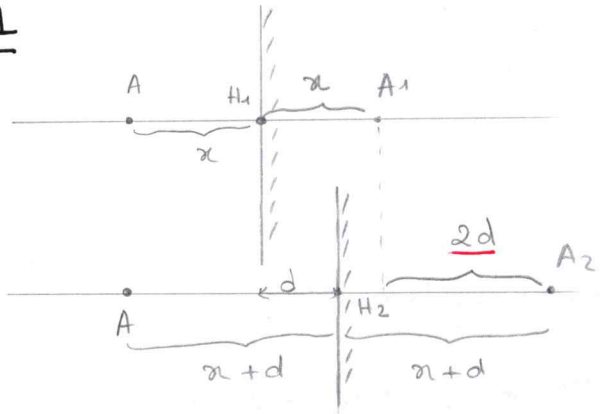
Chapitre 2 - Formation d'1 image

QCM : 1c ; 2a,e ; 3b ; 4.bc ; 5b ; 6a,e ; 7a

Exercices

Ex 1

1)

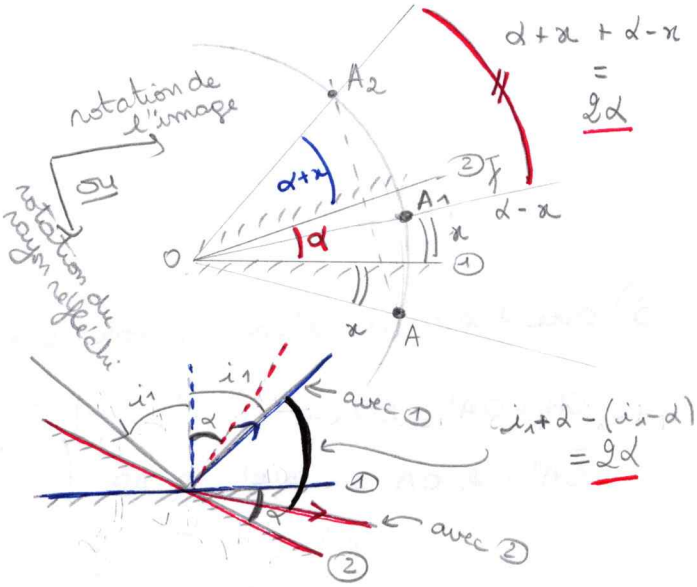


$AA_2 = 2x + 2d$ $\quad AA_1 = 2x$

$A_1A_2 = AA_2 - AA_1 = 2d$

ou $\overline{A_1A_2} = \underbrace{\overline{A_1H_1}}_{-x} + \underbrace{\overline{H_1H_2}}_{d} + \underbrace{\overline{H_2A_2}}_{d+x} = 2d$

2)

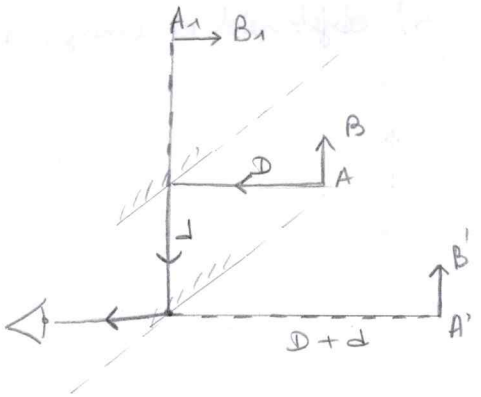


Ex 2

1) $AB \xrightarrow{M_1} A_1B_1 \xrightarrow{M_2} A'B'$

A_1B_1 : symétrique de AB / rapport au plan du miroir M_1

$A'B'$: symétrique de A_1B_1 / rapport au plan du miroir M_2



2) $\gamma = \gamma_1 \times \gamma_2 = 1$

Ex 3/4

...

Ex 5

$\dfrac{1}{\overline{OA'}} - \dfrac{1}{\overline{OA}} = \dfrac{1}{f'}$ $\qquad \overline{OA'} = 2\,m$ $\qquad \overline{OA} = \dfrac{\overline{OA'} \times f'}{f' - \overline{OA'}} = \dfrac{2 \times 5 \times 10^{-2}}{5 \times 10^{-2} - 2} = -0{,}051\,m$

Rq : $\overline{OA'} \gg f'$ on peut considérer une image à l'∞ $\rightarrow OA \simeq f'$

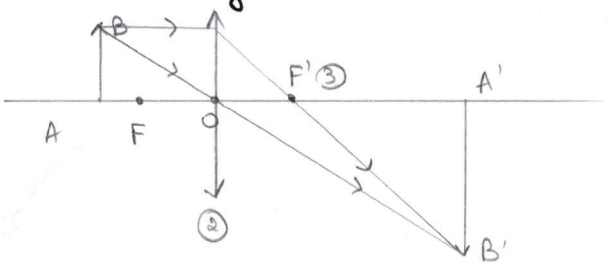
- $\overline{AB} = 24\,mm \Rightarrow |\overline{A'B'}| = 24 \times \dfrac{2}{0{,}051} = 941\,mm$
- $\overline{AB} = 36\,mm \Rightarrow |\overline{A'B'}| = 36 \times \dfrac{2}{0{,}051} = 1412\,mm$

$\Big\}$ $0{,}94\,m \times 1{,}41\,m$

Ex 6 :

1) objet réel et image réelle : lentille CV

2)



⚠ image renversée

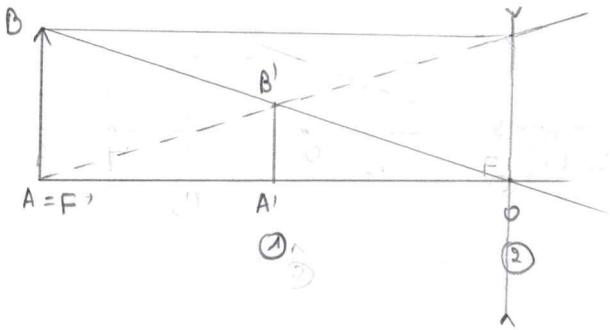
① $A'B' = 2\,AB$
② on place O et donc la lentille
③ on détermine F et F' graphiquement

3) avec l'aide du schéma et donc sans grandeur algébrique :

$$\left.\begin{array}{l} OA + OA' = 90\ cm \\ OA' = 2\,OA \text{ car } A'B' = 2\,AB \end{array}\right\} \quad 3\,OA = 90\ cm \Rightarrow \begin{array}{l} \overline{OA} = -30\ cm \\ \overline{OA'} = 60\ cm \end{array}$$

$$f' = \frac{\overline{OA'} \times \overline{OA}}{\overline{OA} - \overline{OA'}} = \frac{-30 \times 60}{-90} = 20\ cm$$

4) objet réel et image virtuelle +petite : lentille DV



$$OA' = \frac{OA}{2} \text{ car } A'B' = \frac{AB}{2}$$

$$AA' = 90\ cm = OA - OA' = OA'$$

$$\overline{OA'} = -90\ cm \quad \overline{OA} = -180\ cm$$

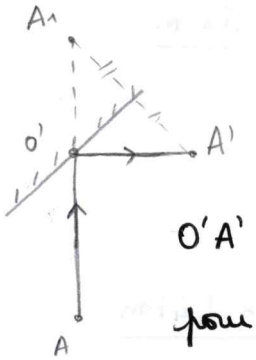
$$f' = \frac{90 \times 180}{-180 + 90} = -180\ cm$$

Ex 7

1) $AB \xrightarrow{L} A_1B_1$ $\quad \frac{1}{\overline{OA_1}} - \frac{1}{\overline{OA}} = \frac{1}{f'} \rightarrow \overline{OA_1} = \frac{f'\,\overline{OA}}{f' + \overline{OA}} = \frac{30 \times (-35)}{30 - 35} = 210\ cm$

$$A_1B_1 = AB\ \frac{OA_1}{OA} = 10 \times \frac{210}{35} = 60\ cm$$

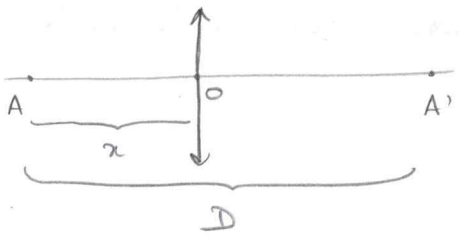
2)



$O'A' = O'A_1 = OA_1 - d = 2\ m$

pour 1 miroir $\gamma = 1 \Rightarrow A'B' = A_1B_1 = 60\ cm$

Ex 8 :



1) $\overline{OA} = -x$

$\overline{OA'} = D - x$

$$\frac{1}{D-x} + \frac{1}{x} = \frac{1}{f'} \iff \frac{D}{(D-x)x} = \frac{1}{f'}$$

$$\iff x^2 - xD + Df' = 0$$

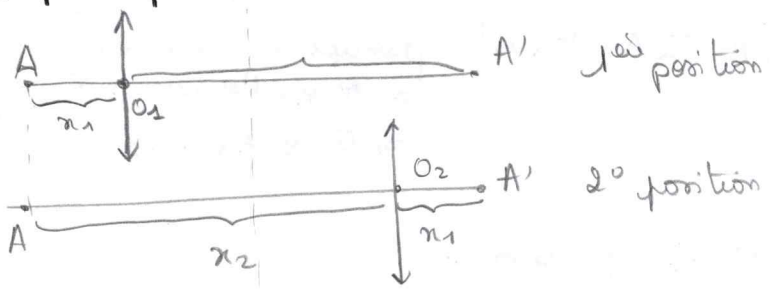
2) cette équation admet 2 solutions réelles si $\Delta \geq 0$

$$\Delta = D^2 - 4Df' > 0 \iff D \geq 4f'$$

3) $x_1 = \frac{D + \sqrt{\Delta}}{2}$ $\quad x_2 = \frac{D - \sqrt{\Delta}}{2}$ $\quad d = x_1 - x_2 = \sqrt{\Delta}$

$$d^2 = D^2 - 4Df' \rightarrow f' = \frac{D^2 - d^2}{4D}$$

4) principe de retour inverse de la lumière :

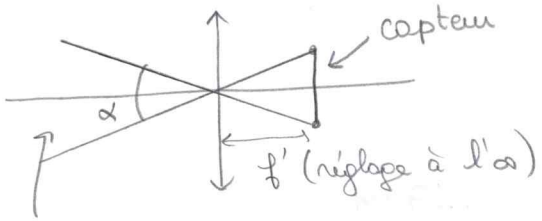


$x_1 + x_2 = D$

$\gamma_1 = \frac{1}{\gamma_2}$

Ex 9 :

1)

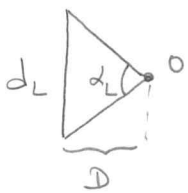


portion de l'espace photographié

$$\alpha_v = 2 \arctan\left(\frac{d_v}{2f'}\right) = 0{,}12 \text{ rad}$$

$$\alpha_h = 2 \arctan\left(\frac{d_h}{2f'}\right) = 0{,}17 \text{ rad}$$

2)



$$\alpha_L = 2 \arctan\left(\frac{d}{2D}\right) = 9 \times 10^{-3} \text{ rad}$$

$\alpha_L < \alpha_h$ et α_v → en entier sur le capteur

3) on veut $\alpha_v = \alpha_L \iff \frac{d_v}{2f'} = \frac{d}{2D}$ → $f' = \frac{d_v D}{d} = 1{,}6 \text{ m}$

Ex 10

1) on ne peut pas obtenir 1 image réelle d'1 objet réel avec 1 lentille divergente

2) L' doit être convergente

3) $A \xrightarrow{L'} A_1 \xrightarrow{L_1} A'$

$$\frac{1}{\overline{O_1A'}} - \frac{1}{\overline{O_1A_1}} = \frac{1}{f'_1} \qquad \overline{O_1A_1} = 60 \text{ mm}$$

$\overline{O_1A'} = 180$ mm ; $f'_1 = -90$ mm

$$\frac{1}{\overline{O'A_1}} - \frac{1}{\overline{O'A}} = \frac{1}{f'}$$

$\overline{O'A_1} = \overline{O'O_1} + \overline{O_1A_1} = 84$ mm

$\overline{O'A} = -180$ mm

$f' = 57,3$ mm

4) $\gamma_{total} = \gamma' \times \gamma_1 = 1,4$ en surface : $\gamma^2_{total} = 2$ → tirage $A_4 \rightarrow A_3$

5) $\frac{1}{f'} = \frac{1}{f'_2} + \frac{1}{f'_3} \rightarrow f'_3 = \frac{f' f'_1}{f'_1 - f'} = 35$ mm CV

6) on obtient la situation inverse : $A \xrightarrow{L_1 = L_2} A'_1 \xrightarrow[L_1+L_3]{L'} A'$: principe de retour inverse

⇒ A' sur l'écran et $\gamma_{total} = \frac{1}{1,4}$

⇒ tirage $A_4 \rightarrow A_5$

Ex 11

Ⓗ objet à l'∞ car distance = 1,46 km >> $f' = 18$ mm.

$\overline{OA} = -1,46$ km $\quad \overline{OA'} = 18$ mm

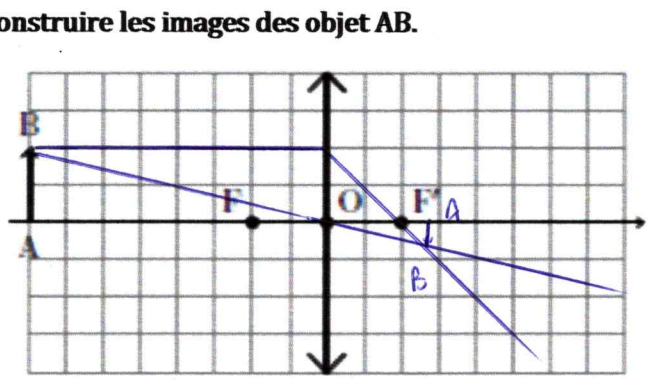
$$|\gamma| = \frac{18 \times 10^{-3}}{1,46 \times 10^3} = \frac{A'B'}{AB}$$

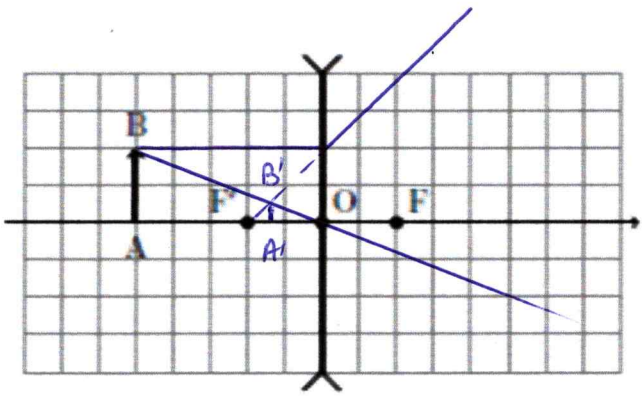
On estime $A'B'$: $A'B' \simeq 1,9$ mm → $AB \simeq 157$ m

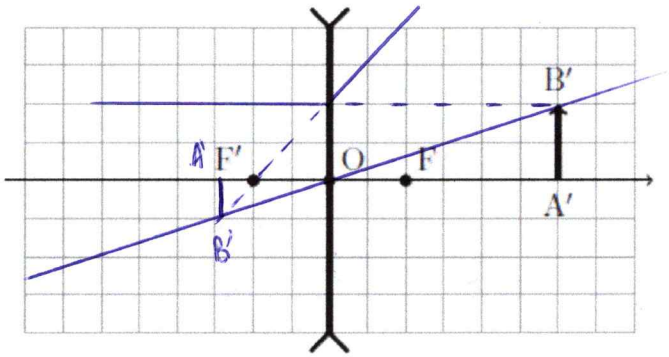
Rq : hauteur réelle = 157,10 m

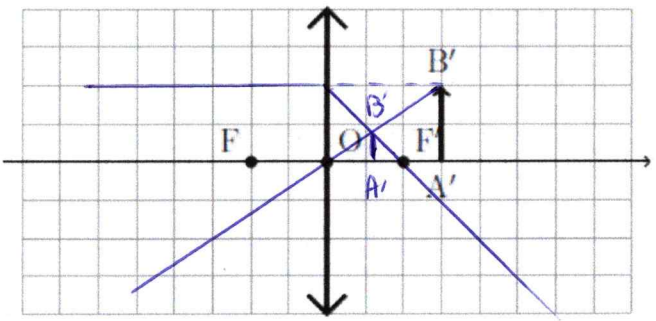
Ex 3

Construire les images des objet AB.



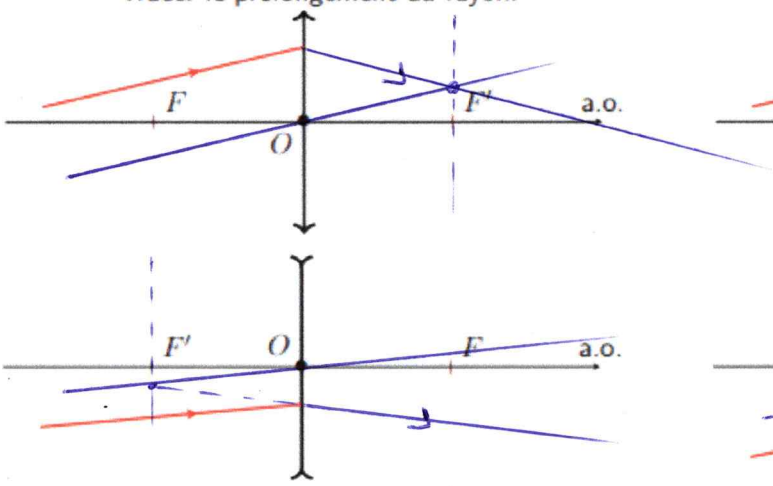




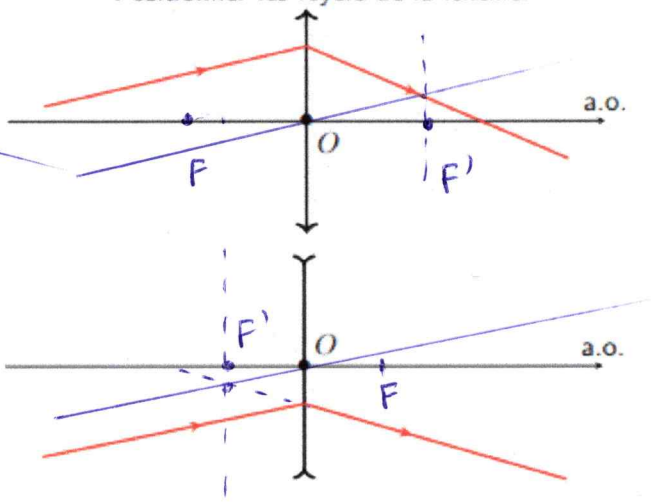


Ex 4

Tracer le prolongement du rayon.



Positionner les foyers de la lentille.



Ex 2 Tracé des rayons