Ex. 1

Ett reducerat öga har $n' = 1.336$, $F_0 = 62\,D$ och längden 26.2 mm. Vilken av följande linser fungerar bäst för

a) avståndsseende och

b) närarbete (0.5 m)

(i) + 2 D, (ii) − 9 D, (iii) −11 D

Lösning:

$n' = 1.336$

$F_0 = 62\,D \Rightarrow f' = \frac{n'}{F} = \frac{1.336}{62}\,m \approx 0.02155\,m = 21.55\,mm$

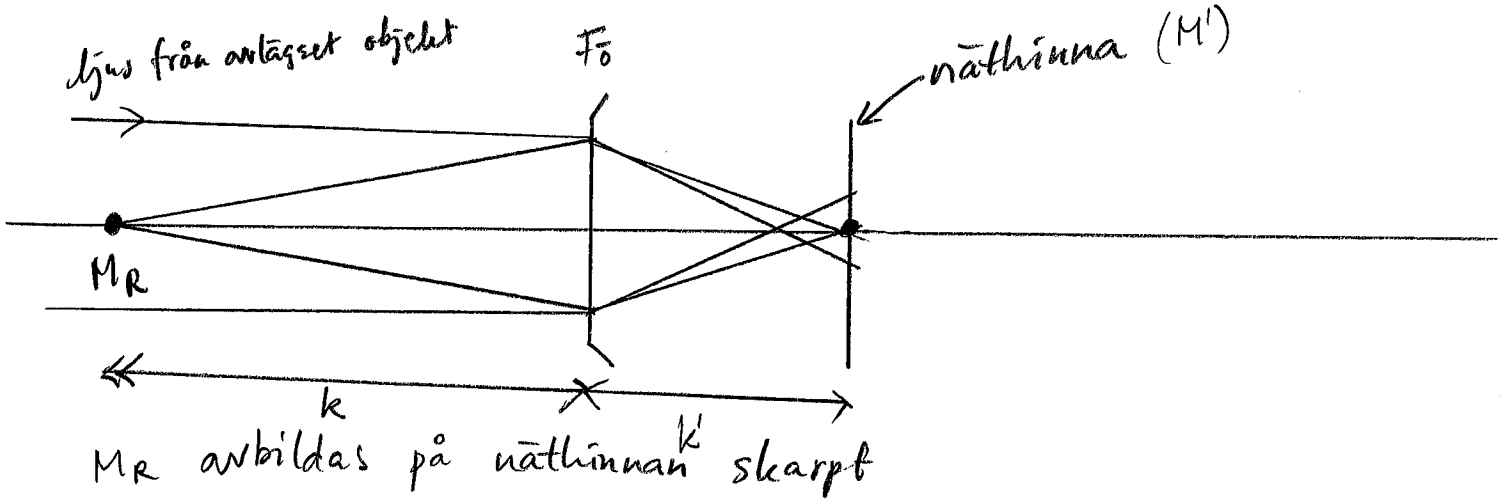
$k' = 26.2\,mm = 0.0262\,m$

$K' = \frac{n'}{k'} = \frac{1.336}{0.0262}\,D \approx 51\,D$

$K = K' - F_0 = 51 - 62\,D = -11\,D$

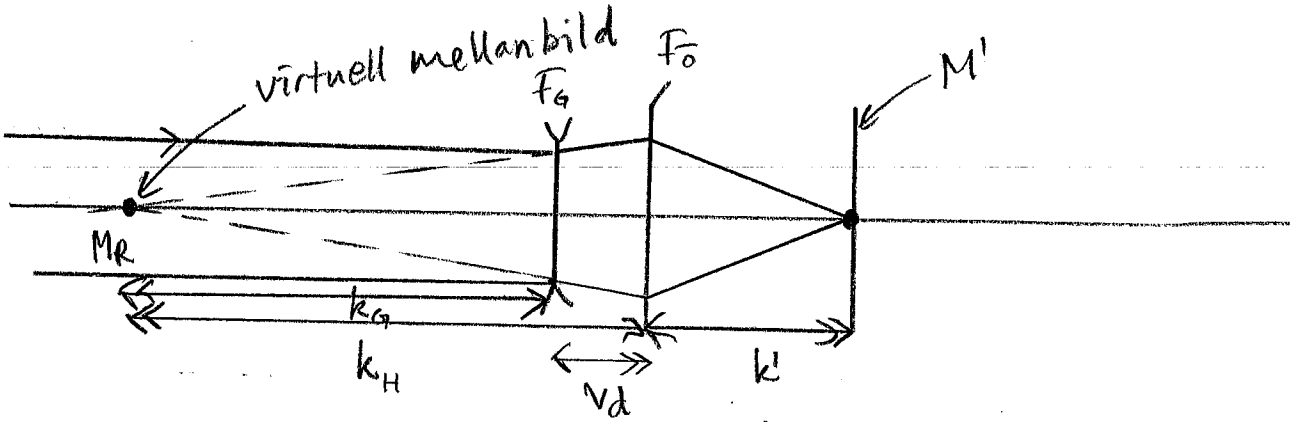
$\Rightarrow K < 0 \iff$ Myopi

k är avståndet från ögat till ögats fjärrpunkt (M_R)



M_R avbildas på näthinnan skarpt

Med glasögonkorrektion skall linsen avbilda objektet (avlägset/närliggande) till en mellanbild i ögats fjärrpunkt.



K_H = Huvudpunktsrefraktion ($v_d = 0$)

K_G = Glasögonrefraktion

Antag nu att v_d är litet $\Rightarrow v_d \approx 0$.

$\Rightarrow k_G \approx k_H$

$\Rightarrow K_G \approx K_H$

$K_G = L_G + F_G \Rightarrow F_G = K_G - L_G$

a) avståndsseende:

$$L_G = \frac{1}{-\infty} = 0\,D \Rightarrow F_G = -11 - 0\,D = \underline{-11\,D}$$

b) närarbete ($l = -0.5\,m$)

$$L_G = \frac{1}{-0.5} D = -2\,D$$

$$F_G = -11 - (-2)\,D = \underline{-9\,D}$$

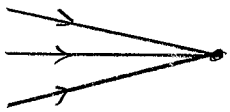
CVO

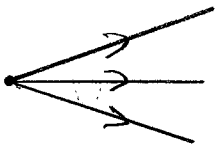
2.1

a) A pencil of rays emerges from a lens with a vergence of +6.00 D. What is its vergence after a travel of 10 mm in air?

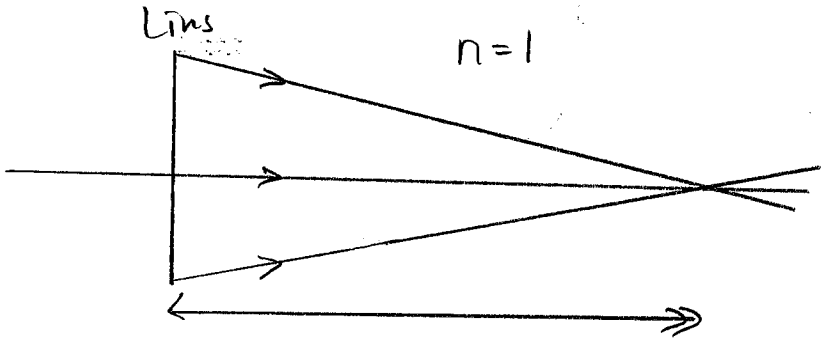
b) A pencil of rays emerges from a lens with a vergence of -8.00 D. What is its vergence after a travel of 15 mm in air?

Lösning

Vergens > 0 $\Longleftrightarrow$ Strålar konvergerar 

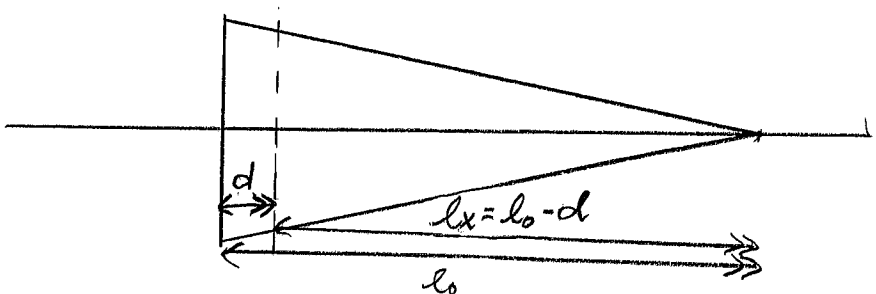
Vergens < 0 $\Longleftrightarrow$ Strålar divergerar 

a)



$$L_o = \frac{1}{l_o} = +6.00\ D \Rightarrow l = \frac{1}{6}\ m = 0.167\ m$$

Tittar på situationen d=10mm efter linsen:

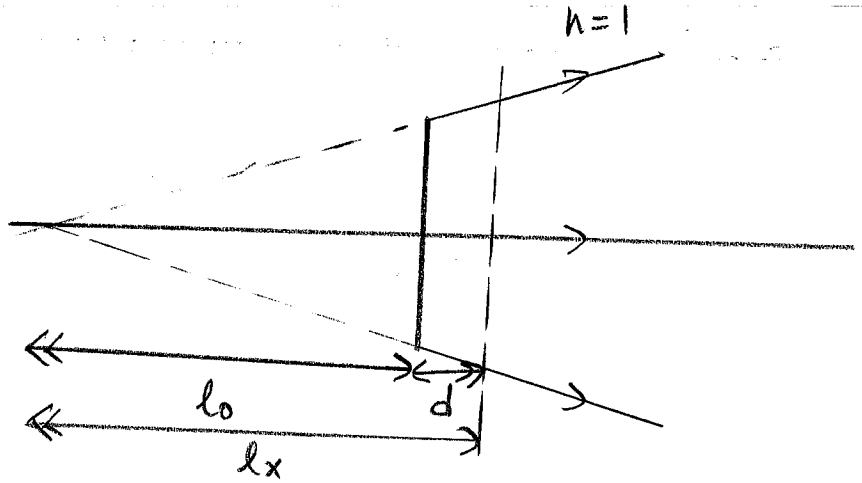


$$L_x = \frac{1}{l_x} = \frac{1}{l_0 - d} = \frac{1}{0.167 - 0.01} D = \frac{1}{0.157} D \approx \underline{6.38\,D}$$

Alt. ekv. (2-11)

$$L_x = \frac{L_0}{1 - \frac{d}{n} L_0} = \frac{6}{1 - 0.01 \cdot 6} D \approx \underline{6.38\,D}$$

b)



$$L_0 = \frac{1}{l_0} = -8.00\,D \Rightarrow l_0 = \frac{1}{-8.00} = -0.125\,m$$

$$L_x = \frac{1}{l_x} = \frac{1}{l_0 - d} = \frac{1}{-0.125 - 0.015} D = \frac{1}{-0.140} D \approx \underline{-7.14\,D}$$

Alt. ekv. (2-11)

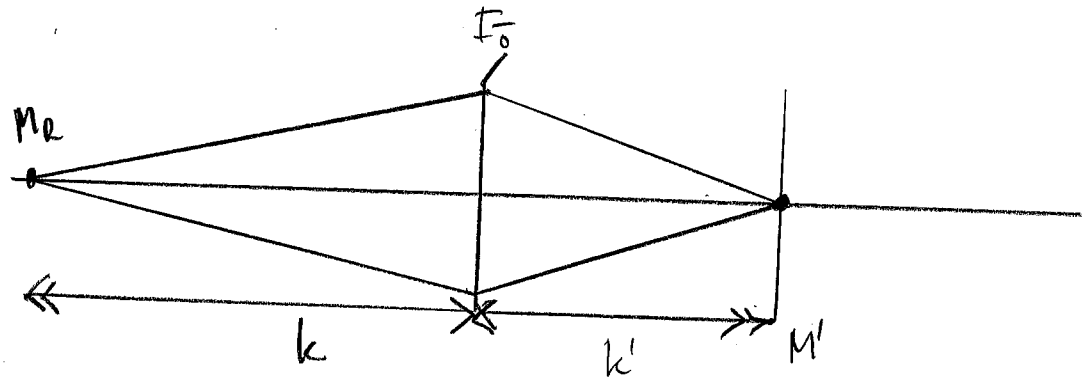
$$L_x = \frac{L_0}{1 - \frac{d}{n} L_0} = \frac{-8.00}{1 - 0.015(-8.00)} D \approx \underline{-7.14\,D}$$

CVO

4.1 Find the position of the far-point for each of the following ocular refraction errors:
a) ± 2.50 D, b) ± 5.00 D, c) ± 7.50 D, d) ± 10.00 D.
Make a graph of the results, choosing suitable scales for each variable.

Lösning

Ocular refraction $\Leftrightarrow K = K' - F_0$



Fjärrpunkten ligger på avstånd k från ögat.

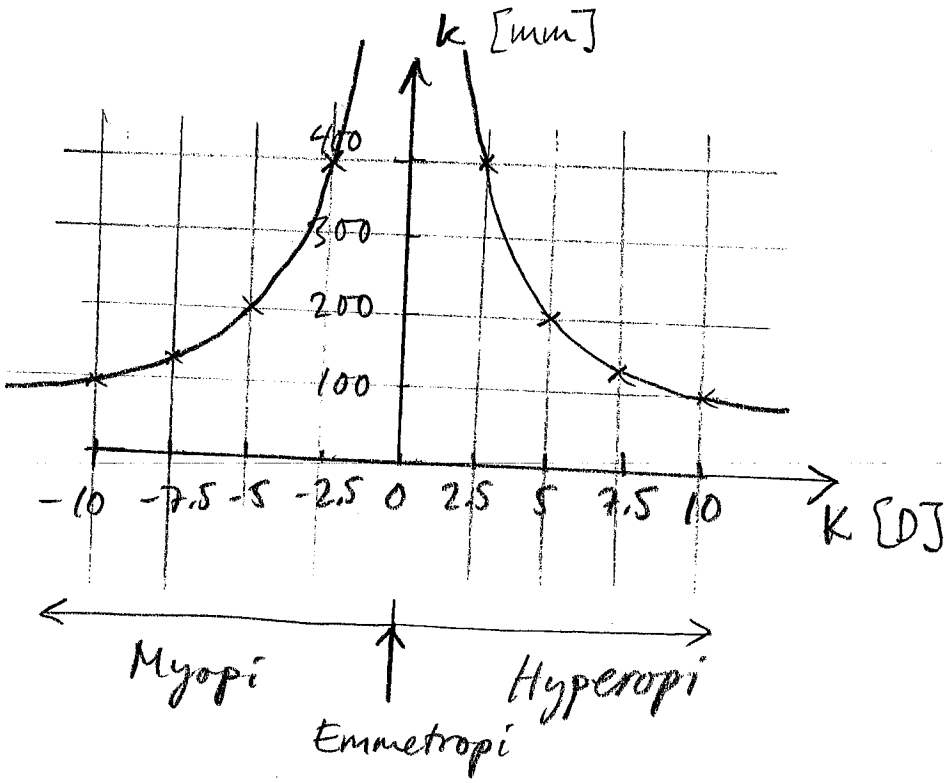
$$k = \frac{n}{K} = \frac{1}{K}$$

a) $k = \frac{1}{\pm 2.50}\ m = \pm 0.4\ m = \pm 400\ mm$

b) $k = \frac{1}{\pm 5.00}\ m = \pm 0.2\ m = \pm 200\ mm$

c) $k = \frac{1}{\pm 7.5}\ m \approx \pm 0.133\ m \pm$

d) $k = \frac{1}{\pm 10.00}\ m = \pm 0.1\ m$


k [mm]
400
300
200
100
-10
-7.5
-5
-2.5
0
2.5
5
7.5
10
K [D]
Myopi
Hyperopi
Emmetropi

CVO

4.2

Calculate the static refractive error (if any) of each of the following reduced eyes, taking $n' = 1.336$

d) Corneal radius = $5.86\,mm = 5.86 \cdot 10^{-3}\,m$
Axial length = $22.22\,mm = 22.22 \cdot 10^{-3}\,m$

Løsning:

$$K = K' - F_0'$$

$$F_0' = \frac{n' - n}{r} = \frac{1.336 - 1.0}{5.86 \cdot 10^{-3}}\,D \approx 57.34\,D$$

$$K' = \frac{n'}{k'} = \frac{1.336}{22.22 \cdot 10^{-3}}\,D \approx 60.13\,D$$

$$K = 60.13 - 57.34\,D = \underline{\underline{2.79\,D}}\ (>0 \Leftrightarrow \text{hyperopi})$$