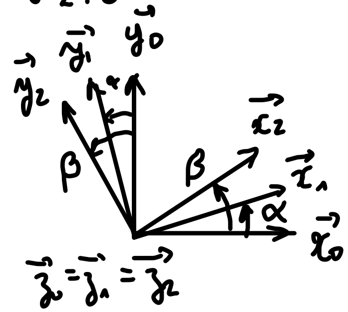
td CIN 2.0 — 7h55

(1)



(2) $\boxed{\vec{\Omega}_{1/0} = \dot{\alpha}\,\vec{z_0}}$ $\boxed{\vec{\Omega}_{2/0} = \dot{\beta}\,\vec{z_0}}$ $\boxed{\vec{\Omega}_{3/0} = \vec{0}}$

Composition des vitesses : $\vec{\Omega}_{2/1} = \vec{\Omega}_{2/0} + \vec{\Omega}_{0/1}$

$$\boxed{\vec{\Omega}_{2/1} = (\dot{\beta} - \dot{\alpha})\,\vec{z_0}}$$

(3) $\vec{V}_{B,3/0} = \left(\dfrac{d\,\vec{OB}}{dt}\right)_0 = \left(\dfrac{d\,\lambda(t)\,\vec{y_0}}{dt}\right)_0$

$$\boxed{\vec{V}_{B,3/0} = \dot{\lambda}(t)\,\vec{y_0}}$$ car $\left(\dfrac{d\vec{y_0}}{dt}\right)_0 = \vec{0}$

(4) $\vec{V}_{A,1/0} = \left(\dfrac{d\,\vec{OA}}{dt}\right)_0 = \left(\dfrac{d\,e\,\vec{y_1}}{dt}\right)_0 = e\left(\dfrac{d\vec{y_1}}{dt}\right)_0$

car e : constant

Bour $\left(\dfrac{d\vec{y_1}}{dt}\right)_0 = \vec{\Omega}_{1/0} \wedge \vec{y_1} = \dot{\alpha}\,\underset{\text{ou } \vec{z_1}}{\vec{z_0}} \wedge \vec{y_1}$

$\left(\dfrac{d\vec{y_1}}{dt}\right)_0 = -\dot{\alpha}\,\vec{x_1}$

$$\boxed{\vec{V}_{A,1/0} = -e\,\dot{\alpha}\,\vec{x_1}}$$

8h06

(5) $V_{A,1/0} = e\,.\,|\dot{\alpha}| = e\,\dfrac{2\pi N_{1/0}}{60}$

$$\boxed{V_{A,1/0} = e\,\dfrac{\pi N_{1/0}}{30}}$$

$= 0{,}041\,.\,\pi\,.\,\dfrac{2000}{30}$

$\underline{V_{A,1/0} = 8{,}58\ m.s^{-1}}$

1,7 cm

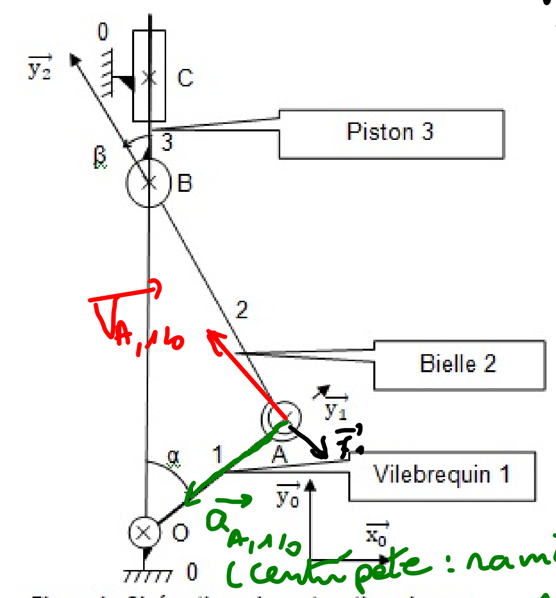


Figure 1 : Cinématique du moteur thermique.

(centripète : ramène la vitesse vers l'intérieure)

$(uv)' = u'v + uv'$

(6) $\vec{a}_{A,1/0} = \left(\dfrac{d\,\vec{V}_{A,1/0}}{dt}\right)_0 = \left(\dfrac{d\,-e\,\dot{\alpha}\,\vec{x_1}}{dt}\right)_0$

$\vec{a}_{A,1/0} = \underbrace{-e\ddot{\alpha}}_{u'}\,\underbrace{\vec{x_1}}_{v} \underbrace{-e\dot{\alpha}}_{u}\underbrace{\left(\dfrac{d\vec{x_1}}{dt}\right)_0}_{v'}$

Bour $\left(\dfrac{d\vec{x_1}}{dt}\right)_0 = \vec{\Omega}_{1/0} \wedge \vec{x_1} = \dot{\alpha}\,\vec{z_1} \wedge \vec{x_1}$

$\left(\dfrac{d\vec{x_1}}{dt}\right)_0 = \dot{\alpha}\,\vec{y_1}$

$\vec{a}_{A,1/0} = -e\,\ddot{\alpha}\,\vec{x_1} - e\,\dot{\alpha}^2\,\vec{y_1}$

si $\dot{\alpha} = N_{1/0}\,.\,\dfrac{\pi}{30}$ alors $\ddot{\alpha} = 0$

$$\boxed{a_{A,1/0} = e\left(\dfrac{N_{1/0}\,\pi}{30}\right)^2}$$

$a_{A,1/0} = 1800\ m.s^{-2}$ (1,8 cm)

8h18

⑦ Varignon : $\vec{V}_{A,1/0} = \vec{V}_{O,1/0} + \vec{AO} \wedge \vec{\Omega}_{1/0}$ 8h36

$= \vec{0} - e\vec{y_1} \wedge \dot\alpha\, \vec{z_1}$

$$\boxed{\vec{V}_{A,1/0} = -e\dot\alpha\, \vec{x_1}}$$

⑧ Composition des vitesses en A :

$$\vec{V}_{A,2/0} = \underbrace{\vec{V}_{A,2/1}}_{=\vec{0} \text{ car pivot en } \underline{A} \text{ entre } \underline{1} \text{ et } \underline{2}} + \vec{V}_{A,1/0}$$

Finalement $\boxed{\vec{V}_{A,2/0} = -e\dot\alpha\, \vec{x_1}}$

⑨ Varignon : $\vec{V}_{B,2/0} = \vec{V}_{A,2/0} + \vec{BA} \wedge \vec{\Omega}_{2/0}$

$= -e\dot\alpha\, \vec{x_1} + -L\vec{y_2} \wedge \dot\beta\, \vec{z_2}$

$$\boxed{\vec{V}_{B,2/0} = -e\dot\alpha\, \vec{x_1} - L\dot\beta\, \vec{x_2}}$$

⑩ Composition des vitesses :

$\vec{V}_{B,3/0} = \cancel{\vec{V}_{B,3/2}} + \vec{V}_{B,2/0}$

↳ car B : centre de la pivot entre $\underline{3}$ et $\underline{2}$

$$\boxed{\vec{V}_{B,3/0} = -e\dot\alpha\, \vec{x_1} - L\dot\beta\, \vec{x_2}}$$

⑪ Projection sur $\vec{y_0}$

$\dot\lambda(t) = -e\dot\alpha\, \vec{x_1}\cdot\vec{y_0} - L\dot\beta\, \vec{x_2}\cdot\vec{y_0}$

$\dot\lambda(t) = -e\dot\alpha \cdot \sin\alpha - L\dot\beta\, \sin\beta$

$\dot\lambda(t) = -e\dot\alpha\, \sin\alpha - L\dot\beta\, \sin\beta$

Projection sur $\vec{x_0}$: $0 = -e\dot\alpha\cos\alpha - L\dot\beta\cos\beta$

$\dot\beta = -\frac{e}{L}\frac{\cos\alpha}{\cos\beta}\dot\alpha$ si $\beta = \frac{\pi}{2}\ [\pi]$

8h50

$\dot\lambda(t) = -e\dot\alpha\sin\alpha + e\frac{\cos\alpha}{\cos\beta}\dot\alpha\sin\beta$

$$\boxed{\dot\lambda(t) = e\dot\alpha\,(\cos\alpha\tan\beta - \sin\alpha)}$$

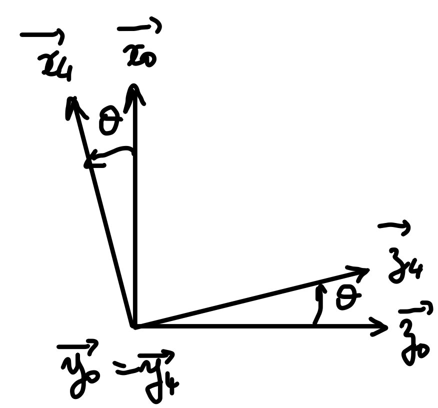
⑫ $|\dot\lambda_{max}| = 12\ m.s^{-1} < 30\ m.s^{-1}$

Les segments supportent largement ce critère, ce qui est normal car le moteur peut tourner plus vite que sa vitesse nominale.

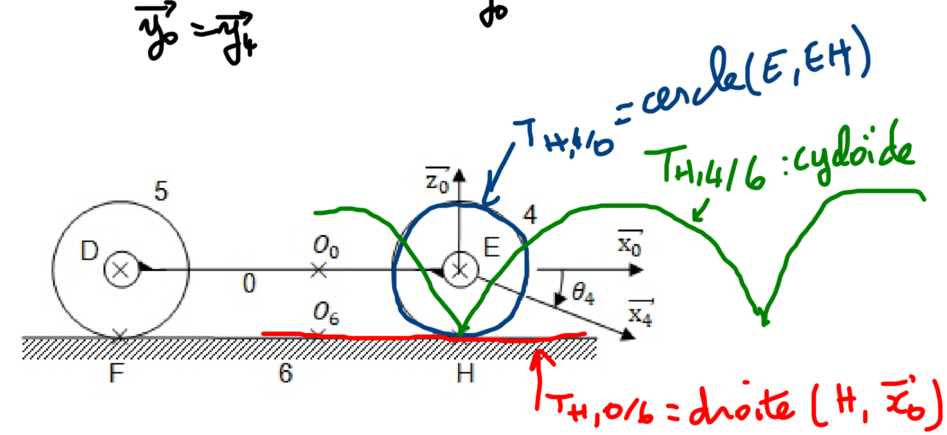
9h00

10h04

⑬



⑭



15 Roulement sans glissement en H entre 4 et 6 :

$$\boxed{\overrightarrow{V_{H,4/6}} = \vec{0}}$$

16 Composition des vitesses :

$$\overrightarrow{V_{H,4/0}} + \overrightarrow{V_{H,0/6}} = \vec{0}$$

soit $\boxed{\overrightarrow{V_{H,4/0}} = -\overrightarrow{V_{H,0/6}}}$

17 Varignon : $\overrightarrow{V_{H,4/0}} = \underbrace{\overrightarrow{V_{E,4/0}}}_{=\vec{0}} + \overrightarrow{HE} \wedge \overrightarrow{\Omega_{4/0}}$

$= \vec{0}$ car E centre de la pivot entre 4 et 0.

$$\overrightarrow{V_{H,4/0}} = R\,\vec{z_0} \wedge \dot{\theta}_4\,\vec{y_0}$$

$$\boxed{\overrightarrow{V_{H,4/0}} = -R\dot{\theta}_4\,\vec{x_0}}$$

Varignon : $\overrightarrow{V_{H,0/6}} = \overrightarrow{V_{E,0/6}} + \overrightarrow{HE} \wedge \underbrace{\overrightarrow{\Omega_{0/6}}}_{=\vec{0}}$ translation.

$$= \left(\frac{d\overrightarrow{OE}}{dt}\right)_0$$

$$\boxed{\overrightarrow{V_{H,6/0}} = \dot{x}\,\vec{x_0}}$$

18 Par identification des 2 expressions :

$\dot{x} = R\dot{\theta}_4$ donc $\boxed{V = R\,\frac{\pi N_{4/0}}{30}}$

19 en 1ère : $\boxed{V = R\,\frac{\pi N_{1/0}}{30\,R_1}}$

$V = 0,406 \cdot \frac{\pi . 2000}{30 . 15,3}$

$V = 5,55\ m.s^{-1}$

(20 km.h^{-1})

en 5e : $\boxed{V = R\,\frac{\pi N_{1/0}}{30\,R_5}}$

$V = 0,406 \cdot \frac{\pi . 2000}{30 . 3,06}$

$V = 27,8\ m.s^{-1}$

(100 km.h^{-1})

19h35