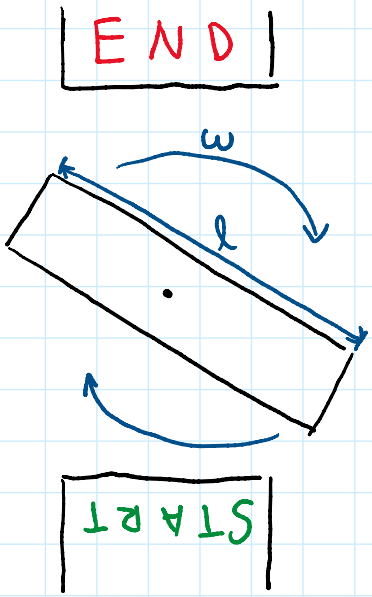
20-R-KM-DK-18

July 31, 2020 11:26 AM

20-R-KM-DK-18 Beginner Rotating Frame

Inspiration: 16-131 Hibbeler



On a televised show, contestants run through an obstacle course. One obstacle is a turning platform which rotates at a constant ***omega = 4 rad/s*** clockwise. A contestant has successfully jumped onto one end and runs at a constant speed of ***v = 6.5 m/s*** relative to the platform. What is the magnitude of her velocity and acceleration when she reaches the other end of the platform? The platform has a length ***l = 2 m***.

$$\vec{v}_A = \vec{v}_O + \vec{\Omega} \times \vec{r}_{A/O} + (v_{A/O})_{xyz}$$
$$= 0 + (-4\hat{k}) \times 1\hat{j} + 6.5\hat{j} = 4\hat{i} + 6.5\hat{j}$$
$$\|\vec{v}_A\| = v_A = \sqrt{4^2 + 6.5^2} = \boxed{7.6321 \text{ m/s}}$$

$$\vec{a}_A = \vec{a}_O + \dot{\vec{\Omega}} \times \vec{r}_{A/O} + \vec{\Omega} \times (\vec{\Omega} \times \vec{r}_{A/O}) + 2\vec{\Omega} \times (v_{A/O})_{xyz} + (a_{A/O})_{xyz}$$
$$= 0 + 0 + (-4\hat{k} \times (-4\hat{i} \times 1\hat{j}) + (-8\hat{i}) \times 6.5\hat{j} + 0$$
$$= -16\hat{j} + 52\hat{i}$$

$$\|\vec{a}_A\| = a_A = \sqrt{52^2 + (-16)^2} = 4\sqrt{185} \qquad \boxed{a_A = 54.410588 \text{ m/s}^2}$$