Rotational Motion Test Review (Ch 9-10) Name Key - Mr. Sudbury

Ch 9: Circular Motion

1. What does centripetal mean? What does centrifugal mean? Which one is "fake"? Which force is present in the "spin" cycle of a washing machine? Centripetal means center seeking and centrifugal means center fleeing. Centrifugal force is not a true force; it is actually the inertia of the object wanting to move in a straight line tangent to its current circular motion. The spin cycle of a washing machine utilizes centripetal force to push the clothes inward while holed in the tub allow water to escape due to centrifugal force.
2. What is an axis? An axis is the imaginary point around which motion rotates or revolves. The axis is internal for rotation and external for revolutions.
3. Who would spin (tangential/linear speed) faster: *someone on the edge* or on the inside of a carousel? Tangential velocity depends on the radius of the circular motion ($V = \frac{2\pi r}{T}$) and the T (period) of the motion. Since both people are on the same carousel with the same rotational (or angular) speed they have the same period (time of rotation) and the one with the largest radius (farthest from the axis) has the fastest tangential velocity.
4. Compare the following: angular speed, linear speed, rotational speed, tangential speed. (Some of these are the same thing! Know which is which!) Angular speed and rotational speed are the same thing. That is the number of rotations/revolutions per unit time. Linear speed and tangential speed are the same and describe the total distance traveled (2πr for objects moving in a curved or circular path) divided by the time (T; period) of one rotation/revolution.
5. List 2 possible units for rotational speed. (AKA Angular speed) Rotations per minute (RPM), rotations per second.
6. Which direction does centripetal force ALWAYS go? Centripetal is center seeking so it always has a direction towards the center of the circle or the axis of rotation/revolution.
7. What is the so called outward force on a rotating object really? Inertia.
8. If you were to cut or release a circular object, what direction would it move off in? In a direction tangent to the circular path it was traveling before the centripetal force was removed.
9. Make sure you can calculate tangential speed, centripetal acceleration, and centripetal force. All of these formulas will be provided. ($V = \frac{2\pi r}{T}$) ($a_c = \frac{V^2}{r}$) ($F_c = m \bullet a_c = \frac{m \bullet v^2}{r}$) ($T = \frac{1}{f}$) ($f = \frac{1}{T}$)
10. What is the difference between frequency and period? Period is the time of one complete rotation /revolution and frequency is how many rotations/revolutions happen in a unit of time, usually seconds and the frequency unit is Hertz if the time is in seconds.

Ch 10: Center of Gravity

1. What prevents something from toppling? When the center of gravity is above the support base.
2. How can you find the center of gravity of an object? Process described on pg. 139. Suspend a pendulum from many points around an object and all the intersections of the pendulum string are the center of gravity.
3. Where would the center of gravity of a baseball bat be located? Towards the barrel of the bat where the balance point is. With equal masses on each side of the balance point.
4. When you throw an irregular object what shaped path does the center of gravity take? Parabolic.
5. When you throw an irregular object through the air *(Figure 10.4, pg 137.)* what point does the entire object rotate around? The center of gravity.
6. List an object that would have its center of gravity not in the center. Bat, golf club, bucket, anything not symmetrical.

7. How can you adjust your center of gravity? How does a monkey's long tail help him keep his balance? *(Monkey hint on pg 141)* Lower your stance or stand with your feet wider. When a monkey's tail is extended it allows him to keep his center of gravity over his feet (support base).
8. Why can't you touch your toes with your back and heels flat against a wall? Because your center of gravity is no longer over your support base.
9. Where is your center of gravity located? Human males, high because of broad shoulders, females lower because of narrower shoulders and wider hips, and toddlers very high because of large head to body ratio.
10. Objects tend to rotate around what point? The center of gravity.

Problems:

1. What is the frequency of a carousel that takes 12 seconds for one rotation?

$f = \frac{1}{T} = \frac{1}{12\,sec} = 0.083\ Hz$

2. What is the period of an object with a frequency of 0.5 Hz.

$T = \frac{1}{f} = \frac{1}{0.5\,Hz} = 2\,sec$

3. Find the tangential speed of an object that is spinning around a circle once every 3 seconds at a distance of .5 meters from the center?

$V = \frac{2\pi r}{T} = \frac{2\pi(0.5m)}{3\,sec} = 1.047\ m/s$

4. Find the radius of a carousel that has a speed of 10 m/s and a period of 5 seconds.

$V = \frac{2\pi r}{T} \quad \therefore \quad r = \frac{VT}{2\pi} = \frac{(10\,m/s \cdot 5\,sec)}{(2\pi)} = 7.957m$

5. Find the centripetal acceleration of an object with a speed of 6 m/s and a radius of 2m.

$a_c = \frac{V^2}{r} = \frac{(6\,m/s)^2}{2m} = 18\ m/s^2$

6. Find the centripetal force of an object with a mass of 5 kg, a radius of 2 meters and a speed of 6 m/s?

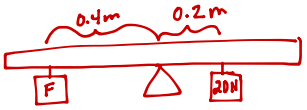
$F_c = m \cdot a_c = 5kg \cdot 18\,m/s^2 = 90\ Kg \cdot m/s^2$ (Newtons)

where $a_c = \frac{V^2}{r} = \frac{(6\,m/s)^2}{2m} = 18\,m/s^2$

7. A wrench is pulled with a force of 9 N. The length of the effort arm is 0.12m, what is the torque produced?

$\tau = F_\perp \cdot r \qquad \tau = 9N \cdot 0.12m = 1.08\ N \cdot m$

8. What force is needed 0.4 m away from the pivot point of a lever to balance a torque produced by a 20 N force 0.2 m away? *(draw a picture, it may help)*



clockwise = counter clockwise

$F_\perp \cdot r = F_\perp \cdot r$

$F \cdot 0.4m = 20N \cdot 0.2m$

$F = \frac{20N \cdot 0.2m}{0.4m} = 10\ N$

#4	#2		#8	#3	#5	#7	#6	#1
7.96 m	2 s	~~2 m/s~~	10 N	1.04 m/s	18 m/s^2	1.08 N·m	90 N	0.083 Hz