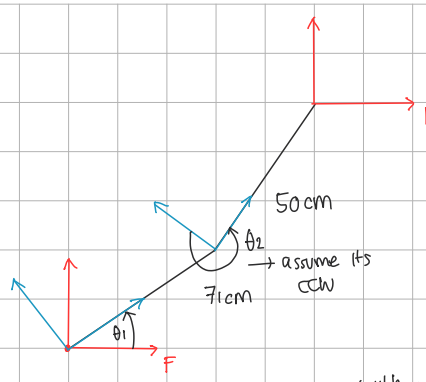

F = fixed frame
M = moving frame

$a_1 = 71cm$
$a_2 = 50cm$

Since this model has 2 joints :

$$T_1 = \begin{bmatrix} \cos(\theta_1) & -\sin(\theta_1) & a_1\cos\theta_1 \\ \sin(\theta_1) & \cos(\theta_1) & a_1\sin\theta_1 \\ 0 & 0 & 1 \end{bmatrix} \quad T_2 = \begin{bmatrix} \cos\theta_2 & -\sin\theta_2 & a_2\cos\theta_2 \\ \sin\theta_2 & \cos\theta_2 & a_2\sin\theta_2 \\ 0 & 0 & 1 \end{bmatrix}$$

coxa → femur femur → tibia

with :

$$x = a_1\cos(\theta_1) + a_2\cos(\theta_1+\theta_2)$$
$$y = a_1\sin(\theta_1) + a_2\sin(\theta_1+\theta_2)$$

answer :

$x = 71\cos 40 + 50\cos(40+30)$
$= 54,3$
$y = 71\sin 40 + 50\sin(40+30)$
$= 45,6$

$$T_1 = \begin{bmatrix} \cos 40 & -\sin 40 & 54,3 \\ \sin 40 & \cos 40 & 45,6 \\ 0 & 0 & 1 \end{bmatrix} \quad T_2 = \begin{bmatrix} \cos 30 & -\sin 30 & 43,3 \\ \sin 30 & \cos 30 & 25 \\ 0 & 0 & 1 \end{bmatrix}$$

$$T_1 \times T_2 = \begin{bmatrix} 0,76 & -0,64 & 54,3 \\ 0,64 & 0,76 & 45,6 \\ 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} 0,86 & -0,5 & 43,3 \\ 0,5 & 0,8 & 25 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0,76\times0,86 & 0,64\times-0,5 & 54,3\times43,3 \\ -0,64\times0,5 & 0,76\times0,8 & 45,6\times25 \\ 54,3\times0 & 45,6\times0 & 1\times1 \end{bmatrix}$$

$$= \begin{bmatrix} 0,34 & -0,9 & 71,4 \\ 0,93 & 0,34 & 92,6 \\ 0 & 0 & 1 \end{bmatrix}$$

→ translation matrix

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} 71,4 \\ 92,6 \end{bmatrix}$$

rotation matrix

$$R = \begin{bmatrix} \cos 70 & -\sin 70 \\ \sin 70 & \cos 70 \end{bmatrix}$$