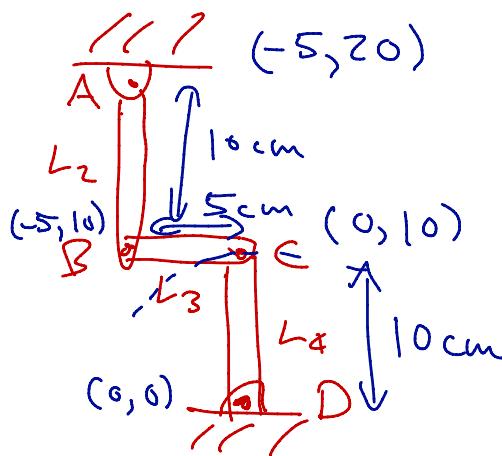


10/13/17

Lecture #18

example:



Given: geometry

$$\omega_4 = 2 \text{ rad/sec}$$

$$\alpha_4 = 0 \text{ rad/sec}^2$$

Find: ω_3, α_3

Velocities: $\vec{v}_C = \vec{\omega}_4 \times \vec{r}_{DC}$ \square

starting from point A:

$$\vec{v}_B = \vec{v}_C + \vec{\omega}_3 \times \vec{r}_{CB}$$
 $\begin{matrix} 2 \text{ eqns} \\ 3 \text{ unknowns} \end{matrix}$

$$\vec{v} = \vec{v}_B + \vec{\omega}_2 \times \vec{r}_{BA} \leftarrow 2 \text{ equations.}$$

$$\Rightarrow -\vec{\omega}_2 \times \vec{r}_{BA} = \vec{v}_C + \vec{\omega}_3 \times \vec{r}_{CB} \leftarrow \begin{matrix} 1 \text{ new unknown} \\ \text{solve for } \omega_2, \omega_3 \end{matrix}$$

$$\omega_2 = -2 \text{ rad/sec}$$

$$\omega_3 = 0 \text{ rad/sec}$$

General acceleration expression rigid body:

$$\vec{a}_A = \vec{a}_P + \vec{\alpha} \times \vec{r}_{PA} - \omega^2 \vec{r}_{PA}$$

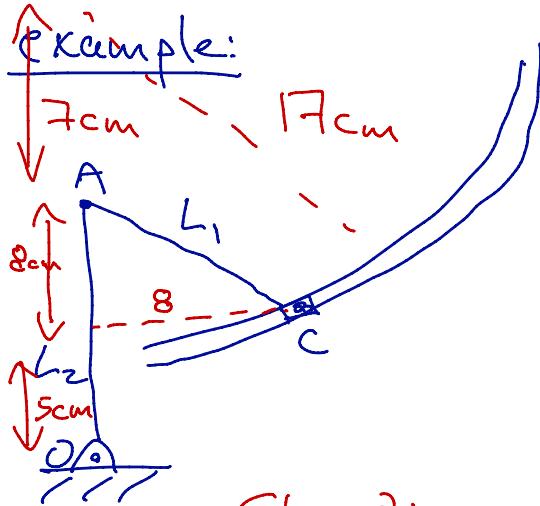
$$\vec{a}_C = -(-2)^2 \vec{r}_{DC} \quad \square$$

$$\vec{a}_B = \vec{a}_A + \vec{\alpha}_2 \times \vec{r}_{AB} - \omega_2^2 \vec{r}_{AB}$$

$$\vec{a}_B = \vec{a}_C + \vec{\alpha}_3 \times \vec{r}_{CB} - \omega_3^2 \vec{r}_{CB}$$

Equating $(\alpha_2 \hat{k}) \times \vec{r}_{AB} - \omega_2^2 \vec{r}_{AB}$
 $= \vec{a}_C + (\alpha_3 \hat{k}) \times \vec{r}_{CB}$

2 eqns 2 unknowns $\smiley \Rightarrow \alpha_3 = -16 \text{ rad/sec}^2.$



Given: the geometry
 $\omega_1 = 3 \text{ rad/sec}$
 $\alpha_1 = -2 \text{ rad/sec}^2$
 $R = 17 \text{ cm}$

Find: α_2 for Link 2.

$$\vec{\omega} \times (\vec{\omega} \times \vec{r}_{Ac}) \rightarrow \omega^2 \vec{r}_{Ac}$$

Step 0: relationships we know

$$\vec{a}_c = \vec{a}_A + \vec{\alpha}_1 \times \vec{r}_{Ac} - \omega_1^2 \vec{r}_{Ac}$$

$$\vec{a}_A = \vec{\alpha}_2 \times \vec{r}_{OA} - \omega_2^2 \vec{r}_{OA}$$

geometry: $\vec{a}_c = \frac{r_c^2}{s} \hat{e}_n + \ddot{s} \hat{e}_T$ $\ddot{s} = \frac{d}{dt} \{ |\vec{v}| \}$

If we can determine r_c and ω_2 then we can reduce these eqns to 2 eqns in \dot{s}, α_2

Step I: relate \vec{v}_A and \vec{v}_c to get r_c and ω_2