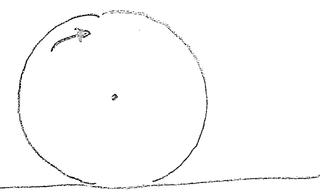


$$\Theta(t) = \omega_0 t + \alpha t^2/2 \quad (1)$$
$$\omega(t) = \omega_0 + \alpha t \quad (2)$$

- $\omega_0 = 120 \left[\frac{\text{tours}}{\text{minute}}\right] = \underbrace{120 \frac{2\pi}{60}}_{12,6} \left[\frac{\text{rad}}{\text{sec}}\right]$

  1 tour = 2π rad
  1 mn = 60 sec

- $t = 60s$
- $\Theta(t) = 90 \text{ [tours]} = \underbrace{90 \; 2\pi}_{565,5} \text{ [rad]}$

$$\alpha = \frac{2\,\Theta(t)}{t^2} - \frac{2\omega_0}{t}$$

VALEUR NUMERIQUE

$\alpha = -0,105 \text{ rad/s}^2$

↑ NEGATIF CAR DECELERATION !

ON AURAIT AUSSI PU METTRE LE SIGNE NEGATIF DIRECTEMENT DANS (1) ET ECRIRE : $\Theta(t) = \omega_0 t - \alpha t^2/2$:-)

TEMPS REQUIS POUR S'ARRETER

$$t^* = \frac{-\omega_0}{\alpha}$$

CAR $\underbrace{\omega(t^*)}_{\omega_0 - \alpha t^*} = 0$

VALEUR NUMERIQUE

$t^* = \frac{12,6}{0,105} = 120 \text{ sec}$

APPROXIMATIVEMENT 2 minutes !

$$\Theta(t^*) = \omega_0\left(-\frac{\omega_0}{\alpha}\right) + \frac{\alpha}{2}\left(-\frac{\omega_0}{\alpha}\right)^2 = -\frac{1}{2}\frac{\omega_0^2}{\alpha}$$

ANGLE PARCOURU

VALEUR NUMERIQUE 756 rad
120 tours

DISTANCE PARCOURUE PAR LA ROUE

$$x = \Theta \cdot R$$

VALEURS NUMERIQUE

$x = 151 \text{ m}$

58

$$\theta(t) = \omega_0 t + \alpha t^2/2$$
$$\omega(t) = \omega_0 + \alpha t$$

$\omega_0 = 20$

RESOUDRE LE PROBLEME EN TOURS/MINUTES !!

EST NETTEMENT PLUS SIMPLE !

$$\begin{cases} 40 = 20t + \alpha t^2/2 \\ 50 = 20 + \alpha t \end{cases}$$

$$\begin{cases} 40 = 20t + \alpha t^2/2 \\ 30/\alpha = t \end{cases}$$

ON DEDUIT QUE

$$40 = \frac{600}{\alpha} + \alpha\left(\frac{900}{\alpha^2}\right)\frac{1}{2}$$

$$4\alpha = 60 + 45$$

$$\alpha = \frac{105}{4} = 26{,}25 \left[\frac{\text{tour}}{(\text{minute})^2}\right]$$

$$0{,}046 \, [\text{rad}/s^2]$$

$\alpha = 26{,}25$

$$\theta = \alpha t^2/2$$
$$20 = \alpha t$$

ON DEDUIT QUE

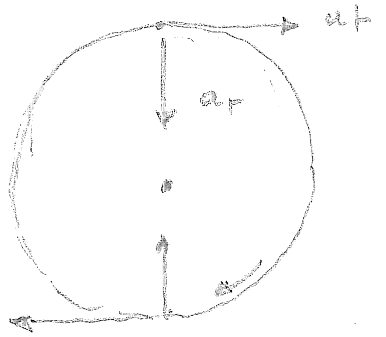
$$t = \frac{20}{\alpha}$$

$$\theta = \alpha\left(\frac{400}{\alpha^2}\right)\frac{1}{2}$$

$$= \frac{200}{26{,}25} = 7{,}62 \, [\text{tour}]$$

C'EST JUSTE COMME DES EXERCICES ELEMENTAIRES DE MRUA !!

59



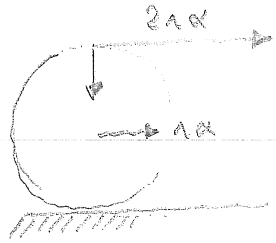
PAR RAPPORT AU CENTRE

$$a_t = r\alpha \quad (3\ m/s^2)$$

$$a_c = \frac{v^2}{r} = 16\ m/s^2 \qquad \left(\frac{2^2}{0{,}25}\right)$$

$$a = \sqrt{a_t^2 + a_c^2} = 16{,}3\ m/s^2$$

PAR RAPPORT AU SOL

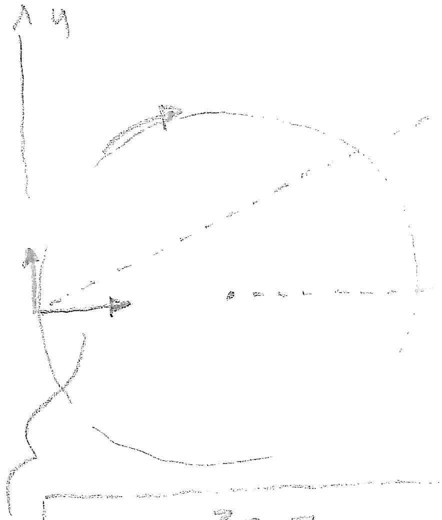


$$a_t = 2r\alpha = 6\ m/s^2 \quad (\triangle !)$$

$$a_c = \frac{v^2}{r} = 16\ m/s^2$$

$$a = \sqrt{a_t^2 + a_c^2} = 17{,}1\ m/s^2$$

60



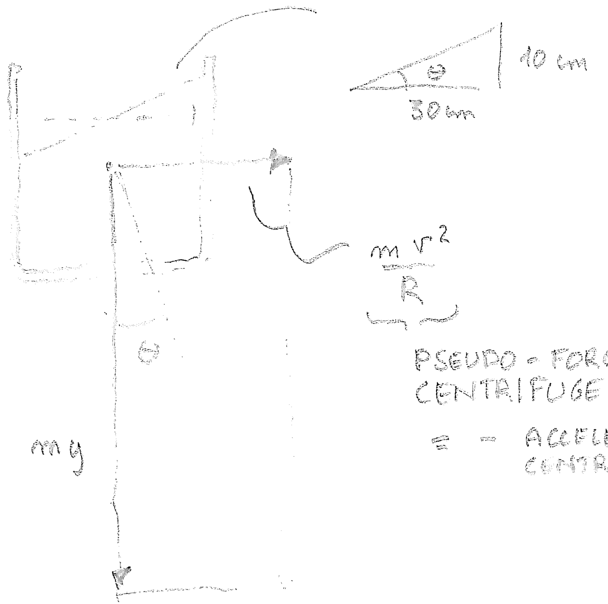
TRAJECTOIRE DE LA BALLE !

$$\vec{v} = \begin{bmatrix} 30 \\ R\omega \end{bmatrix} m/s \qquad (R\omega = 3{,}6)$$

$$x = 30\,t \quad (4{,}5\ m)$$
$$y = 3{,}6\,t$$

$$y = 3{,}6\ \frac{4{,}5}{30} = 0{,}54\ m$$

G1



LA SURFACE DE L'EAU EST PERPENDICULAIRE A LA RESULTANTE DES 2 FORCES !

PSEUDO-FORCE CENTRIFUGE

= − ACCELERATION CENTRIPETE × MASSE

$$\frac{1}{3} = \operatorname{tg}\theta = \frac{\frac{mv^2}{R}}{mg}$$

$$\downarrow$$

$$v^2 = \frac{Rg}{3}$$

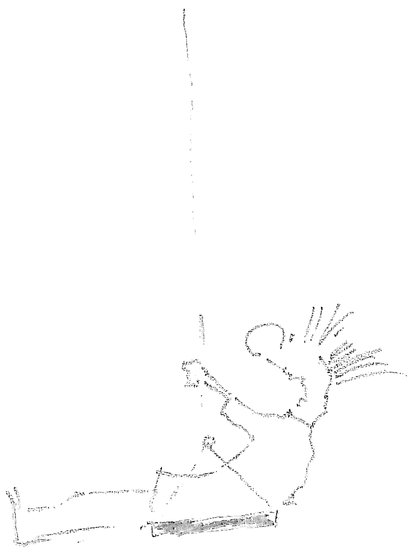
$$\downarrow$$

$$\boxed{v = \sqrt{\frac{Rg}{3}}}$$

VALEUR NUMERIQUE

$v = 11{,}5$ m/s

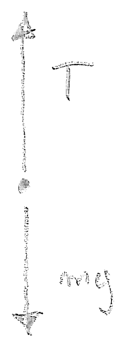
G2



TERME DÛ A L'ACCELERATION CENTRIPETE

$$\frac{mv^2}{R} = T - mg$$

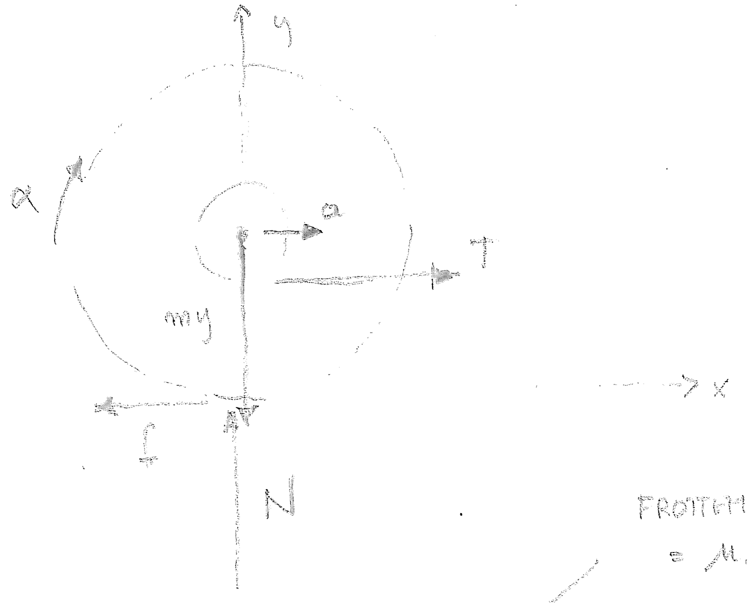
$$\boxed{T = m\left(g + \frac{v^2}{R}\right)}$$



453,75 N avec g = 10 m/s²

445,77 N avec g = 9,81 m/s²

63



FROTTEMENT $= \mu \cdot N = \mu\, mg$ ← car $N = mg$:-)

$\sum F_x = ma$ $\qquad m a = T - \mu m g \qquad (1)$

$\sum M = I\alpha$ $\qquad \frac{mR^2}{2}\alpha = -rT + R\mu m g \qquad (2)$

CONDITION DE ROULEMENT SANS GLISSEMENT $\quad +\alpha R = a$

LA ROUE PROGRESSE DANS LE SENS DU FROTTEMENT !

ATTENTION !!

$$\begin{cases} m a = T - \mu m g \\ -\frac{m R a}{2} = r T - R \mu m g \end{cases}$$

↓

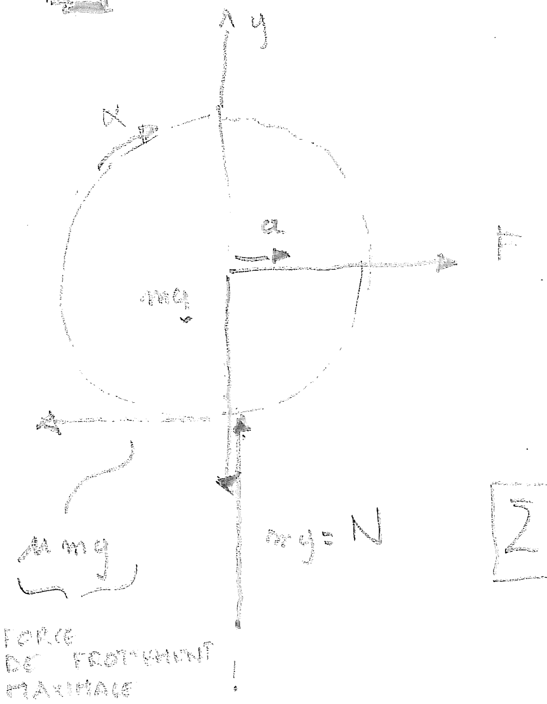
$$\begin{cases} \frac{1}{2} m R a = \frac{R}{2} T - \mu \frac{R}{2} m g \\ -\frac{1}{2} m R a = r T - R \mu m g \end{cases}$$

EN ADDITIONNANT LES 2 ÉQUATIONS

$$\left(\tfrac{1}{2} R + r\right) T = m g \mu \left(\frac{3R}{2}\right)$$

$$T = \frac{3 \mu m g R}{(R + 2r)}$$

64



ROULEMENT SANS GLISSEMENT

$\alpha R = a$

x

$$\sum F_x = ma$$

$$ma = F - \mu mg$$

$$\sum M = I\alpha$$

$$\frac{1}{2} m R^2 \alpha = R \mu mg$$

$$= \frac{1}{2} m R a$$

$$\mu = \frac{a}{2g}$$

3 EQUATIONS
3 INCONNUES
μ, α, a

$$F = ma + \frac{a}{2g} mg$$

$$F = \frac{3}{2} ma$$

$$a = \frac{2F}{3m}$$

$$f = \frac{2F}{3m} \frac{1}{2g} mg = F/3$$

IL FAUT

$$\mu_S > \frac{F}{3mg}$$

COEFFICIENT MINIMAL DE FROTTEMENT POUR ROULEMENT SANS GLISSEMENT