Chapter 8 Answers to Problems

2. 0.98 kg·m^2 **3.** (a) reduced by a factor of 8 (b) reduced by a factor of 32 **4.** (a) 13,000 g·cm^2 (b) 25,000 g·cm^2 (c) 38,000 g·cm^2 (d) −1.3 cm, −1.0 cm **5.** (a) 1.5 kg·m^2 (b) 0.75 kg·m^2 (c) 1.5 kg·m^2 **6.** 0.0512 J **7.** $2R_E^2/5R_O^2$, where R_E is the Earth's radius and R_O is Earth's orbital radius about the Sun. **8.** 0.019 **9.** (a) no (b) 0.017 **10.** 570 J **11.** 4.0 N·m **12.** 4.5 N·m **13.** 780 N·m **14.** 0.30 N·m **15.** 25 N·m **16.** (a) 0 (b) 790 N·m **18.** (a) 58.5 N·m (b) 39.9 N·m (c) 0 **19.** 57.4 N·m **20.** 5.83 m **21.** 1.2 cm toward the doorknob as measured from the center of the door **22.** (0.42s, 0.58s) **23.** 150 J **24.** (a) 3.14 m (b) 15.7 J (c) 2.50 N·m (d) 6.28 rad **25.** (a) 5.5 kJ (b) 29 N·m **26.** (a) 53.0 kJ (b) 1.51 MN·m **27.** 98 N **28.** 200 N **29.** 17.0º **30.** (a) 540 N (b) 390 N **31.** the center of mass = 0.8542 m < 0.8600 m, so the system balances **32.** 2.2 kN downward, 3.4 kN upward **33.** 180 N toward the wall **34.** (a) 730 N (b) 330 N at 19º above the horizontal **35.** 350 N, 290 N, −2 N, The magnitude of F_y is small **36.** $(mg/2+W)/\tan\theta$ For $\theta = 0$, $T \to \infty$, and for $\theta = 90º$, $T \to 0$ **37.** 22.3° **38.** 1.3 m **39.** 390 N, 270 N **40.** 640 N **41.** tendon, 2100 N upward and tibia, 2800 N downward **42.** 7.0 kN **43.** 130 N **44.** (a) 330 N (b) 670 N **45.** 3.0 kN, about 5.5 times larger **46.** (a) 620 N·m (b) 6800 N at 12° above the horizontal (c) 6600 N **48.** 26.7 N·m opposite the flywheel's rotation **49.** 0.0012 N·m **50.** 0.88 N **51.** 4.3 N·m **52.** 1.5 N·m **53.** 0.09 N·m **54.** (a) 48 N·m (b) 19 N **55.** (a) 0.11 rad/s^2 (b) 0.44 rad/s **56.** (a) $a = R\alpha$ (b) $(T_1 - T_2)R$ CCW (c) If $m_1 \neq m_2$, the blocks accelerate, so the pulley has an angular acceleration. Since a nonzero net torque is required for the pulley to accelerate, $T_1 - T_2 \neq 0$, thus $T_1 \neq T_2$. (d) $T_1 = m_1(g-a)$, $T_2 = m_2(g+a)$, $a=(m_1-m_2)g/(M/2+m_1+m_2)$ **58.** 4.0 m/s^2 **59.** 2.9 m/s **60.** solid sphere: $K=7mv^2/10$; solid cylinder: $K=3mv^2/4$; hollow cylinder: $K=mv^2$ **61.** 1.79 m **62.** (a) 3.0 m/s (b) 8.4 N (c) 5.6 m/s^2 down **63.** 2.75 s **64.** (a) the drilled cylinder takes more time because its rotational inertia is larger (b) 4.08% longer **65.** (a) $5r/2$ (b) $27r/10$ **66.** $3r$ 67. h will decrease. The smaller the rotational inertia, the less gravitational energy will go into rotational energy, and the more will go into translational energy. Problem 67 had a minimum of $h=3r$. With a solid sphere, the minimum is $h=2.7r$, which is a little less than $3r$. **68.** (a) 1.5 m/s (b) 1.36 s **69.** 0.0864 kg·m^2/s **70.** 7.0×10^{33} kg·m^2/s **71.** 1.4×10^{7} kg·m^2/s **72.** 50 N·m opposite the rotation of the wheel **73.** 1.60 s **74.** 1.5 rev/s **75.** 15.6 rad/s **76.** 16.9 Hz **77.** 0.125 rad/s **78.** 3.15 rad/s **79.** (a) 3.0 (b) 1.6 **80.** 0.61 rev/s, −660 J **81.** 2.10×10^{6} N·m **82.** The disk should rotate in a horizontal plane so that the angular momentum vector is vertical. This does not make it difficult to steer; the ship can change direction without affecting the direction of the angular momentum. **83.** 1.14 **84.** 0.44 N·m **85.** 98 N·m **86.** $\sqrt{(3gL)}$ **87.** 5.4 rad/s **88.** T_1 = 67 kN, T_2=250 kN, $\mathbf{F}_p$=380 kN at 51º with the horizontal **89.** The objects reach the bottom in the following order from first to last: cube, solid sphere, solid cylinder, hollow sphere, and hollow cylinder. **90.** (a) 6.53 m/s^2 down (b) 4.2 N **91.** 0.792 m **92.** (a) 0.96 m from the RH edge (b) 0.58 m from the LH edge **93.** (a) 16 kg·m^2 (b) 8.0×10^{7} J (c) 320 (d) 120 km **94.** (a) 2.6×10^{29} J (b) The length of the day would increase by 7 minutes. (c) 2.6 million years **96.** (a) 3.54 m (b) 2.50 m (c) 4.3×10^{8} W **97.** 110 N **98.** (a) 98 N (b) This does not help the person trying to lift the ladder, since the torque problem is not alleviated by exerting a force at the point of rotation. **99.** (a) 1.35×10^{-5} kg·m^2 (b) 524 N **100.** $m_2 g/(m_1+m_2+I/R^2)$ **101.** 0.19 kg·m^2/s **102.** (a) 6.28 rad/s (b) 0.955 kg·m^2/s (c) friction (d) 0.300 N **103.** (a) 9.4×10^{-4} kg·m^2/s (b) 1.2×10^{-6} kg·m^2/s **104.** (b) $mr^2\omega$ (c) $r^2\omega\Delta t/2$ **105.** 230 N **106.** (a) $I_i\omega_i/(I_i+mR^2)$ (b) $I_i\omega_i^2/2$, $I_i\omega_i$, $I_i^2\omega_i^2/2(I_i+mR^2)$, $I_i\omega_i$ **107.** (a) 735.0 N (b) 0.88 m (c) 0.55h **108.** The spool spins and moves down the incline with $a_{CM}=g\sin\theta/(1+I/(mgR))$ (b) $mg\sin\theta/(1+R/r)$ up the incline (c) $\tan\theta/(1+R/r)$ **109.** 23 N **110.** (a) $\sqrt{(2gL)}$ (b) $\sqrt{(3gL)}$ (c) the roustabout should jump

111. 1.3 rev/s **112.** 1.5 kN **113.** (a) 9.6 m/s (b) 3.1 m/s (c) 21 m/s **114.** (a) $(\mu_s(M+m)\tan\theta/M - m/(2M))L$ (c) 63º