Multiple-Choice Questions of Chapter 8

Question 1
A force of 200 N acts tangentially on the rim of a wheel 25 cm in radius. (a) Find the torque. (b) Repeat if the force makes an angle of 40°; to a spoke of the wheel.

(A) (a) 50 N·m (b) 32 N·m
B) (a) 5000 N·m (b) 38 N·m
C) (a) 8.0 N·m (b) 50 N·m
D) (a) 314 N·m (b) 3200 N·m

a) $\tau = rF = (.25)(200) = 50\ N$

b) $\tau = rF\sin 40^\circ = 32N$

-5 pt
16

Question 2
A neutron star is formed when an object such as our Sun collapses. Suppose a uniform spherical star of mass M and radius R collapses to a uniform sphere of radius 10-5R. If the original star has a rotation rate of 1 rev each 25 days (as does the Sun), what will be the rotation rate of the neutron star?

(A) 4.6 x 10^3 rev/s
B) 1.7 x 10^7 rev/s
C) 1.2 x 10^5 rev/s
D) 5.0 x 10^{-2} rev/s

$L_i = I_i w_i = \frac{2}{5} M R^2 w_i$

$L_f = I_f w_f = \frac{2}{5} M (10^{-5}R)^2 w_f$

$L_i = L_f \Rightarrow w_f = \cdots = 4.6 \times 10^3$ rev/s

Question 3
A large horizontal disk is rotating on a vertical axis through its center; for the disk, I=4000 kg m2. The disk is coasting at a rate of 0.150 rev/s when a 90.0-kg person drops onto the disk from an overhanging tree limb. The person lands and remains at a distance of 3.00 m from the axis of rotation. What will be the rate of rotation after the person has landed?

(A) 0.125 rev/s
B) 0.141 rev/s
C) 5.5 rev/s
D) 0.137 rev/s

$L_i = I_i w_i = (4000)(0.15) = 600\ kg\cdot m^2/s$

$L_f = (4000 + 90 \times 3^2) w_f = 4810\, w_f$

$L_i = L_f \Rightarrow w_f = 0.125$ rev/s

Question 4
A 500-g wheel that has a moment of inertia of 0.015 kg·m2 is initially turning at 30 rev/s. It coasts to rest after 163 rev. How large is the torque that slowed it?

A) 0.04 N·m
(B) 0.26 N·m
C) 0.09 N·m
D) 4.50 N·m

$\theta = 163\ rev = 163(2\pi)$
$w_i = 30\ rev/s = (30)(2\pi)$
$w_f = 0$

$w_f^2 = w_i^2 + 2\alpha\theta$

$\alpha = \frac{w_f^2}{2\theta} = 17.3\ rad/s^2$

$\tau = I\alpha = 0.26\ kg\cdot m^2$

Question 5
A 20-kg solid disk (I= 1/2Mr2) rolls on a horizontal surface at the rate of 4.0 m/s. Compute its total KE.

A) 80 J
(B) 240 J
C) 160 J
D) 320 J

$m = 20\ kg \quad v = 4\ m/s$

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

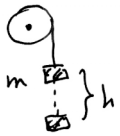
$= \frac{1}{2}mv^2 + \frac{1}{2}\left(\frac{1}{2}mr^2\right)w^2 = \frac{3}{4}mv^2$

$KE = \left(\frac{3}{4}\right)(20)(4)^2 = 240\ J$

Question 6

A wheel and axle having a total moment of inertia of 0.0020 kg · m2 is caused to rotate about a horizontal axis by means of an 800-g mass attached to a cord wrapped around the axle. The radius of the axle is 2.0 cm. Starting from rest, how far must the mass fall to give the wheel a rotational rate of 3.0 rev/s?

(A) 5.3 cm
B) 4.5 cm
C) 52 cm
D) 3.8 cm



See last Page for Solution to #6

Question 7
A certain coin and a wedding ring have exactly the same mass and radius. When placed at the top of an incline, which object reaches the bottom of the incline first?

(A) the coin ← Coin has a smaller moment of inertia
B) the wedding ring
C) the two objects reach the bottom at the same time
D) we cannot answer this question with the given information

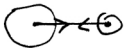
Question 8
An ice skater is in a fast spin with her arms held tightly to her body. When she extends her arms, which of the following statements is not true?

A) She increases her moment of inertia.
B) She decreases her angular speed.
→ (C) Her moment of inertia remains constant.
D) Her total angular momentum remains constant.

Her moment of inertia will increase

Question 9
The torque exerted on the moon by the gravitational pull of the earth is

A) normal to the direction of the moon's path.
B) parallel to the direction of the moon's path.
C) tangent to the imaginary line connecting the earth and the moon.
(D) zero.



lever arm = 0 $\Rightarrow \boxed{\tau = 0}$

Question 10
A turntable rotates through 10 radians in 4 seconds. The turntable experiences uniform acceleration. If the turntable started from rest, what is its angular velocity at the end of the 4 seconds?

A) 2.5 rad/s
→ (B) 5 rad/s
C) 40 rad/s
D) we cannot calculate the answer since the angular acceleration was not given.

$\theta = 10$ radians
$t = 4$ s
$\omega_i = 0$
$\omega_f = ?$

$\omega_f^2 - \omega_i^2 = 2\alpha\theta$ → 10 rad.
($\omega_i = 0$)

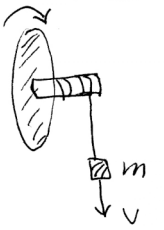
we need α : $\omega_f = \omega_i + \alpha t$

$\alpha = \frac{\omega_f}{4}$

$\Rightarrow \omega_f^2 = 2\left(\frac{\omega_f}{4}\right)\theta = 5\ \omega_f$

$\omega_f = 5$ rad/s

Question 6



$K_i + U_i = K_f + U_f$

$0 \quad 0 = \frac{1}{2} I\omega^2 + \frac{1}{2} mv^2 - mgy$

$\frac{1}{2} I\omega^2$: wheel; $\frac{1}{2} mv^2$: mass; mgy: drop in PE

"PE" is negative because it is decreasing.

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

$\omega = (3 \times 2\pi) = 18.84$ rad/s

$V = r\omega = (0.02)(3 \times 2\pi) = 0.38$ m/s

(r: radius of axel)

$$\Rightarrow \underbrace{\frac{1}{2}(0.002)(18.84)^2}_{0.35} + \underbrace{\frac{1}{2}(0.8)(0.38)^2}_{0.06} = \underbrace{(0.8)(9.8)}_{7.84} y$$

$$y = 0.053 \text{ m} = \boxed{5.3 \text{ cm}}$$

Notice the term "$\frac{1}{2} mv^2$" is small. If you did not include it, you still should get the same answer!