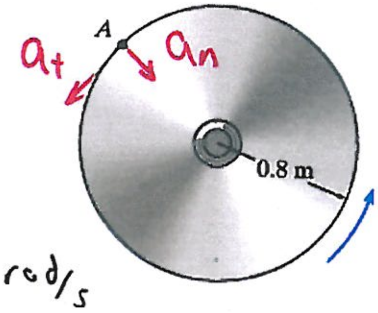
16–1.

The angular velocity of the disk is defined by $\omega = (5t^2 + 2)$ rad/s, where t is in seconds. Determine the magnitudes of the velocity and acceleration of point A on the disk when $t = 0.5$ s.



$a_t = \alpha r \qquad V = \omega r$

$a_n = \omega^2 r$

$\alpha = \dot{\omega} = 10t$

$\alpha(0.5s) = 5 \text{ rad/s}^2$

$\omega(0.5) = 5(0.5)^2 + 2 = 3.25 \text{ rad/s}$

$r = 0.8 \text{ m}$

$\therefore \; a_t = 5(0.8) = 4 \text{ m/s}^2$

$a_n = (3.25)^2(0.8) = 8.45 \text{ m/s}^2$

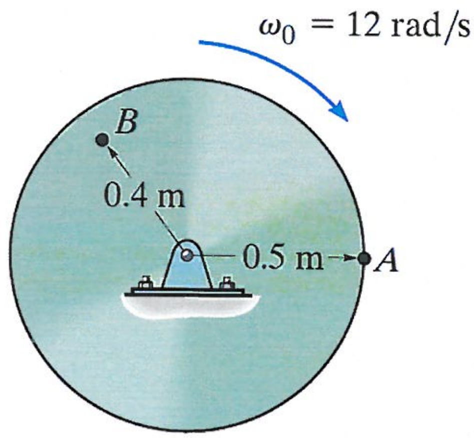
$|\vec{a}_A| = \sqrt{a_t^2 + a_n^2} = \sqrt{4^2 + 8.45^2} = 9.34 \text{ m/s}^2$

$V = 3.25(0.8) = 2.6 \text{ m/s}$

$\boxed{|\vec{a}_A| = 9.34 \text{ m/s}^2 \qquad |\vec{V}_A| = 2.6 \text{ m/s}}$

16-3

The disk is originally rotating at $\omega_0 = 12$ rad/s. If it is subjected to a constant angular acceleration of $\alpha = 20$ rad/s^2, determine the magnitudes of the velocity and the n and t components of acceleration of point A at the instant $t = 2$ s.



$\omega = \omega_0 + \alpha t$

$\therefore \omega = 12 + 20(2)$

$= 52$ rad/s

$v_A = \omega r_A$

$\therefore v_A = 52(0.5) = \underline{\underline{26.0 \text{ m/s}}}$

$(a_A)_t = \alpha r_A$

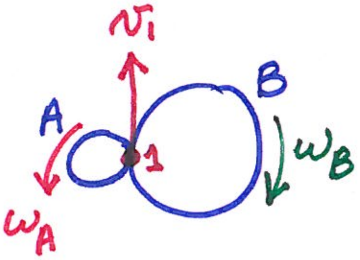
$\therefore (a_A)_t = 20 \times 0.5 = \underline{\underline{10.00 \text{ m/s}^2}}$

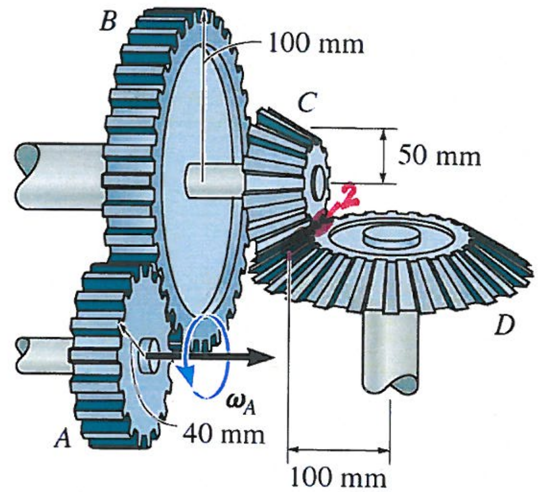
$(a_A)_n = \omega^2 r_A$

$\therefore (a_A)_n = 52^2 \times 0.5 = \underline{\underline{1352 \text{ m/s}^2}}$

16-22

If the motor turns gear A with an angular acceleration of $\alpha_A = 2\ \text{rad/s}^2$ when the angular velocity is $\omega_A = 20\ \text{rad/s}$, determine the angular acceleration and angular velocity of gear D.





$v_1 = \omega_A r_A = \omega_B r_B$

$(20\ \frac{\text{rad}}{\text{s}})(40\text{mm}) = \omega_B(100\text{mm})$

$\therefore \omega_B = 8\ \text{rad/s}$

$(a_1)_T = \alpha_A r_A = \alpha_B r_B$

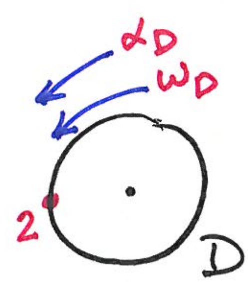
$(2\ \frac{\text{rad}}{\text{s}^2})(40\text{mm}) = \alpha_B(100\text{mm})$

$\therefore \alpha_B = 0.8\ \text{rad/s}^2$

Since gear B is attached to gear C $\Rightarrow \therefore \omega_C = \omega_B = 8\text{rad/s}$

$\alpha_C = \alpha_B = 0.8\text{rad/s}^2$

Now looking at Gear D from above and noticing that point 2 is a common point for gears D & C



$\therefore v_2 = \omega_C r_C = \omega_D r_D$

$(8\ \frac{\text{rad}}{\text{s}})(50\text{mm}) = \omega_D(100\text{ mm})$

$\therefore \omega_D = \underline{\underline{4.00\ \text{rad/s}}}$ $\underline{\text{CCW}}$

$(a_2)_T = \alpha_C r_C = \alpha_D r_D \quad \therefore \alpha_D = \frac{0.8 \times 50}{100} = \underline{\underline{0.400\ \text{rad/s}^2}}$ $\underline{\text{ccw}}$