#	Name	Date	Period	Score

Gen Physics STEP WS 15

1. A special talent of Devon's is being able spin his expensive china on a 0.750 m rod. The largest plate he has been able to master spinning has a 2.5 kg and radius of 0.87 m. Determine the rotational inertia.

Use $I = \frac{1}{2} MR^2$

$I = \frac{1}{2} \cdot 2.5\,Kg\,(0.87m)^2 = 0.95\ Kgm^2$

2. The mighty ducks are tied at five to five with ten seconds to go before the game ending. With a 3.75 kg hockey stick, Chuck uses the hockey stick to take the winning shot.
   a. What is the moment of inertia of the 1.15 m long hockey stick?

Use $I = \frac{1}{3} ML^2$, so $I = \frac{1}{3} \cdot 3.75\,Kg\,(1.15m)^2 =$

$1.65\ Kgm^2$

   b. How much torque is applied to the puck if Chuck uses the end of the stick to accelerate the puck at 4.8 m/s^2.

$\tau = I\alpha = I \cdot \frac{a}{r} = \frac{1.65\,Kgm^2 \cdot (4.8\frac{m}{s^2})}{1.15m} =$

angular acceleration

$6.9\ N \cdot m$

   c. If the hockey puck has a mass of 1.82 kg, a radius of 0.051 m, and a height of 3.00 cm, what is the puck's moment of inertia?

Use $I = \frac{1}{2} Mr^2$, so $I = \frac{1}{2} \cdot 1.82\,Kg\,(0.051m)^2 =$

$0.002367\ Kgm^2$ or $2.37 \times 10^{-3}\ Kgm^2$

3. The earth has a mass of 5.98x10^{24} kg and a radius of 6.38x10^{6}m. What is the rotational inertia of the earth as it turns on its axis?

Use $I = \frac{2}{5} MR^2 = \frac{2}{5} \cdot 5.98 \times 10^{24}\,Kg\,(6.38 \times 10^6\,m)^2 =$

$9.74 \times 10^{37}\ Kg \cdot m^2$

4. A 30. N force is applied to a 0.20 m long beam at its right end, at an angle of 65 degrees to the beam. Determine the torque caused about an axis perpendicular to the beam and through its left end.

$\tau = r \times F = rF\sin(\theta) = (0.20m \cdot 30N)\sin 65°) =$ **5.44 N·m**

5. While studying the solar system, Mrs. Walsh's Science class learned about angular momentum. The students learned that Jupiter orbits the sun with a tangential velocity of 2079 m/s at an average distance of 71,398,000. m from the sun. If Jupiter's mass is 1.90×10^{27} kg, what is Jupiter's angular momentum?

$L = m \cdot v \cdot r = 1.90 \times 10^{27} Kg \cdot 2079 \frac{m}{s} \cdot 71398000 m =$ $2.82 \times 10^{38} \frac{Kg\,m^2}{s}$

6. A cat crawls into a trashcan with a diameter of 0.60 m. The can tips over and begins to roll with the combined mass of 40.0 kg. What is the moment of inertia?

Use $I = MR^2 = 40.0 Kg \cdot (0.60 m)^2 =$ $14.1\ Kg\,m^2$

7. Jet Li and Mike Tyson are having a fight at a construction site. They end up on opposite ends of a 50.0 kg uniform steal beam hanging from a rope tied in the middle. Mike Tyson is 89.6 kg and 3.7 m from the fulcrum. Jet Li is 67.3 kg and crouches 4.2 m from the fulcrum. If neither of the men move from this position, determine the net torque on the beam.

$\Sigma\tau = (m \cdot d \cdot g)_{Tyson} - (m \cdot d \cdot g)_{Li}$

$\Sigma\tau = (89.6 Kg \cdot 3.7m \cdot 9.8 \frac{m}{s^2}) - (67.3 Kg \cdot 4.2m \cdot 9.8 \frac{m}{s^2})$

$\Sigma\tau = 3248.9 \frac{Kg\,m^2}{s^2} - 2770 \frac{Kg\,m^2}{s^2} =$

$479 \frac{Kg\,m^2}{s^2} = 479 N \cdot m$

8. Victoria(35.0 kg) and Rachel(48.6 kg) are on one side of a seesaw at 1.0 m and 2.0 m respectively. Luck sits on the other side 1.5 m from the center. Find the mass of Luke that balances the torque caused by the girls.

$m_V d_V + m_R d_R = m_L \cdot d_L \quad \therefore m_L = \frac{(m_V d_V + m_R d_R)}{d_L}$

↑ Victoria ↑ ~~Rachel~~ ↑ Luke

$m_L = \frac{((35.0\,kg \cdot 1.0\,m) + (48.6\,kg \cdot 2.0\,m))}{1.5\,m} = \frac{35.0\,kg\cdot m + 97.2\,kg\cdot m}{1.5\,m} = 88.1\,kg$

9. The average distance from Earth to the moon is 3.84×10^5 km. However, at one point in 1912 that distance was only 3.56×10^5 km. The average orbital speed of the moon when it is at its average distance from Earth is 3.68×10^3 km/hr. Calculate the speed the moon was traveling during 1912. (Use conservation of angular momentum.)

$m V_0 r_0 = m V_f r_f$

$V_f = \frac{m V_0 r_0}{m \cdot r_f} = \frac{V_0 r_0}{r_f} = \frac{(3.68 \times 10^3 \frac{km}{hr} \cdot 3.84 \times 10^5\,km)}{3.56 \times 10^5\,km} = 3969 \frac{km}{hr}$

or $3.97 \times 10^3 \frac{km}{hr}$

10. When swinging your leg from your hip, why is the rotational inertia of the leg less when it is bent?

You are reducing the length, so rotational inertial is less according to $I = \frac{1}{3} ML^2$.

11. A heavy iron cylinder and a light wooden cylinder, similar in shape roll down an incline. Which will have more acceleration?

$\tau = I \cdot \alpha \quad \therefore \alpha = \frac{\tau}{I}$. I for iron cylinder is larger, so α is smaller. So the wooden cylinder will have more angular acceleration.

12. Explain why gymnasts tuck in their arms and legs as they flip through the air.

Gymnasts tuck to increase angular velocity according to $L = I \cdot \omega$

$I_0 \omega_0 = I_f \cdot \omega_f$

Ch 5 & 8 Equations

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$\Delta\theta = \omega_o t + \frac{1}{2}\alpha t^2$

$\omega = \frac{\Delta\theta}{\Delta t}$

$L = mvr = I\omega$

$\omega_f^2 - \omega_o^2 = 2\alpha\Delta\theta$

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

$\omega_f = \omega_o + \alpha t$

$\theta = \frac{s}{r}$

$\tau = I\alpha$

$a_t = \alpha r$

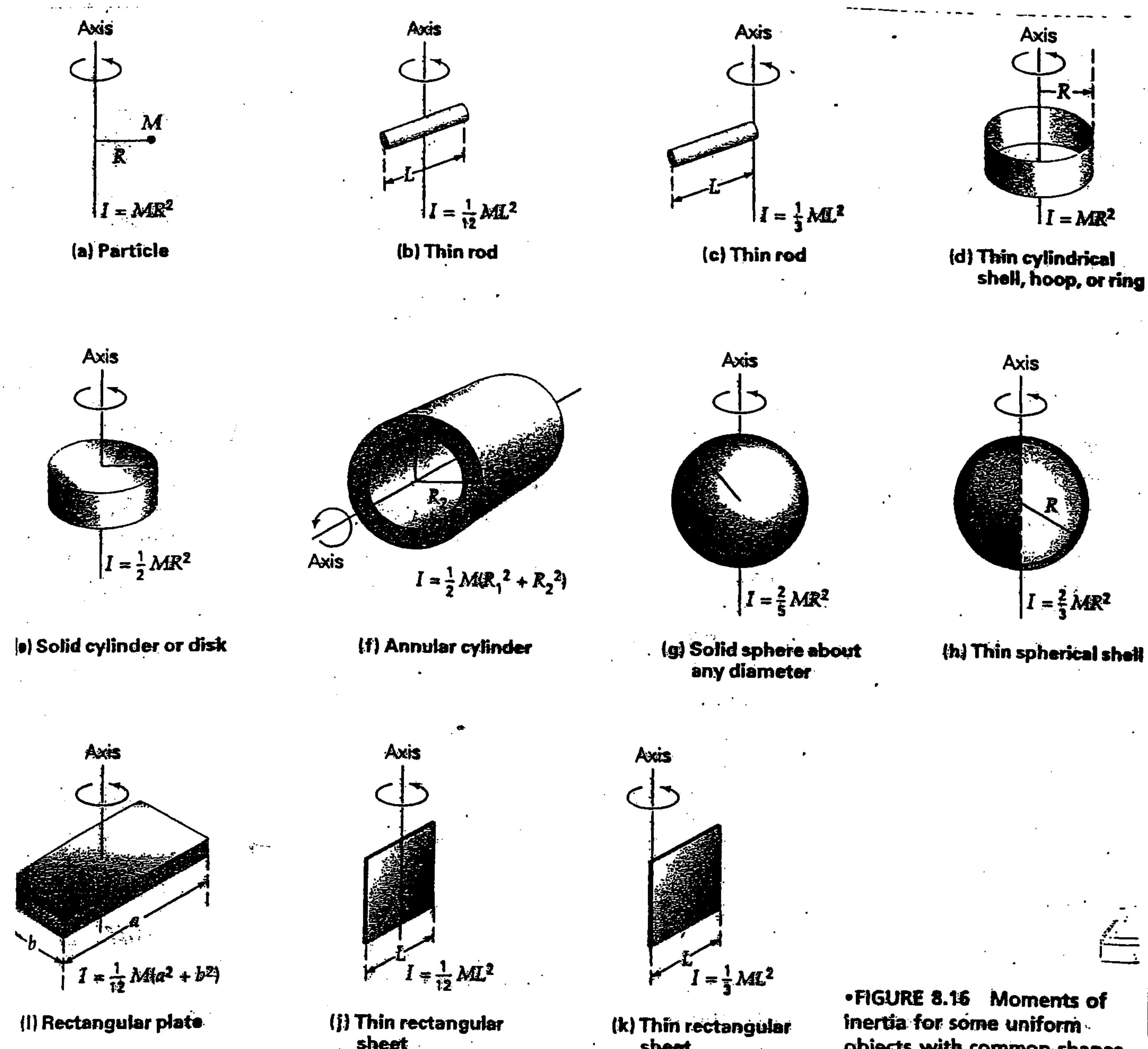
$v_t = \omega r$

$\tau = F \times r_\perp$

$a_c = v^2/r$

$v_t = 2\pi r / T$

$F_c = \frac{mv^2}{r}$



•FIGURE 8.16 Moments of inertia for some uniform objects with common shapes