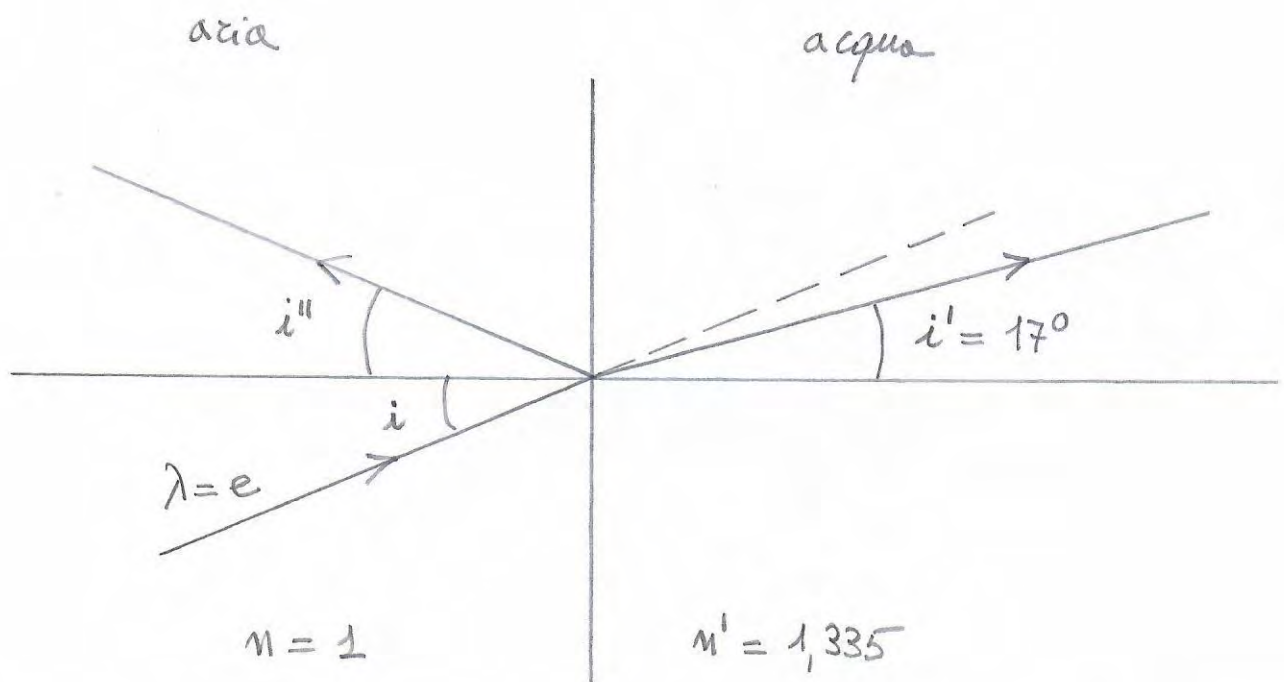


$$i'' = -i$$

\Rightarrow

$$i'' = -45^\circ$$

ESERCIZI 1/3



$$n \sin i = n' \sin i' \Rightarrow \sin i = 1,335 \sin(17^\circ)$$

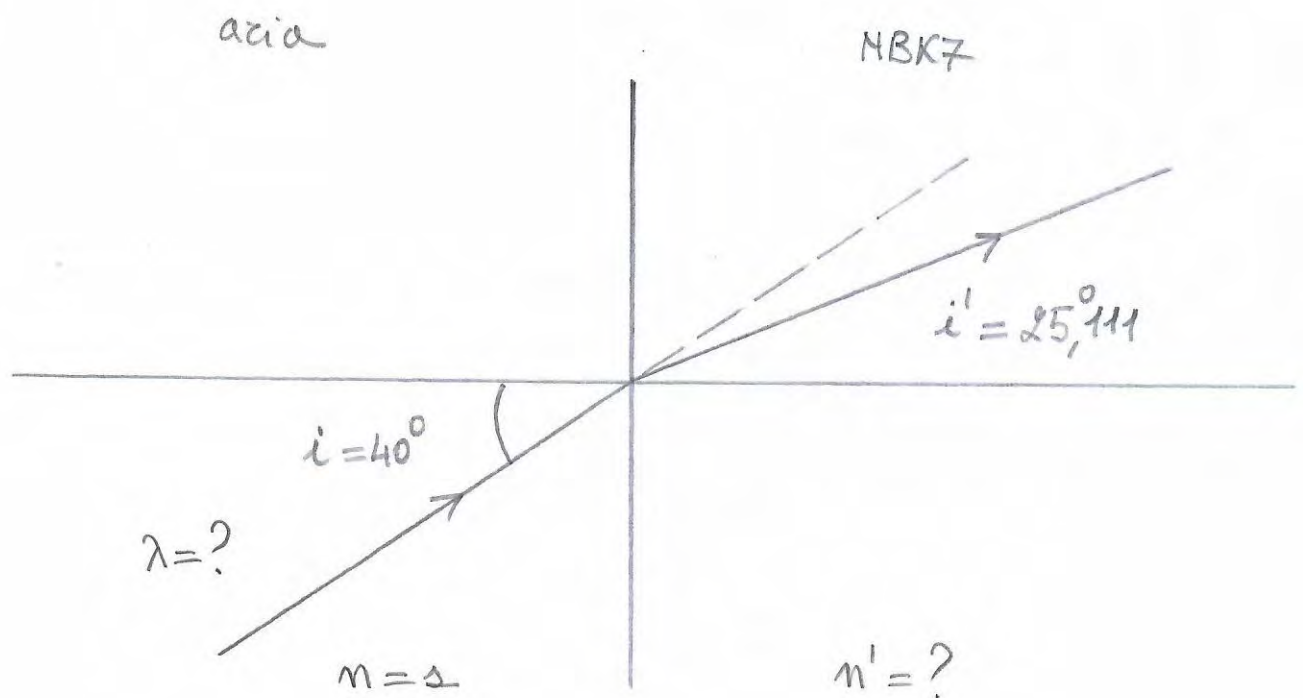
$$i = \sin^{-1} [1,335 \cdot \sin(17^\circ)] \Rightarrow$$

$$i = 22,97$$

$$i'' = -i$$

$$\Rightarrow i'' = -22,97$$

ESERCIZIO 1/4

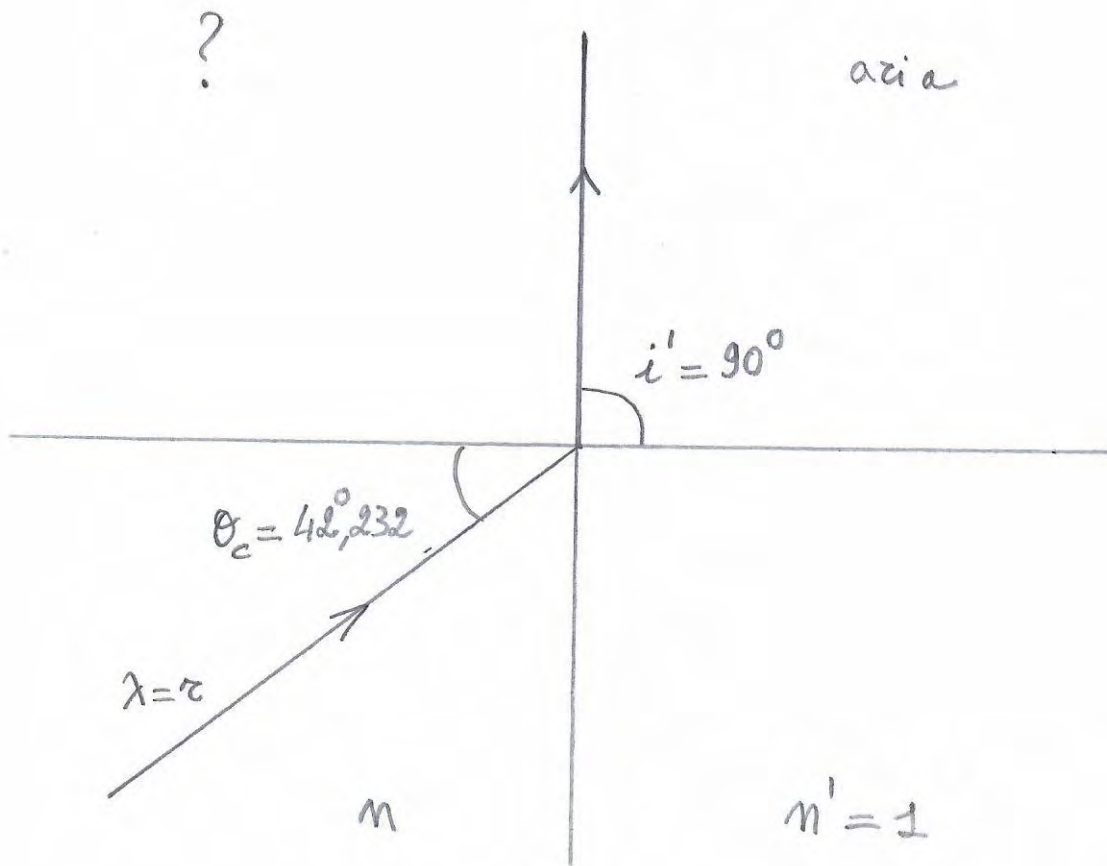


$$n' \sin i' = n \sin i \Rightarrow n' \sin(25,111) = \sin(40) \Rightarrow$$

$$n' = \frac{\sin(40)}{\sin(25,111)} \Rightarrow n' = 1,515 @ \text{NBK7} \Rightarrow$$

$$\lambda = c'$$

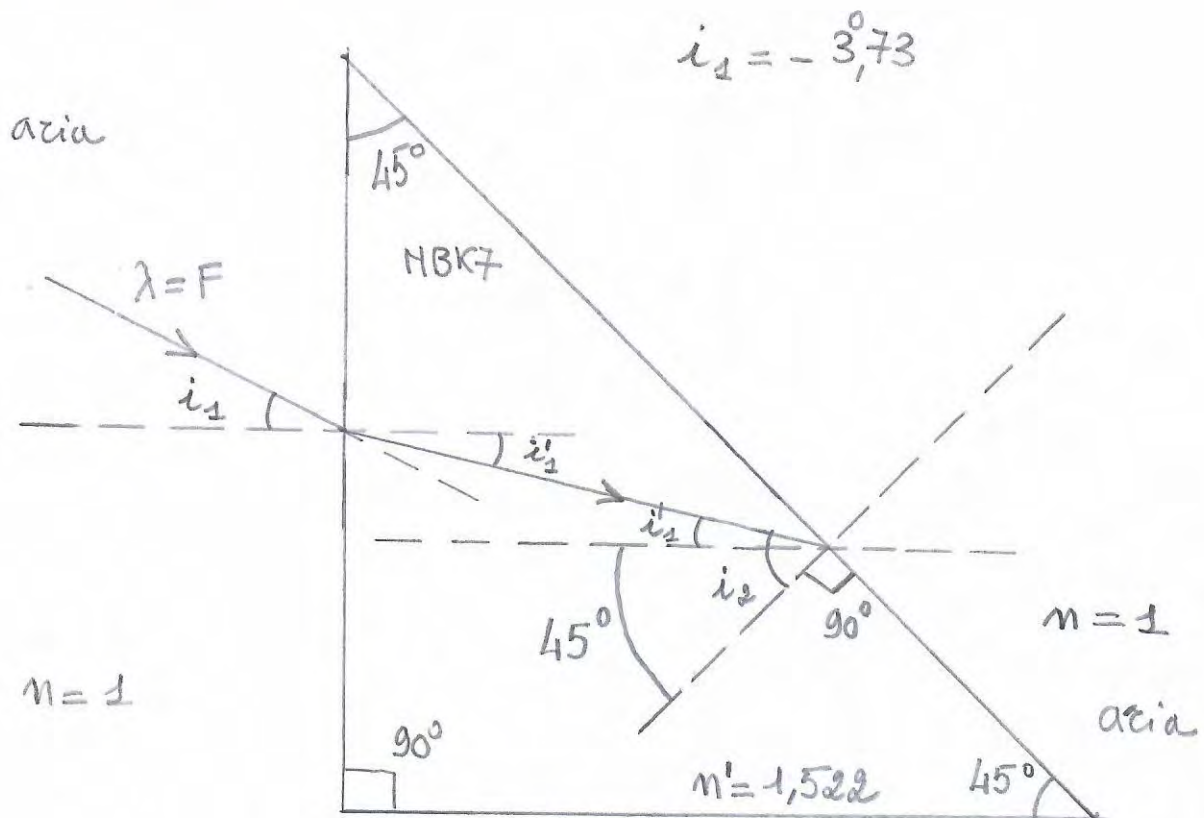
ESERCIZIO 1/5



$$n \sin \theta_c = n' \sin(90^\circ) \Rightarrow n = \frac{1}{\sin(42,232)}$$

$$n = 1,488 \text{ @ } \lambda = z \Rightarrow \boxed{\text{PMMA}}$$

ESERCIZIO 1/6



$$n' \sin i_2' = n \sin i_2 \Rightarrow \sin i_2' = \frac{1}{1.522} \sin(-3.73)$$

$$i_2' = \sin^{-1} \left[\frac{1}{1.522} \sin(-3.73) \right] \rightarrow \boxed{A}$$

$$|i_2| = 45^\circ + |i_2'| = 45^\circ + \boxed{A} \Rightarrow |i_2| = 47.45^\circ \Rightarrow$$

$$\boxed{i_2 = -47.45^\circ}$$

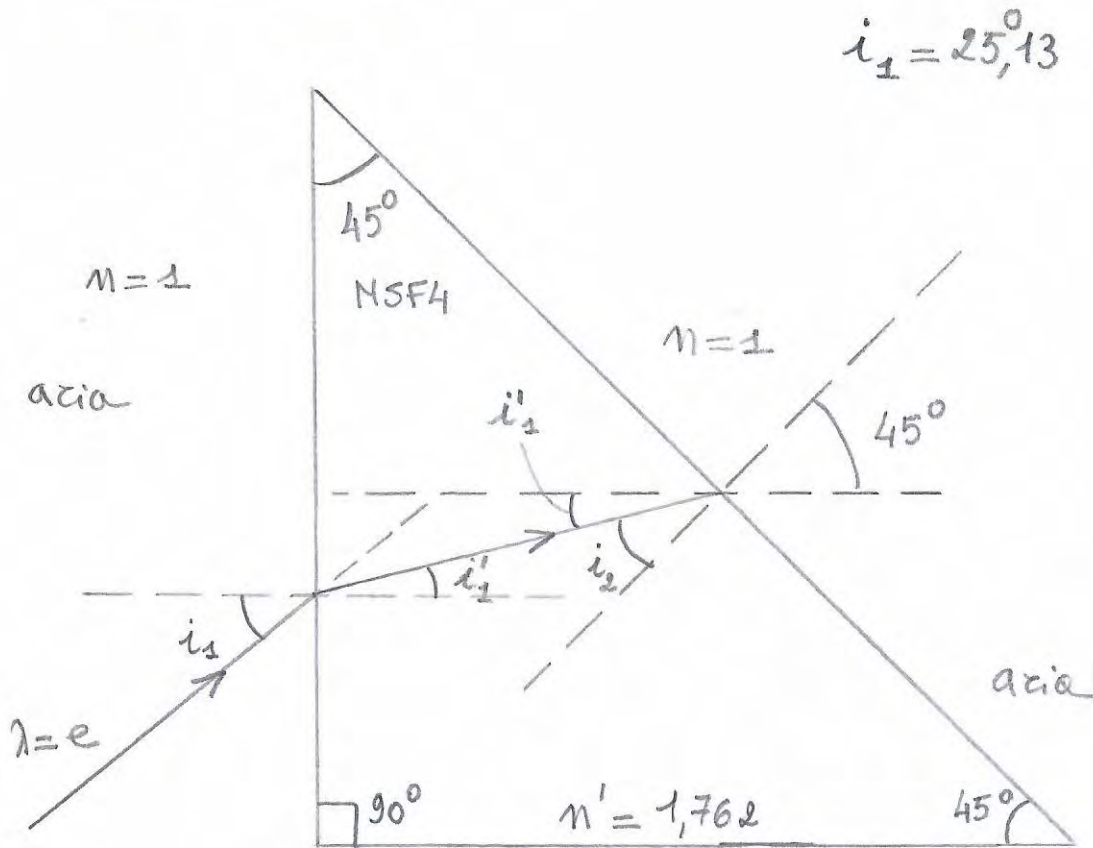
$$\theta_c = \sin^{-1} \left(\frac{n}{n'} \right) = \sin^{-1} \left(\frac{1}{1.522} \right) \Rightarrow \theta_c = 41.07^\circ$$

$$|i_2| > \theta_c$$

$$n' > n$$

RIFLESSIONE TOTALE SULL'IPOTENUSA

ESERCIZIO 2/6



$$n' \sin i'_2 = n \sin i_1 \Rightarrow \sin i'_2 = \frac{1}{1,762} \sin(25,13)$$

$$i'_2 = \sin^{-1} \left[\frac{1}{1,762} \sin(25,13) \right] \rightarrow \boxed{A}$$

$$|i_2| = 45^\circ - |i'_2| = 45^\circ - \boxed{A} \Rightarrow |i_2| = 31,05 \Rightarrow$$

$$\boxed{i_2 = -31,05}$$

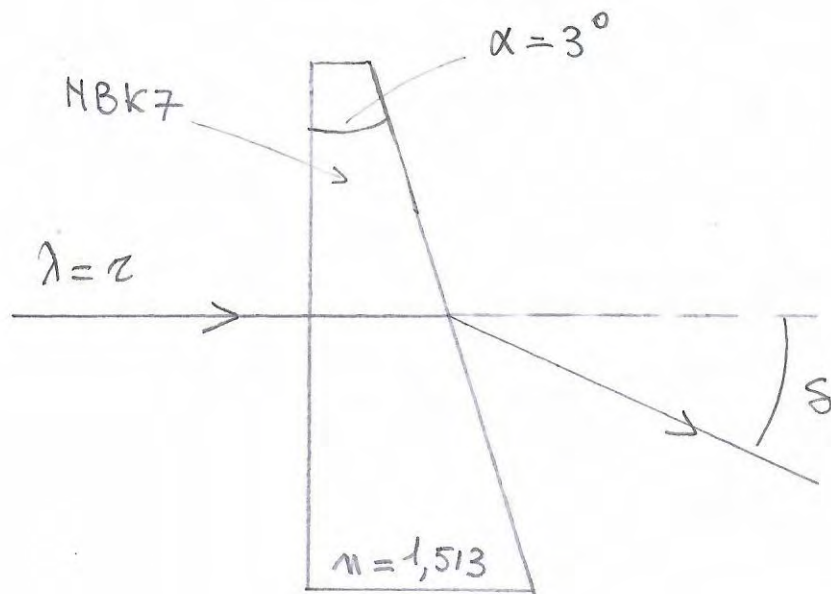
$$\theta_c = \sin^{-1} \left(\frac{n}{n'} \right) = \sin^{-1} \left(\frac{1}{1,762} \right) \Rightarrow \theta_c = 34,58^\circ$$

$$|i_2| < \theta_c \Rightarrow$$

$$n' > n$$

NON SI HA RIFLESSIONE TOTALE
SULL' IPOTENUSA

ESERCIZIO 1/7

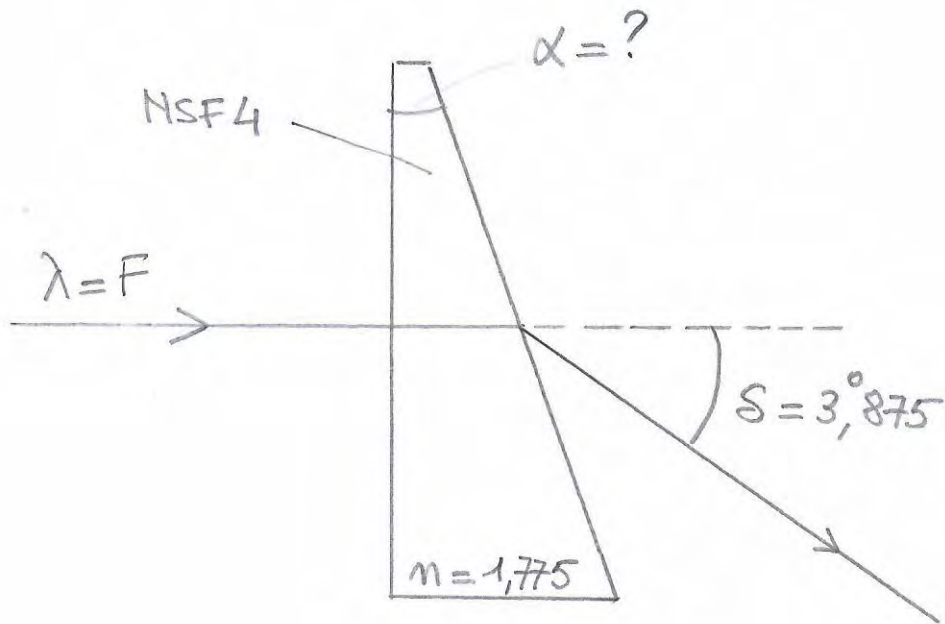


$$\delta = (n-1)\alpha = 0,513 \cdot 3^\circ$$

\Rightarrow

$$\delta = 1,539$$

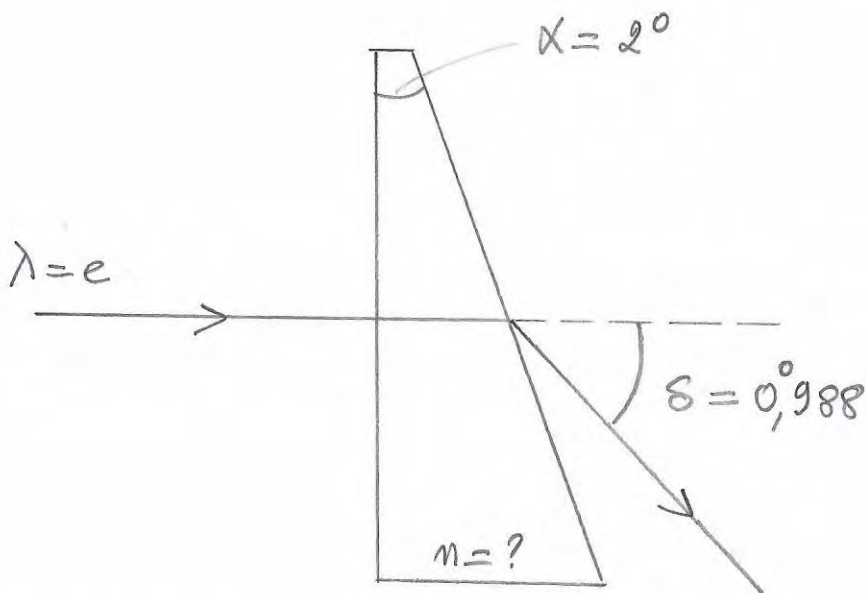
ESERCIZIO 2/7



$$\delta = (n-1) \alpha \Rightarrow \alpha = \frac{\delta}{n-1} = \frac{3,875}{0,775} \Rightarrow$$

$\alpha = 5^\circ$

ESERCIZIO 3/7



$$\delta = (n-1)\alpha \Rightarrow n-1 = \frac{\delta}{\alpha} \Rightarrow n = 1 + \frac{\delta}{\alpha} \Rightarrow$$

$$n = 1 + \frac{0,988^\circ}{2^\circ} \Rightarrow n = 1.494 @ \lambda = e \Rightarrow$$

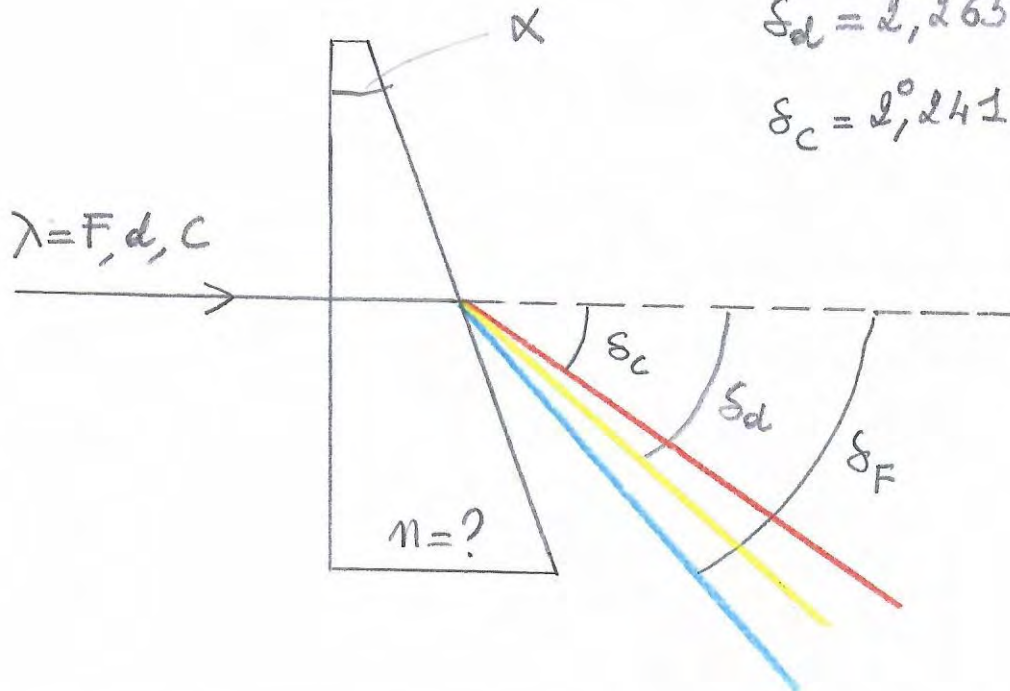
PMMA

ESERCIZIO 4/7

$$\delta_F = 2^{\circ},325$$

$$\delta_d = 2^{\circ},265$$

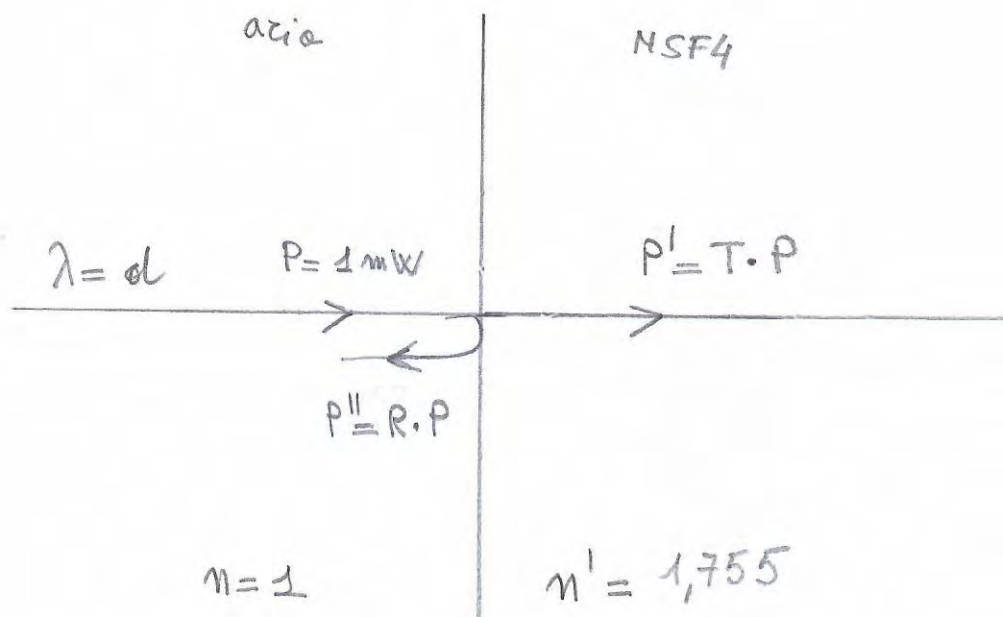
$$\delta_C = 2^{\circ},241$$



$$\begin{aligned}
 V_d &= \frac{n_d - 1}{n_F - n_C} = \frac{n_d - 1}{n_F - 1 + 1 - n_C} = \frac{n_d - 1}{(n_F - 1) - (n_C - 1)} = \\
 &= \frac{(n_d - 1) \cdot \alpha}{(n_F - 1) \alpha - (n_C - 1) \alpha} = \frac{\delta_d}{\delta_F - \delta_C} \Rightarrow
 \end{aligned}$$

$$V_d = \frac{2^{\circ},265}{2,325 - 2^{\circ},241} \Rightarrow \boxed{V_d = 27.0}$$

ESERCIZIO 1/8

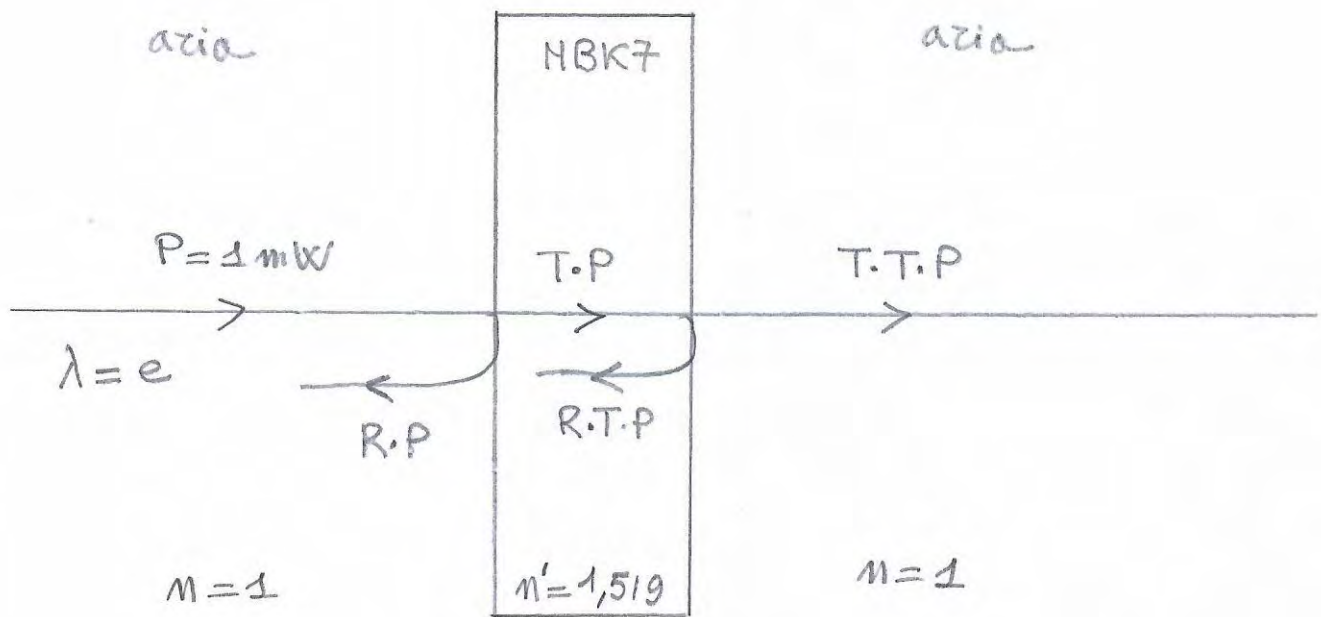


$$R = \left[\frac{n - n'}{n + n'} \right]^2 = \left[\frac{0,755}{2,755} \right]^2 \rightarrow \boxed{A} ; T = 1 - R = 1 - \boxed{A}$$

$$P'' = \boxed{A} \cdot 1 \text{ mW} \Rightarrow \boxed{P'' = 0,07510 \text{ mW}}$$

$$P' = [1 - \boxed{A}] \cdot 1 \text{ mW} \Rightarrow \boxed{P' = 0,92490 \text{ mW}}$$

ESERCIZIO 1/9



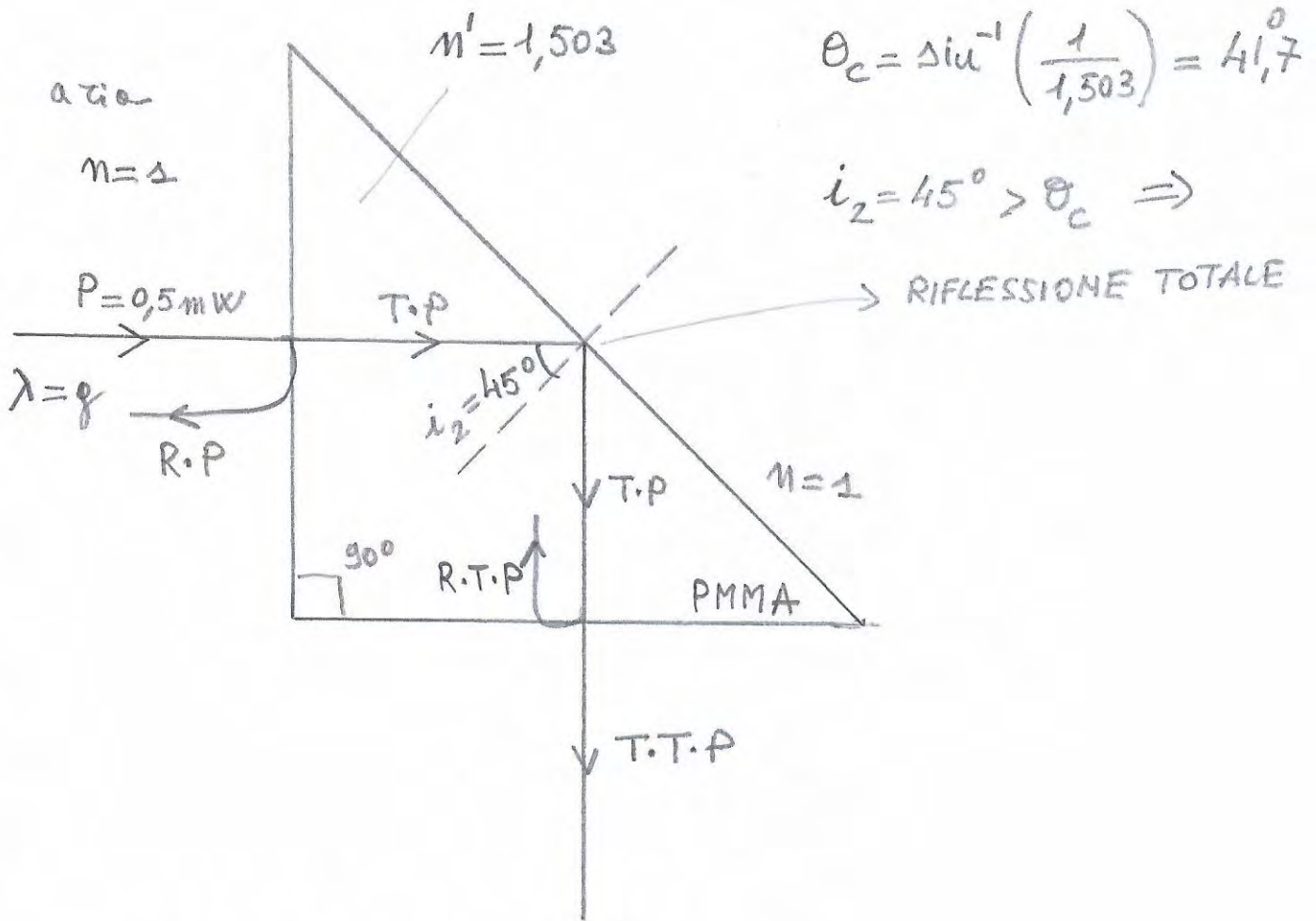
$$R = \left[\frac{n' - n}{n' + n} \right]^2 = \left[\frac{0,519}{2,519} \right]^2 \rightarrow \boxed{A}$$

$$T = 1 - R = 1 - \boxed{A}$$

$$P_{\text{emergeute}} = T^2 \cdot P = \left[1 - \boxed{A} \right]^2 \cdot 1\text{ mW} \Rightarrow$$

$$P_{\text{emergeute}} = 0,91690\text{ mW}$$

ESERCIZIO 3/9



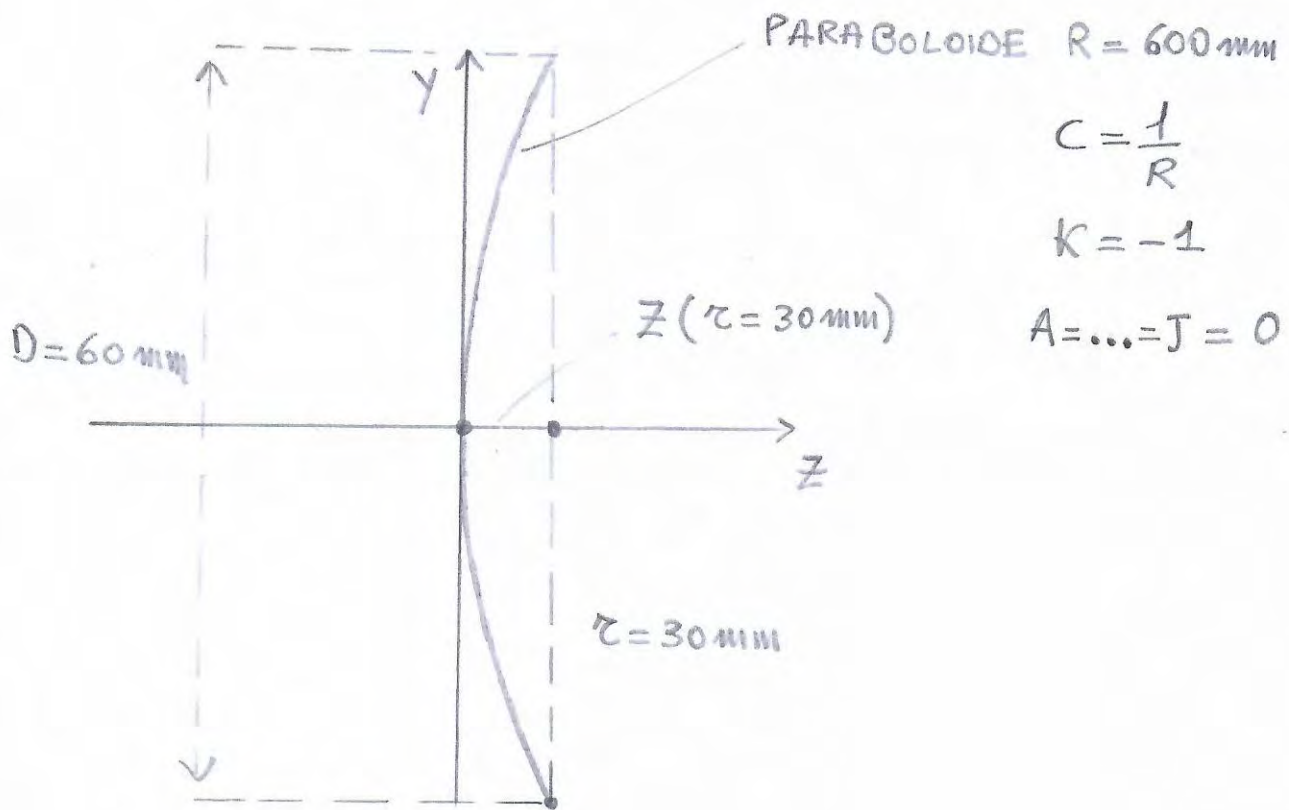
$$R = \left[\frac{n' - n}{n' + n} \right]^2 = \left[\frac{0,503}{2,503} \right]^2 \rightarrow \boxed{A}$$

$$T = 1 - R = 1 - \boxed{A}$$

$$P_{\text{emergeute}} = T^2 \cdot P = \left[1 - \boxed{A} \right]^2 \cdot 0,5 \text{ mW}$$

$$P_{\text{emergeute}} = 0,46043 \text{ mW}$$

ESERCIZIO 1/10

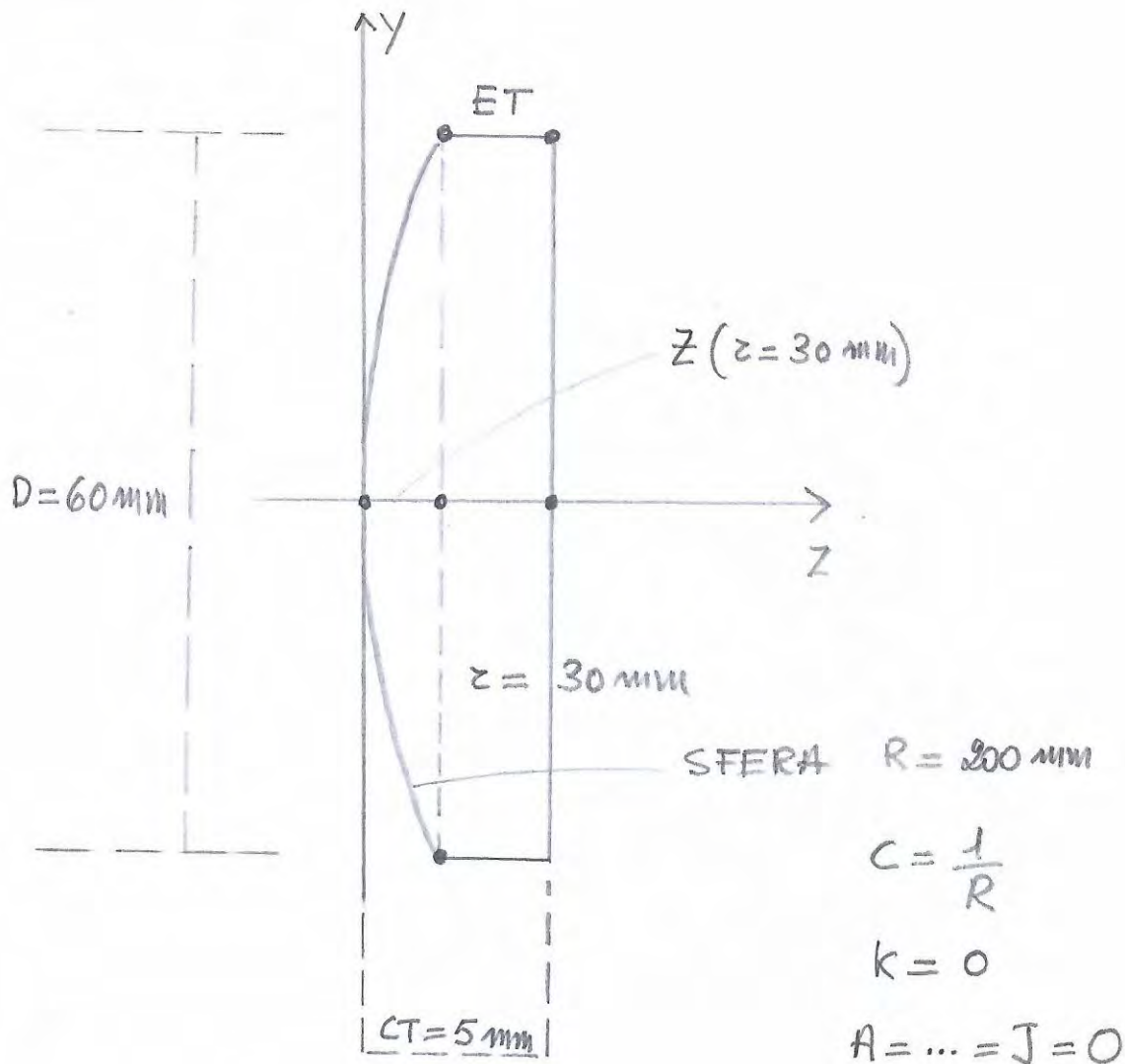


$$z(z) = \frac{c z^2}{1 + \sqrt{1 - (1+k) c^2 z^2}} = \frac{z^2}{2R}$$

$$z_{\text{parab}} = z(z = 30 \text{ mm}) = \frac{3^2}{2 \cdot 600} \text{ mm} = \frac{3}{4} \text{ mm}$$

$$z_{\text{parab}} = 0,750 \text{ mm}$$

ESERCIZIO 2/10



$$Z(z) = \frac{cz^2}{1 + \sqrt{1 - c^2z^2}}$$

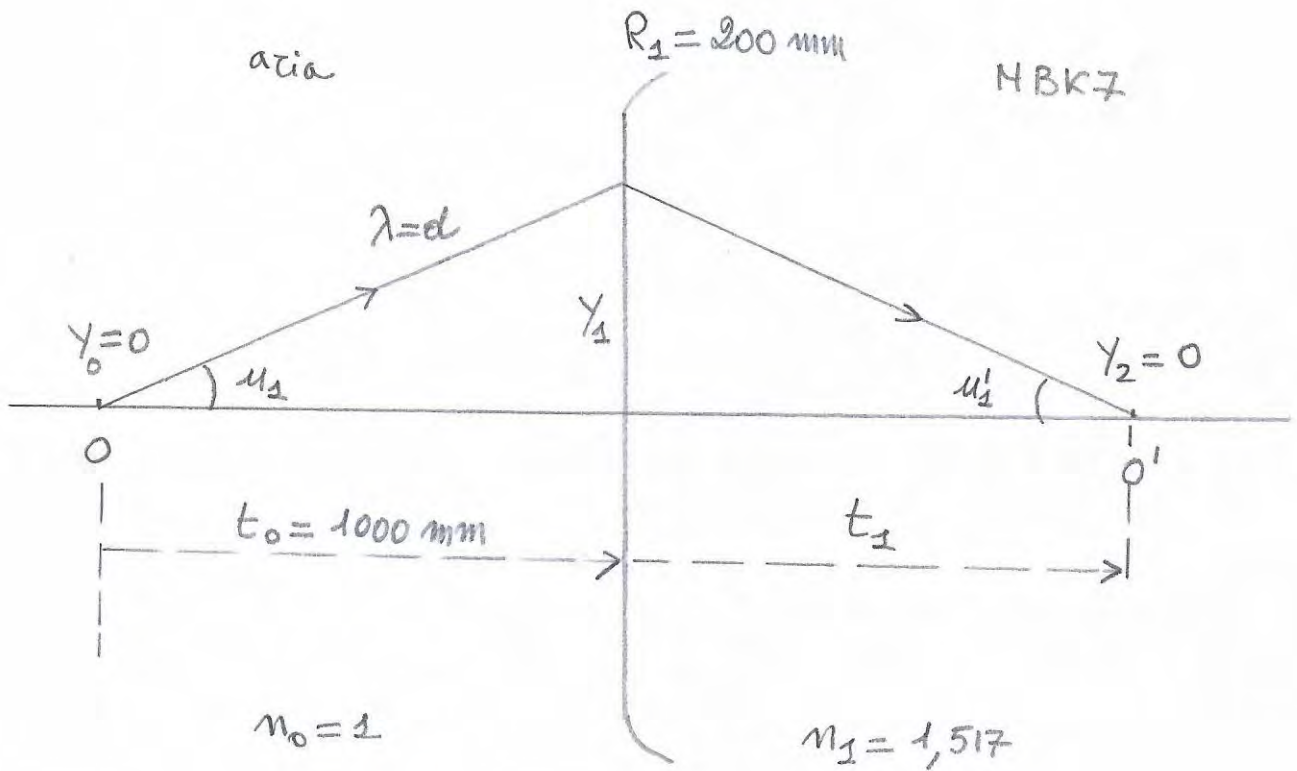
$$cz^2 = \frac{900}{200} \text{ mm} = 4,5 \text{ mm}$$

$$c^2z^2 = \frac{900}{40000} = 0,0225$$

$$Z(z = 30 \text{ mm}) = \frac{4,5}{1 + \sqrt{1 - 0,0225}} \text{ mm} \rightarrow \boxed{A}$$

$$ET = CT - Z(z = 30 \text{ mm}) = [5 - \boxed{A}] \text{ mm} \Rightarrow \boxed{ET = 2,737 \text{ mm}}$$

ESERCIZIO 1/11



$$y_1 = y_0 + t_0 \cdot u_1 = 1000 u_1$$

$$n_1 u_1' = n_0 u_1 - (n_1 - n_0) \frac{y_1}{R_1} \Rightarrow 1,517 u_1' = u_1 - 0,517 \cdot \frac{1000 u_1}{200} \Rightarrow$$

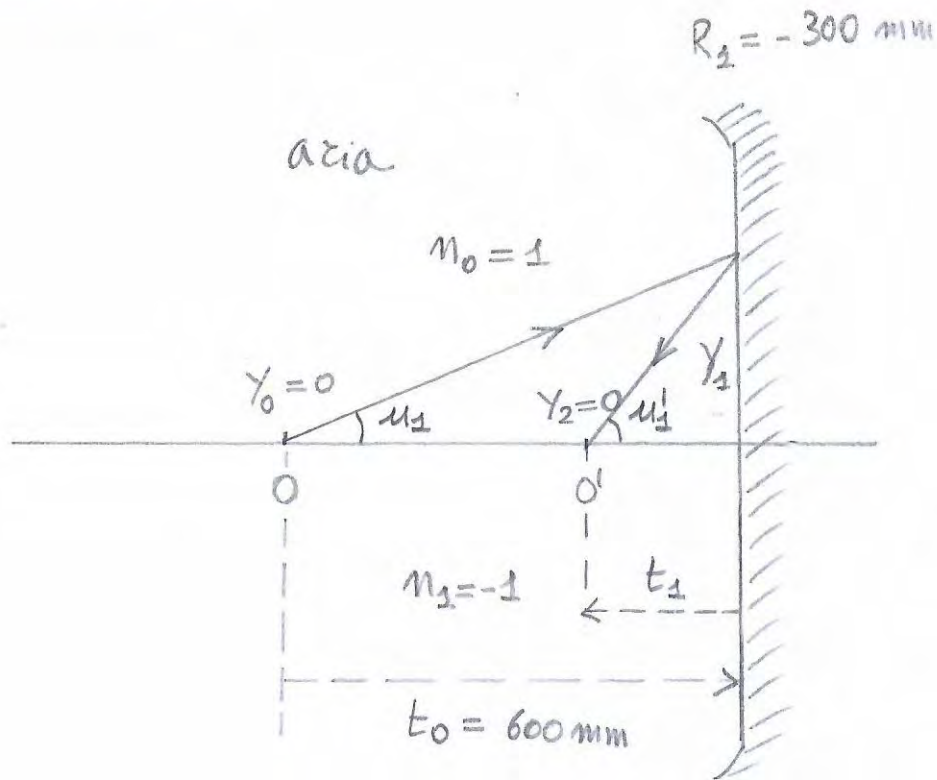
$$u_1' = \frac{1}{1,517} (1 - 2,585) u_1 \Rightarrow u_1' = - \frac{1,585}{1,517} u_1$$

$$0 = y_2 = y_1 + t_1 \cdot u_1' \Rightarrow t_1 = - \frac{y_1}{u_1'} = -1000 u_1 / \left(- \frac{1,517}{1,585} u_1 \right)$$

$$\Rightarrow t_1 = \frac{1,517}{1,585} \cdot 1000 \text{ mm} \Rightarrow$$

$$t_1 = 957,1 \text{ mm}$$

ESERCIZIO 2/11



$$\gamma_2 = \gamma_0 + t_0 \cdot u_1 \Rightarrow \gamma_2 = 600 u_1$$

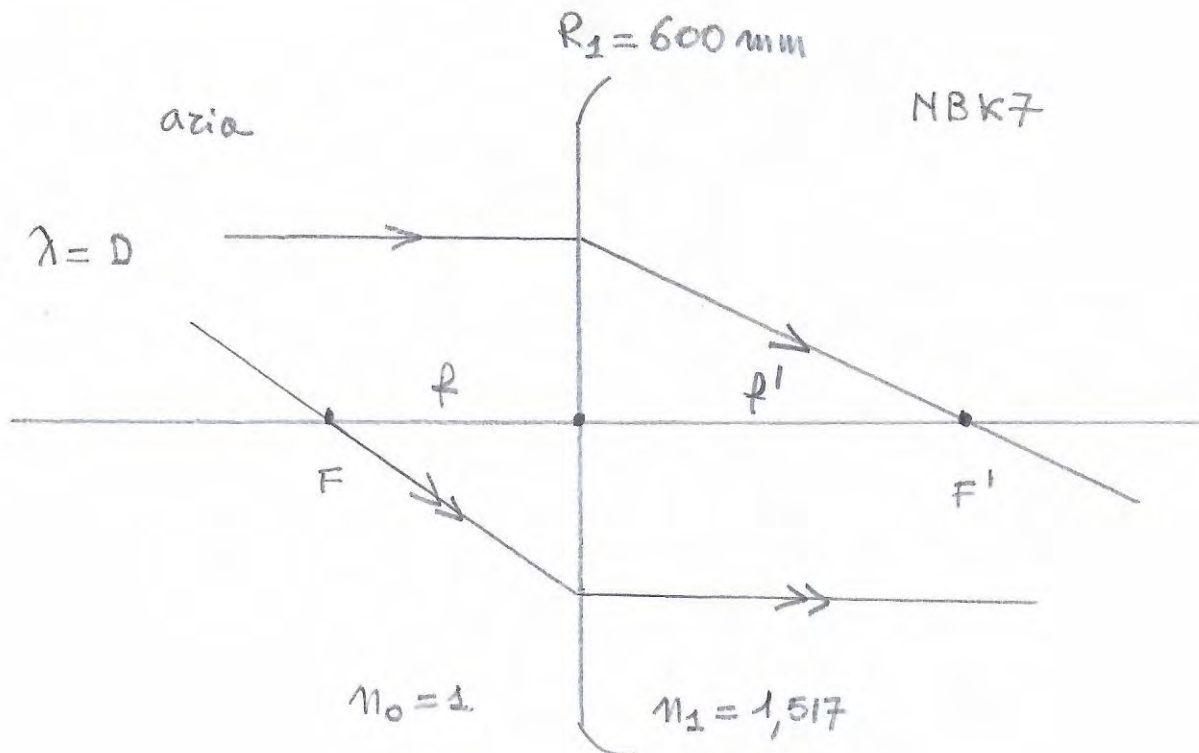
$$m_2 u'_2 = m_0 u_1 - (m_2 - m_0) \frac{\gamma_2}{R_2} \Rightarrow -u'_2 = u_1 - (-1 - 1) \frac{600 u_1}{-300}$$

$$-u'_2 = [1 - 2 \cdot 2] u_1 \Rightarrow u'_2 = 3 u_1$$

$$0 = \gamma_2 = \gamma_1 + t_1 u'_2 \Rightarrow t_1 = -\frac{\gamma_2}{u'_2} = -\frac{600 u_1}{3 u_1} \Rightarrow$$

$$t_1 = -200 \text{ mm}$$

ESERCIZIO 1/12



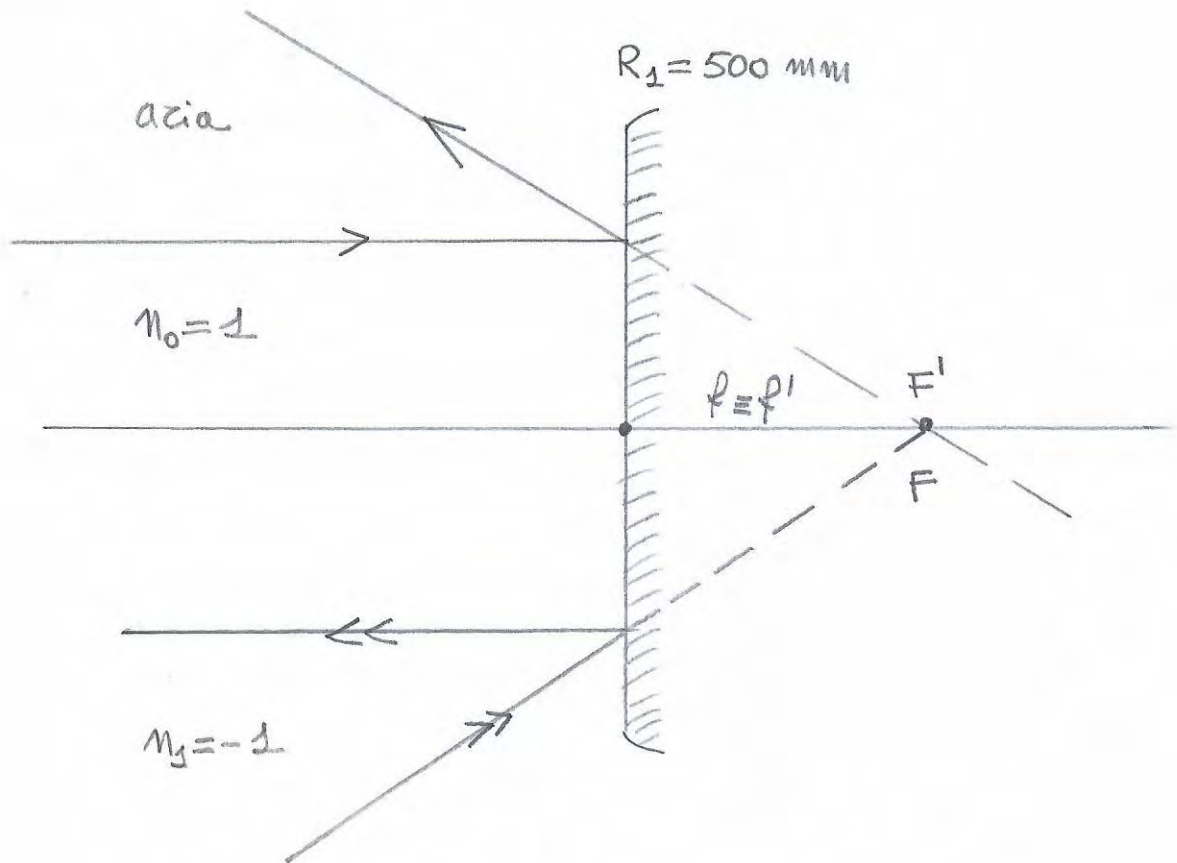
$$f' = \frac{n_1}{n_1 - n_0} \cdot R_1 = \frac{1,517}{0,517} \cdot 600 \text{ mm} \Rightarrow \boxed{f' = 1760,5 \text{ mm}}$$

$$f = -\frac{n_0}{n_1 - n_0} \cdot R_1 = -\frac{1}{0,517} \cdot 600 \text{ mm} \Rightarrow \boxed{f = -1160,5 \text{ mm}}$$

$$\phi = \frac{n_1 - n_0}{R_1} = \frac{0,517}{600} \text{ mm}^{-1} = \frac{0,517}{600} \left(10^{-3} \text{ m}\right)^{-1} = \frac{0,517 \cdot 1000}{600} \text{ D}$$

$$\boxed{\phi = 0,862 \text{ D}}$$

ESERCIZIO 2/12



$$r = r' = \frac{R_1}{2}$$

\Rightarrow

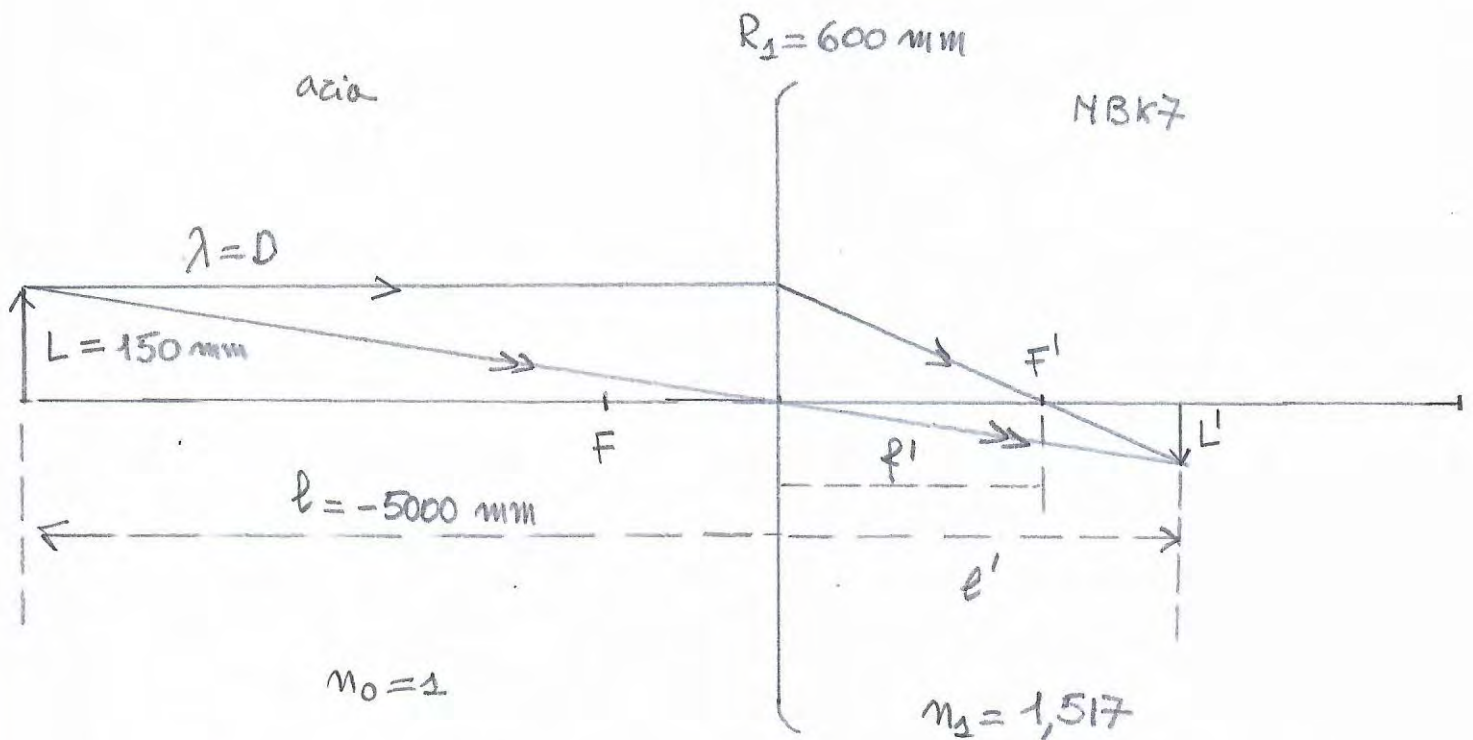
$$r = r' = 250 \text{ mm}$$

$$\phi = \frac{n_1}{r'} = -\frac{1}{250} \text{ mm}^{-1} = -\frac{1}{250} (10^{-3} \text{ m})^{-1} = -\frac{1000}{250} \text{ D}$$

\Rightarrow

$$\phi = -4 \text{ D}$$

ESERCIZIO 1/13



$$\phi = \frac{n_1}{f'} = \frac{n_1 - n_0}{R_1} = \frac{0,517}{600} \text{ mm}^{-1}$$

$$\frac{n_1}{l'} = \frac{n_0}{l} + \frac{n_1}{f'} \Rightarrow \frac{1,517}{l'} = -\frac{1}{5000} + \frac{0,517}{600} \Rightarrow$$

$$l' = 2292,695 \text{ mm} \rightarrow \boxed{A}$$

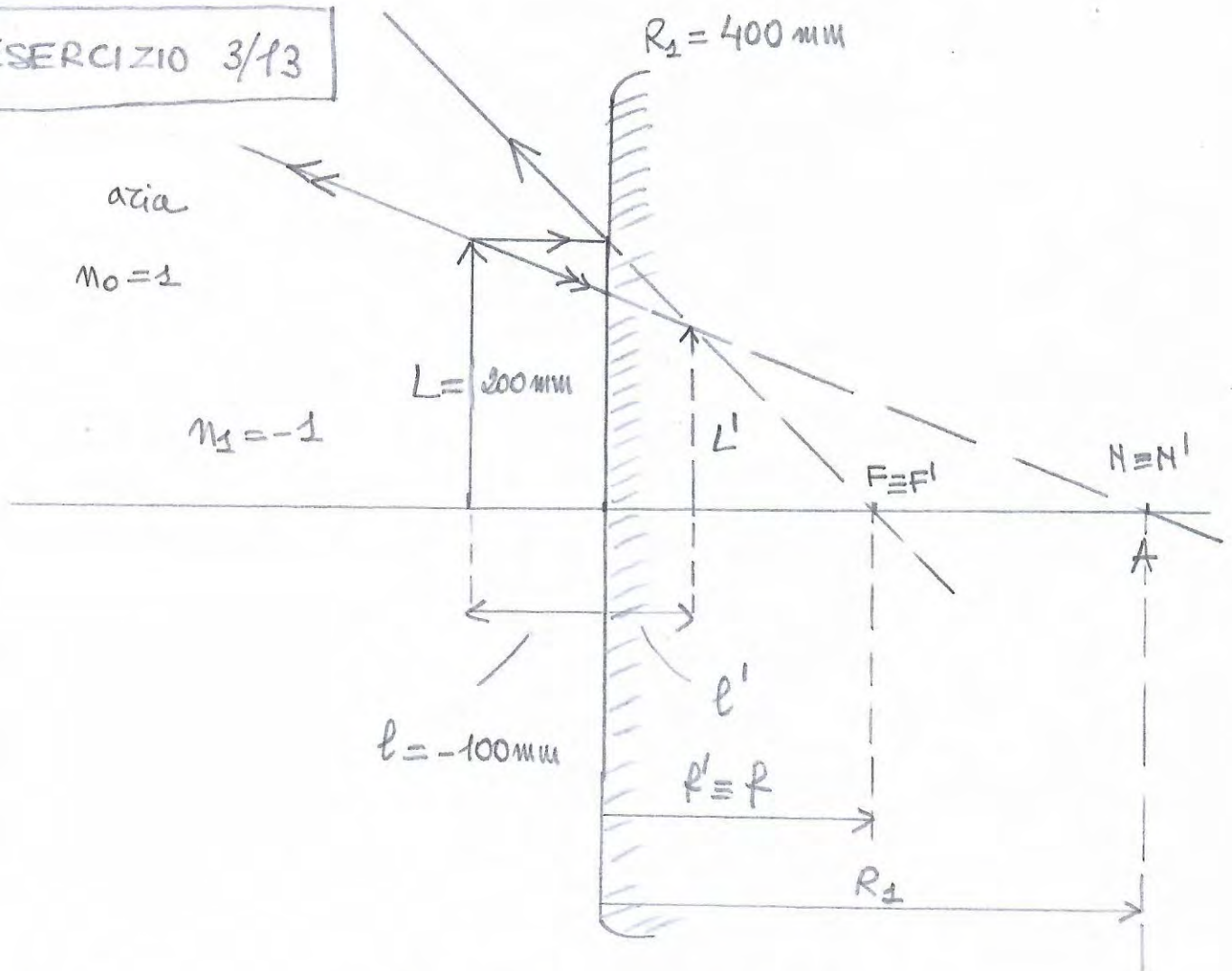
$$m = \frac{n_0 l'}{n_1 l} = -\frac{\boxed{A}}{1,517 \cdot 5000} = -0,30227 \rightarrow \boxed{B}$$

$$L' = |m| \cdot L = \boxed{B} \cdot 150 \text{ mm} \Rightarrow \boxed{L' = 45,340 \text{ mm}}$$

$l' > 0 \Rightarrow$ IMMAGINE REALE

$m < 0 \Rightarrow$ IMMAGINE ROVESCATA

ESERCIZIO 3/13



$$f' = \frac{R_2}{2} \Rightarrow f' = \frac{400}{2} \text{ mm} \Rightarrow f' = 200 \text{ mm}$$

$$\frac{m_k}{l'} = \frac{m_o}{l} + \frac{m_k}{f'} \Rightarrow \frac{-1}{l'} = \frac{1}{l} - \frac{1}{f'} \Rightarrow \frac{1}{l'} = -\frac{1}{l} + \frac{1}{f'} \Rightarrow$$

$$\frac{1}{l'} = +\frac{1}{100} + \frac{1}{200} = \frac{+2+1}{200} = \frac{3}{200} \Rightarrow \boxed{l' = \frac{200}{3} \text{ mm} = 66,6 \text{ mm}}$$

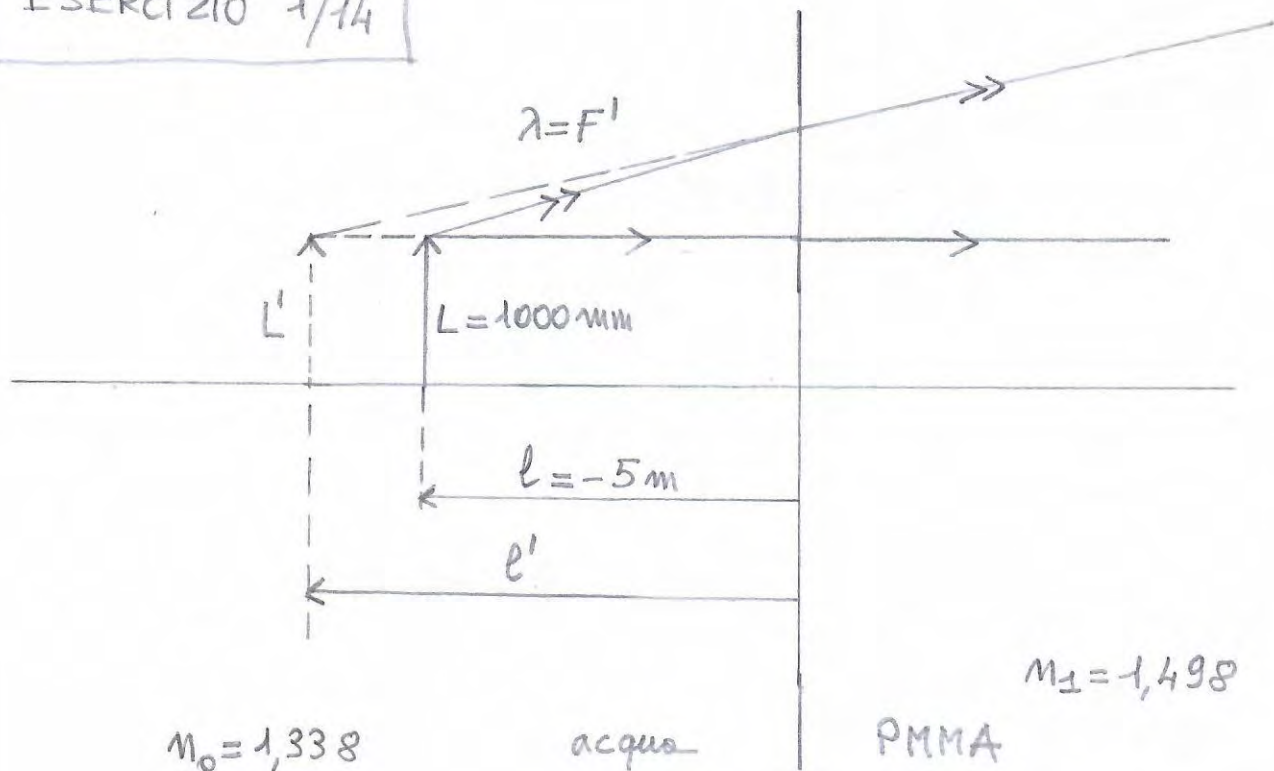
$$l' > 0 \Rightarrow \boxed{\text{IMMAGINE VIRTUALE}}$$

$$m = \frac{m_o}{m_k} \frac{l'}{l} = \frac{1}{-1} \cdot \frac{200}{3} \cdot \frac{-1}{100} = \frac{2}{3}$$

$$L' = |m| \cdot L = \frac{2}{3} \cdot 200 \text{ mm} \Rightarrow \boxed{L' = \frac{400}{3} \text{ mm} = 133,3 \text{ mm}}$$

$$m > 0 \Rightarrow \boxed{\text{IMMAGINE ERETTA}}$$

ESERCIZIO 1/14



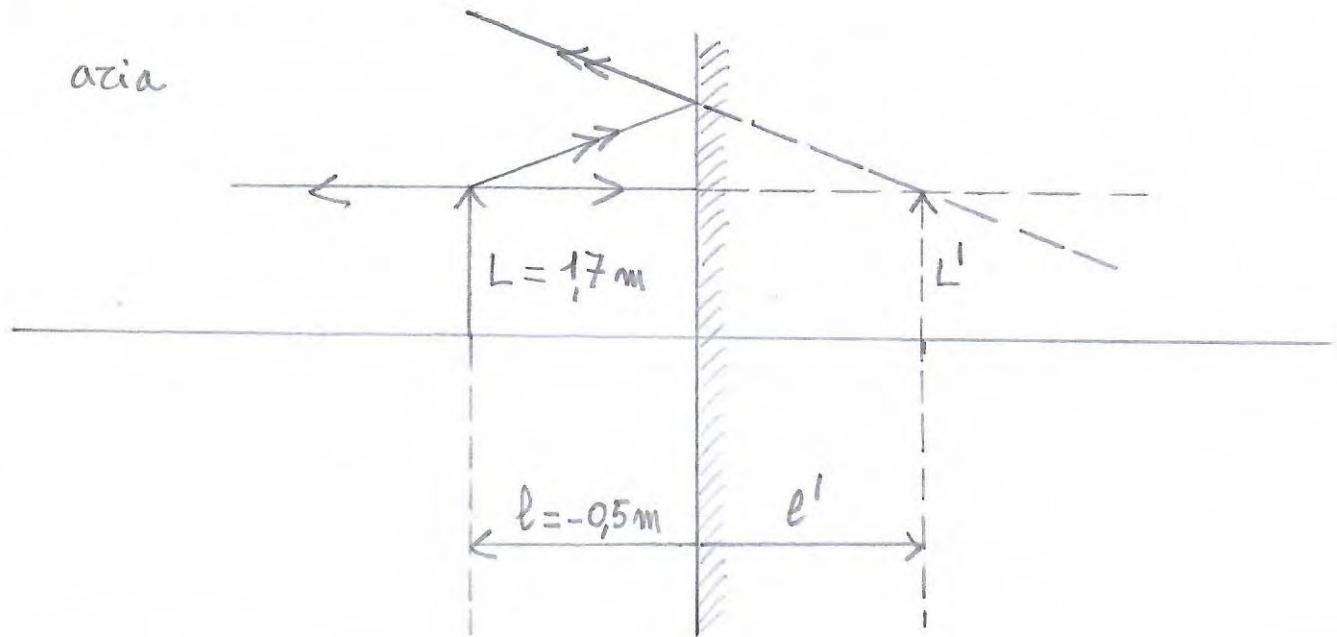
$$e' = \frac{n_1}{n_0} \cdot l = \frac{1,498}{1,338} \cdot (-5000) \text{ mm} \Rightarrow e' = -5597,9 \text{ mm}$$

$$m = 1 \Rightarrow L' = 1000 \text{ mm}$$

$$e' < 0 \Rightarrow \text{IMMAGINE VIRTUALE}$$

$$m > 0 \Rightarrow \text{IMMAGINE ERETTA}$$

ESERCIZIO 2/14



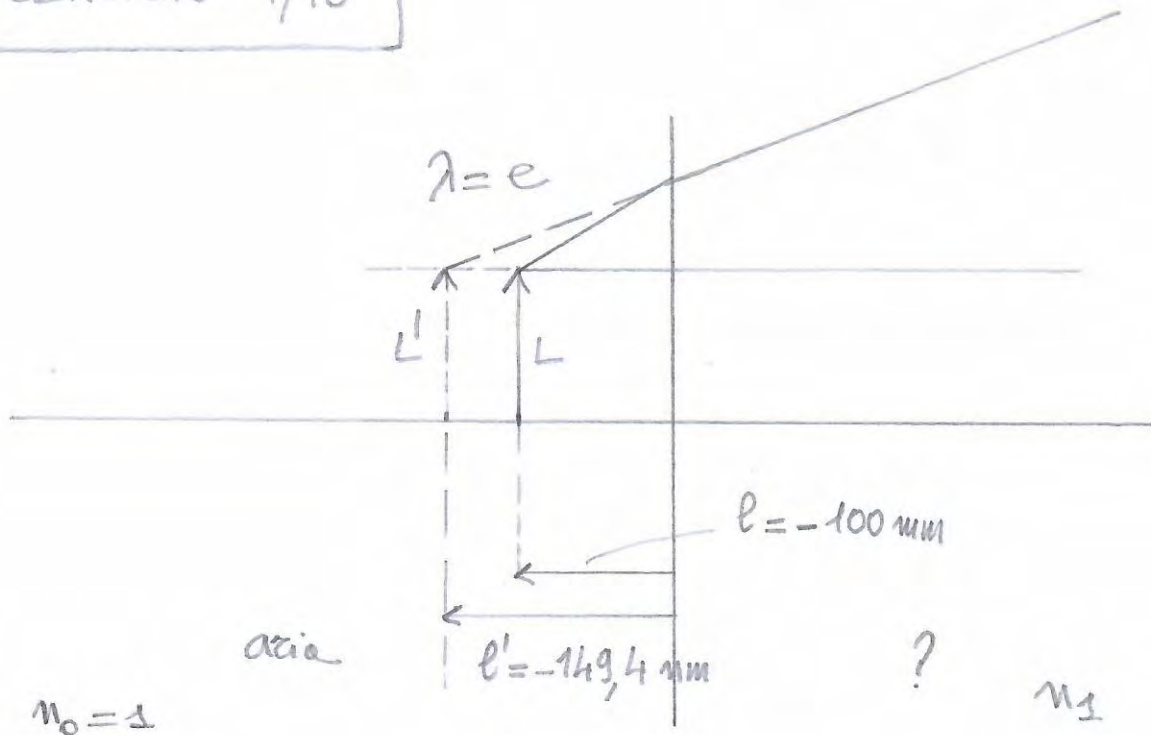
$$l' = -l = -(-0,5 \text{ m}) \Rightarrow \boxed{l' = 0,5 \text{ m}}$$

$$l' > 0 \Rightarrow \boxed{\text{IMMAGINE VIRTUALE}}$$

$$m = 1 \Rightarrow L' = |m| \cdot L \Rightarrow \boxed{L' = 1,7 \text{ m}}$$

$$m > 0 \Rightarrow \boxed{\text{IMMAGINE ERETTA}}$$

ESERCIZIO 1/15



$$n_0 = 1$$

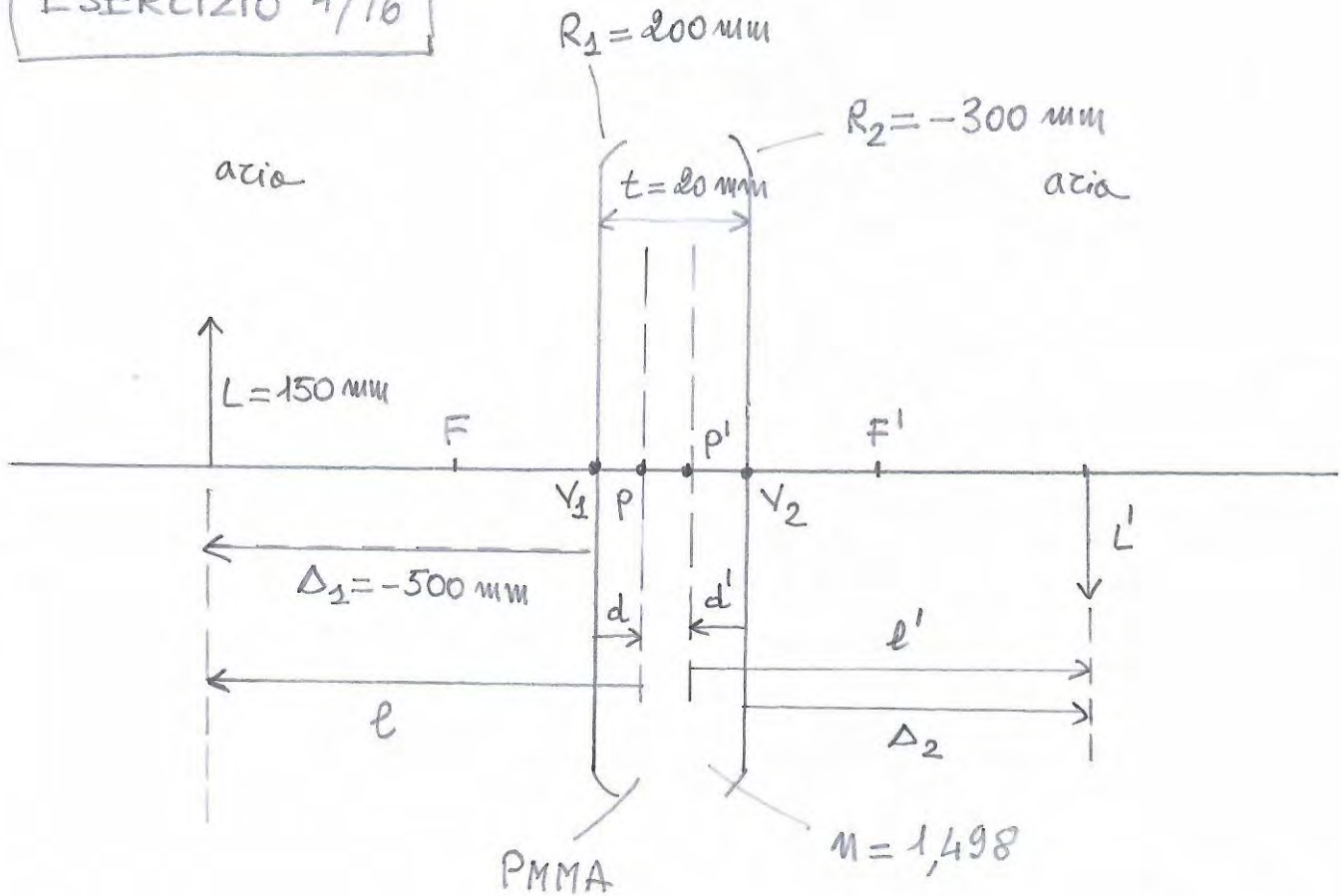
$$n_1$$

$$e' = \frac{n_1}{n_0} L \Rightarrow \frac{n_1}{n_0} = \frac{e'}{L} \Rightarrow n_1 = \frac{-149,4}{-100} \Rightarrow$$

$$n_1 = 1,494 @ \lambda = e \Rightarrow \boxed{\text{PMMA}}$$

a

ESERCIZIO 1/16



$R_1 > 0; R_2 < 0; R_1 \neq |R_2| \Rightarrow$ LENTE BICONVESSA

$\phi_1 = \frac{0,498}{200} \text{ mm}^{-1} \rightarrow$ A

$\phi_2 = \frac{-0,498}{-300} \text{ mm}^{-1} \rightarrow$ B

$\phi = \left[\text{A} + \text{B} - \frac{\text{A} \cdot \text{B} \cdot 20}{1,498} \right] \text{ mm}^{-1} \rightarrow$ C

$\phi = 4,09 \cdot 10^{-3} \text{ mm}^{-1} = 4,09 \cdot 10^{-3} \cdot (10^{-3})^{-1} \text{ m}^{-1} \Rightarrow$ $\phi = 4,09 \text{ D}$

$f' = \frac{1}{\text{C}} \Rightarrow$ $f' = 244,21 \text{ mm}$

$b_{fl} = \frac{1 - \text{A} \cdot 20}{\text{C}} \text{ mm} \Rightarrow$ $b_{fl} = 236,09 \text{ mm}$

ESERCIZIO 1/16

b

$$fpe = - \frac{1 - \boxed{B} \cdot \frac{20}{1,498}}{\boxed{C}} \text{ mm} \Rightarrow \boxed{fpe = -238,80 \text{ mm}}$$

$$d = \frac{\boxed{B}}{\boxed{C}} \cdot \frac{20}{1,498} \text{ mm} \rightarrow \boxed{D} \quad \boxed{d = 5,41 \text{ mm}}$$

$$d' = - \frac{\boxed{A}}{\boxed{C}} \cdot \frac{20}{1,498} \text{ mm} \rightarrow \boxed{E} \quad \boxed{d' = -8,12 \text{ mm}}$$

$$l = \Delta_1 - d = (-500 - \boxed{D}) \text{ mm} \rightarrow \boxed{F} \quad \boxed{l = -505,41 \text{ mm}}$$

$$\frac{1}{e'} = \frac{1}{\boxed{F}} + \boxed{C} \Rightarrow e' = \frac{\boxed{F}}{1 + \boxed{F} \cdot \boxed{C}} \text{ mm} \rightarrow \boxed{X} \quad \boxed{e' = 472,54 \text{ mm}}$$

$$\Delta_2 = (\boxed{X} + \boxed{E}) \text{ mm} \Rightarrow \boxed{\Delta_2 = 464,42 \text{ mm}}$$

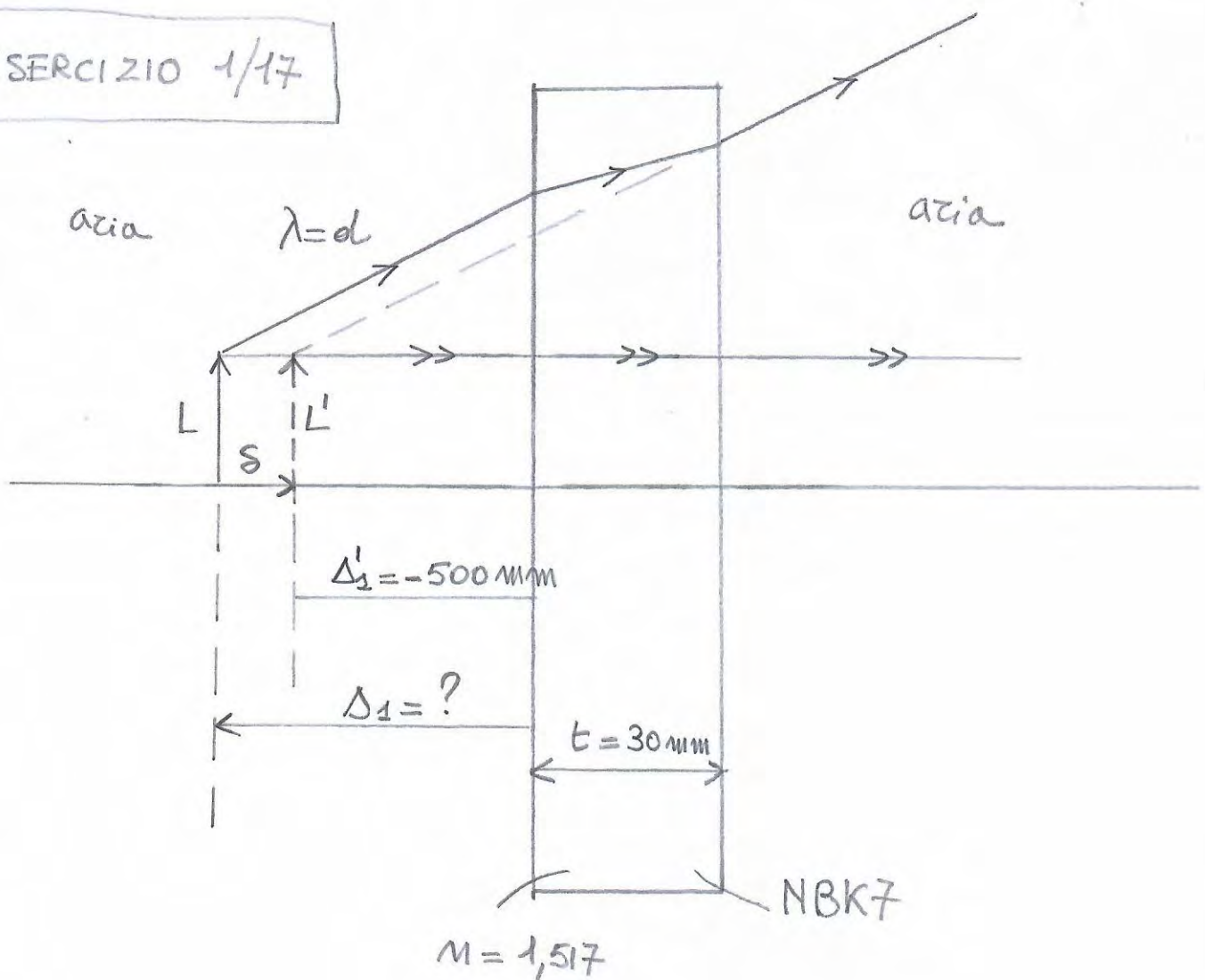
$$m = \frac{\boxed{X}}{\boxed{F}} \rightarrow \boxed{Y} \quad \boxed{m = -0,935}$$

$$L' = |\boxed{Y}| \cdot 150 \text{ mm} \Rightarrow \boxed{L' = 140,24 \text{ mm}}$$

$$e' > 0 \Rightarrow \boxed{\text{IMMAGINE REALE}}$$

$$m < 0 \Rightarrow \boxed{\text{IMMAGINE ROVESCIATA}}$$

ESERCIZIO 1/17

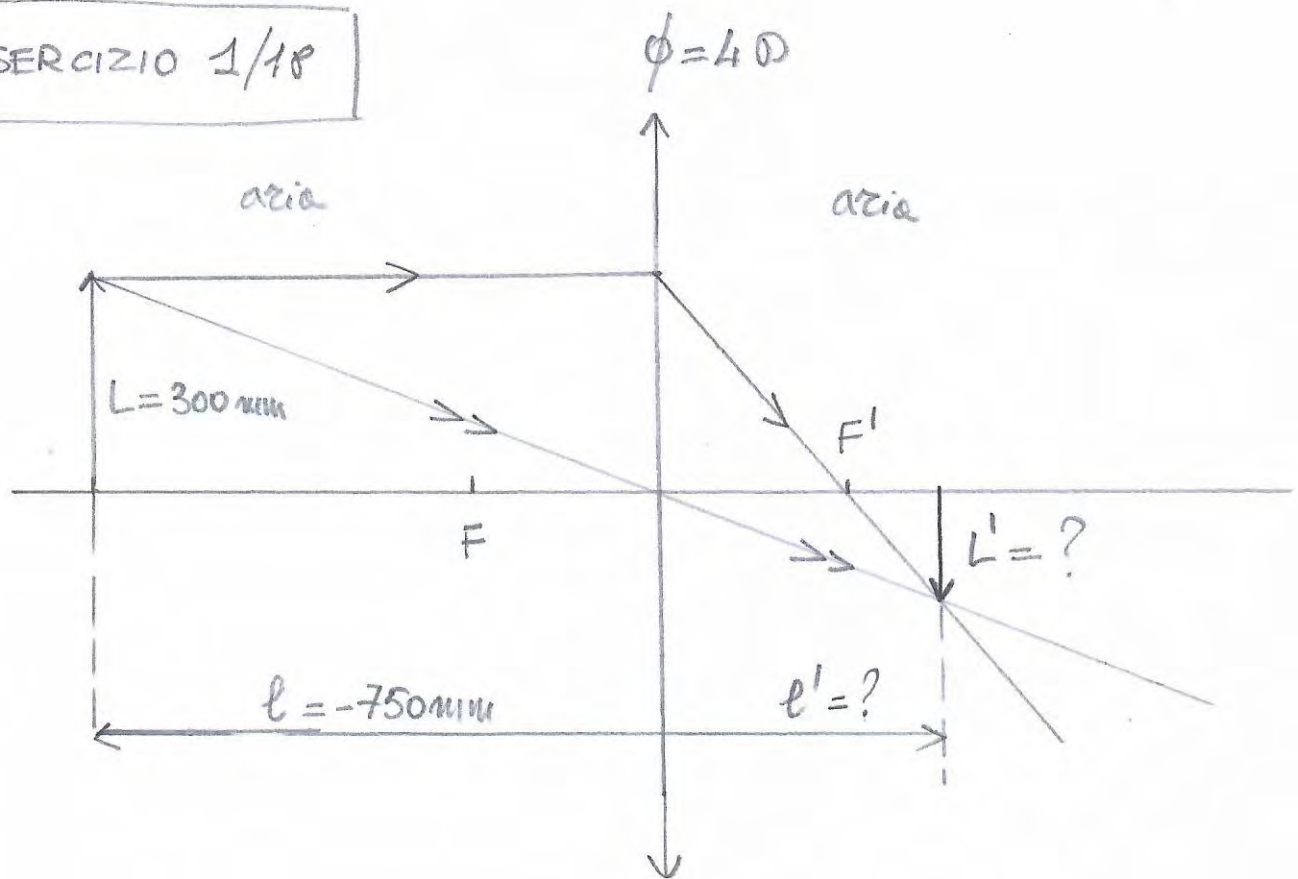


$$S = \frac{n-1}{n} \cdot t \Rightarrow S = \frac{0,517}{1,517} \cdot 30 \text{ mm}$$

$$\Delta_1 \equiv \text{distanza effettiva} = \Delta_1' - S = \left[-500 - \frac{0,517}{1,517} \cdot 30 \right] \text{ mm}$$

$$\Rightarrow \boxed{\Delta_1 = -510,2 \text{ mm}}$$

ESERCIZIO 1/18



$$\phi = 40 = 4 \text{ m}^{-1} = 0,004 \text{ mm}^{-1} = \frac{1}{250} \text{ mm}^{-1}$$

$$\frac{1}{l'} = \left(-\frac{1}{750} + \frac{1}{250} \right) \text{ mm}^{-1} = \frac{-1+3}{750} \text{ mm}^{-1} = \frac{2}{750} \text{ mm}^{-1} \Rightarrow$$

$$l' = \frac{750}{2} \text{ mm} \Rightarrow \boxed{l' = 375 \text{ mm}}$$

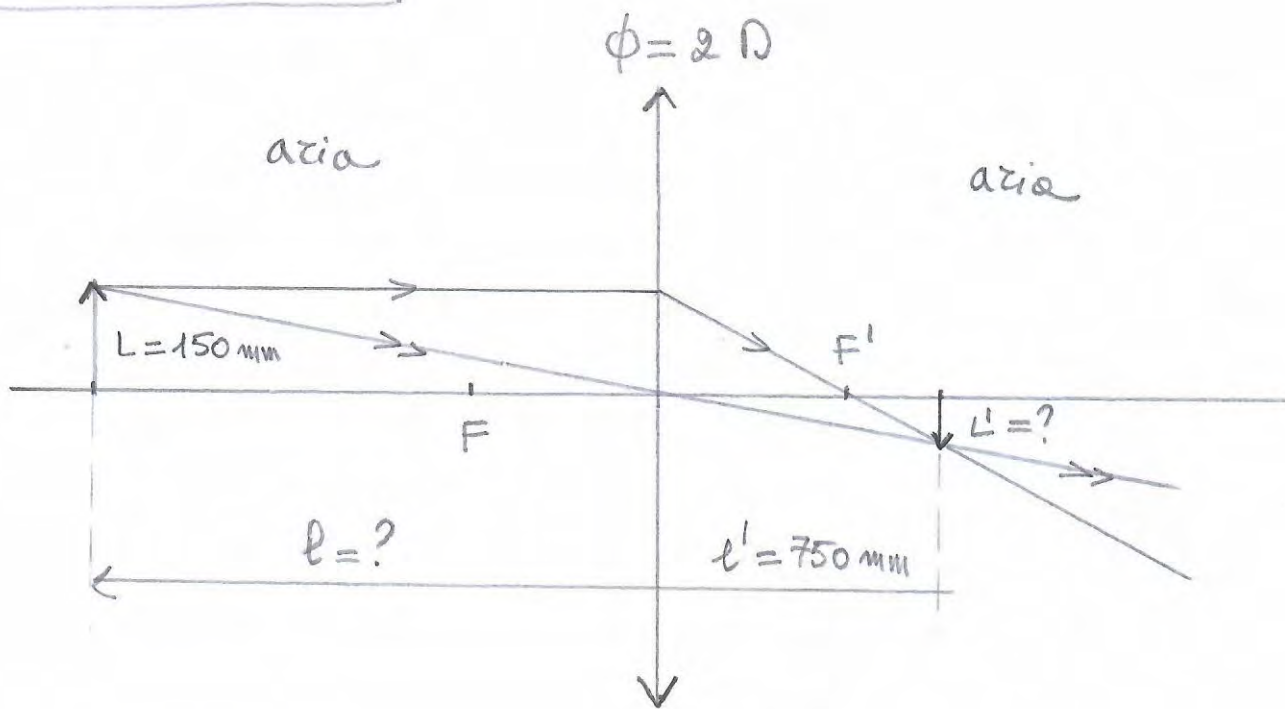
$$m = \frac{l'}{l} = -\frac{375}{750} \Rightarrow m = -\frac{1}{2}$$

$$L' = |m| \cdot L \Rightarrow L' = \frac{300}{2} \text{ mm} \Rightarrow \boxed{L' = 150 \text{ mm}}$$

$$l' > 0 \Rightarrow \boxed{\text{IMMAGINE REALE}}$$

$$m < 0 \Rightarrow \boxed{\text{IMMAGINE ROVESCIATA}}$$

Esercizio 3/18



$$\phi = 2 \text{ D} = 2 \text{ m}^{-1} = 0,002 \text{ mm}^{-1} = \frac{1}{500} \text{ mm}^{-1}$$

$$\frac{1}{e'} = \frac{1}{e} + \phi \Rightarrow \frac{1}{e} = \frac{1}{e'} - \phi = \left(\frac{1}{750} - \frac{1}{500} \right) \text{ mm}^{-1} \Rightarrow$$

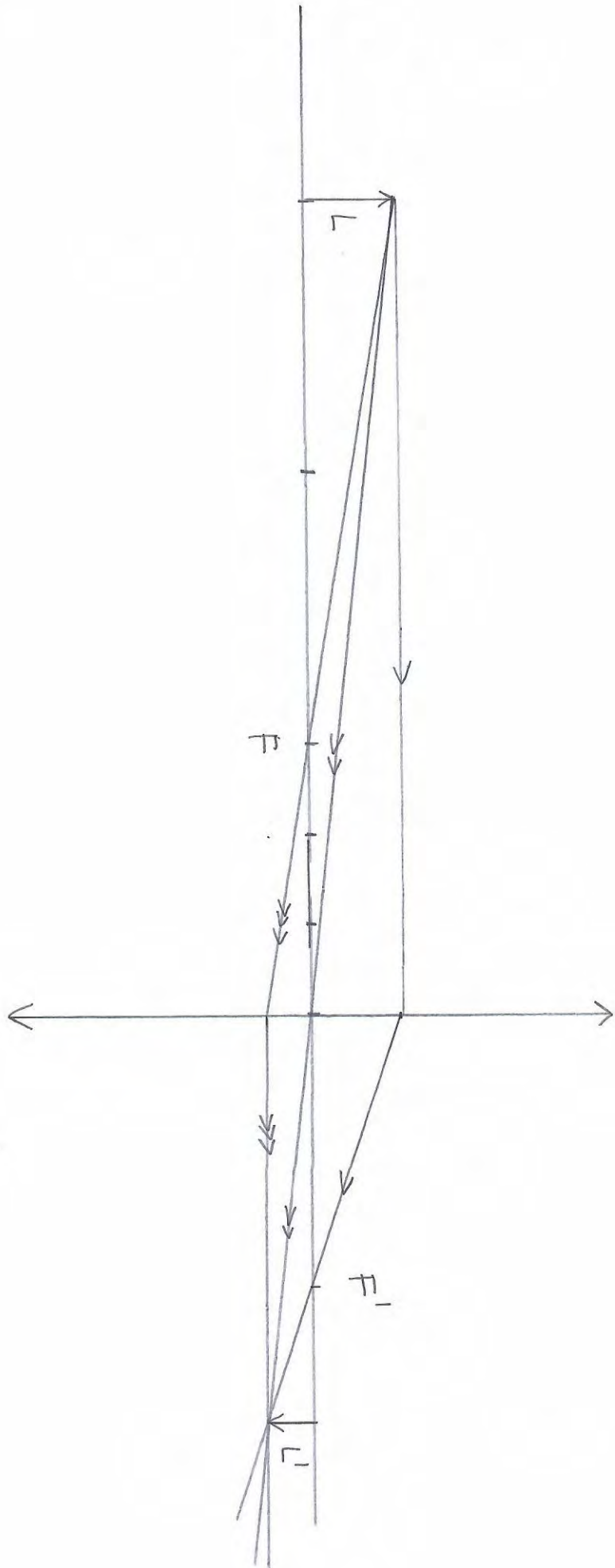
$$\frac{1}{e} = \frac{1}{250} \left(\frac{1}{3} - \frac{1}{2} \right) \text{ mm}^{-1} = \frac{1}{250} \frac{2-3}{6} \text{ mm}^{-1} = -\frac{1}{250 \cdot 6} \text{ mm}^{-1}$$

$$e = -250 \cdot 6 \text{ mm} \Rightarrow \boxed{e = -1500 \text{ mm}}$$

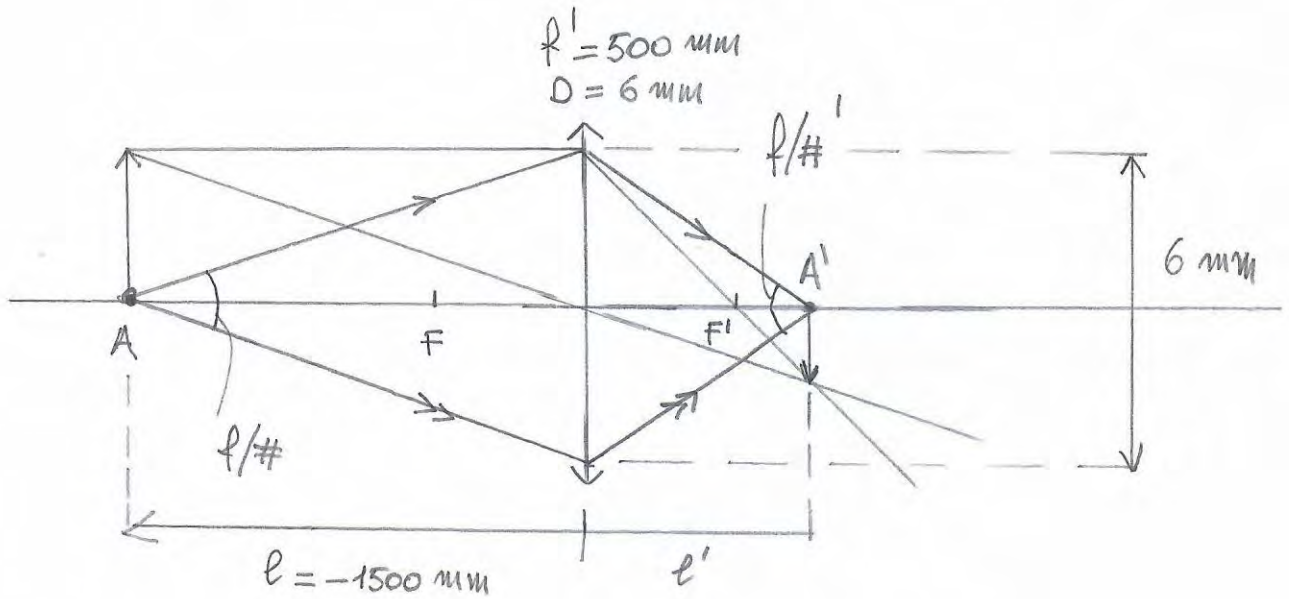
$$m = \frac{e'}{e} = \frac{750}{-1500} \Rightarrow m = -\frac{1}{2}$$

$$L' = |m| L = \frac{1}{2} \cdot 150 \text{ mm} \Rightarrow \boxed{L' = 75 \text{ mm}}$$

ESERCIZIO 1/19



ESERCIZIO 1/20



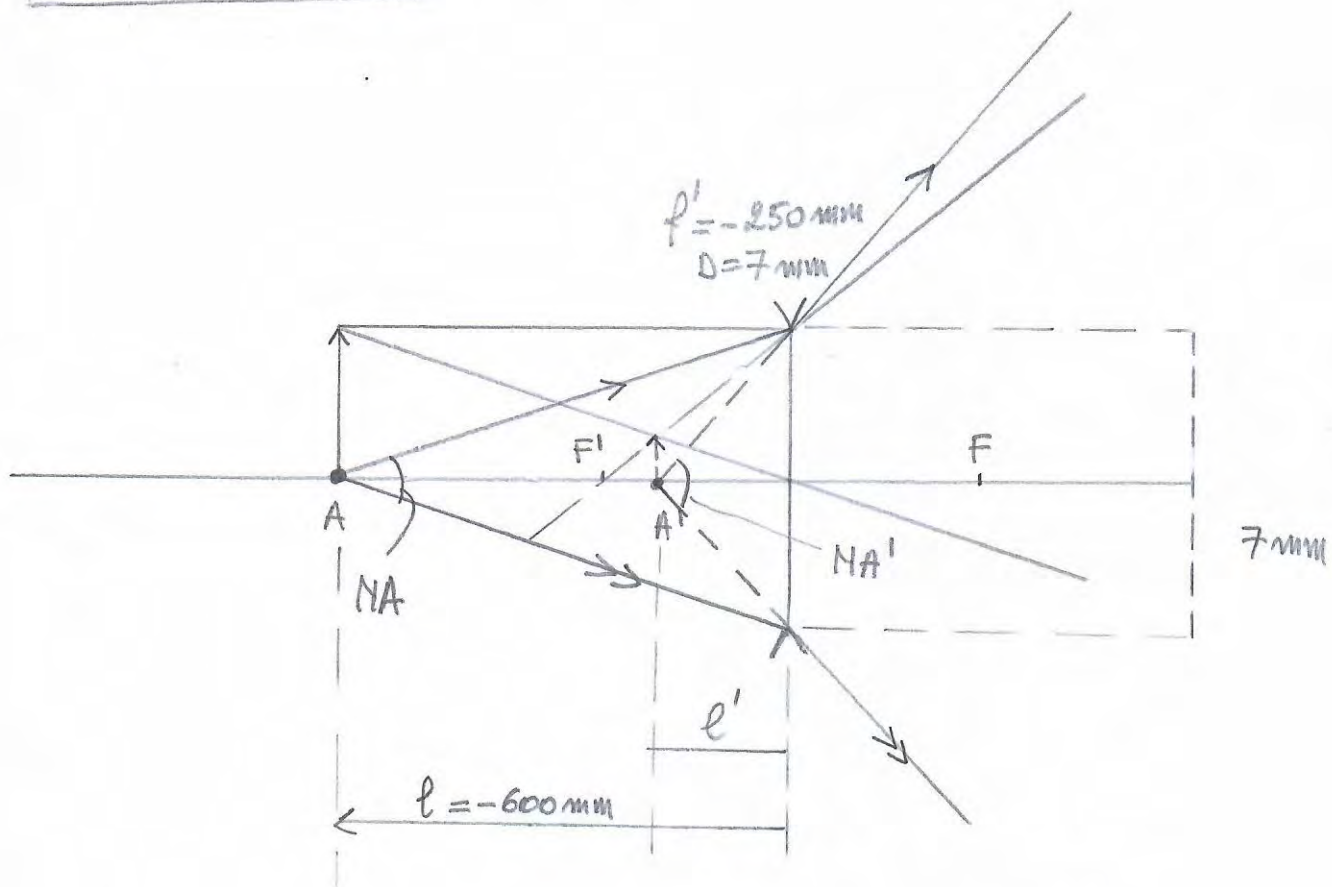
La costruzione grafica ha solo lo scopo di individuare la posizione di A' sull'asse.

$$\frac{1}{l'} = \left(\frac{-1}{1500} + \frac{1}{500} \right) \text{mm}^{-1} = \frac{-1 + 3}{1500} \text{mm}^{-1} \Rightarrow l' = \frac{1500}{2} = 750 \text{ mm}$$

$$f/\# = \frac{|l|}{D} = \frac{1500}{6} \Rightarrow \boxed{f/\# = 250}$$

$$f/\#' = \frac{|l'|}{D} = \frac{750}{6} \Rightarrow \boxed{f/\#' = 125}$$

ESERCIZIO 2/20



$$\frac{1}{l'} = \frac{-1}{600} - \frac{1}{250} \Rightarrow l' = 176,47 \rightarrow \boxed{A}$$

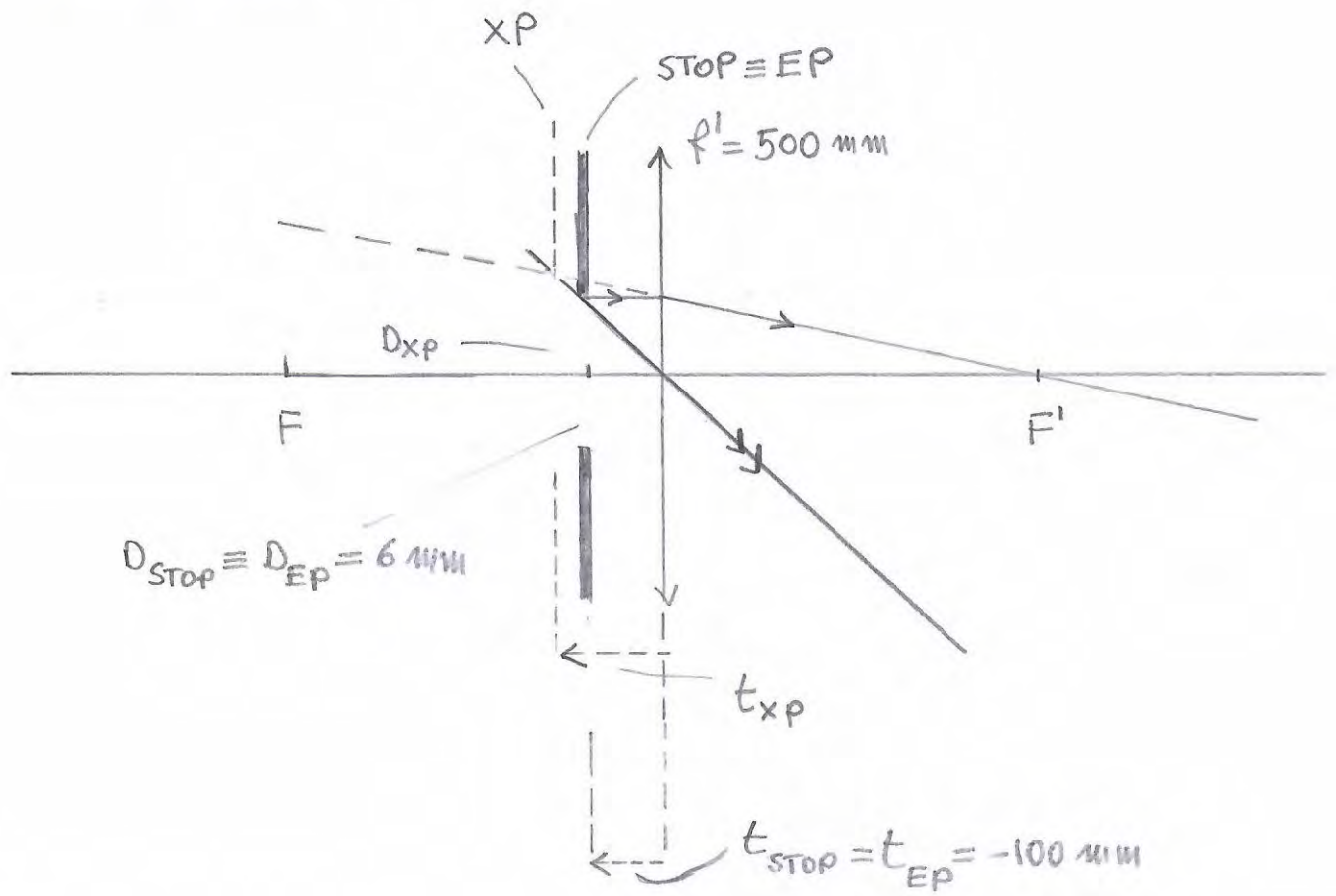
$$f/\# = \frac{|l|}{D} = \frac{600}{7}$$

$$NA = \frac{1}{2 f/\#} = \frac{7}{1200} \Rightarrow \boxed{NA = 0,0058\bar{3}}$$

$$f/\#' = \frac{|l'|}{D} = \frac{\boxed{A}}{7}$$

$$NA' = \frac{1}{2 f/\#'} = \frac{7}{2 \cdot \boxed{A}} \Rightarrow \boxed{NA' = 0,0198\bar{3}}$$

ESERCIZIO 1/21



Prima dello STOP non ci sono componenti ottici $\Rightarrow EP \equiv STOP \Rightarrow$

$$\boxed{t_{EP} = -100 \text{ mm}} \quad \text{e} \quad \boxed{D_{EP} = 6 \text{ mm}}$$

$$\frac{1}{t_{XP}} = \frac{1}{t_{STOP}} + \frac{1}{f'} = \left(\frac{-1}{100} + \frac{1}{500} \right) \text{mm}^{-1} = \frac{-5+1}{500} \text{mm}^{-1} = -\frac{4}{500} \text{mm}^{-1} = -\frac{1}{125} \text{mm}^{-1}$$

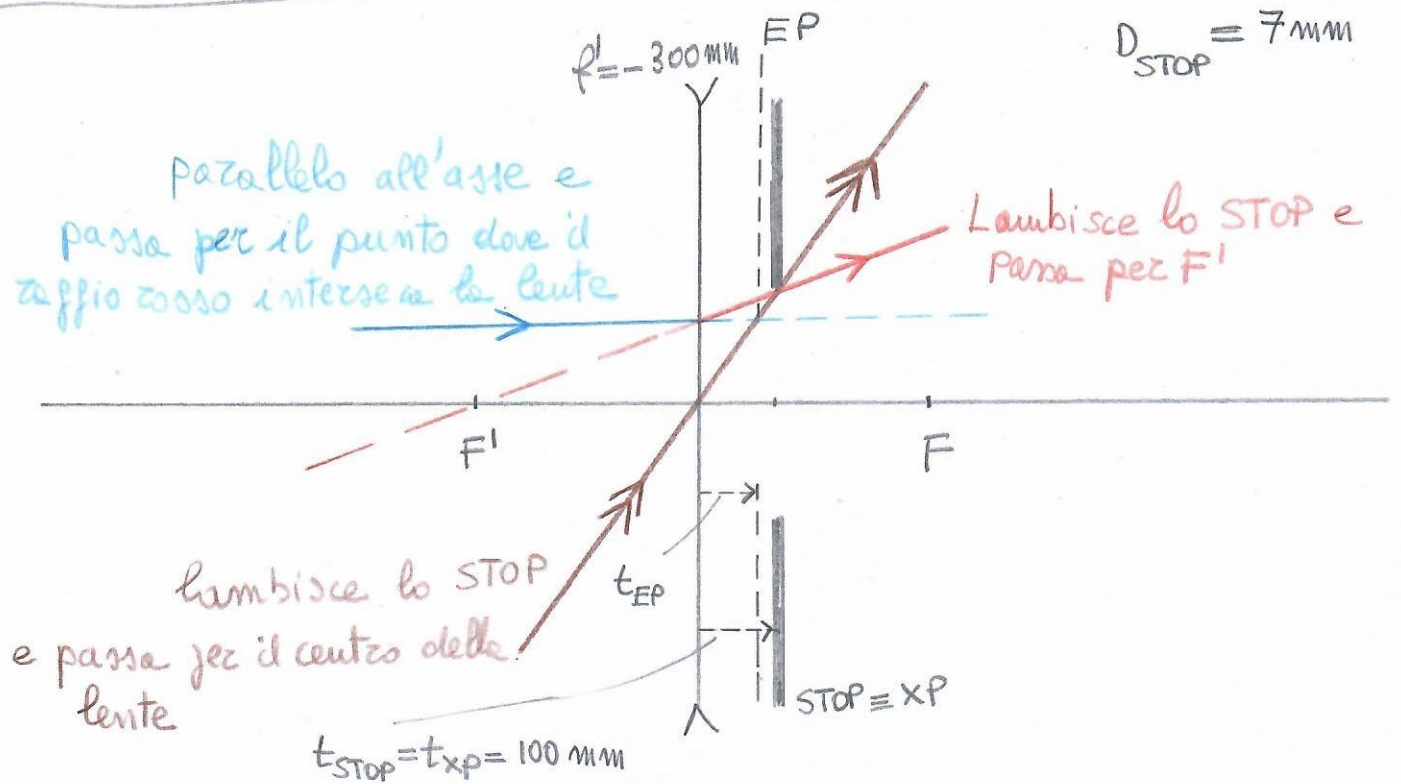
$$\boxed{t_{XP} = -125 \text{ mm}}$$

$$m = \frac{t_{XP}}{t_{STOP}} = \frac{-125}{-100} \Rightarrow m = 1,25$$

$$D_{XP} = |m| \cdot D_{STOP} = 1,25 \cdot 6 \text{ mm} \Rightarrow \boxed{D_{XP} = 7,5 \text{ mm}}$$

ESERCIZIO 2/21

a



Costruzione grafica per determinare l'oggetto (EP) conoscendo la sua immagine (STOP):

- 1) traccio il raggio rosso
 - 2) traccio il raggio blu
 - 3) traccio il raggio magenta
- } l'oggetto si trova dalle intersezione del raggio magenta con il prolungamento del raggio blu

Dopo lo STOP non ci sono componenti ottici $\Rightarrow \text{XP} \equiv \text{STOP} \Rightarrow$

$$t_{\text{XP}} = 100 \text{ mm}$$

$$D_{\text{XP}} = 7 \text{ mm}$$

$$\frac{1}{t_{\text{STOP}}} = \frac{1}{t_{\text{EP}}} + \frac{1}{f'} \Rightarrow \frac{1}{t_{\text{EP}}} = \frac{1}{t_{\text{STOP}}} - \frac{1}{f'} = \frac{1}{100} + \frac{1}{300} = \frac{3+1}{300} \text{ mm}^{-1}$$

$$t_{\text{EP}} = \frac{75}{\frac{300}{41}} \text{ mm} \Rightarrow t_{\text{EP}} = 75 \text{ mm}$$

ESERCIZIO 2/21

6

$$m = \frac{t_{\text{STOP}}}{t_{\text{EP}}} = \frac{100 \text{ mm}}{75 \text{ mm}} = \frac{100}{75}$$

$$D_{\text{STOP}} = |m| \cdot D_{\text{EP}} \Rightarrow D_{\text{EP}} = \frac{1}{|m|} \cdot D_{\text{STOP}} = \frac{75}{100} \cdot 7 \text{ mm} \Rightarrow$$

$$D_{\text{EP}} = 5,25 \text{ mm}$$

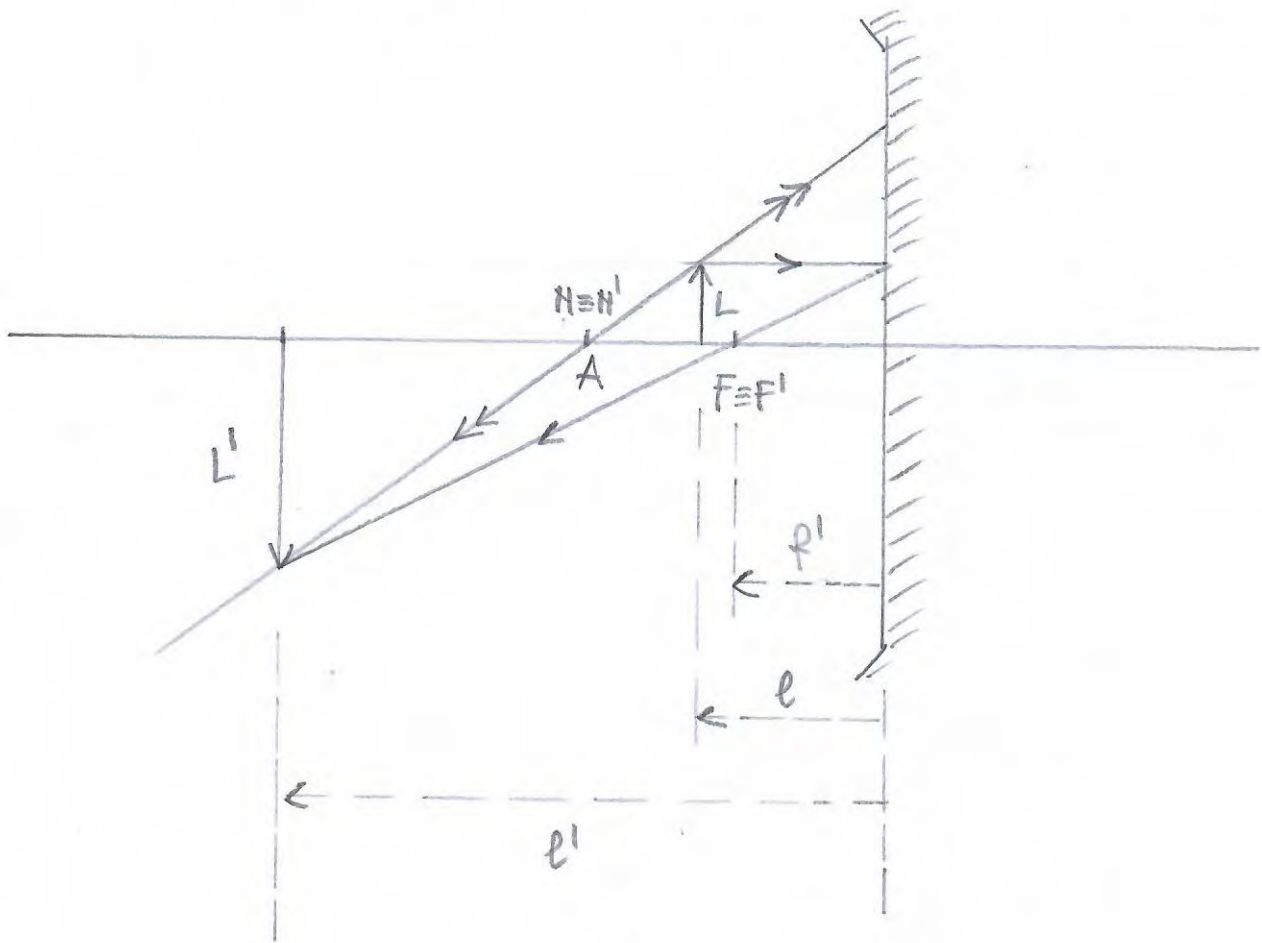
ESERCIZIO 1/22

$f' = -500 \text{ mm}$; $m = -3$; specchio in aria $\Rightarrow n_0 = 1$; $n_1 = -1$

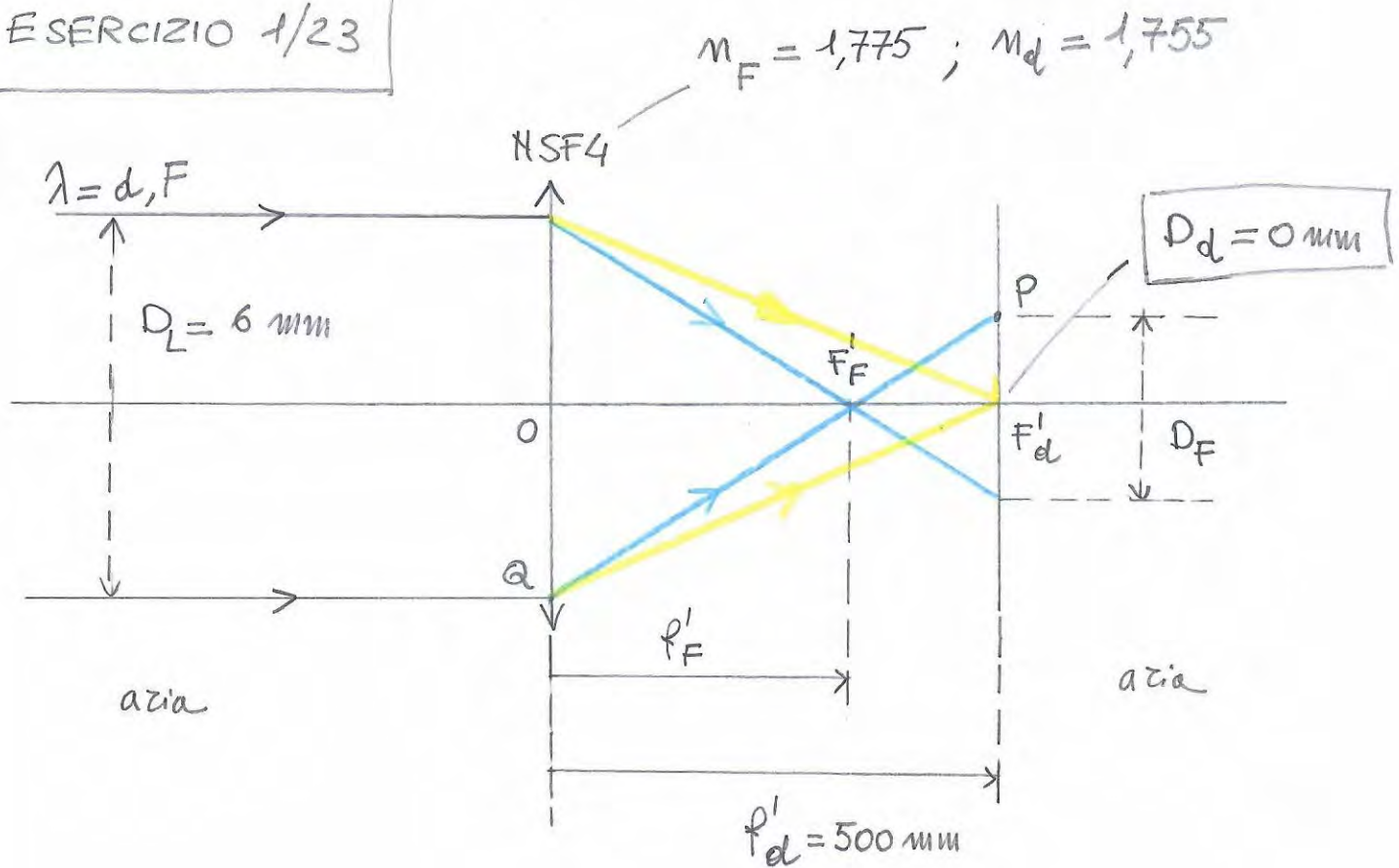
$$l = \frac{n_0}{n_1} \frac{1-m}{m} f' = - \frac{1+3}{-3} (-500) \text{ mm} = - \frac{2000}{3} \text{ mm} \Rightarrow$$

$$l = - \frac{2000}{3} \text{ mm} = -666,6 \text{ mm}$$

$$l' = (1-m) f' = (1+3)(-500) \text{ mm} \Rightarrow l' = -2000 \text{ mm}$$



ESERCIZIO 1/23



L'immagine della sorgente puntiforme gialla si trova sullo schermo nel punto F'_d . Mentre quella della sorgente blu è in F'_F a causa della dispersione $n_F \neq n_d$

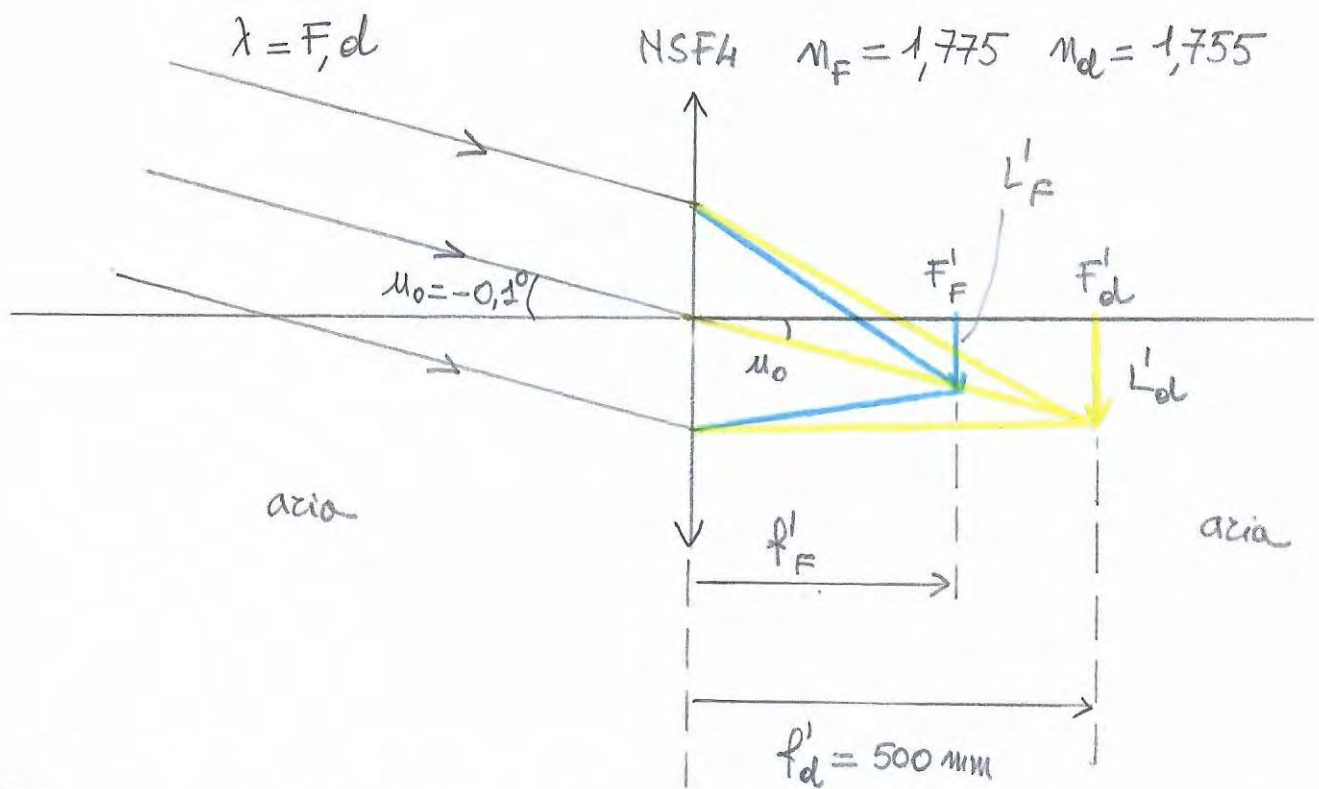
$$\frac{1}{f'_F} = (n_F - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right) = \frac{n_F - 1}{n_d - 1} \cdot \underbrace{(n_d - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)}_{1/f'_d} = \frac{n_F - 1}{n_d - 1} \frac{1}{f'_d} \Rightarrow$$

$$f'_F = \frac{0,755}{0,775} \cdot 500 \text{ mm} \rightarrow \boxed{A}$$

Essendo $f'_F \neq f'_d$, la sorgente puntiforme blu formerà sullo schermo una macchia luminosa di diametro D_F .
 $\triangle OAF'_F$ è simile a $\triangle F'_dPF'_F \Rightarrow$

$$\frac{D_F/2}{f'_d - f'_F} = \frac{D_L/2}{f'_F} \Rightarrow D_F = \frac{500 - \boxed{A}}{\boxed{A}} \cdot 6 \text{ mm} \Rightarrow \boxed{D_F = 0,159 \text{ mm}}$$

ESERCIZIO 1/24



Il piano oggetto all'infinito è coniugato con il secondo piano focale.

$$l'_d = f'_d \Rightarrow \boxed{f'_d = 500 \text{ mm}}$$

$$L'_d = |f'_d \cdot u_0| \Rightarrow L'_d = 500 \cdot \frac{0,1^\circ}{180^\circ} \cdot \pi \text{ mm} \Rightarrow \boxed{L'_d = 0,873 \text{ mm}}$$

$$\frac{1}{f'_F} = (n_F - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right) = \frac{n_F - 1}{n_d - 1} \underbrace{(n_d - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)}_{1/f'_d} \Rightarrow f'_F = \frac{n_d - 1}{n_F - 1} f'_d$$

$$f'_F = \frac{0,755}{0,775} \cdot 500 \text{ mm} \rightarrow \boxed{A}$$

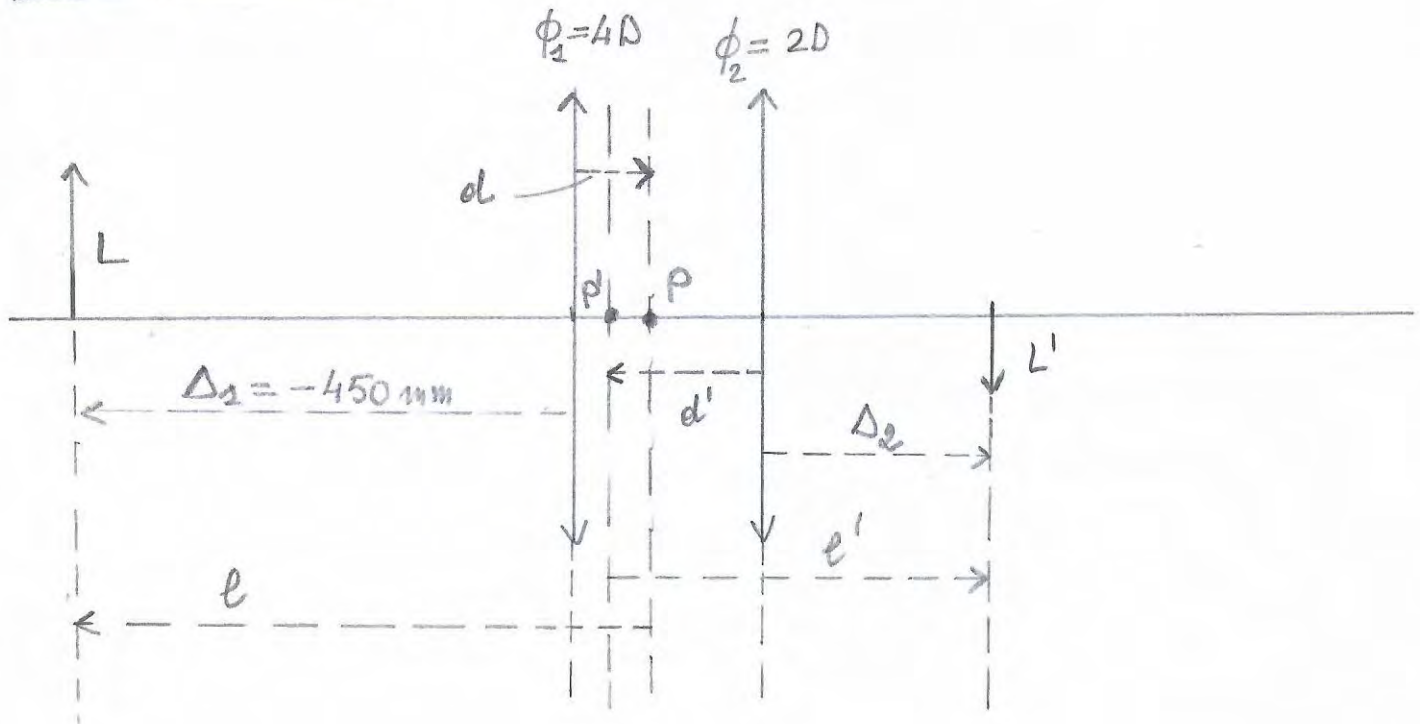
$$l'_F = f'_F \Rightarrow \boxed{l'_F = 487,097 \text{ mm}}$$

$$L'_F = |f'_F \cdot u_0| \Rightarrow L'_F = \boxed{A} \cdot \frac{0,1^\circ}{180^\circ} \cdot \pi \text{ mm} \Rightarrow \boxed{L'_F = 0,850 \text{ mm}}$$

Esercizio 1/25

a

$$\phi = 50$$



$$\phi = \phi_1 + \phi_2 - t \phi_1 \phi_2 = 50 \Rightarrow \phi_1 + \phi_2 - 50 = t \phi_1 \phi_2 \Rightarrow$$

$$t = \frac{\phi_1 + \phi_2 - 50}{\phi_1 \phi_2} = \frac{4 + 2 - 5}{8} \text{ m} \Rightarrow t = \frac{1}{8} \text{ m} = 125 \text{ mm}$$

$$f' = \frac{1}{\phi} = \frac{1}{5} \text{ m} \Rightarrow f' = \frac{1}{5} \text{ m} = 200 \text{ mm}$$

$$f_{pe} = -\frac{1 - t \phi_2}{\phi} = -\frac{1 - \frac{1}{8} \cdot 2}{5} \text{ m} = -\frac{4 - 1}{4} \cdot \frac{1}{5} \text{ m} \Rightarrow$$

$$f_{pe} = -\frac{3}{20} \text{ m} = 150 \text{ mm}$$

$$b_{pe} = \frac{1 - t \phi_1}{\phi} = \frac{1 - \frac{1}{8} \cdot 4}{5} \text{ m} = \frac{2 - 1}{2} \cdot \frac{1}{5} \text{ m}$$

$$b_{pe} = \frac{1}{10} \text{ m} = 100 \text{ mm}$$

ESERCIZIO 1/25

6

$$d = \frac{\phi_2 \cdot t}{\phi} = \frac{2}{5} \cdot \frac{1}{8} \text{ m} \Rightarrow d = \frac{1}{20} \text{ m} = 50 \text{ mm}$$

$$d' = -\frac{\phi_1}{\phi} \cdot t = -\frac{4}{5} \cdot \frac{1}{2} \text{ m} \Rightarrow d' = -\frac{1}{10} \text{ m} = -100 \text{ mm}$$

osservare che P' è a sinistra di P .

$$l = \Delta_1 - d = (-450 - 50) \text{ mm} \Rightarrow l = -500 \text{ mm}$$

$$\frac{1}{e'} = \frac{1}{l} + \frac{1}{f'} = \left(\frac{-1}{500} + \frac{1}{200} \right) \text{ mm}^{-1} = \frac{-2 + 5}{1000} \text{ mm}^{-1} \Rightarrow l' = \frac{1000}{3} \text{ mm}$$

$$\Delta_2 = l' + d' = \left(\frac{1000}{3} - 100 \right) \text{ mm} = \frac{1000 - 300}{3} \text{ mm} \Rightarrow$$

$$\Delta_2 = \frac{700}{3} \text{ mm} = 233,3 \text{ mm}$$