Palestine Technical University- Kadoorie (PTUK)

Mechanical Engineering Department

12210244: Dynamics

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This is an explanation of the Dynamics course

offered at Palestine Technical University - Kadoorie

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Textbook:

Engineering Mechanics: Dynamics, 7th Edition

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Chapter Five: Plane Kinematics of Rigid Bodies

Section Six: Relative Acceleration

5 Chapter Five: Plane Kinematics of Rigid Bodies

5.6 Relative Acceleration

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

$$\vec{a}_A = \vec{a}_B + (\vec{a}_{A/B})_n + (\vec{a}_{A/B})_t$$

$$(\vec{a}_{A/B})_n = \vec{\omega} \times (\vec{\omega} \times \vec{r}) \Rightarrow (a_{A/B})_n = \frac{v_{A/B}^2}{r} = r\omega^2$$

$$(\vec{a}_{A/B})_t = \vec{\alpha} \times \vec{r} \Rightarrow (a_{A/B})_t = \dot{v}_{A/B} = r\alpha$$

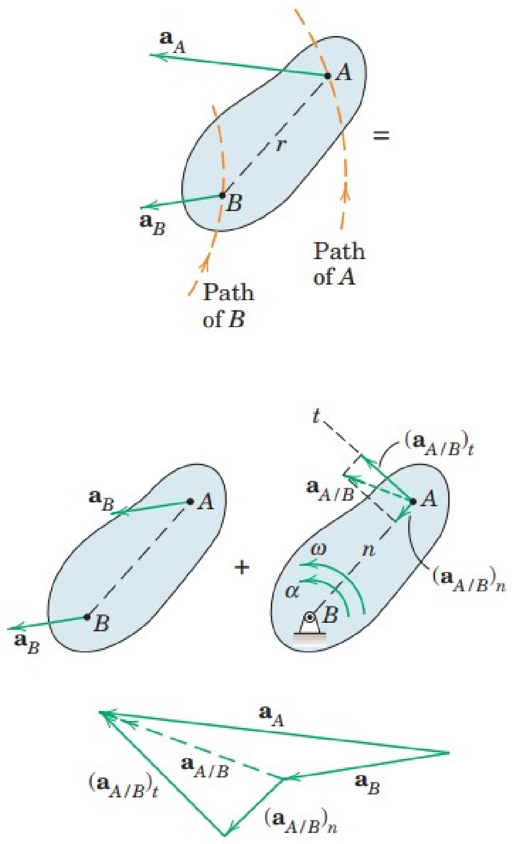


Figure 5/9

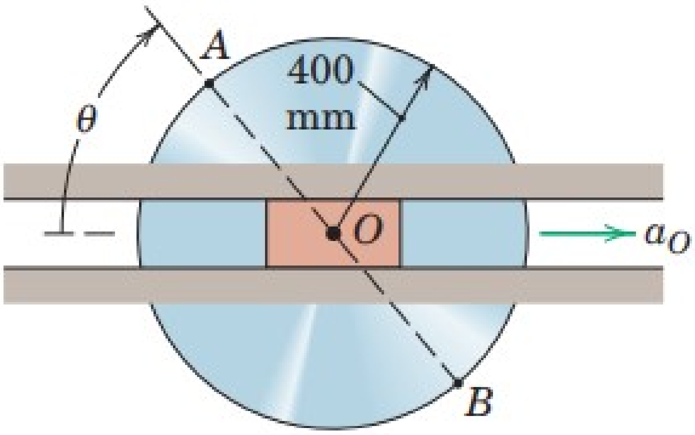
End of Section 5.6

Example 1:

The center O of the wheel is mounted on the sliding block, which has an acceleration $a_O = 8$ m/s^2 to the right. At the instant when $\theta = 45°$, $\dot{\theta} = 3$ rad/s and $\ddot{\theta} = -8$ rad/s^2, determine the magnitudes of the accelerations of points A and B.

Answer:

$a_A = 9.58$ m/s^2 and $a_B = 9.09$ m/s^2

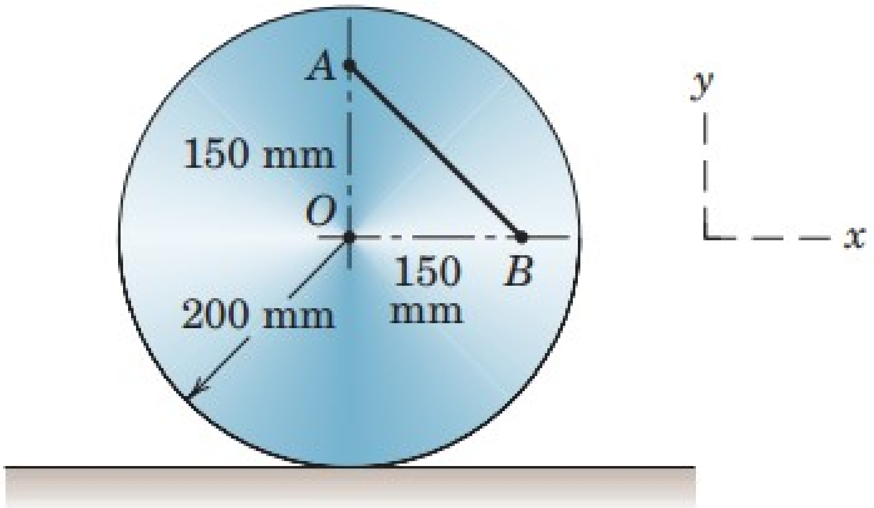


Ans.

Example 2:

The circular disk rolls to the left without slipping. If $a_{A/B} = -2.7\hat{j}\ m/sec^2$, determine the velocity and acceleration of the center O of the disk.

ans. $v_O = -0.6\hat{i}\ m/sec$ $v_O = -1.8\hat{i}\ m/sec^2$

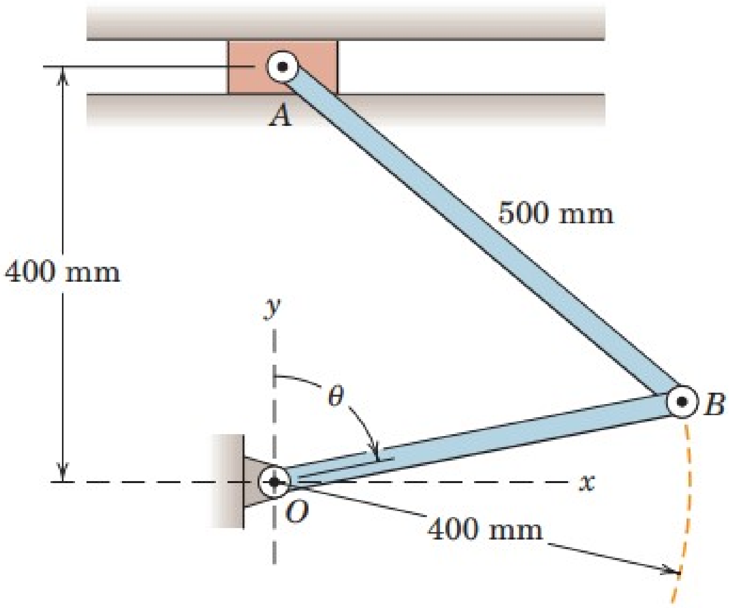


Ans.

Example 3:

Determine the angular acceleration of link AB and the linear acceleration of A for $\theta = 90°$ if $\dot{\theta} = 0\ rad/sec$ and $\ddot{\theta} = 3\ rad/sec^2$ at that position. Carry out your solution using vector notation.

$\alpha AB = -4\hat{k}\ rad/sec^2 \qquad a_A = 1.6\hat{i}\ m/sec^2$

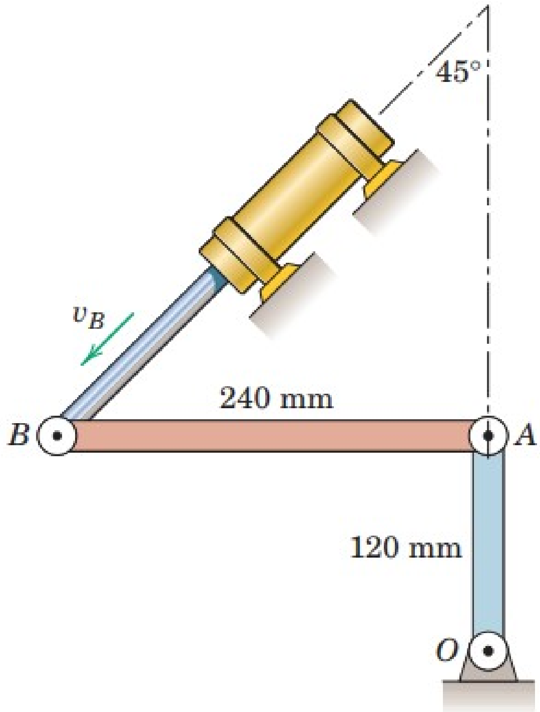


Ans.

Example 4:

The hydraulic cylinder imparts motion to point B which causes link OA to rotate. For the instant shown where OA is vertical and AB is horizontal, the velocity of pin B is 4 m/sec and is increasing at the rate of 20 m/sec^2. For this position determine the angular acceleration of OA.

ans. $\alpha_{OA} = 396\ rad/sec^2\ CCW$



Ans.