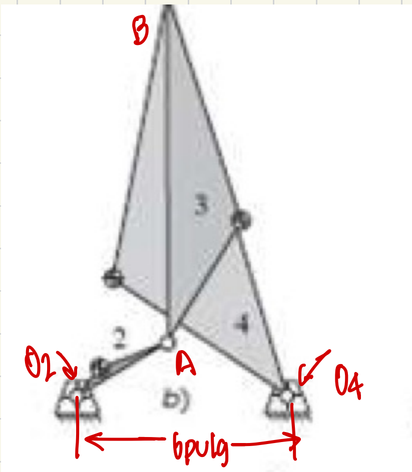
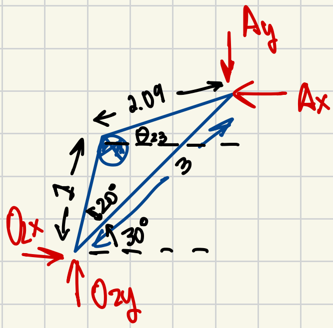
Mecánica de maquinaria   II término 2024
Paralelo 104
Grupo 01

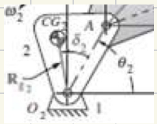
Parte 1	Longitudes en pulgadas, ángulos en grados, aceleración angular en rad/s²						
Fila	eslabón 2	eslabón 3	eslabón 4	eslabón 1	θ_2	θ_3	θ_4
a.	4	12	8	15	45	24.97	99.30
b.	3	10	12	6	30	90.15	106.60

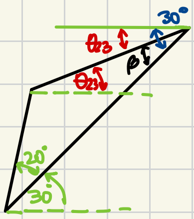
Parte 2	Velocidad angular en rad/s, masa en blobs, momento de inercia en blob-pulg²					
Fila	m_2	m_3	m_4	I_2	I_3	I_4
a.	0.002	0.02	0.10	0.10	0.20	0.50
b.	0.050	0.10	0.20	0.20	0.40	0.40

Parte 3	Longitudes en pulgadas, ángulos en grados, aceleraciones lineales en pulg/s²					
Fila	R_{g2} mag	R_{g2} ang	R_{g3} mag	R_{g3} ang	R_{g4} mag	R_{g4} ang
a.	2	0	5	0	4	30
b.	1	20	4	-30	6	40







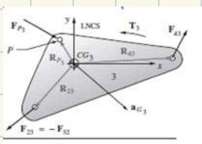


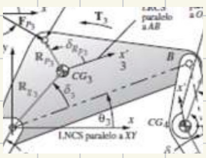
$\delta_2 = 20°$
$\theta_2 = 30°$

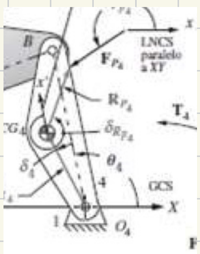
$$\frac{\operatorname{sen}\beta}{1} = \frac{\operatorname{sen} \overset{\delta_2}{20}}{2.09}$$

$$\beta = \operatorname{sen}^{-1}\left(\frac{\operatorname{sen}\delta_2}{2.09}\right) \text{ constante!}$$

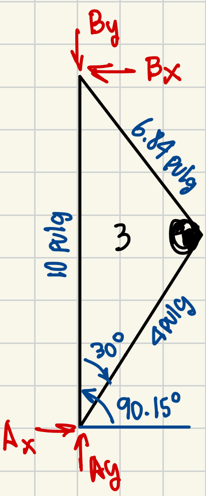
$$\theta_{23} = \theta_2 - \beta$$

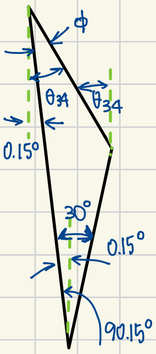






$\theta_4 = 106.60°$
$\delta_4 = 40$





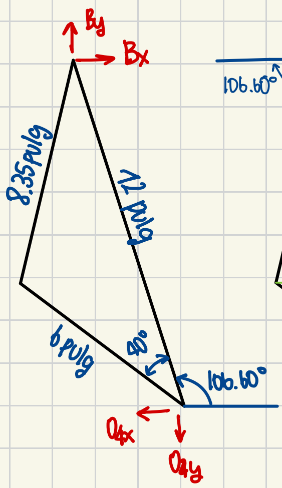
$\theta_3 = 90.15°$ → $\theta_{g3} = 60.15°$
$\delta_3 = -30$

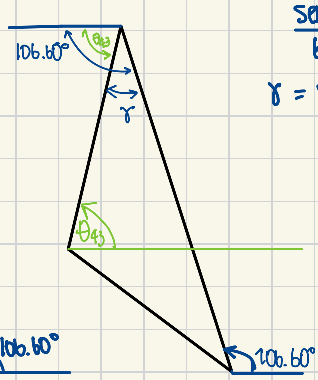
$$\phi = \cos^{-1}\left(\frac{10^2 - 4^2 - 6.84^2}{-2(4)(6.84)}\right)$$

$$\phi = 17.05° \text{ constante!}$$

θ_3
$90.15° - 90 = 0.15°$

$$\theta_{34} = \theta_3 - 90° + \phi$$



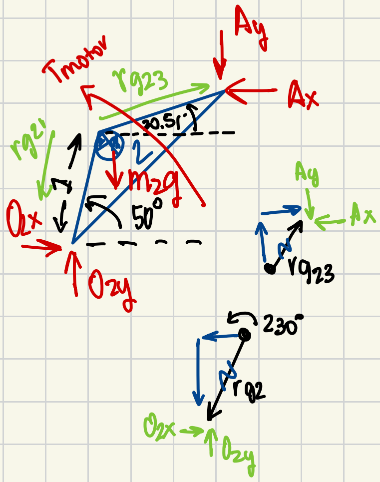


$$\frac{\operatorname{sen}\gamma}{6} = \frac{\operatorname{sen}40}{8.35}$$

$$\gamma = \operatorname{sen}^{-1}\left(\frac{6\operatorname{sen}40°}{8.35}\right)$$

$$\gamma = 27.51°$$

$$\theta_{43} = \theta_4 - \gamma$$



$\xrightarrow{+} \sum F_x = m_2 a_{g2x}$

$O_{2x} - A_x = m_2 a_{g2x}$ $\quad j=0$

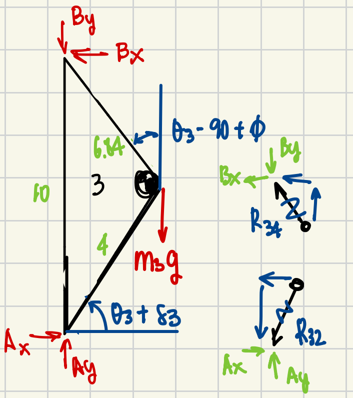
$+\uparrow \sum F_y = m_2 a_{g2y}$

$O_{2y} - A_y - m_2 g = m_2 a_{g2y}$ $\quad j=1 \rightarrow O_{2y} - A_y = m_2 g + m_2 a_{g2y}$

$\circlearrowleft + \sum M_{g2} = I_2 \alpha_2$

$-R_{21}\cos(\theta_2+\delta_2)(O_{2y}) + R_{21}\,\text{sen}(\theta_2+\delta_2)\,O_{2x} - R_{23}\cos(\theta_2-\beta)A_y + R_{23}\,\text{sen}(\theta_2-\beta)A_x + T_m = I_2\alpha_2$ $\rightarrow j=2$

$R_{21} = R_{2g}$



$\xrightarrow{+} \sum F_x = m_3 a_{g3x}$

$-B_x + A_x = m_3 a_{g3x}$ $\quad j=3$

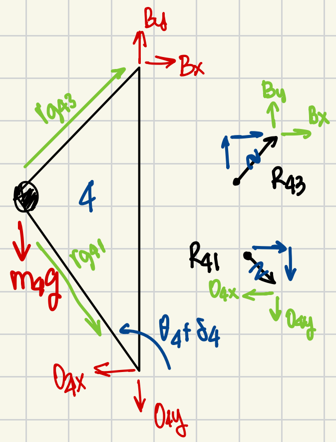
$+\uparrow \sum F_y = m_3 a_{g3y}$

$-B_y + A_y - m_3 g = m_3 a_{g3y}$ $\quad j=4 \rightarrow -B_y + A_y = m_3 g + m_3 a_{g3y}$

$\circlearrowleft + \sum M_{g3} = I_3 \alpha_3$

$+R_{32}\,\text{sen}(\theta_3+\delta_3)A_x - R_{32}\cos(\theta_3+\delta_3)A_y + R_{34}\cos(\theta_3-90+\phi)B_x + R_{34}\,\text{sen}(\theta_3-90+\phi)B_y = I_3\alpha_3$ $\quad j=5$

$R_{32} = R_{g3}$



$\xrightarrow{+} \sum F_x = m_4 a_{g4x}$

$B_x - O_{4x} = m_4 a_{g4x}$ $\quad j=6$

$+\uparrow \sum F_y = m_4 a_{g4y}$

$B_y - O_{4y} - m_4 g = m_4 a_{g4y}$ $\quad j=7 \rightarrow B_y - O_{4y} = m_4 g + m_4 a_{g4y}$

$\circlearrowleft + \sum M_{g4} = I_4 \alpha_4$

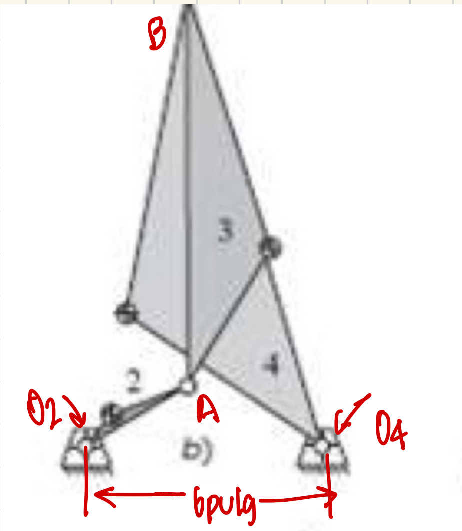
$R_{43}\cos(\theta_4+\delta_4-90^\circ) - R_{43}\,\text{sen}(\theta_4+\delta_4-90^\circ) - R_{g4}\cos(\theta_4-\gamma) - R_{g4}\,\text{sen}(\theta_4-\gamma) = I_4\alpha_4$ $\quad j=8$

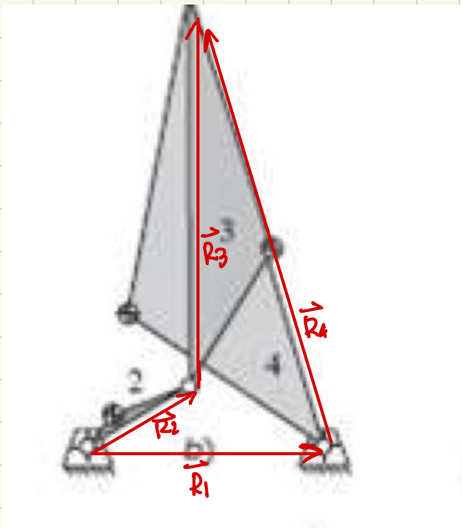
$R_{g4} = R_{41}$

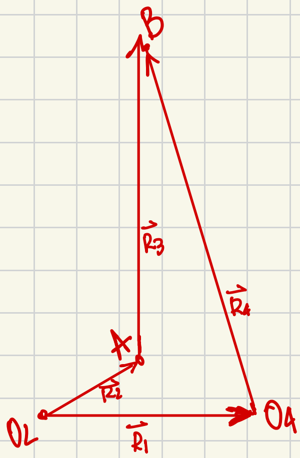
Cálculo aceleración centro de masa (A_{g2}, A_{g3}, A_{g4})

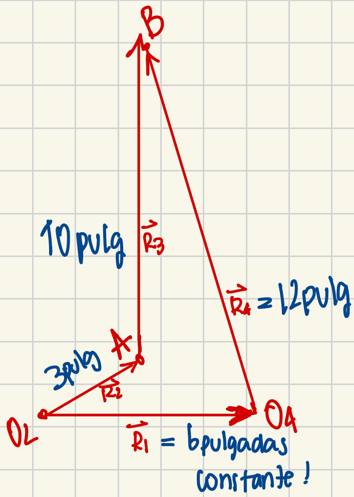
Parte 1	Longitudes en pulgadas, ángulos en grados, aceleración angular en rad/s²						
Fila	**eslabón 2**	**eslabón 3**	**eslabón 4**	**eslabón 1**	θ_2	θ_3	θ_4
a.	4	12	8	15	45	24.97	99.30
b.	3	10	12	6	30	90.15	106.60

Parte 3	Longitudes en pulgadas, ángulos en grados, aceleraciones lineales en pulg/s²					
Fila	R_{g2} mag	R_{g2} ang	R_{g3} mag	R_{g3} ang	R_{g4} mag	R_{g4} ang
a.	2	0	5	0	4	30
b.	1	20	4	-30	6	40









x: $R_2\cos\theta_2 + R_3\cos\theta_3 - R_1\cancel{\cos\theta_{1}}^{1} - R_4\cos\theta_4 = 0$

y: $R_2\,\text{sen}\,\theta_2 + R_3\,\text{sen}\,\theta_3 - \cancel{R_1\,\text{sen}\,\theta_1} - R_4\,\text{sen}\,\theta = 0$

1er derivada

x: $-R_2\,\text{sen}\,\theta_2\,\dot{\theta}_2 - R_3\,\text{sen}\,\theta_3\,\dot{\theta}_3 + R_4\,\text{sen}\,\theta_4\,\dot{\theta}_4 = 0$ ✓

y: $+R_2\cos\theta_2\,\dot{\theta}_2 + R_3\cos\theta_3\,\dot{\theta}_3 - R_4\cos\theta_4\,\dot{\theta}_4 = 0$ ✓

2da derivada

x: $-R_2\cos\theta_2\,\dot{\theta}_2^2 - R_2\,\text{sen}\,\theta_2\,\cancel{\ddot{\theta}_2}^{0} - R_3\cos\theta_3\,\dot{\theta}_3^2 - R_3\,\text{sen}\,\theta_3\,\ddot{\theta}_3 + R_4\cos\theta_4\,\dot{\theta}_4^2 + R_4\,\text{sen}\,\theta_4\,\ddot{\theta}_4 = 0$ ✓

y: $-R_2\,\text{sen}\,\theta_2\,\dot{\theta}_2^2 + R_2\cos\theta_2\,\cancel{\ddot{\theta}_2}^{0} - R_3\,\text{sen}\,\theta_3\,\dot{\theta}_3^2 + R_3\cos\theta_3\,\ddot{\theta}_3 + R_4\,\text{sen}\,\theta_4\,\dot{\theta}_4^2 - R_4\cos\theta_4\,\ddot{\theta}_4 = 0$ ✓

Jacobiano !

$$\begin{pmatrix} -R_3 \operatorname{sen} \overset{\text{var}}{\theta_3} & +R_4 \operatorname{sen} \overset{\text{var}}{\theta_4} \\ R_3 \cos\theta_3 & -R_4 \cos\theta_4 \end{pmatrix} \begin{pmatrix} \overset{\text{var}}{\dot\theta_3} \\ \dot\theta_4 \end{pmatrix} = \begin{pmatrix} R_2 \operatorname{sen}\theta_2 \dot\theta_2 \\ -R_2 \cos\theta_2 \dot\theta_2 \end{pmatrix}$$

Velocidad angular!

$$\begin{pmatrix} -R_3 \operatorname{sen}\theta_3 & R_4 \operatorname{sen}\theta_4 \\ R_3 \cos\theta_3 & -R_4 \cos\theta_4 \end{pmatrix} \begin{pmatrix} \ddot\theta_3 \\ \underbrace{\ddot\theta_4}_{\text{var}} \end{pmatrix} = \begin{pmatrix} R_2 \cos\theta_2 \dot\theta_2^2 + R_3 \cos\theta_3 \dot\theta_3^2 - R_4 \cos\theta_4 \dot\theta_4^2 \\ R_2 \operatorname{sen}\theta_2 \dot\theta_2^2 + R_3 \operatorname{sen}\theta_3 \dot\theta_3^2 - R_4 \operatorname{sen}\theta_4 \dot\theta_4^2 \end{pmatrix}$$

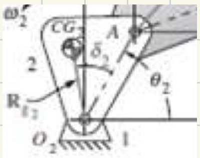
aceleración angular !

Aceleración centro de masa (A_{g2}, A_{g3}, A_{g4})

$\dot\theta_3 = \omega_3$ $\quad$ $\dot\theta_4 = \omega_4$

$\ddot\theta_3 = \alpha_3$ $\quad$ $\ddot\theta_4 = \alpha_4$

Eslabón 2



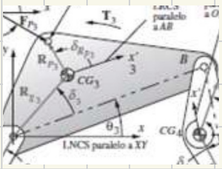
$$\vec{A}_A = \cancelto{0}{\vec{A}_{O2}} + \cancelto{0}{\vec{A}} + (\cancelto{0}{\alpha_2} \times R_2) + 2(\vec{\omega}_2 \times \cancelto{0}{\vec{V}}) + \omega_2 \times (\omega_2 \times R_2)$$

$$\vec{A}_A = \vec{\omega}_2 \times (\vec{\omega}_2 \times (R_2 \cos\theta_2 \hat{i} + R_2 \operatorname{sen}\theta_2 \hat{j}))$$

$$\vec{A}_{g2} = \vec{A}_{O2} + \vec{A} + (\alpha_2 \times R_{g2}) + 2(\vec{\omega}_2 \times \vec{V}) + \omega_2 \times (\omega_2 \times R_{g2})$$

$$\vec{A}_{g2} = \omega_2 \times (\omega_2 \times (R_{g2} \cos(\delta_2 + \theta_2) \hat{i} + R_{g2} \operatorname{sen}(\delta_2 + \theta_2) \hat{j}))$$

Eslabón 3

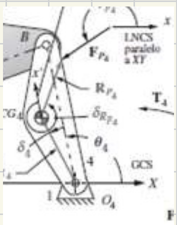


$$\vec{A}_B = \vec{A}_A + \vec{A} + (\alpha_3 \times R_3) + 2(\omega_3 \times V) + \omega_3 \times (\omega_3 \times R_3)$$

$$\vec{A}_B = \vec{A}_A + (\vec{\alpha}_3 \times (R_3 \cos\theta_3 \hat{i} + R_3 \operatorname{sen}\theta_3 \hat{j})) + \omega_3 \times (\omega_3 \times (R_3 \cos\theta_3 \hat{i} + R_3 \operatorname{sen}\theta_3 \hat{j}))$$

$$\vec{A}_{g3} = \vec{A}_A + (\vec{\alpha}_3 \times (R_{g3} \cos(\delta_3 + \theta_3) \hat{i} + R_{g3} \operatorname{sen}(\delta_3 + \theta_3) \hat{j})) + \omega_3 \times (\omega_3 \times (R_{g3} \cos(\delta_3 + \theta_3) \hat{i} + R_{g3} \operatorname{sen}(\delta_3 + \theta_3) \hat{j}))$$

Eslabón 4



$$\vec{A}_C = \vec{A}_B + \vec{A} + (\vec{\alpha}_4 \times \vec{R}_4) + 2(\vec{\omega}_4 \times \vec{V}) + (\vec{\omega}_4 \times (\vec{\omega}_4 \times \vec{R}_4))$$

$$\vec{A}_C = \vec{A}_B + (\vec{\alpha}_4 \times (R_4 \cos\theta_4 \hat{i} + R_4 \operatorname{sen}\theta_4 \hat{j})) + \omega_4 \times (\omega_4 \times (R_4 \cos\theta_4 \hat{i} + R_4 \operatorname{sen}\theta_4 \hat{j}))$$

$$\vec{A}_{g4} = \vec{A}_B + (\vec{\alpha}_4 \times (R_{g4} \cos(\delta_4 + \theta_4) \hat{i} + R_{g4} \operatorname{sen}(\delta_4 + \theta_4) \hat{j})) + (\omega_4 \times (\omega_4 \times (R_{g4} \cos(\delta_4 + \theta_4) \hat{i} + R_{g4} \operatorname{sen}(\delta_4 + \theta_4) \hat{j})))$$