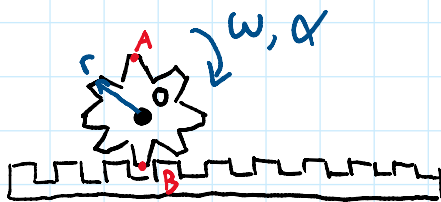


20-R-KM-DK-10 Beginner Acceleration (Relative Motion)

Inspiration: F16-20 Hibbeler

A gear rolls on a fixed rack with an angular velocity of $\omega = 7 \text{ rad/s}$ and an angular acceleration of $\alpha = 5.25 \text{ rad/s}^2$. Determine the acceleration at point O, B, and A. The gear has a radius $r = 0.4 \text{ m}$.



$$v_B = 0 \quad \vec{v}_O = \vec{\omega} \times \vec{r}_{O/B} = -7 \hat{k} \times 0.4 \hat{j} = 2.8 \hat{i} \text{ m/s}$$

$$\vec{a}_O = \vec{a}_B + \vec{\alpha} \times \vec{r}_{O/B} - \omega^2 \vec{r}_{O/B} \quad \vec{a}_O = a_O \hat{i}$$

$$a_O \hat{i} = a_B \hat{j} + (-5.25 \hat{k}) \times (0.4 \hat{j}) - (7^2)(0.4 \hat{j})$$

$$\hat{i}: a_O = 2.1$$

$$\hat{j}: a_B = 19.6$$



a_B must be \hat{j} only

Alternatively: $v_O = \omega r \Rightarrow \frac{dv_O}{dt} = \frac{d\omega}{dt} r$

\downarrow \downarrow
 a_O α

$$a_O = \alpha r$$

$$a_O = (5.25)(0.4) = 2.1$$

$$\boxed{\vec{a}_O = 2.1 \hat{i} \text{ m/s}^2}$$

$$\boxed{a_B = 19.6 \hat{j} \text{ m/s}^2}$$

$$\boxed{a_A = -19.6 \hat{j} \text{ m/s}^2}$$