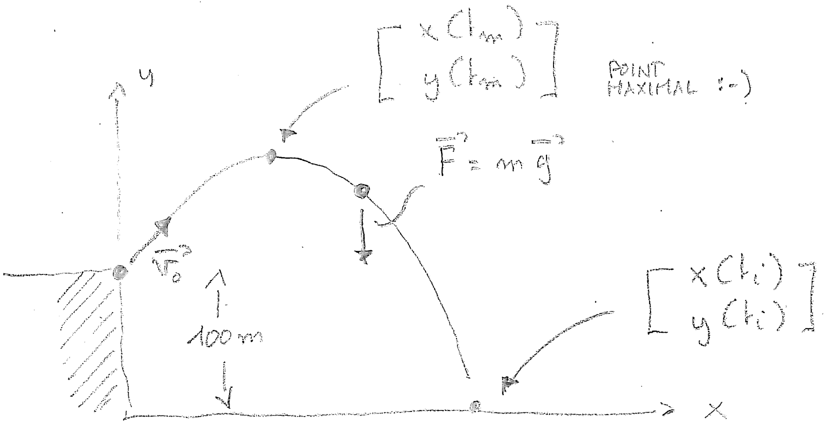
1



$$x(t) = 0 + v_{x0}\, t$$
$$y(t) = 100 + \underbrace{v_{y0}}\, t - g\frac{t^2}{2}$$

MRUA :-)

$v_0 = 25$, 53°

$v_{y0} = \underbrace{25 \sin(53^\circ)}_{20\ m/s}$

$v_{x0} = \underbrace{25 \cos(53^\circ)}_{15\ m/s}$

1 $\quad 0 = 100 + 20t - 4,9t^2$

$$0 = \underbrace{4,9}_{a}\, t^2 - \underbrace{20}_{b}\, t - \underbrace{100}_{c}$$

$$t'_{''} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \begin{cases} 6,9 \text{ [sec]} \\ -2,9 \text{ [sec]} \text{ à rejeter!} \end{cases}$$

TEMPS
$t_i = 7$ [sec]

2 $\quad t_m$ tel que $\frac{dy}{dt}(t_m) = 0$

$$20 - g\, t_m = 0$$
$$\to t_m = \frac{20}{9,81} = 2 \text{ [sec]}$$

$$y(t_m) = 100 + \underbrace{20 \times 2}_{40} - \underbrace{9,81 \times \frac{4}{2}}_{20} = 120 \text{ [m]}$$

3 $\quad x(t_i) = 0 + 15 \times 7 = 105$ [m]

4 $\quad v_x(t_i) = 15$ [m/s]

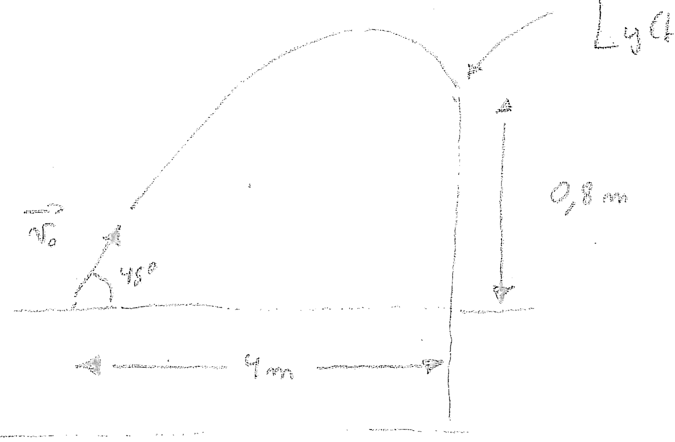
$v_y(t_i) = 20 - 9,81 * 7 = -48,6$ [m/s]

$\vec{v}(t_i)$

$$v(t_i) = \sqrt{15^2 + 48,6^2} \text{ [m/s]}$$

2

$$\begin{bmatrix} x(t_i) \\ y(t_i) \end{bmatrix} = \begin{bmatrix} 4 \\ 0{,}8 \end{bmatrix}$$



$$\boxed{\begin{aligned} x(t) &= v_0 \cos(45°)\, t \\ y(t) &= v_0 \sin(45°)\, t - g\, t^2/2 \end{aligned}}$$

MRUA :-)

$$\boxed{\begin{aligned} 4 &= v_0 \cos(45°)\, t_i \\ 0{,}8 &= v_0 \sin(45°)\, t_i - g\, t_i^2/2 \end{aligned}}$$

$$t_i = \frac{4}{v_0 \cos(45°)}$$

2 EQUATIONS
2 INCONNUES OK !

$$0{,}8 = 4 \underbrace{\frac{\sin(45°)}{\cos(45°)}}_{=1} - g \frac{16}{v_0^2 \underbrace{\cos^2(45°)}} \frac{1}{2}$$

$$1/2 = \frac{\sqrt{2}}{2}\frac{\sqrt{2}}{2} = \frac{2}{4} \text{ :-)}$$

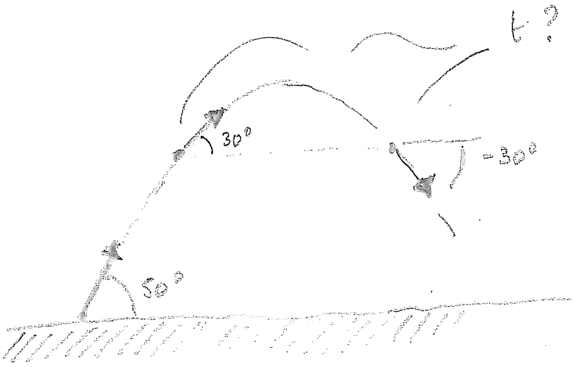
$$0{,}8 = 4 - \frac{9{,}81 \times 16}{v_0^2}$$

$$9{,}81 \times 16 = v_0^2 \,(\underbrace{4 - 0{,}8}_{3{,}2})$$

$$49 = v_0^2$$

$$\boxed{v_0 = 7 \text{ [m/s]}}$$

3



$$\boxed{\begin{aligned} x(t) &= \underbrace{25\cos(50°)}_{16{,}07}\, t \\ y(t) &= \overbrace{25\sin(50°)}^{19{,}15}\, t - \frac{9{,}81}{2} t^2 \end{aligned}}$$

MRUA :-)

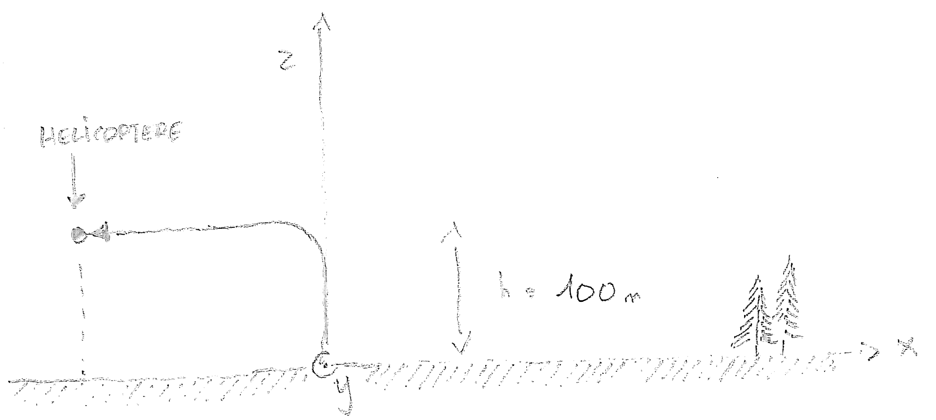
$$v_x(t) = 16{,}07$$
$$v_y(t) = 19{,}15 - 9{,}81\,t$$

$$\underbrace{\operatorname{tg}(\pm 30°)}_{\pm 1/\sqrt{3}} = \frac{19{,}15 - 9{,}81\,t}{16{,}07} = \frac{v_y(t)}{v_x(t)} \quad !$$

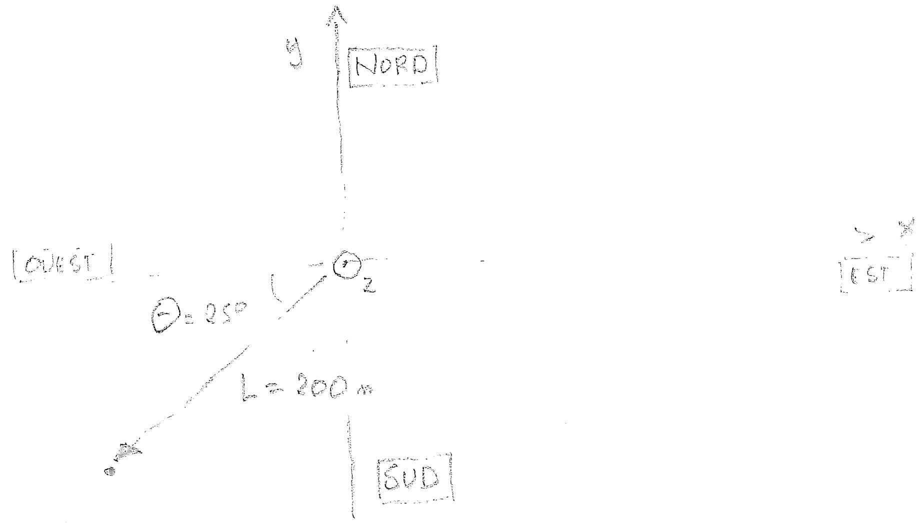
$$\underbrace{\pm \frac{16{,}07}{\sqrt{3}}}_{\pm 9{,}28} + 19{,}15 = 9{,}81\,t$$

$$\boxed{t = \begin{cases} 2{,}9\ [\text{sec}] \\ 1{,}0\ [\text{sec}] \end{cases}}$$

[4]



VUE EN COUPE !



VUE DU DESSUS !

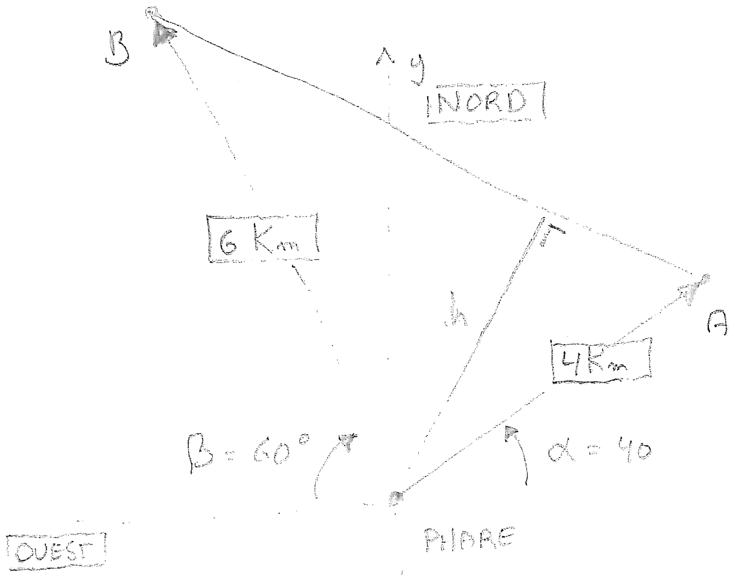
$$\vec{x} = \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -L\cos\theta \\ -L\sin\theta \\ h \end{bmatrix}$$

$$\vec{d} = \begin{bmatrix} x \\ y \\ z \end{bmatrix} - \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} -L\cos\theta \\ -L\sin\theta \\ h \end{bmatrix} = \underbrace{\begin{bmatrix} -200\cos(25°) \\ -200\sin(25°) \\ 100 \end{bmatrix}}_{\text{VECTEUR DEPLACEMENT}}$$

DEPLACEMENT

$$\boxed{\begin{bmatrix} -181{,}26 \\ -84{,}5 \\ 100 \end{bmatrix} = \vec{d}}$$

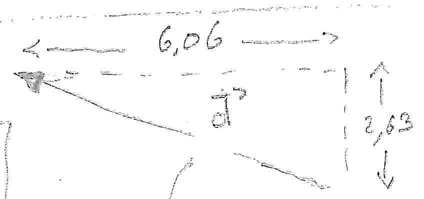
$$\begin{bmatrix} -6\cos(60) \\ 6\sin(60) \end{bmatrix} = \begin{bmatrix} 6\cos(120) \\ 6\sin(120) \end{bmatrix} = \begin{bmatrix} -3 \\ 5,2 \end{bmatrix} = \underset{\sim}{x}_B$$



$$\begin{bmatrix} 4\cos(40°) \\ 4\sin(40°) \end{bmatrix} = \begin{bmatrix} 3,06 \\ 2,57 \end{bmatrix} = \underset{\sim}{x}_A$$

DEPLACEMENT

$$\vec{d} = \vec{x}_B - \vec{x}_A = \begin{bmatrix} -6,06 \\ 2,63 \end{bmatrix}$$



SIGNE NEGATIF car DIRIGE VERS L'OUEST !

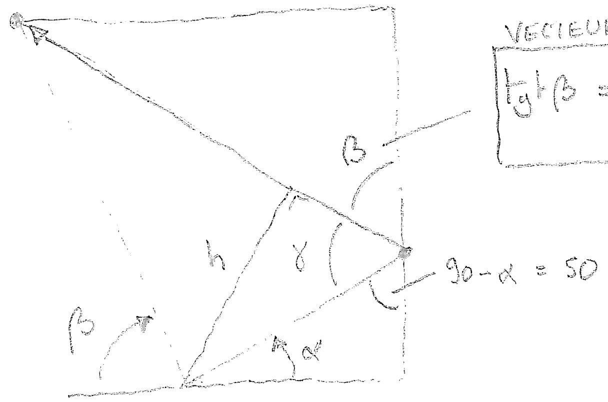
TRICKY !

C'EST VRAIMENT PLUS COMPLIQUÉ QUE CE QUI EST EXIGÉ !

$\underbrace{(***)}$ • UN PEU DE TRIGONOMETRIE

↑

DIFFICILE !



VECTEUR d

$$\boxed{tg\,\beta = \frac{6.06}{2,63}} \Rightarrow \boxed{\beta = 66,5°}$$

$$\Downarrow$$

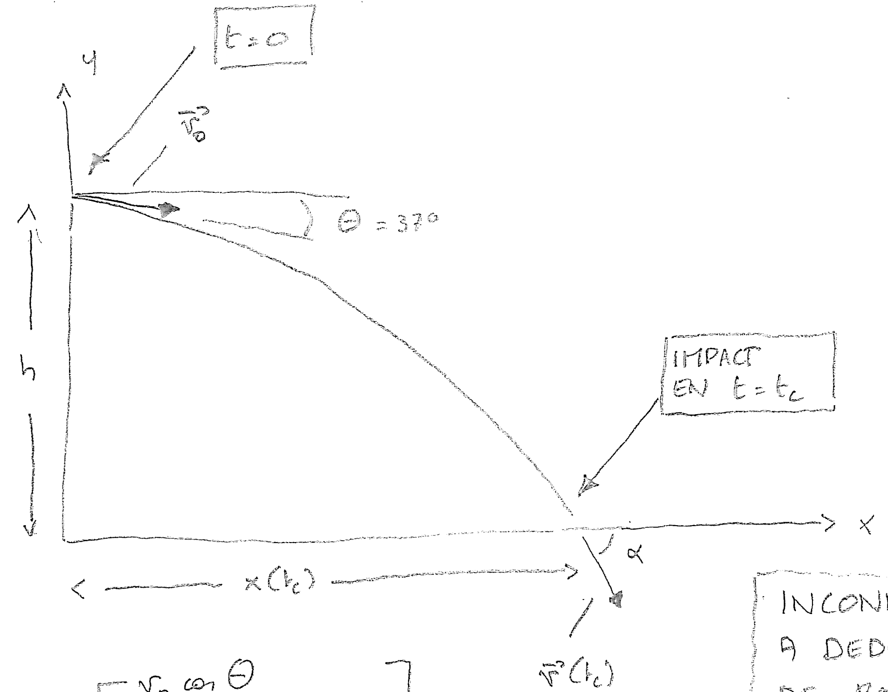
$$\boxed{\gamma = \underbrace{180 - 66,5° - 50°}_{63,5°}}$$

$$\Downarrow$$

$$\boxed{\begin{aligned} h &= 4\sin(\gamma) \\ &= 4\sin(63,5) = 3,58 \end{aligned}}$$

$$\boxed{h = 3,58\ \text{Km}}$$

6



INCONNUE v_0.
A DEDUIRE
DE ROMEO ATTRAPE
LA CLE APRES 2 sec !

$$\vec v(t) = \begin{bmatrix} v_0\cos\theta \\ -v_0\sin\theta - gt \end{bmatrix}$$

$$\vec x(t) = \begin{bmatrix} 0 + v_0\cos\theta\, t \\ h - v_0\sin\theta\, t - gt^2/2 \end{bmatrix}$$

LA CLE TOUCHE LE SOL EN $t = 2$

DISTANCE DE ROMEO

$$\underbrace{y(t_c)}_{0} = h - v_0\sin\theta\, t_c - g\frac{t_c^2}{2}$$

$$\boxed{v_0 = \frac{h}{\sin\theta\, t_c} - \frac{g\, t_c}{2\sin\theta}} \rightarrow \boxed{x(t_c) = v_0\cos\theta\, t_c}$$

IL FAUT SAVOIR OBTENIR L'EXPRESSION SYMBOLIQUE !

$\frac{[m]}{[s]}$ CHECK DIMENSION $\left[\frac{m}{s^2}\right][s]$

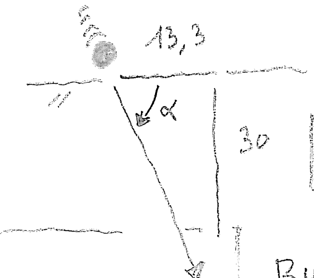
VALEURS NUMERIQUES

$$v_0 = \frac{40-20}{2\sin\theta} = 16{,}6\ m/s$$

$$x(t_c) = \underbrace{16{,}6 \times \cos(\theta)\, 2}_{26{,}5\ m}$$

VITESSE D'IMPACT

$$\vec v(t_c) = \begin{bmatrix} v_0\cos\theta \\ -v_0\cos\theta - gt_c \end{bmatrix} = \begin{bmatrix} 13{,}3 \\ -30 \end{bmatrix}$$

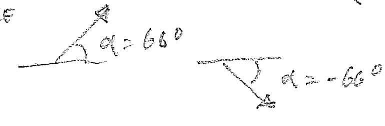


$$\alpha = \underbrace{\mathrm{arctg}\left(\frac{v_y}{v_x}\right)}_{-66°}$$

$\boxed{\alpha = 66°}$

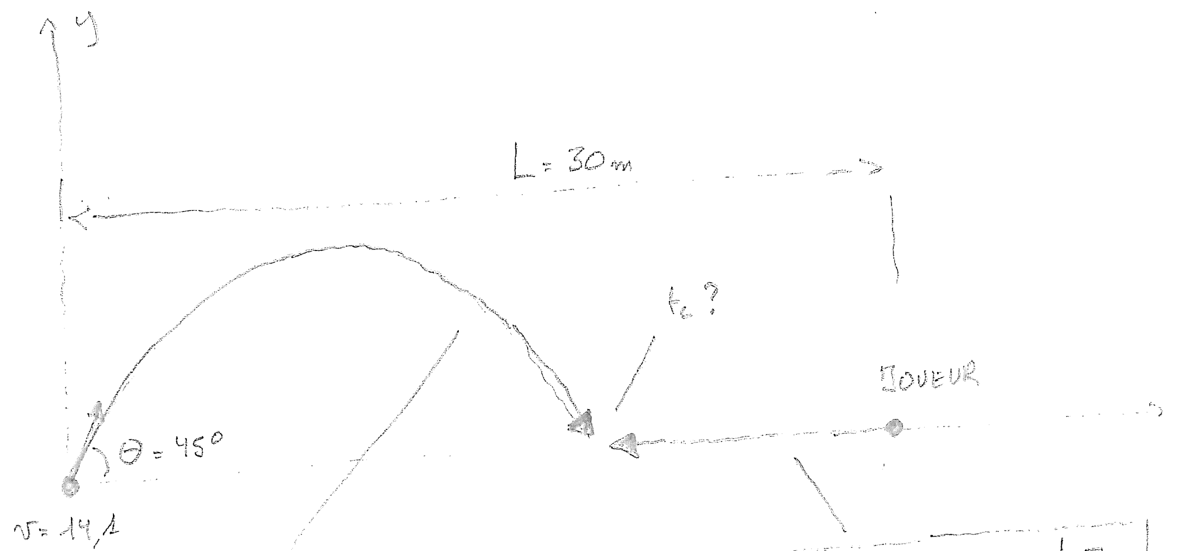
LA VALEUR NUMERIQUE SANS LE DESSIN EST AMBIGUE !

C'EST NEGATIF CAR C'EST UN ANGLE VERS LE BAS !



BIEN INTERPRETER GEOMETRIQUEMENT !

$\boxed{7}$



$$\boxed{\vec{x}(t) = \begin{bmatrix} v\cos\theta\ t \\ v\sin\theta\ t - g\frac{t^2}{2} \end{bmatrix}}$$

$$\boxed{\vec{x}_J(t) = \begin{bmatrix} L - u_J t \\ 0 \end{bmatrix}}$$

u_J NORME DE LA VITESSE DU JOUEUR

$$\vec{v} = \begin{bmatrix} -u_J \\ 0 \end{bmatrix}$$

• TEMPS D'IMPACT ?

$$\underbrace{y(t_c)}_{=0} = v\sin\theta\ t_c - g\frac{t_c^2}{2}$$

$$t_c\left(\underbrace{v\sin\theta - g\,t_c/2}\right) = 0$$

LE POINT DE DEPART !

$[\frac{m}{s}][\frac{s^2}{m}]$ OK CHECK DIMENSION

$$\boxed{t_c = \frac{2v\sin\theta}{g}}$$

$v\sin\theta$

$$\boxed{t_c = \frac{20}{10} = 2 \text{ sec}}$$

• VITESSE DU JOUEUR POUR ATTRAPER LA BALLE ?

$$\underbrace{v\cos\theta\ t_c}_{x(t_c)} = \underbrace{L - u_J t_c}_{x_J(t_c)}$$

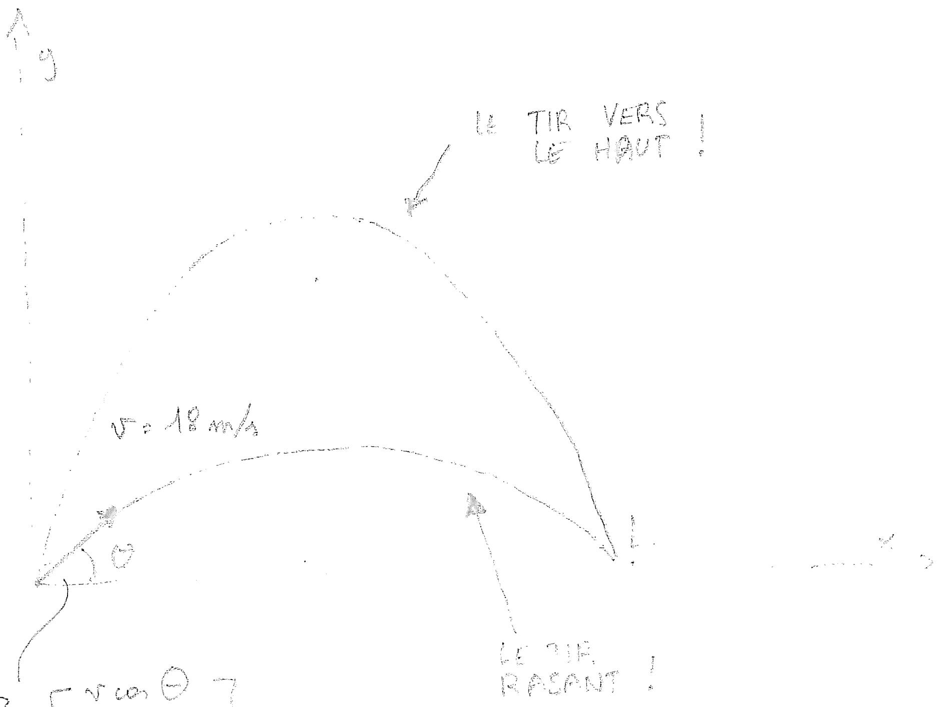
POSITION DE LA BALLE !

POSITION DU JOUEUR

$$u_J = \frac{Lg}{2v\sin\theta} - v\cos\theta$$

$$\boxed{u_J = \underbrace{\frac{L}{t_c}}_{30/2} - \underbrace{v\cos\theta}_{10}}$$

$$\boxed{u_J = 5 \text{ m/s}}$$



$$\vec{v} = \begin{bmatrix} v\cos\theta \\ v\sin\theta \end{bmatrix}$$

$$\underbrace{\vec{x}(t_c)}_{\begin{bmatrix} L \\ 0 \end{bmatrix}} = \begin{bmatrix} v\cos\theta\, t_c \\ -g\frac{t_c^2}{2} + v\sin\theta_c\, t_c \end{bmatrix}$$

2 EQUATIONS
AVEC 2 INCONNUES t_c et θ

$$\begin{cases} L = v\cos\theta\; t_c & (1) \\ 0 = -g\frac{t_c^2}{2} + v\sin\theta\; t_c & (2) \end{cases}$$

EN REMPLAÇANT DANS (2) $\underbrace{t_c = \frac{L}{v\cos\theta}}_{\text{OBTENU A PARTIR DE (1)}}$

$$\frac{gL^2}{2v^2\cos^2\theta} = \frac{\sin\theta}{\cos\theta} L$$

$$\frac{gL}{2v^2\cos\theta} = \sin\theta$$

$$\frac{gL}{v^2} = \underbrace{2\sin\theta\cos\theta}_{\sin(2\theta)}$$

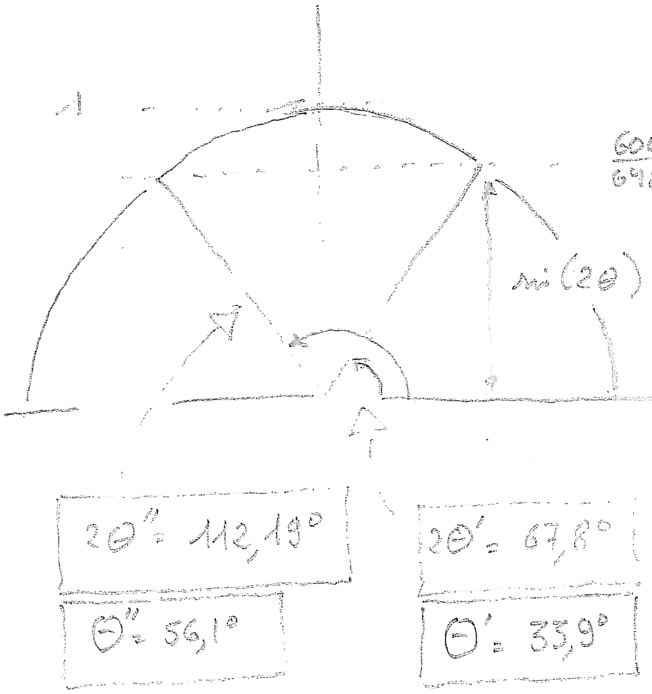
CHECK DIMENSION

$$\left[\frac{m}{s^2}\right][m]\left[\frac{s^2}{m^2}\right] \text{ ok !}$$

$$\frac{600}{648} = \sin(2\theta)$$

$$\boxed{\theta = \frac{1}{2}\underbrace{\operatorname{asin}\left(\frac{600}{648}\right)}_{32^\circ}}$$

ET LE DEUXIEME ANGLE ?

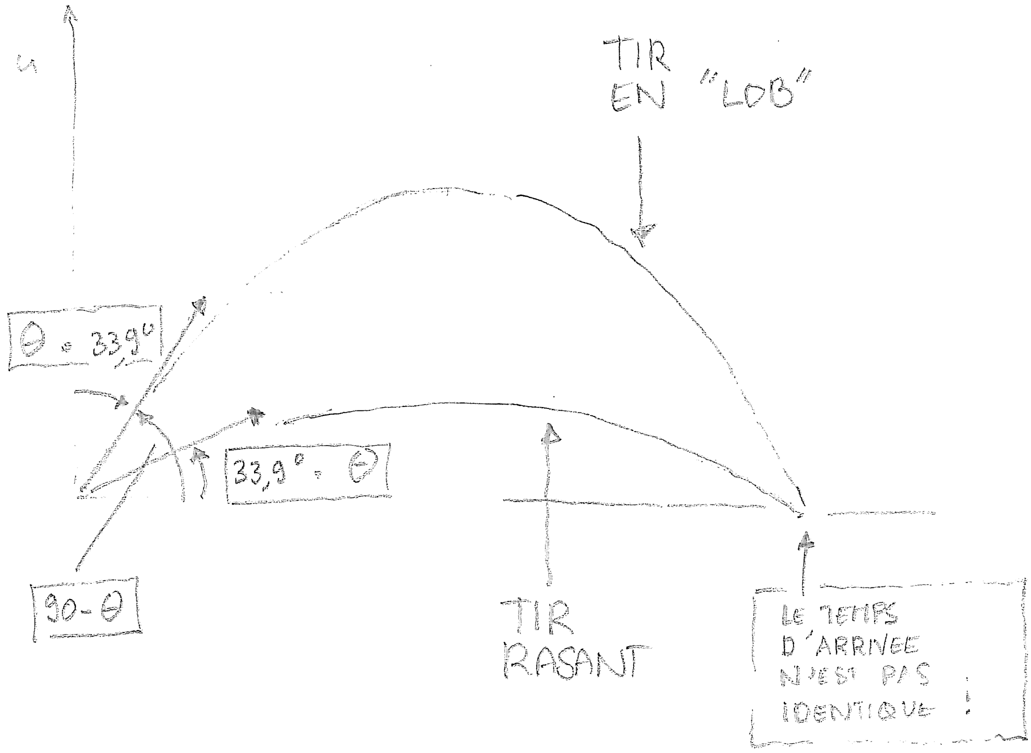


$\frac{600}{648} = 0,926$

CERCLE TRIGONOMETRIQUE

TRIGONOMETRIE !

$2\Theta'' = 180 - 2\Theta'$!



$\cos(56°) < \cos(33°)$ $\quad t_c = \frac{L}{v \cos\Theta}$

LE TIR EN "LOB"
PRENDRA PLUS DE TEMPS QUE LE TIR "RASANT" !