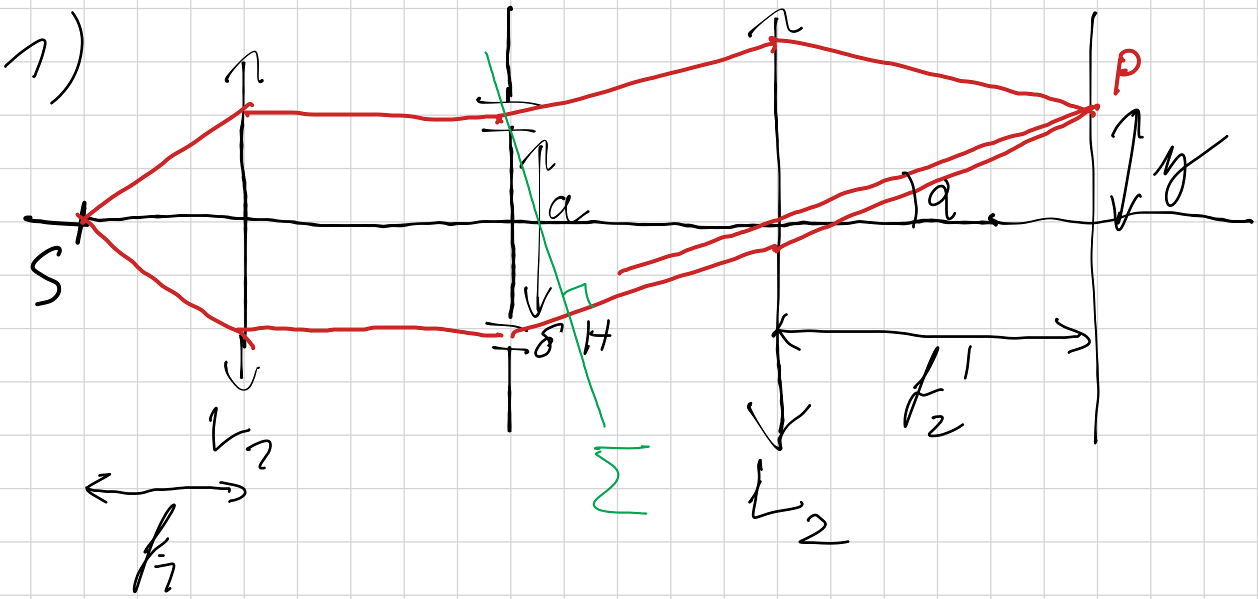
Exo 3 - Optique

1)



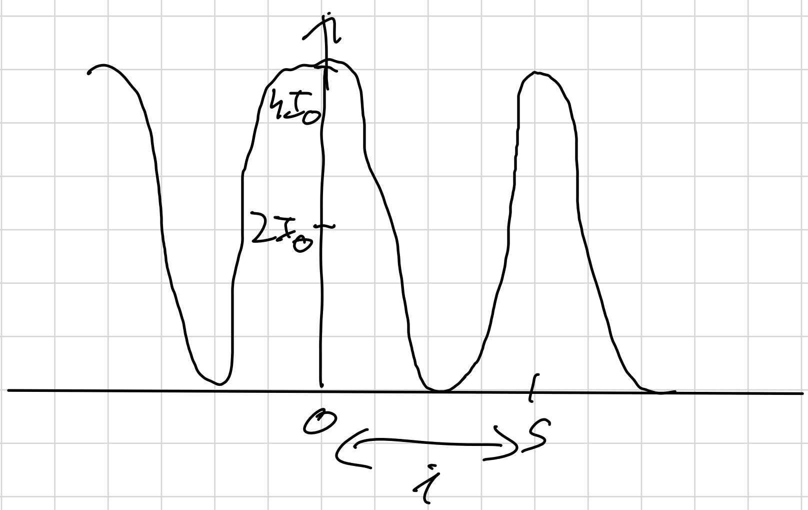
$$\tan(\alpha) = \frac{y}{f_2'}$$

$$\sin(\alpha) = \frac{\delta}{a}$$

2) $\delta = \dfrac{ya}{f_2'}$

$$I(y) = 2I_0\left(1 + \cos\left(\frac{2\pi\delta}{\lambda_0}\right)\right)$$

$$= 2I_0\left(1 + \cos\left(\frac{2\pi y a}{\lambda_0 f_2'}\right)\right)$$



$$i = \frac{\lambda_0 f_1'}{a}$$

3)

$$10\, i = 1{,}2 \,.\, 10^{-2}$$

$$\frac{\lambda_0 f_1'}{a} = 1{,}2 \,.\, 10^{-3}$$

$$a = \frac{480 \times 10^{-9} \times 1{,}00}{1{,}2 \,.\, 10^{-3}}$$

$$= \frac{480}{1{,}2} \cdot 10^{-6} = 4 \,.\, 10^{-6}\ \text{m}$$

4) $\delta' = \frac{ya}{f_2'} + ne - e$

$\delta = 0$ pour $y = 0$

$\delta' = 0$ pour $y = -\frac{(n-1)e f_2'}{a}$

< 0

5) $\delta'(0) = \left(k + \frac{1}{2}\right) \lambda_0$ $\quad k \in \mathbb{Z}$

$(n-1)e = \left(k + \frac{1}{2}\right) \lambda_0$

$$n = \frac{\left(k + \frac{1}{2}\right)\lambda_0}{e} + 1$$

$\longrightarrow 1{,}490 < n < 1{,}500$

$$k = \frac{(n-1)e - \frac{\lambda_0}{2}}{\lambda_0} = (n-1)\frac{e}{\lambda_0} - \frac{1}{2}$$

A.N: $0{,}49 \times \frac{e}{\lambda_0} - \frac{1}{2} < k < 0{,}5 \frac{e}{\lambda_0} - \frac{1}{2}$

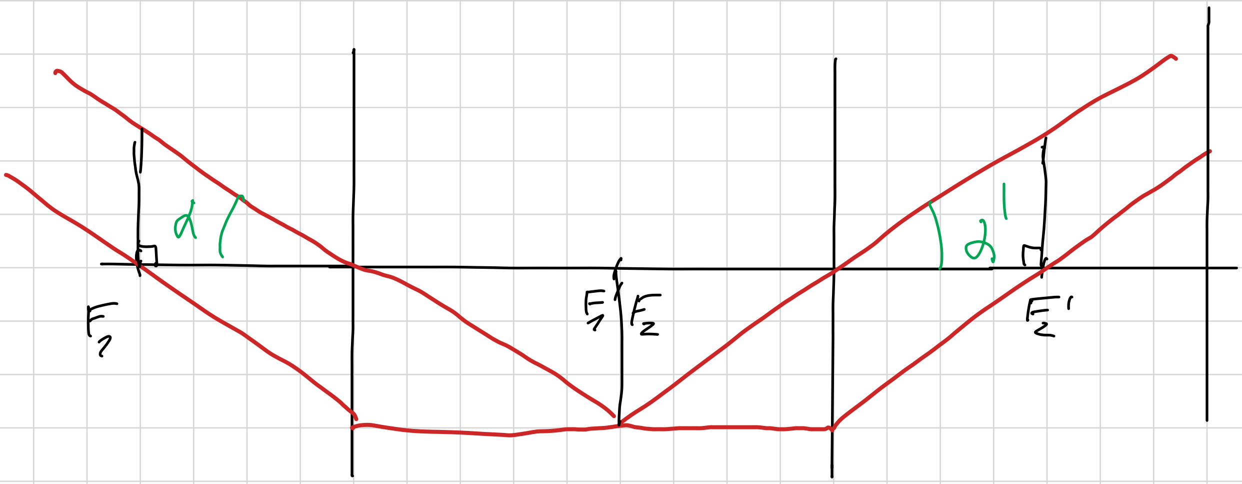
$14{,}8 < k < 15{,}1$

$k = 15$

Exo 2 - Optique

1) A la fin

2)



Système afocal

3) $G = \dfrac{\alpha'}{\alpha} = \dfrac{f_1'}{f_2'}$

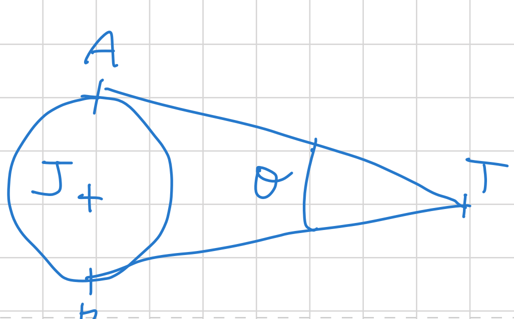
4) $f' = 10$ mm (ou 25 mm)(ou 30 mm)

A.N: $50 = \dfrac{f_1'}{10}$

$\Rightarrow f_1' = 500$ mm
$= 50$ cm

1) limite de résolution de l'oeil : $1' = \dfrac{1^\circ}{60}$

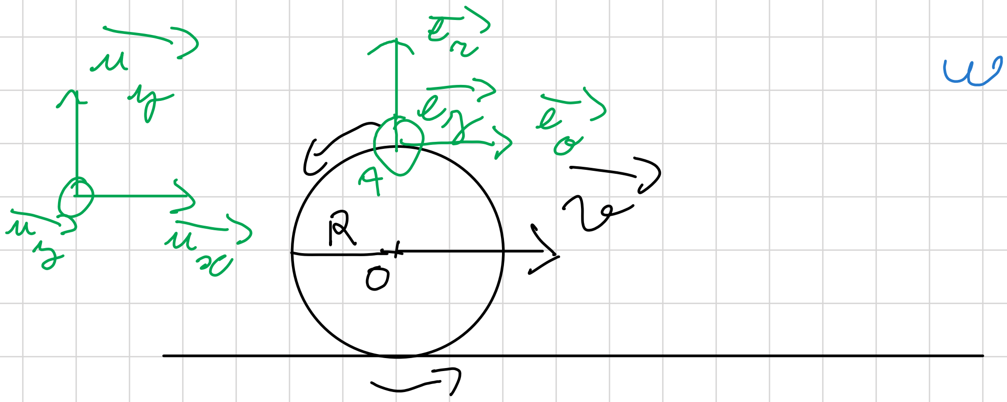
$= 0{,}3$ mrad



$\theta \simeq \dfrac{AB}{d_{TJ}}$

d_{TJ}

Exo 5 - Mécanique



$\omega = \frac{2\pi}{T}$, $v = \frac{2\pi R}{T}$, $R\omega = v$

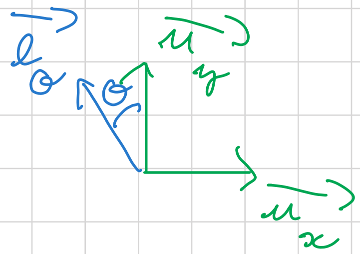
1)

$\vec{v_A} = \vec{v_O} + \vec{AO} \wedge \vec{\Omega}$

$= v\,\vec{u_x} + R\,\vec{e_r} \wedge \omega\,\vec{e_y}$

$= v\,\vec{u_x} + v\,\vec{e_\theta}$

⚠ $\vec{\Omega} = -\omega\,\vec{e_y}$



$\vec{e_\theta} = \cos\theta\,\vec{u_y} - \sin\theta\,\vec{u_x}$

$\vec{v_A} = (v - v\sin\theta)\,\vec{u_x} + v\cos\theta\,\vec{u_y}$

2)

$$\begin{cases} \dot{x}_A = v - v\sin\theta = R\dot{\theta} - R\dot{\theta}\sin\theta \\ \dot{y}_A = v\cos\theta = R\dot{\theta}\cos\theta \end{cases}$$

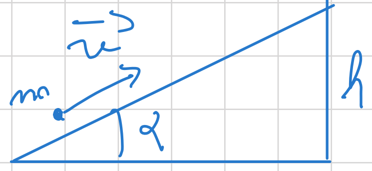
$x_A = R\theta + R\cos\theta = R\omega t + R\cos(\omega t) + cste1$

$y_A = R\sin\theta = R\sin(\omega t) + cste\,2$

$x_A(0) = 0 \Rightarrow cste\,1 = -R$

$y_A(0) = R \Rightarrow cste\,2 = R$

3)



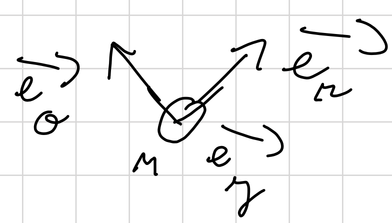
$$\Delta E_c = 0$$

$$\Delta E_m = mgh = \mathcal{P}_{cycliste}\,\Delta t - f_{fr}\, v\, \Delta t$$

$$\frac{h}{\Delta t} = v_y$$

Exo 3 - Mécanique

7)



$$\overrightarrow{OM} = r\,\vec{e_r}$$

$$\vec{v} = r\dot{\theta}\,\vec{e_\theta}$$

$$\vec{a} = r\ddot{\theta}\,\vec{e_r} - r\dot{\theta}^2\,\vec{e_\theta}$$

Bilan des forces : $\vec{f}(r) = f(r)\,\vec{e_r}$

PFD :

$$m\vec{a} = f(r)\,\vec{e_r}$$

donc $r\ddot{\theta} = 0$

Donc $\dot{\theta}$ est constante

$$f_{g,T} = G\,\frac{m M_T}{r_0^2} \qquad f_{g,S} = G\,\frac{m M_S}{R_{TS}^2}$$

$$\frac{f_{g,T}}{f_{g,S}} = \frac{M_S\, r_0^2}{M_T\, R_{ST}^2} = \frac{10^{30}\cdot 10^{6}}{10^{24}\cdot 10^{16}} \approx 10^{-4}$$