Correction DS de SI, MP, mars 26, Jackson — CCINP PSI 23

(Q4) $W_{utile} = 10780$ kJ ; $W_{conso} = 2800$ kJ / cycle $\Rightarrow$ 3,8 et donc 3 cycles

(Q5) $H = 2L \sin\theta$ et $\lambda = 2L\cos\theta$

(Q6) $$l_3^2 = [\underbrace{(2L - l_1 - l_2)}_{A_3}\cos\theta + \underbrace{(l_1 - l_2)}_{B_3}\sin\theta]^2 + [\underbrace{(-l_1 - l_2)}_{C_3}\cos\theta + \underbrace{(l_2 - l_1)}_{D_3}\sin\theta]^2$$

(Q7) Course $= \Delta l_3 = 375$ mm

(Q8) $L = 510$ mm > 440 mm $=$ course + longueur écrou

(Q9) $v_{43}(t) = \frac{N_m}{60} \rho \times r$

(Q10) $\{\mathcal{V}1/0\} = \begin{Bmatrix} \dot\theta \vec{z_0} \\ L\dot\theta \vec{y_1} \end{Bmatrix}_B$ $\qquad \{\mathcal{V}2/0\} = \begin{Bmatrix} -\dot\theta \vec{z_0} \\ L\dot\theta \vec{y_1} \end{Bmatrix}_B$

(Q11) $v_{43}(t) = \vec{v}(M \in 3/0) - \vec{v}(N \in 4/0) = -\vec{\Omega}1/0 \wedge (\vec{BM} + \vec{BN})\vec{x_3}$

(Q12) $T1/0 = \frac{1}{2} C_1 \dot\theta^2 \Rightarrow J_1 = C_1$

(Q13) $\vec{v}(G_2 \in 2/0) = \vec{v}(B \in 2/0) + \vec{\Omega}2/0 \wedge \vec{BG_2} = L\sin(2\theta)\dot\theta \vec{x_2} - (L\cos(2\theta) + a_2)\dot\theta \vec{y_2}$

(Q14) $\{\mathcal{C}2/0\} = \begin{Bmatrix} m\vec{v}(G_2 \in 2/0) \\ \vec{J}(G_2 \in 2/0) \end{Bmatrix}_{G_2}$ $\qquad \vec{J}(G_2 \in 2/0) = D_2\dot\theta \vec{y_2} - C_2\dot\theta \vec{z_0}$

(Q15) $$T2/0 = \frac{1}{2}\{\mathcal{V}2/0\}_{G_2} \otimes \{\mathcal{C}2/0\}_{G_2} = \dots = \frac{1}{2}\Big[\underbrace{m_2(L\sin 2\theta)^2 + m_2(L\cos 2\theta + a_2)^2 + C_2}_{J_2}\Big]\dot\theta^2$$

(Q16) $\vec{v}(C \in 2/0) = 2L\dot\theta\cos\theta \vec{y_0}$; $T M/0 = \frac{1}{2}\underbrace{M(2L\cos\theta)^2}_{J_{ch}}\dot\theta^2$

(Q17) $T_{mot/0} = \frac{1}{2} J_m \omega_m^2$

$$T\Sigma/0 = \frac{1}{2}\Big[\underbrace{k^2(J_1 + J_2 + J_{ch}) + J_m}_{J_\Sigma}\Big]\omega_m^2$$

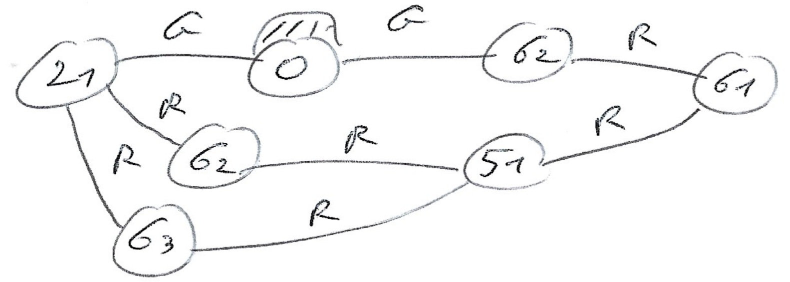
(Q18) $P_{mot} = C_m \omega_m$; $P_{pes} = -2MgL\dot\theta\cos\theta = -M\vec{g}\cdot\vec{V}(C)$

$P_{pes} = -2MgLk\cos\theta\,\omega_m = C_{pes}\,\omega_m$

(2)

Q19 Courbes identiques, Ca négligeable
⇒ le couple moteur Cm lutte contre la pesanteur

Q22



Glissière
Rotule

Q25 Pour $\theta \in [45;65]$, on a $J_\Sigma = cte = 173,4 \text{ kg mm}^2$

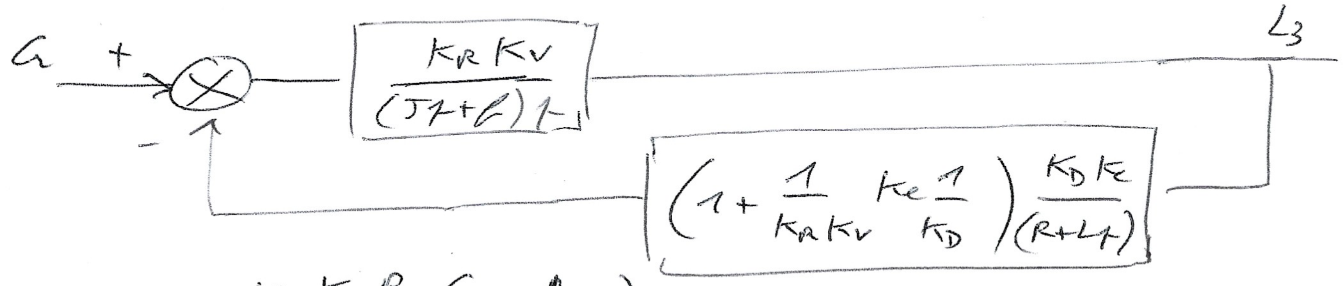
Q26
$$FTBO = F(p) = \frac{\frac{K_D K_c K_R K_V}{A}}{p\left(1 + \frac{Lf + RJ_\Sigma}{A} p + \frac{L J_\Sigma}{A} p^2\right)}$$
Avec $A = K_E K_c + Rf$

Q27 Pour $\varphi = -180$, on a $G_{dB} = -73$ dB
On veut $G_{dB} = -18$ dB ⇒ Il faut $20 \log K_D = 73 - 18 = 55$
$K_D = 10^{55/20} = 560$
Dans ce cas $M\varphi > 90°$

Q28 $t_{5\%} = 0,055$ s ; à $t=0$, $U = K_D \, \varepsilon = 500 \times 372 = 186000$ V
$\gg 72$ V

Q29 $t_{5\%} = 2,80$ s ; saturation jusqu'à $t = 2,75$ s

Q30



$$G(p) = \frac{\frac{K_R K_v R}{A}\left(1 + \frac{L}{R} p\right)}{\frac{LJ}{A} p^3 + \frac{JR + Lf}{A} p^2 + \frac{fR + K_c K_e}{A} p + 1}$$
$A = K_c K_R K_v K$

Q31 entrée $C(p) = \frac{C_{R0}}{p}$ ⇒ $\lim_{t \to 0} l_3(t) = C_{R0} \frac{R}{K_D K_c} = -0,0046$ m
$= -4,6$ mm

Q32 Correcteur PI ⇒ Améliore la précision

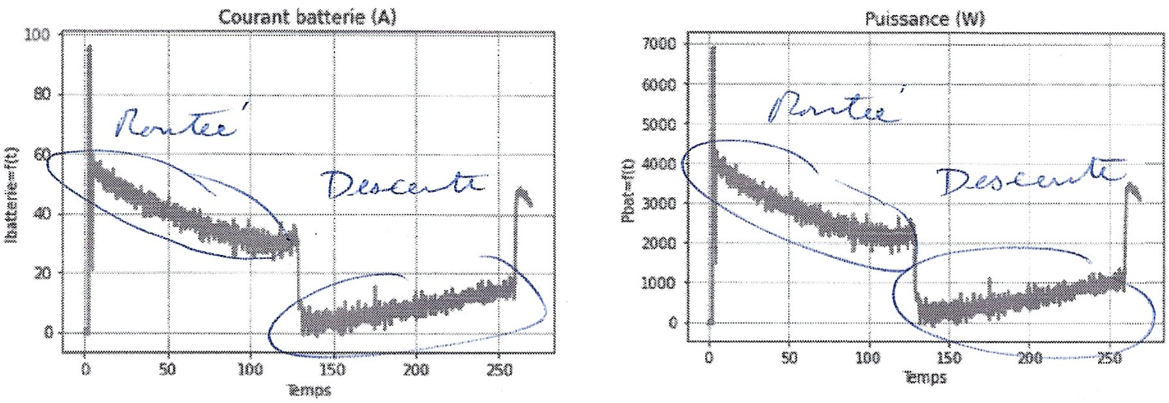
Q33 $\varepsilon(\infty) = 0$

MP, DS4 de SI, mars 2026, Document réponses

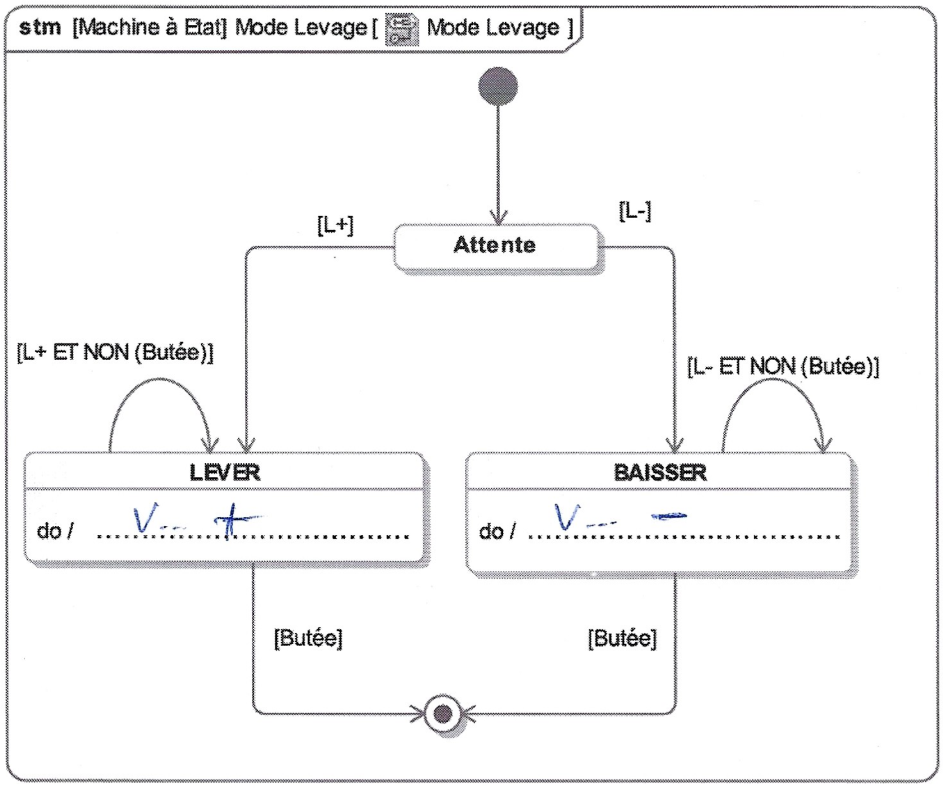
Question 1

Identification	Type MEI	Flux	Effort
1	E	I	U
2	E	ω	C
3	I		
4	E	ω	C

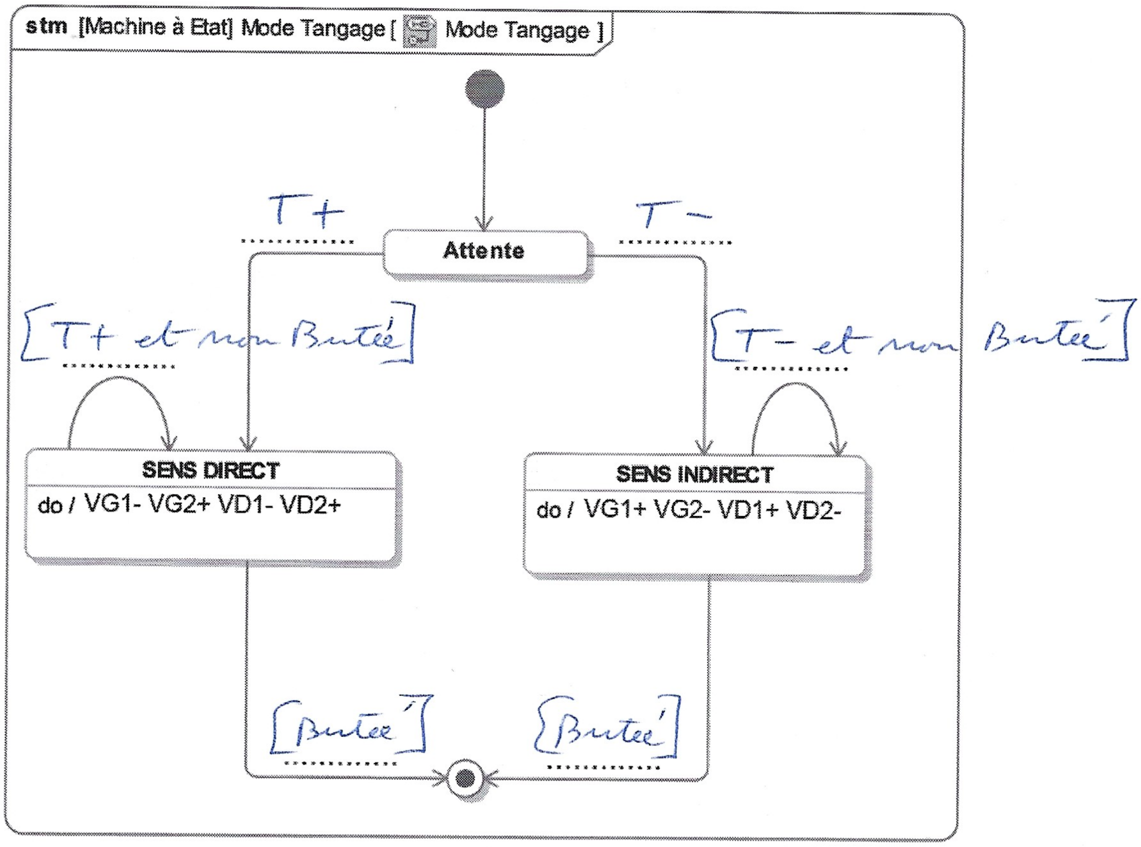
Question 2



Question 23



Question 23



Question 24