CHAPTER EIGHT SOLUTIONS

8.25 $I = \Sigma m_i r_i^2$

(a) First, apply the above equation about the x axis. We have,

$I_x = (3.00\ \text{kg})(9.00\ \text{m}^2) + (2.00\ \text{kg})(9.00\ \text{m}^2) + (2.00\ \text{kg})(9.00\ \text{m}^2)$

$+ (4.00\ \text{kg})(9.00\ \text{m}^2) = 99.0\ \text{kg m}^2.$

(b) About the y axis, we have

$I_y = (3.00\ \text{kg})(4.00\ \text{m}^2) + (2.00\ \text{kg})(4.00\ \text{m}^2) + (2.00\ \text{kg})(4.00\ \text{m}^2)$

$+ (4.00\ \text{kg})(4.00\ \text{m}^2) = 44.0\ \text{kg m}^2.$

(c) The distance, r, (from an axis through O and perpendicular to the page) out to each of the masses is found from the pythagorean theorem: $r = \sqrt{(2.00\ \text{m})^2 + (3.00\ \text{m})^2} = \sqrt{13.00\ \text{m}^2}$,

and the moment of inertia is

$I_o = (3.00\ \text{kg})(r^2) + (2.00\ \text{kg})(r^2) + (2.00\ \text{kg})(r^2) + (4.00\ \text{kg})(r^2)$, or

$= (11.00\ \text{kg})(13.00\ \text{m}^2) = 143\ \text{kg m}^2.$

8.28 (a) $\tau_{net} = I\alpha = (6.8 \times 10^{-4}\ \text{kg m}^2)(66\ \text{rad/s}^2) = 4.49 \times 10^{-2}\ \text{kg m}^2.$

The torque exerted by the fish $= Fr$, so the net torque is

$\tau_{net} = Fr - 1.3\ \text{Nm} = 4.49 \times 10^{-2}\ \text{kg m}^2.$

From which, $F = \dfrac{1.345\ \text{Nm}}{4.0 \times 10^{-2}\ \text{m}} = 34\ \text{N}.$

(b) $\theta = \omega_0 t + \frac{1}{2}\alpha t^2 = 0 + \frac{1}{2}(66\ \text{rad/s}^2)(0.50\ \text{s})^2 = 8.25\ \text{rad}$, and

$s = r\theta = (4.0 \times 10^{-2}\ \text{m})(8.25\ \text{rad}) = 0.33\ \text{m} = 33\ \text{cm}.$

8.35 (a) $KE_{trans} = \frac{1}{2}mv^2 = \frac{1}{2}(10.0\ \text{kg})(10.0\ \text{m/s})^2 = 500\ \text{J}.$

(b) $KE_{rot} = \frac{1}{2}I\omega^2 = \frac{1}{2}\left(\frac{1}{2}mr^2\right)\left(\frac{v^2}{r^2}\right) = \frac{1}{4}(10.0\ \text{kg})(10.0\ \text{m/s})^2 = 250\ \text{J}.$

(c) $KE_{total} = KE_{trans} + KE_{rot} = 750\ \text{J}.$

8.40 We will use conservation of energy in the form

$$\frac{1}{2}Mv_i^2 + \frac{1}{2}I\omega_i^2 + Mgy_i = \frac{1}{2}Mv_f^2 + \frac{1}{2}I\omega_f^2 + Mgy_f$$

$$0 + 0 + Mg(6.0\ \text{m})\sin 37° = \frac{1}{2}M(0.20\ \text{m})^2\omega_f^2 + \left(\frac{1}{2}\right)\frac{2}{5}M(0.20)^2\omega_f^2 + 0$$

where we have used $v_f = r\omega_f$ and $I = \frac{2}{5}MR^2$.

The mass cancels from the equation, and we find the angular velocity to be $\omega_f = 36$ rad/s.

8.63 (a) $L = 2(5.0\ \text{m})(75.0\ \text{kg})(5.00\ \text{m/s}) = 3750\ \text{kg m}^2/\text{s}$

(b) $KE_1 = 2\left(\frac{1}{2}\right)(75.0\ \text{kg})(5.00\ \text{m/s})^2 = 1.88\ \text{kJ}$

(c) Angular momentum is conserved $L = 3750\ \text{kg m}^2/\text{s}$

(d) By conservation of angular momentum,

$3750 = 2(2.5)(75.0)(v)$

$v = 10.0$ m/s

(e) $KE_2 = 2(\frac{1}{2})(75.0\ \text{kg})(10.00\ \text{m/s})^2 = 7500\ \text{J}$

(f) $W = K_2 - K_1 = 5.62$ kJ

ANSWERS TO EVEN ASSIGNED CONCEPTUAL QUESTIONS

8. You can use conservation of energy to find the velocity of the objects at the bottom of the incline. You will find that the solid sphere moves fastest, and the hollow cylinder moves the slowest. Thus, the sphere wins the race and the hollow cylinder finishes last.