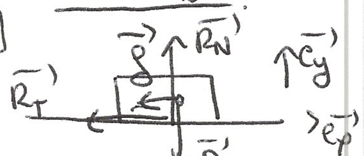
Correction DM · Sécurité routière

$2^{ème}$ partie -

Partie B

B1]



B2] PFD projeté sur $\vec{e_z}$: $\vec{R_N} = R_N \vec{e_y}$, $\vec{P} = - mg \vec{e_y}$

$R_N - mg = 0 \rightarrow R_N = mg$

B3] • Non glissement $\|\vec{R_T}\| < \lambda \|\vec{R_N}\|$

• Glissement : $\|\vec{R_T}\| = \lambda \|\vec{R_N}\|$ et $\vec{R_T}$ opposé au déplacement $\Rightarrow \vec{R_T} = -R_T \vec{e_x}$

B4] $m\vec{a} = -a_0 \vec{e_x}$ $m\vec{a} = \vec{P} + \vec{R_N} + \vec{R_T} + \vec{f}$

proj/$\vec{e_x}$ $-ma_0 = -\lambda mg - f$ avec $\vec{f} = -f \vec{e_x}$.

$$\boxed{f = ma_0 - \lambda mg}.$$

B5] Béton sec $\begin{cases} \lambda = 0{,}7 \\ a_0 = 12 ms^{-2} \\ m = 1000 kg. \end{cases}$ $\Rightarrow$ $\|\vec{R_T}\| = 7 \cdot 10^3 N$

$f = 5 \cdot 10^3 N$.

B.6] $\Delta E_c = E_c(F) - E_c(I) = \sum W_{I \to F}(\vec{F}) = \underbrace{W_{I \to F}(\vec{R_T}) + W_{I \to F}(\vec{f})}_{W}$.

$= 0 - \frac{1}{2} m v_0^2 \Rightarrow \boxed{W = -\frac{1}{2} m v_0^2.}$

AN $V_0 = 90 km h^{-1} = \frac{90 \cdot 10^3}{3600} = \frac{90}{3{,}6} ms^{-1}$. AN $\boxed{W = -312{,}5 kJ.}$

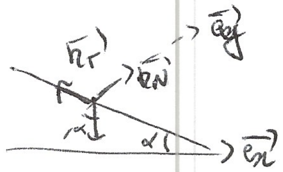
B.7]. Proj/PFD sur $\vec{e_x}$ $-ma_0 = -R_T - f \rightarrow R_T = ma_0 - f$.

sur $\vec{e_y}$ $R_N - mg = 0 \Rightarrow R_N = mg \rightarrow$ ~~$R_T = \lambda T$~~

$R_T < \lambda R_N \Rightarrow ma_0 - f < \lambda mg$ $\boxed{ma_0 < f + \lambda mg.}$

à freinage constant $a_0 \searrow$ si $\lambda \searrow$ (route mouillée).

B.9]



PFD en projection sur $\vec{e_y}$ sur $\vec{e_x}$:

$R_N - mg\cos\alpha = 0$ $-ma_0 = mg\sin\alpha - R_T - f$

$\Rightarrow R_T = mg\sin\alpha - f + ma_0$.

donc $\boxed{ma_0 < f + mg(\lambda\cos\alpha - \sin\alpha)} \Leftarrow$

c] Repèrement d'un virage.

C.1 

$\vec{OM} = R\vec{e_r}$ $\quad \vec{v} = \dot{r}\vec{e_r} + r\dot{\theta}\vec{e_\theta}$ $\quad$ avec $\begin{cases} z = 0 \\ r = R \\ \dot{r} = 0 \end{cases}$

$\Rightarrow \vec{v} = R\dot{\theta}\vec{e_\theta}$

$\vec{a} = -R\dot{\theta}^2\vec{e_r} + R\ddot{\theta}\vec{e_\theta}$.

C.2 $\dot{\theta} = \dfrac{v}{R}$ mouvement uniforme $\Rightarrow \dot{\theta} = cste$.

$$\boxed{\vec{a} = -\frac{v^2}{R}\vec{e_r}}$$

C3] $\vec{P} = -mg\vec{e_z}$ $\quad R_N = R_N\vec{e_z}$ $\quad$ PFD projeté suivant $\vec{e_z}$ $\Rightarrow \boxed{R_N = mg}$

C4] $m\vec{a} = \Sigma\vec{F}$ et $\vec{P} + \vec{R_N} = \vec{0}$ or $\vec{a}$ radial $\Rightarrow \exists$ force

radiale $\vec{T} = m\vec{a}$ $\quad$ avec $\boxed{\vec{T} = -m\dfrac{v^2}{R}\vec{e_r}}$

C5] $\|\vec{T}\| < \lambda\|\vec{R_N}\| \Rightarrow \dfrac{mv^2}{R} < \lambda mg \rightarrow \boxed{v^2 < \lambda Rg}$.

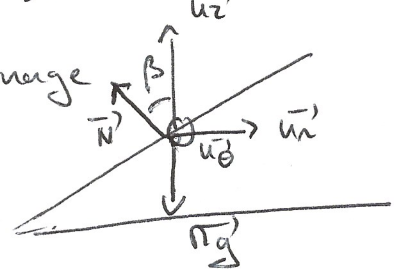
AN Route sèche $\lambda = 0{,}7$ $\quad R = 50\,m$ $\quad g = 10\,m\,s^{-2}$.

$$\boxed{v_{max} = 18{,}7\,m\,s^{-1} = 67{,}3\,km\,h^{-1}.}$$

C6] Virage verglacé $\lambda\searrow \Rightarrow v_{max}\searrow$.

$R\searrow \rightarrow v_{max}\searrow$.

C7] On relève le virage



avec $\boxed{R_N\cos\beta = mg}$

$m\vec{a} = \vec{P} + \vec{R_N}$

proj/$\vec{e_z}$ $\quad 0 = -mg + R_N\cos\beta \Rightarrow \boxed{mg = R_N\cos\beta.}$

proj/$\vec{e_r}$ $\quad -m\dfrac{v^2}{R} = -R_N\sin\beta = -\dfrac{mg}{\cos\beta}\cdot\sin\beta \Rightarrow \dfrac{v^2}{R} = \operatorname{tg}\beta\cdot g \Rightarrow \boxed{v^2 = \operatorname{tg}\beta\cdot Rg}$

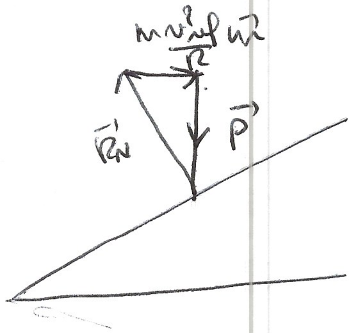
AN $\beta = 20°$ $\quad R = 50\,m$ $\rightarrow \boxed{v = 13{,}5\,m\,s^{-1} = 48{,}6\,km\,h^{-1}.}$

C9] $v_{max} = \sqrt{\lambda R g} = v = \sqrt{R g \, tg\beta} \rightarrow \boxed{tg\beta = \lambda.}$

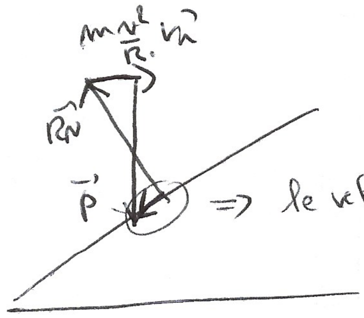
($\hat{n}$ valeur de vitesse) sans frottement mais avec une marge relative.

$\Rightarrow$ AN $\beta = 35°$ avec $\lambda = 0{,}7$.

C10] $m\vec{a} = \vec{R_N} + \vec{P}$ avec $\vec{a} = -\frac{v^2}{R}\vec{u_n} \Rightarrow \vec{R_N} + \vec{P} + m\frac{v^2}{R}\vec{u_n} = 0$

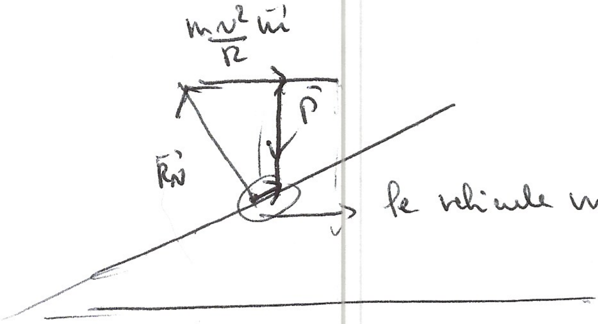


$\vec{v} = \vec{v_{ref}}$



$\Rightarrow$ le véhicule descend.

$v < v_{ref}$.



$\Rightarrow$ le véhicule monte

dans le cas où $v \neq v_{ref}$

$\Sigma \quad \underbrace{\vec{P_N} + \vec{P} + m\frac{v^2}{R}\vec{u_n}}_{} \neq 0.$

direction du vecteur somme donne le mvt.