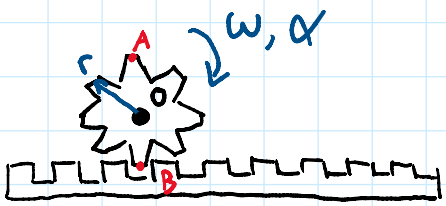
20-R-KM-DK-10

July 31, 2020 11:24 AM

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 rad/s*** and an angular acceleration of ***alpha = 5.25 rad/s^2***. Determine the acceleration at point O, B, and A. The gear has a radius ***r = 0.4 m***.

$v_B = 0$ $\quad \vec{v}_O = \vec{\omega} \times \vec{r}_{O/B} = -7\hat{k} \times 0.4\hat{j} = 2.8\hat{i}$ 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: $v_O = \omega r \Rightarrow \frac{dv_O}{dt} = \frac{d\omega}{dt} r$ $\quad a_O = \alpha r$

a_O $\quad \alpha$ $\quad a_O = (5.25)(0.4) = 2.1$

$\vec{a}_O = 2.1\hat{i}$ m/s^2 $\quad a_B = 19.6\hat{j}$ m/s^2 $\quad a_A = -19.6\hat{j}$ m/s^2