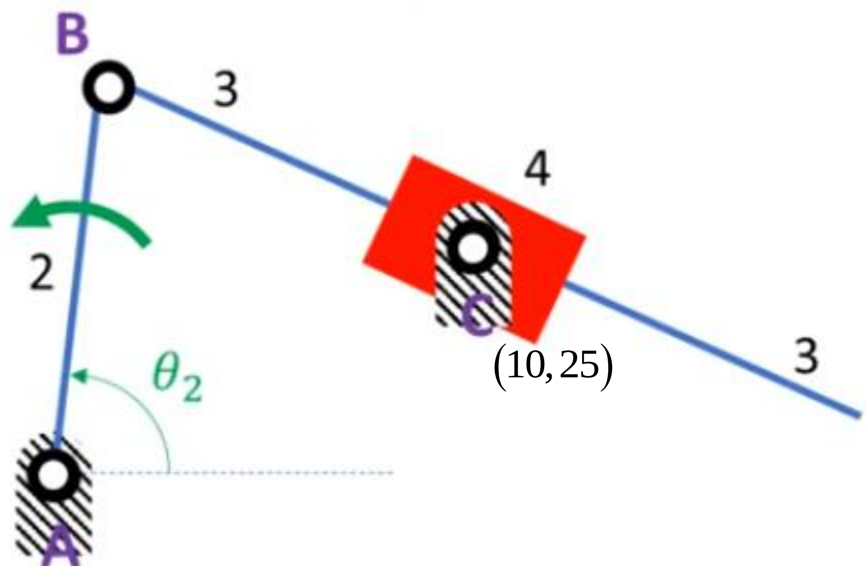
Solve position equation for the mechanism shown. Consider link 2 (bar AB) as the input.

Given : $AB = 15cm$; $CD = 10cm$; $AD = 25cm$

$\theta_2 = 60°$

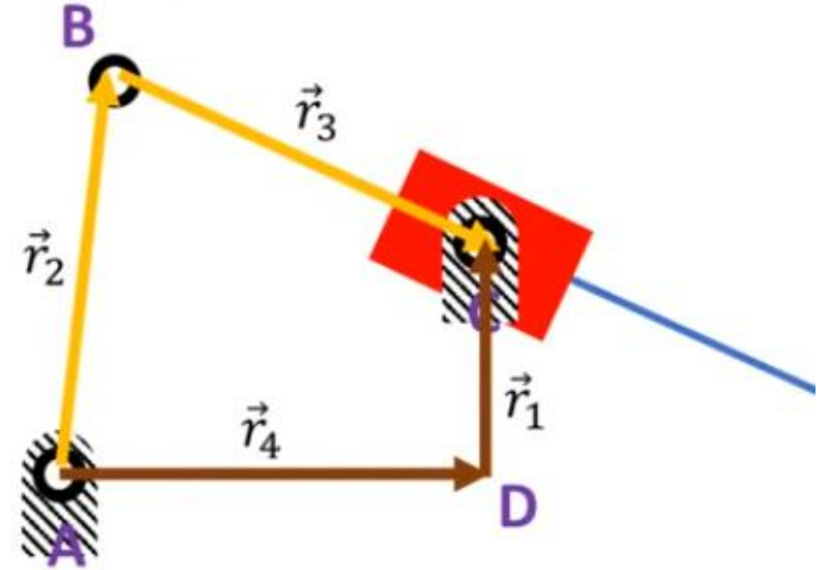


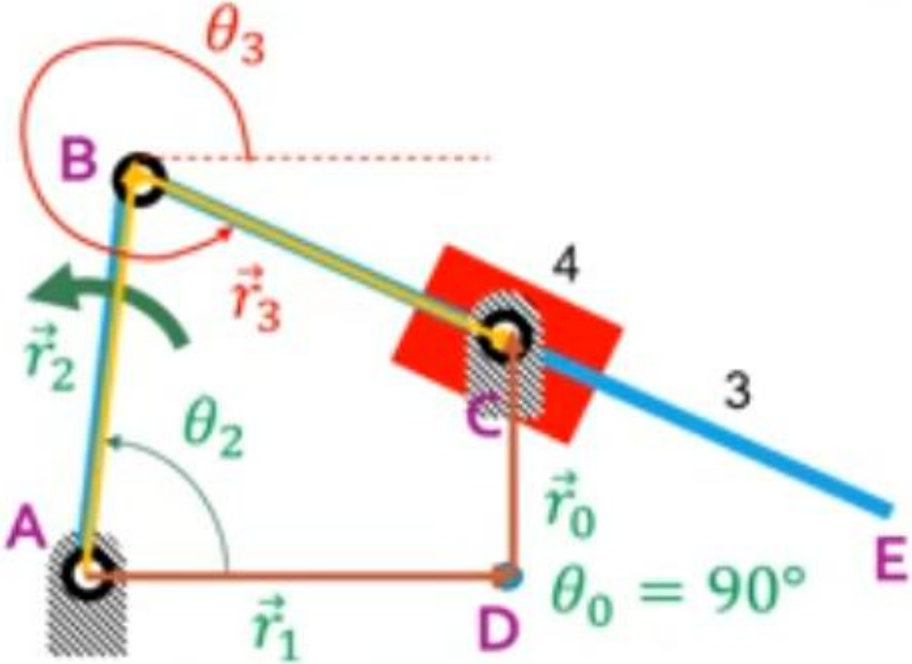
$\overrightarrow{AB} = \vec{r}_2$

$\overrightarrow{BC} = \vec{r}_3$

$\overrightarrow{AD} = \vec{r}_1$

$\overrightarrow{DC} = \vec{r}_0$





$$\overrightarrow{AB} + \overrightarrow{BC} = \overrightarrow{AD} + \overrightarrow{DC}$$

$$\vec{r}_2 + \vec{r}_3 = \vec{r}_1 + \vec{r}_0$$

$$\vec{r}_3 = \vec{r}_1 + \vec{r}_0 - \vec{r}_2$$

$$\begin{cases} r_3 \cos\theta_3 = r_1 \cos\theta_1 + r_0 \cos\theta_0 - r_2 \cos\theta_2 \\ r_3 \sin\theta_3 = r_1 \sin\theta_1 + r_0 \sin\theta_0 - r_2 \sin\theta_2 \end{cases}$$

$$\Rightarrow \begin{cases} r_3 \cos\theta_3 = r_1 - r_2 \cos\theta_2 \\ r_3 \sin\theta_3 = r_0 - r_2 \sin\theta_2 \end{cases}$$

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$$r_3 = \sqrt{(r_1 - r_2 \cos\theta_2)^2 + (r_0 - r_2 \sin\theta_2)^2}$$

$$\tan\theta_3 = \frac{r_0 - r_2 \sin\theta_2}{r_1 - r_2 \cos\theta_2}$$

$$\cos\theta_3 = \frac{r_1 - r_2 \cos\theta_2}{r_3}$$

$$r_3 = \sqrt{(r_1 - r_2 \cos\theta_2)^2 + (r_0 - r_2 \sin\theta_2)^2}$$

$$\tan\theta_3 = \frac{r_0 - r_2 \sin\theta_2}{r_1 - r_2 \cos\theta_2} \qquad \cos\theta_3 = \frac{r_1 - r_2 \cos\theta_2}{r_3}$$

$$\Rightarrow \begin{cases} \theta_3 = \arctan\left(\frac{r_0 - r_2 \sin\theta_2}{r_1 - r_2 \cos\theta_2}\right), \text{if} \cos\theta_3 \geq 0 \\ \theta_3 = 180° + \arctan\left(\frac{r_0 - r_2 \sin\theta_2}{r_1 - r_2 \cos\theta_2}\right), \text{if} \cos\theta_3 < 0 \end{cases}$$

$$r_3 = \sqrt{(r_1 - r_2\cos\theta_2)^2 + (r_0 - r_2\sin\theta_2)^2}$$
$$= \sqrt{(25 - 15\cos 60°)^2 + (10 - 15\sin 60°)^2}$$

$$r_3 \approx 17.75\ \text{cm}$$

$$\cos\theta_3 \approx \frac{25 - 15\cos 60°}{17.75} \approx 0.9857 > 0$$

$$\theta_3 = \arctan\left(\frac{r_0 - r_2\sin\theta_2}{r_1 - r_2\cos\theta_2}\right) = \arctan\left(\frac{10 - 15\sin 60°}{25 - 15\cos 60°}\right)$$

$$\theta_3 \approx -9.7° = 350.3°$$