GIANCOLI HOMEWORK SOLUTIONS
Section 8-7, #43-48

43. GIVEN

$I = 3.75x10^{-2} kg \cdot m^2$

8250 rpm

KNOWN

$KE = \frac{1}{2} I\omega^2$

SOLUTION

$\omega = \frac{8250 rev}{min} x \frac{2\pi rad}{rev} x \frac{1 min}{60 sec} = 864\, rad/s$

$KE = \frac{1}{2} I\omega^2 = \frac{1}{2}(3.75x10^{-2})(864)^2 = 1.40x10^4 J$

44. GIVEN

$\tau = 280 m \cdot N$

3800 rpm

KNOWN

$P = \frac{W}{\Delta t} = \frac{\tau \Delta\theta}{\Delta t} = \tau \frac{\Delta\theta}{\Delta t} = \tau\omega$

SOLUTION

$\omega = \frac{3800 rev}{min} x \frac{2\pi rad}{rev} x \frac{1 min}{60 sec} = 398\, rad/s$

$P = \tau\omega = (280)(398) = 1.11x10^5 W x \frac{1 hp}{746 W} = 149 hp$

45. GIVEN

$m = 7.3 kg$

$r = 9.0 cm = 0.09 m$

$v = 3.3\, m/s$

rolls without slipping

KNOWN

$$KE = \frac{1}{2}I\omega^2 + \frac{1}{2}mv^2$$

$$v = r\omega$$

$$\frac{v}{r} = \omega$$

$$I_{sphere} = \frac{2}{5}mr^2$$

SOLUTION

$$KE = \frac{1}{2}I\omega^2 + \frac{1}{2}mv^2$$

$$KE = \frac{1}{2}\left(\frac{2}{5}mr^2\right)\left(\frac{v}{r}\right)^2 + \frac{1}{2}mv^2$$

$$KE = \frac{1}{2}\left(\frac{\cancel{2}}{5}(7.3)\cancel{(0.09)^2}\right)\left(\frac{(3.3)}{\cancel{(0.09)}}\right)^2 + \frac{1}{2}(7.3)(3.3)^2 = 55.6J$$

46. GIVEN

$$m_{earth} = 6.0x10^{24}kg$$

$$r_{earth} = 6.4x10^{6}m$$

$$R_{earth-sun} = 1.5x10^{8}km = 1.5x10^{11}m$$

KNOWN

$$KE = \frac{1}{2}I\omega^2$$

$$I_{sphere} = \frac{2}{5}mr^2$$

$$I_{particle} = mr^2$$

SOLUTION

a. $KE = \frac{1}{2}\left(\frac{2}{5}mr^2\right)\omega^2$

$$\omega_{day} = \frac{2\pi rad}{24h}x\frac{1h}{60min}x\frac{1min}{60sec} = 7.27x10^{-5}\,rad/s$$

$$KE = \frac{1}{\cancel{2}}\left(\frac{\cancel{2}}{5}(6.0x10^{24})(6.4x10^{6})^2\right)(7.27x10^{-5})^2 = 2.60x10^{29}J$$

b. $KE = \frac{1}{2}\left(\frac{1}{2}mr^2\right)\omega^2$

$$\omega_{year} = \frac{2\pi rad}{year}x\frac{1year}{365days}x\frac{1day}{24h}x\frac{1h}{60min}x\frac{1min}{60sec} = 1.99x10^{-7}\,rad/s$$

$$KE = \frac{1}{2}\left((6.0x10^{24})(1.5x10^{11})^2\right)(1.99x10^{-7})^2 = 2.67x10^{33}J$$

Yearly + Daily = $2.67x10^{33} + 2.60x10^{29} = 2.67x10^{33}J$

47. GIVEN

$m = 1640kg$

$r = 7.5m$

1 rev in 8.0 s

solid cylinder

KNOWN

$W = \Delta KE$

$\Delta KE = \frac{1}{2}I\omega^2 - 0$

$I_{cylinder} = \frac{1}{2}mr^2$

SOLUTION

$\omega = \frac{1rev}{8.00s}x\frac{2\pi rad}{rev} = 0.785\,rad/s$

$KE = \frac{1}{2}\left(\frac{1}{2}(1640)(7.5)^2\right)(0.785)^2 = 1.42x10^4J$

48. GIVEN

$m = 1.8kg$

$r = 20.0cm = 0.20m$

$\theta = 30°$

$l = 10m$

rolls without slipping

KNOWN

$PE = KE = \frac{1}{2}I\omega^2 + \frac{1}{2}mv^2$

$PE = mgh$

$h = l\sin 30° = 5.0m$

$v = r\omega$

$\frac{v}{r} = \omega$

$I_{sphere} = \frac{2}{5}mr^2$

SOLUTION

a. $\cancel{m}gh = \frac{1}{\cancel{2}}\left(\frac{\cancel{2}}{5}\cancel{m}r^{\cancel{2}}\right)\left(\frac{v}{\cancel{r}}\right)^2 + \frac{1}{2}\cancel{m}v^2$

$$gh = \left(\frac{1}{5}\right)(v)^2 + \frac{1}{2}v^2 = \frac{7}{10}v^2$$

$$\sqrt{\frac{10gh}{7}} = v = \sqrt{\frac{10(9.81)(5)}{7}} = 8.37\,m/s$$

$$\frac{v}{r} = \omega = \frac{8.37}{0.20} = 41.9\,rad/s$$

b. $\frac{\frac{1}{2}mv^2}{\frac{1}{2}\left(\frac{2}{5}mr^2\right)\left(\frac{v}{r}\right)^2} = \frac{1}{\left(\frac{2}{5}\right)} = \frac{5}{2} = 2.5$

c. None of the answers are dependent on mass, only angular velocity depends on radius