20-R-KM-DK-2

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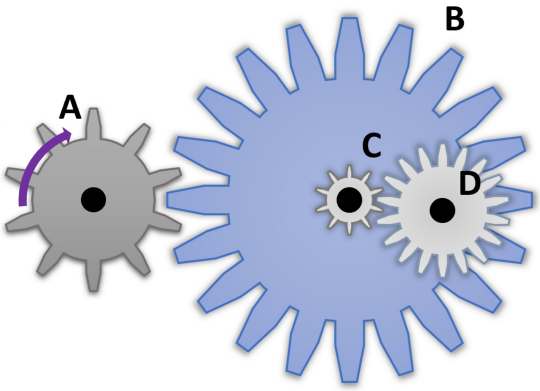
20-R-KM-DK-2 Beginner Gear Systems Inspiration: None

In the following gear train, gear A is in contact with gear B. Gear B and gear C are rigidly attached, and gear C is also in contact with gear D. If gear A rotates at an angular velocity of 5 rad/s in the clockwise direction, what is the magnitude of the angular velocity of gear D?

$\omega_A = 2\ rad/s$



$r_A = 1\ m$

$r_B = 3\ m$

$r_C = 0.5\ m$

$r_D = 1.5\ m$

$r_A = 1m \quad r_B = 3m \quad r_C = 0.5m \quad r_D = 1.5m$

$\left|\frac{\omega_B}{\omega_A}\right| = \frac{r_A}{r_B} \qquad \vec{\omega}_A = -2\ rad/s\ \hat{k}$

$|\omega_B| = |\omega_A|\frac{r_A}{r_B} = (2\ rad/s)\left(\frac{1m}{3m}\right) = \frac{2}{3}\ rad/s$

Gear B and gear C are rigidly attached $\rightarrow \omega_B = \omega_C$

$\left|\frac{\omega_D}{\omega_C}\right| = \frac{r_C}{r_D} \rightarrow |\omega_D| = |\omega_C|\frac{r_C}{r_D} = \left(\frac{2}{3}\ rad/s\right)\left(\frac{0.5m}{1.5m}\right) = \frac{2}{9}\ rad/s$

$|\omega_D| = \frac{2}{9}\ rad/s$