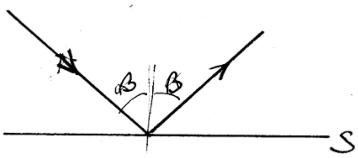
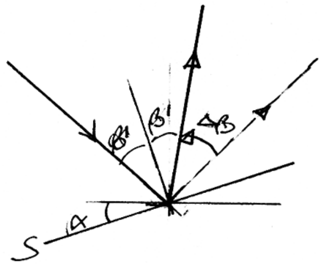
Strahlenoptik

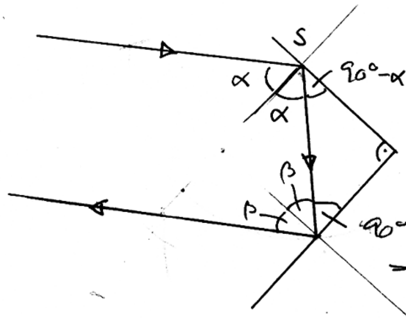
1.





$$\beta' = \beta - \alpha$$
$$\Rightarrow \Delta\beta = 2\cdot\beta - 2\cdot\beta' = 2\cdot(\beta-\beta') = 2\cdot\alpha$$

2.



$90° - (90°-\alpha) = \alpha$

$\Rightarrow \beta = 90° - \alpha$

$\Rightarrow$ totale Ablenkung:

$$2\cdot\alpha + 2\cdot\beta = 2\cdot(\alpha + 90° - \alpha) = 180°$$

$\Rightarrow$ parallele Strahlen

3. $$\Delta t = \frac{l}{c_M} = \frac{l\cdot n}{c} = \frac{5'600\cdot 10^3\,m \cdot 1{,}33}{3{,}0\cdot 10^8\,m/s} = \underline{25\,ms}$$

4. $$n_L\cdot\sin\alpha = n_W \sin\beta \quad\rightarrow\quad \beta = \arcsin\left(\frac{n_L}{n_W}\cdot\sin\alpha\right) = \begin{cases} 17{,}8° & \text{(rot)} \\ 17{,}7° & \text{(blau-violett)}\end{cases}$$
$$n_L \cong 1{,}00, \quad n_W = \begin{cases} 1{,}33 & \text{(rot)} \\ 1{,}34 & \text{(blau-violett)}\end{cases}$$

5. $$n_L \sin\alpha = n_G\cdot(\sin(\alpha-\delta)) \quad\Rightarrow\quad \text{SOLVE}(\sin x = 1{,}9225\cdot\sin(x-9{,}5),\ x)$$
$$\Rightarrow x = \underline{19{,}5°}$$

6. $$\sin\alpha_g = \frac{n_L}{n_G} \quad\Rightarrow\quad n_G = \frac{n_L}{\sin\alpha_g} = \frac{1}{\sin 43°} = \underline{1{,}47}$$

7. $$\sin\alpha_g = \frac{n_P}{n_G} \quad\Rightarrow\quad \alpha_g = \arcsin\left(\frac{n_P}{n_G}\right) = \arcsin\left(\frac{1{,}491}{1{,}5163}\right) = \underline{79{,}5°}$$

8. $$f = \frac{1}{D} = \frac{1}{-5{,}5\,m^{-1}} = \underline{-18\,cm}$$ (Streulinse, daher negative Brennweite)

9. $$\frac{1}{f} = \frac{1}{g} + \frac{1}{b} \quad\rightarrow\quad b = \left(\frac{1}{f} - \frac{1}{g}\right)^{-1} = \left(\frac{1}{50\cdot 10^{-3}\,m} - \frac{1}{0{,}55\,m}\right)^{-1} = \underline{5{,}5\,cm}$$
$$\frac{B}{G} = \frac{b}{g} \quad\rightarrow\quad G = B\,\frac{g}{b} = 35\,mm\cdot\frac{55}{5{,}5} = \underline{35\,cm}$$

10. $$\frac{1}{f} = \frac{1}{g} + \frac{1}{b} \quad\rightarrow\quad f = \left(\frac{1}{g} + \frac{1}{b}\right)^{-1} = \left(\frac{1}{0{,}5\,m} + \frac{1}{0{,}3\,m}\right)^{-1} = 18{,}75\,cm$$
$$\frac{1}{f} = \frac{1}{g'} + \frac{1}{b'} \quad\rightarrow\quad b' = \left(\frac{1}{f} - \frac{1}{g'}\right)^{-1} = \left(\frac{1}{0{,}1875\,m} - \frac{1}{0{,}4\,m}\right)^{-1} = \underline{35\,cm}$$

11. virtuelles Bild $\rightarrow$ negative Bildweite: $b = -25\,cm$
$$\frac{1}{f} = \frac{1}{g} + \frac{1}{b} \quad\Rightarrow\quad g = \left(\frac{1}{f} - \frac{1}{b}\right)^{-1} = \left(\frac{1}{0{,}35\,m} - \frac{1}{-0{,}25\,m}\right)^{-1}$$
$$= \left(\frac{1}{0{,}35\,m} + \frac{1}{0{,}25\,m}\right)^{-1} = \underline{15\,cm}$$