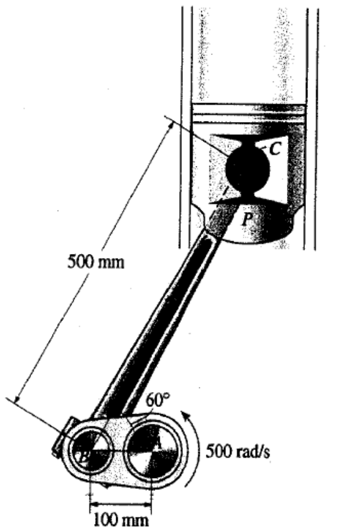
DİNAMİK SINAVLARA HAZIRLIK, ÇALIŞMA SORULARI

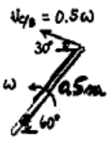
BAĞIL HAREKET ANALİZİ-(Hız)

Örnek

The crankshaft AB is rotating at 500 rad/s about a fixed axis passing through A. Determine the speed of the piston P at the instant it is in the position shown.



$v_B = 500(0.1) = 50$ m/s



$\mathbf{v}_C = \mathbf{v}_B + \mathbf{v}_{C/B}$

$\mathbf{v}_C = 50 + 0.5\omega$

$\downarrow \quad \downarrow \; 30°$

$\overset{+}{\rightarrow} \quad 0 = -0.5\omega\cos 30°, \quad \omega = 0$

$+\downarrow \quad v_C = 50$ m/s **Ans**

Also; $\mathbf{v}_C = \mathbf{v}_B + \boldsymbol{\omega}\times\mathbf{r}_{C/B}$

$-v_C\mathbf{j} = -50\mathbf{j} + \{\omega\mathbf{k}\}\times\{0.5\cos 60°\mathbf{i} + 0.5\sin 60°\mathbf{j}\}$

$\overset{+}{\rightarrow} \quad 0 = 0 - \omega(0.5\sin 60°)$

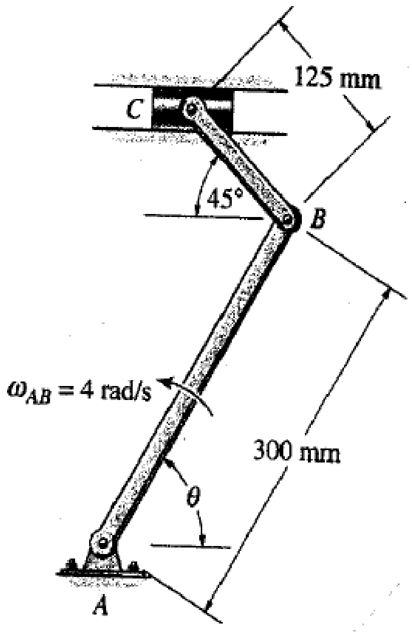
$\omega = 0$

$+\uparrow \quad -v_C = -50 + 0$

$v_C = 50$ m/s **Ans**

Örnek

The shaper mechanism is designed to give a slow cutting stroke and a quick return to a blade attached to the slider at C. Determine the velocity of the slider block C at the instant $\theta = 60°$, if link AB is rotating at 4 rad/s.



$\mathbf{v}_C = \mathbf{v}_B + \boldsymbol{\omega}\times\mathbf{r}_{C/B}$

$-v_C\mathbf{i} = -4(0.3)\sin 30°\mathbf{i} + 4(0.3)\cos 30°\mathbf{j} + \omega\mathbf{k}\times(-0.125\cos 45°\mathbf{i} + 0.125\sin 45°\mathbf{j})$

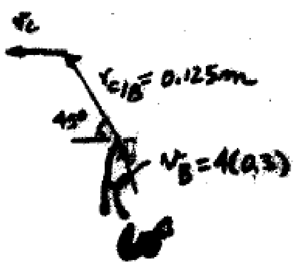
$-v_C = -1.0392 - 0.008839\omega$

$0 = 0.6 - 0.08839\omega$

Solving,

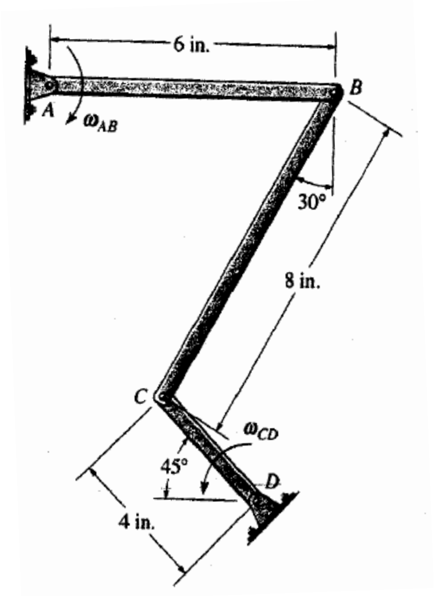
$\omega = 6.79$ rad/s

$v_C = 1.64$ m/s Ans.



Örnek

If link AB is rotating at $\omega_{AB} = 3$ rad/s, determine the angular velocity of link CD at the instant shown.



$$\mathbf{v}_B = \boldsymbol{\omega}_{AB} \times \mathbf{r}_{B/A}$$

$$\mathbf{v}_C = \boldsymbol{\omega}_{CD} \times \mathbf{r}_{C/D}$$

$$\mathbf{v}_C = \mathbf{v}_B + \boldsymbol{\omega}_{BC} \times \mathbf{r}_{C/B}$$

$$(\omega_{CD}\mathbf{k}) \times (-4\cos 45°\mathbf{i} + 4\sin 45°\mathbf{j}) = (-3\mathbf{k}) \times (6\mathbf{i}) + (\omega_{BC}\mathbf{k}) \times (-8\sin 30°\mathbf{i} - 8\cos 30°\mathbf{j}$$

$$-2.828\omega_{CD} = 0 + 6.928\omega_{BC}$$

$$-2.828\omega_{CD} = -18 - 4\omega_{BC}$$

Solving,

$$\omega_{BC} = -1.65 \text{ rad/s}$$

$$\omega_{CD} = 4.03 \text{ rad/s} \qquad \textbf{Ans}$$

Örnek

If disk D has a constant angular velocity $\omega_D = 2$ rad/s, determine the angular velocity of disk A at the instant $\theta = 60°$.

$$\mathbf{v}_B = \mathbf{v}_C + \mathbf{v}_{B/C}$$

$$v_B = 1.5 + 2\omega_{BC}$$

↘45° ∠30° ↗60°

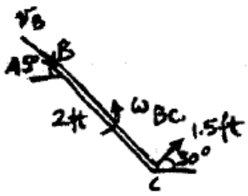
$(\overset{+}{\rightarrow})$ $\quad v_B \cos 45° = 1.5\cos 30° - 2\omega_{BC}\sin 60°$

$(+\downarrow)$ $\quad v_B \sin 45° = -1.5\sin 30° + 2\omega_{BC}\cos 60°$

$$\omega_{BC} = 0.75 \text{ rad/s}$$

$$v_B = 0$$

$$\omega_A = \frac{0}{0.5} = 0 \qquad \textbf{Ans}$$



Also:

$$\mathbf{v}_B = \mathbf{v}_C + \boldsymbol{\omega}_{BC} \times \mathbf{r}_{C/B}$$

$$v_B\cos 45°\mathbf{i} - v_B\sin 45°\mathbf{j} = 1.5\cos 30°\mathbf{i} + 1.5\sin 30°\mathbf{j} + (\omega_{BC}\mathbf{k}) \times (2\cos 60°\mathbf{i} - 2\sin 60°\mathbf{j})$$

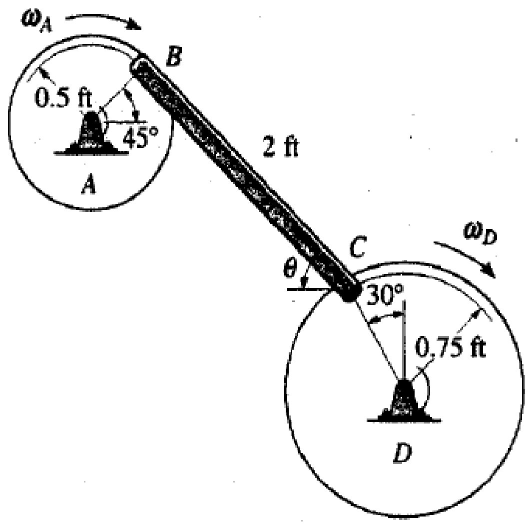
$$v_B\cos 45° = 1.5\cos 30° + \omega_{BC}(2\sin 60°)$$

$$-v_B\sin 45° = 1.5\sin 30° + \omega_{BC}(2\cos 60°)$$

$$\omega_{BC} = 0.75 \text{ rad/s}$$

$$v_B = 0$$

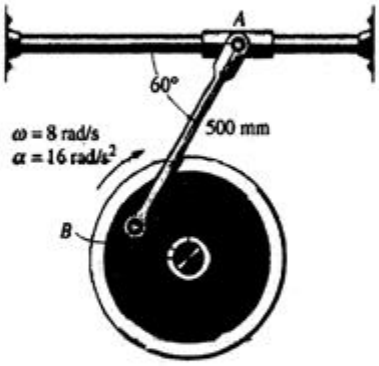
$$\omega_A = \frac{0}{0.5} = 0 \qquad \textbf{Ans}$$



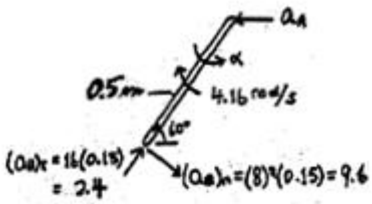
BAĞIL HAREKET ANALİZİ-(İvme)

Örnek

At a given instant the wheel is rotating with the angular motions shown. Determine the acceleration of the collar at A at this instant.



See Prob. 16–59.



$\omega = 4.16\ \text{rad/s}$

$\mathbf{a}_A = \mathbf{a}_B + \mathbf{a}_{A/B}$

$$\underset{\leftarrow}{a_A} = \underset{\angle 60^\circ}{2.4} + \underset{\nabla 30^\circ}{9.6} + \underset{60^\circ\nabla}{(4.16)^2(0.5)} + \underset{\searrow 60^\circ}{\alpha(0.5)}$$

$(\overset{+}{\rightarrow})\quad -a_A = 2.4\cos 60^\circ + 9.6\cos 30^\circ - 8.65\cos 60^\circ - \alpha(0.5)\sin 60^\circ$

$(+\uparrow)\quad 0 = 2.4\sin 60^\circ - 9.6\sin 30^\circ - 8.65\sin 60^\circ + \alpha(0.5)\cos 60^\circ$

$\alpha = 40.8\ \text{rad/s}^2 \circlearrowleft$

$a_A = 12.5\ \text{m/s}^2 \leftarrow$ **Ans**

Also:

$\mathbf{a}_A = \mathbf{a}_B + \boldsymbol{\alpha} \times \mathbf{r}_{A/B} - \omega^2 \mathbf{r}_{A/B}$

$$a_A\mathbf{i} = (8)^2(0.15)(\cos 30^\circ)\mathbf{i} - (8)^2(0.15)\sin 30^\circ\mathbf{j} + (16)(0.15)\sin 30^\circ\mathbf{i} + (16)(0.15)\cos 30^\circ\mathbf{j} + (\alpha\mathbf{k}) \times (0.5\cos 60^\circ\mathbf{i} + 0.5\sin 60^\circ\mathbf{j}) - (4.16)^2(0.5\cos 60^\circ\mathbf{i} + 0.5\sin 60^\circ\mathbf{j})$$

$a_A = 8.314 + 1.200 - 0.433\alpha - 4.326$

$0 = -4.800 + 2.0785 + 0.25\alpha - 7.4935$

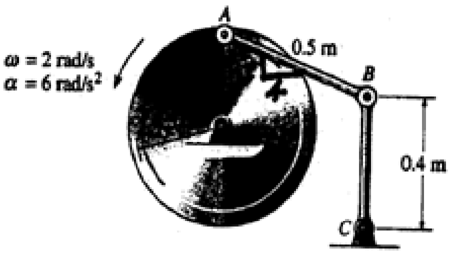
$\alpha = 40.8\ \text{rad/s}^2 \circlearrowleft$

$a_A = 12.5\ \text{m/s}^2 \leftarrow$ **Ans**

Örnek

The flywheel rotates with an angular velocity $\omega = 2\ \text{rad/s}$ and an angular acceleration $\alpha = 6\ \text{rad/s}^2$. Determine the angular acceleration of links AB and BC at this instant.

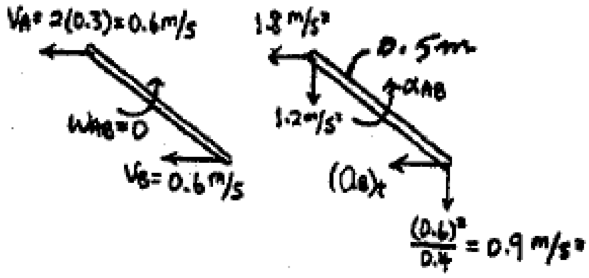
$$\mathbf{a}_B = \mathbf{a}_A + \mathbf{a}_{B/A}$$



$$\underset{\leftarrow}{(a_B)_t} + \underset{\downarrow}{0.9} = \underset{\leftarrow}{1.8} + \underset{\downarrow}{1.2} + \underset{\frac{5}{3}\measuredangle 4}{\alpha_{AB}(0.5)}$$

$$(\overset{+}{\leftarrow}) \quad (a_B)_t = 1.8 - \frac{3}{5}(\alpha_{AB})(0.5)$$

$$(+\downarrow) \quad 0.9 = 1.2 - \frac{4}{5}(\alpha_{AB})(0.5)$$



$\alpha_{AB} = 0.75 \text{ rad/s}^2$ ↺ **Ans**

$(a_B)_t = 1.575 \text{ m/s}^2$

$\alpha_{BC} = \dfrac{1.575}{0.4} = 3.94 \text{ rad/s}^2$ ↺ **Ans**

Also:

$$\mathbf{a}_B = \mathbf{a}_A + \boldsymbol{\alpha}_{AB} \times \mathbf{r}_{B/A} - \omega^2 \mathbf{r}_{B/A}$$

$$-(a_B)_t\mathbf{i} - \frac{(0.6)^2}{0.4}\mathbf{j} = -6(0.3)\mathbf{i} - (2)^2(0.3)\mathbf{j} + (\alpha_{AB}\mathbf{k}) \times (0.4\mathbf{i} - 0.3\mathbf{j}) - 0$$

$$-(a_B)_t = -1.8 + 0.3\alpha_{AB}$$

$$-0.9 = -1.2 + 0.4\alpha_{AB}$$

$\alpha_{AB} = 0.75 \text{ rad/s}^2$ ↺ **Ans**

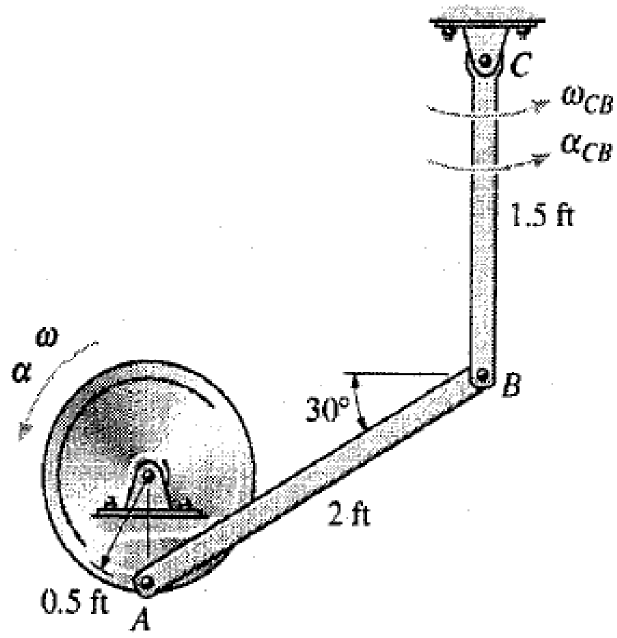
$(a_B)_t = 1.575 \text{ m/s}^2$

$\alpha_{BC} = \dfrac{1.575}{0.4} = 3.94 \text{ rad/s}^2$ ↺ **Ans**

Örnek

The disk rotates with an angular velocity $\omega = 5$ rad/s and an angular acceleration $\alpha = 6$ rad/s^2. Determine the angular acceleration of link CB at this instant.

The IC is at ∞. Thus



$\omega = 0$

$v_A = v_B = 2.5$ ft/s

$$\omega_{BC} = \frac{2.5}{1.5} = 1.667 \text{ rad/s}$$

$\mathbf{a}_B = \mathbf{a}_A + \mathbf{a}_{B/A}$

$$\underset{\rightarrow}{(a_B)_t} + \underset{\uparrow}{4.167} = \underset{\rightarrow}{3} + \underset{\uparrow}{12.5} + \underset{\searrow 30^\circ}{2\alpha_{AB}}$$

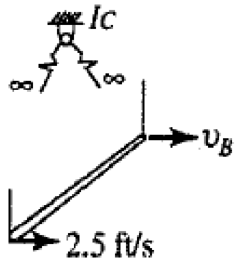
$(\overset{+}{\leftarrow})\quad (a_B)_t = 3 - 2\alpha_{AB}\sin 30^\circ$

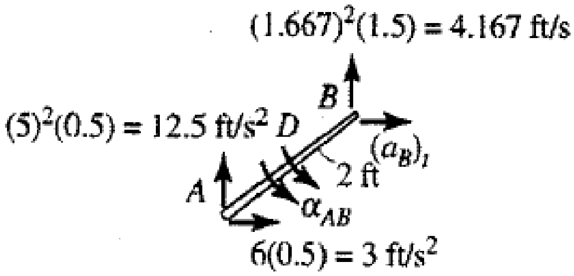
$(+\uparrow)\quad 4.167 = 12.5 + 2\alpha_{AB}\cos 30^\circ$

$\alpha_{AB} = -4.81 \text{ rad/s}^2 = 4.81 \text{ rad/s}^2$ ↻

$(a_B)_t = 7.81 \text{ ft/s}^2$

$$\alpha_{BC} = \frac{7.81}{1.5} = 5.21 \text{ rad/s}^2 \circlearrowleft$$ **Ans**





Also:

$\mathbf{a}_B = \mathbf{a}_A + \boldsymbol{\alpha}_{AB} \times \mathbf{r}_{B/A} - \omega^2 \mathbf{r}_{B/A}$

$(a_B)_t\mathbf{i} + 4.167\mathbf{j} = (3\mathbf{i} + 12.5\mathbf{j}) - 0 + (\alpha_{AB}\mathbf{k}) \times (2\cos 30^\circ\mathbf{i} + 2\sin 30^\circ\mathbf{j})$

$(a_B)_t = 3 - 2\alpha_{AB}\sin 30^\circ$

$4.167 = 12.5 + 2\alpha_{AB}\cos 30^\circ$

$\alpha_{AB} = -4.81 \text{ rad/s}^2 = 4.81 \text{ rad/s}^2$ ↻

$(a_B)_t = 7.81 \text{ ft/s}^2$

$$\alpha_{BC} = \frac{7.81}{1.5} = 5.21 \text{ rad/s}^2 \circlearrowleft$$ **Ans**