6/122 $U'_{1-2} = \Delta T + \Delta V_g + \Delta V_e$

$U'_{1-2} = M\theta = \frac{\pi}{2}M = 1.571\,M$ in.-lb

$\Delta T = \frac{1}{2}I_O\omega^2 - 0 = \frac{1}{2}\left(\frac{12}{32.2\times12}\times10^2\right)4^2 = 24.8$ in.-lb

$\Delta V_g = Wh = 12(-8) = -96$ in.-lb

$\Delta V_e = \frac{1}{2}k(x_2^2 - x_1^2) = \frac{1}{2}3\left([30-15\sqrt{2}]^2 - 0\right) = 115.8$ in.-lb

Thus $1.571M = 24.8 - 96 + 115.8$, $\underline{M = 24.8 \text{ lb-in.}}$

6/134 $\Delta V_e = \frac{1}{2}(1500)\left[(0.1+2\times0.05)^2 - \overline{0.1}^2\right] = 22.5 \text{ J}$

$\Delta V_g = -(150)(9.81)(0.05) = -73.58 \text{ J}$

$\Delta T = \sum \frac{1}{2}m\bar{v}^2 + \frac{1}{2}\bar{I}\omega^2 = \frac{1}{2}(150)v^2 + \frac{1}{2}(50)(0.3)^2\left(\frac{v}{0.4}\right)^2$

$= 75v^2 + 14.06v^2 = 89.06v^2$

$\Delta T + \Delta V_g + \Delta V_e = 0;\quad 89.06v^2 - 73.58 + 22.5 = 0$

$v^2 = 0.573,\quad \underline{v = 0.757 \text{ m/s}}$

6/138 $\Delta T_{translational} = \frac{1}{2}mv^2 - 0 = \frac{1}{2}(10000)\left(\frac{72}{3.6}\right)^2 - 0$

$= 2(10^6)$ J

$\Delta T_{rotation} = \frac{1}{2}I(\omega_2^2 - \omega_1^2)$

$= \frac{1}{2}(1500)(0.5)^2\left(\omega_2^2 - \left[\frac{4000 \times 2\pi}{60}\right]^2\right)$

$= 187.5\,\omega_2^2 - 32.90 \times 10^6$ J

$\Delta E = 0.1\left(187.5\,\omega_2^2 - 32.90 \times 10^6\right) = 18.75\,\omega_2^2 - 3.29 \times 10^6$ J

$\Delta V_g = mgh = 10000(9.81)(20) = 1.96 \times 10^6$ J

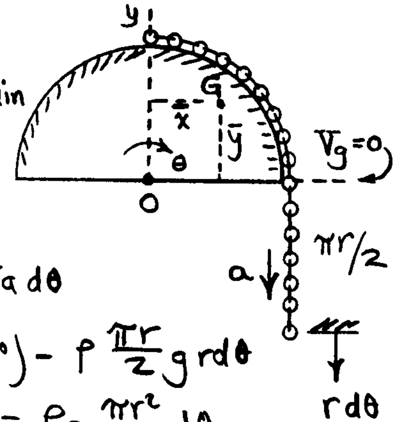
$\Delta E = \Delta T + \Delta V_g$;

$18.75\,\omega_2^2 - 3.29 \times 10^6 = 2 \times 10^6 + 187.5\,\omega_2^2 - 32.90 \times 10^6 + 1.96 \times 10^6$

$168.75\,\omega_2^2 = 25.65 \times 10^6$, $\omega_2^2 = 152\,000$ (rad/s)^2

$\omega_2 = 390$ rad/s or $N = \frac{390 \times 60}{2\pi} = \underline{3720 \text{ rev/min}}$

▶6/170



$dU' = dT + dV_g$ for entire chain

$dU' = 0$

$$dT = d\left(\tfrac{1}{2}mv^2\right) = mv\,dv$$

$$= ma \cdot r\,d\theta = \rho\pi r^2 a\,d\theta$$

$$dV_g = -\rho g \frac{\pi r}{2}\left(\bar{r}\,d\theta \cos 45^\circ\right) - \rho \frac{\pi r}{2} g\, r\,d\theta$$

$$= -\rho g \frac{\pi r}{2} \frac{2r}{\pi}\sqrt{2}\,d\theta \frac{1}{\sqrt{2}} - \rho g \frac{\pi r^2}{2}\,d\theta$$

$$= -\rho g \pi r^2\left(\frac{1}{\pi} + \frac{1}{2}\right)d\theta$$

So $0 = \rho\pi r^2 a\,d\theta - \rho g \pi r^2\left(\frac{1}{\pi} + \frac{1}{2}\right)d\theta$

$$\underline{a = \left(\frac{1}{\pi} + \frac{1}{2}\right)g}$$

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$\circlearrowleft + \quad H_{O_1} = H_{O_2}$ for system

$$mvh = (I_O + mh^2)\omega$$

$$\left(\frac{1/16}{32.2}\right)(1600)\left(\frac{43}{12}\right) = \left[\frac{55}{32.2}\left(\frac{37}{12}\right)^2 + \frac{1/16}{32.2}\left(\frac{43}{12}\right)^2\right]\omega$$

$$\underline{\omega = 0.684 \text{ rad/sec}}$$

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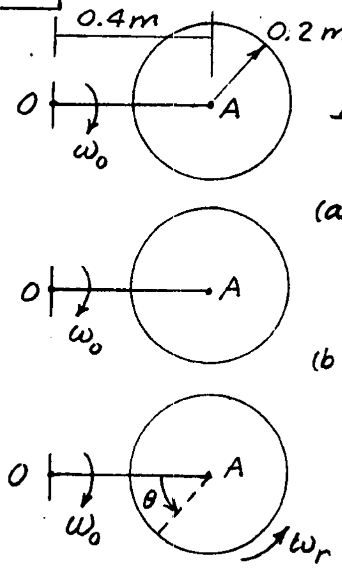
(a) (b) (c)



$\omega_o = 4$ rad/s

ω = angular velocity of disk

$\bar{I} = I_A = \frac{1}{2}mr^2 = \frac{1}{2}25(0.2)^2$

$= \frac{1}{2}$ kg·m²

(a) $\omega = \omega_o$

$H_O = I_O\omega = \left(\frac{1}{2} + 25[0.4]^2\right)4$

$= \underline{18 \text{ kg}\cdot\text{m}^2/\text{s}}$

(b) $\omega = 0$

$H_O = m\bar{v}d = 25(0.4)(4)(0.4)$

$= \underline{16 \text{ kg}\cdot\text{m}^2/\text{s}}$

(c) $\omega = \omega_o - \omega_r = 4 - 8 = -4$ rad/s

$H_O = \bar{I}\omega + m\bar{v}d$

$= \frac{1}{2}(-4) + 16$

$= \underline{14 \text{ kg}\cdot\text{m}^2/\text{s}}$

6/191 | Conservation of angular momentum about the vertical spin axis of the platform:

$$H_1 = H_2$$

$$\left[10(0.3)^2\right]\left(250\ \frac{2\pi}{60}\right) = \left[I + \frac{1}{2}(10)(0.3)^2 + 10(0.6)^2\right] \times \left(30\ \frac{2\pi}{60}\right)$$

$$\underline{I = 3.45\ \text{kg}\cdot\text{m}^2}$$