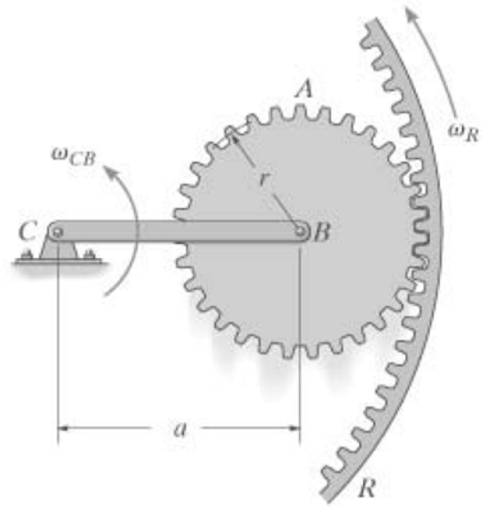
19-4

***Problem 19-4**

Gear A rotates along the inside of the circular gear rack R. If A has weight W and radius of gyration k_B, determine its angular momentum about point C when (a) $\omega_R = 0$, (b) $\omega_R = \omega$.



Given:

$W = 4\ \text{lbf}$ $\qquad r = 0.75\ \text{ft}$

$\omega_{CB} = 30\ \frac{\text{rad}}{\text{s}}$ $\qquad a = 1.5\ \text{ft}$

$\omega = 20\ \frac{\text{rad}}{\text{s}}$ $\qquad k_B = 0.5\ \text{ft}$

$g = 32.2\ \frac{\text{ft}}{\text{s}^2}$

Solution:

(a) $\omega_R = 0\ \frac{\text{rad}}{\text{s}}$

$$v_B = a\omega_{CB} \qquad \omega_A = \frac{\omega_R(a+r) - \omega_{CB}\,a}{r}$$

$$H_c = \left(\frac{W}{g}\right)v_B\,a + \left(\frac{W}{g}\right)k_B^2\,\omega_A \qquad H_c = 6.52\ \text{slug}\cdot\frac{\text{ft}^2}{\text{s}}$$

(b) $\omega_R = \omega$

$$v_B = a\omega_{CB} \qquad \omega_A = \frac{\omega_R(a+r) - \omega_{CB}\,a}{r}$$

$$H_c = \left(\frac{W}{g}\right)v_B\,a + \left(\frac{W}{g}\right)k_B^2\,\omega_A \qquad H_c = 8.39\ \text{slug}\cdot\frac{\text{ft}^2}{\text{s}}$$

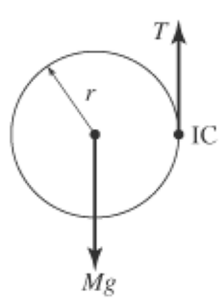
19-13

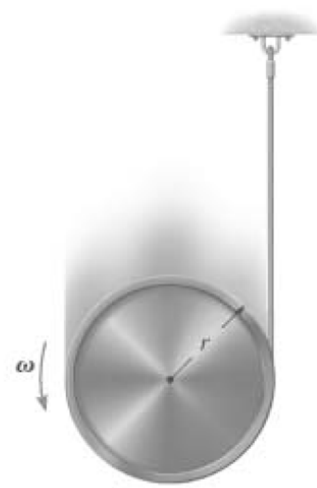
Given:

$M = 2\ \text{kg}$

$t = 3\ \text{s}$

$r = 80\ \text{mm}$





Solution:

$$0 + Mgrt = \frac{3}{2}Mr^2\omega$$

$$\omega = \frac{2}{3}\left(\frac{g}{r}\right)t \qquad \omega = 245\ \frac{\text{rad}}{\text{s}}$$

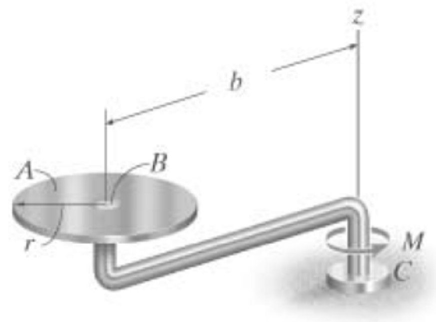
19-22

Given:

$m_A = 4\ \text{kg}$ $M_0 = 5\ \text{N}\cdot\text{m}$ $\omega_D = -80\ \frac{\text{rad}}{\text{s}}$

$r = 60\ \text{mm}$ $a = 0.5\ \text{s}^{-1}$

$b = 250\ \text{mm}$ $t = 2\ \text{s}$



Solution: Guess $\omega_{BC} = 1\ \frac{\text{rad}}{\text{s}}$

(a) Given $\int_0^t M_0 e^{at}\, dt = m_A \omega_{BC} b^2$

$\omega_{BC} = \text{Find}(\omega_{BC})$ $\omega_{BC} = 68.7\ \frac{\text{rad}}{\text{s}}$

(b) Given $\int_0^t M_0 e^{at}\, dt = m_A \omega_{BC} b^2 + m_A\left(\frac{r^2}{2}\right)\omega_{BC}$

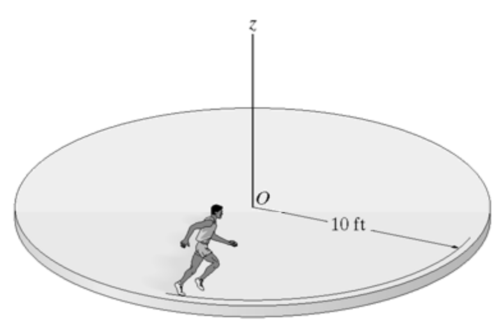
$\omega_{BC} = \text{Find}(\omega_{BC})$ $\omega_{BC} = 66.8\ \frac{\text{rad}}{\text{s}}$

(c) Given $-m_A\left(\frac{r^2}{2}\right)\omega_D + \int_0^t M_0 e^{at}\, dt = m_A \omega_{BC} b^2 - m_A\left(\frac{r^2}{2}\right)\omega_D$

$\omega_{BC} = \text{Find}(\omega_{BC})$ $\omega_{BC} = 68.7\ \frac{\text{rad}}{\text{s}}$

19-34

19–35. A horizontal circular platform has a weight of 300 lb and a radius of gyration $k_z = 8$ ft about the z axis passing through its center O. The platform is free to rotate about the z axis and is initially at rest. A man having a weight of 150 lb begins to run along the edge in a circular path of radius 10 ft. If he maintains a speed of 4 ft/s relative to the platform, determine the angular velocity of the platform. Neglect friction.



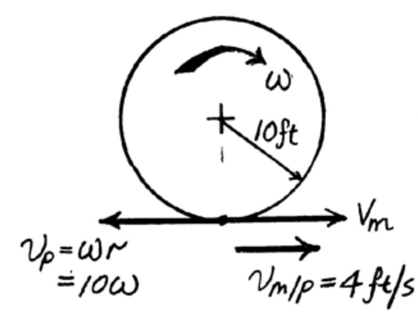
$$\mathbf{v}_m = \mathbf{v}_p + \mathbf{v}_{m/p}$$

$(\overset{+}{\rightarrow})$ $v_m = -10\omega + 4$

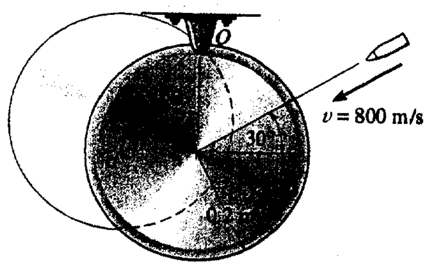
$(\circlearrowleft +)$ $(H_z)_1 = (H_z)_2$

$$0 = -\left(\frac{300}{32.2}\right)(8)^2\,\omega + \left(\frac{150}{32.2}\right)(-10\omega + 4)(10)$$

$\omega = 0.175$ rad/s **Ans.**



19-49. A 7-g bullet having a velocity of 800 m/s is fired into the edge of the 5-kg disk as shown. Determine the angular velocity of the disk just after the bullet becomes embedded in it. Also, calculate how far θ the disk will swing until it stops. The disk is originally at rest.

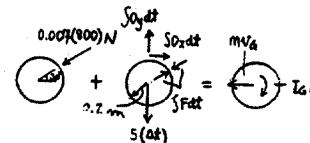


$$\circlearrowleft+ \quad (H_O)_1 + \Sigma\int M_O dt = (H_O)_2$$

$$0.007(800)\cos 30°(0.2) + 0 = \frac{1}{2}(5.007)(0.2)^2\omega + 5.007(0.2\omega)(0.2)$$

$\omega = 3.23$ rad/s **Ans**

$$T_1 + V_1 = T_2 + V_2$$



$$\frac{1}{2}(5.007)[3.23(0.2)]^2 + \frac{1}{2}[\frac{1}{2}(5.007)(0.2)^2](3.23)^2 + 0 = 0 + 0.2(1-\cos\theta)(5.007)(9.81)$$

$\theta = 32.8°$ **Ans**