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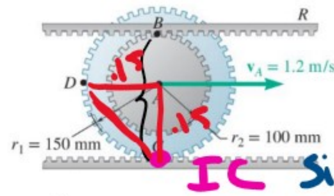
Example: The double gear shown rolls on the stationary lower rack; the velocity of its center A is 1.2 m/s directed to the right. Determine the a) angular velocity of the gear, b) the velocities of the upper rack R and point D of the gear.



IC Since $V_c = 0$

$V_B = 2\ m/s \rightarrow$

$V_D = 1.697\ m/s$

$\omega =$

$V_A = \omega\, r_{A/IC}$

$1.2 = \omega(.15)$

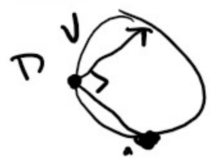
$\omega = 8\ rad/s$

$V_B = \omega\, r_{B/IC}$

$= 8(.25)$

$= 2\ m/s \rightarrow$

$r_{D/IC} = \sqrt{.15^2 + .15^2} = 0.212$



$V_D = \omega\, r_{D/IC}$

$= 8(0.212) = 1.697\ m/s$

$V_A = 2\ m/s$

$A_A = 3\ m/s^2$

$$\bar{a}_B = \bar{a}_A + \bar{\alpha}_{AB} \times \bar{r}_{B/A} - \omega^2 \bar{r}_{B/A}$$

$$\underbrace{a_B\cos45\,\hat{i} + a_B\sin45\,\hat{j}}_{a_B} = \underbrace{3\cos45\,\hat{i} - 3\sin45\,\hat{j}}_{a_A} + \overbrace{\bar{\alpha}_{AB}\hat{k}\times \underbrace{10\,\hat{i}}_{r_{B/A}}}^{10\alpha_{AB}\hat{j}} - \overbrace{\underset{0.282}{\omega^2}(\underbrace{10\,\hat{i}}_{r_{B/A}})}^{0.795\,\hat{i}}$$

$\hat{i}:\ a_B\cos45 = 3\cos45 - 0.795 \qquad a_B = 1.87\ m/s^2$

$\hat{j}:\ \underset{A_B}{1.87}\sin45 = -3\sin45 + 10\alpha_{AB} \qquad \alpha_{AB} = 0.344\ rad/s^2$

$$\bar{V}_B = \bar{V}_A + \omega \times \bar{r}_{B/A}$$

$$V_B\cos45\,\hat{i} + V_B\sin45\,\hat{j} = 2\cos45\,\hat{i} - 2\sin45\,\hat{j} + \underbrace{\omega\hat{k}\times 10\,\hat{i}}_{10\omega\hat{j}}$$

$i:\ V_B\cos45 = 2\cos45 \qquad V_B = 2$

$j:\ \underset{V_B}{2}\sin45 = -2\sin45 + 10\omega \qquad \omega = 0.282\ rad/s$

Relative Accelerations

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$$\bar{V}_B = \bar{V}_A + \bar{\omega} \times \bar{r}_{B/A}$$

$$\bar{a}_B = \bar{a}_A + (\bar{a}_{B/A})_T + (\bar{a}_{B/A})_N$$

$$\bar{a}_B = \bar{a}_A + (\bar{\alpha} \times \bar{r}_{B/A}) - \omega^2 \, \bar{r}_{B/A}$$

Scalar

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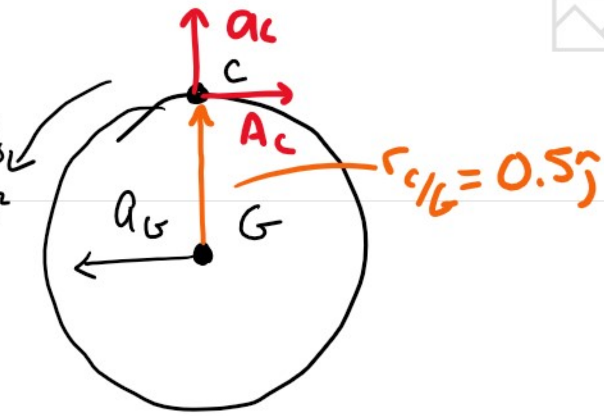
$$\boxed{a_G = \alpha r}$$ ← radius

$\omega = 6\ rad/s$

$\alpha = 4\ rad/s^2$



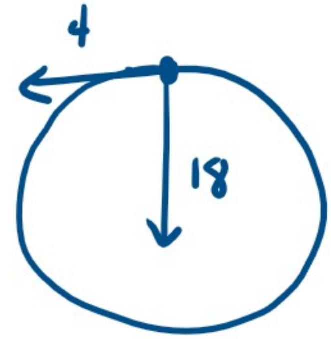
$$a_G = (4)(0.5) = 2\ ft/s^2$$

$$\bar{a}_c = \bar{a}_G + \bar{\alpha} \times \bar{r}_{c/G} - \omega^2\, \bar{r}_{c/G}$$

$$a_c\hat{i} + a_c\hat{j} = -2\hat{i} + \underbrace{4K \times 0.5\hat{j}}_{-2\hat{i}} - \underbrace{(6^2)(0.5\hat{j})}_{18\hat{j}}$$

$\hat{i}$: $a_c = -2 - 2 = -4$

$\hat{j}$: $a_c = -18$



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