

## Chapter 10 Dynamics of Rotational Motion

### Example 1:

Two concentric disks form a single unit. The small disk has a radius of 3 cm and the larger disk has a radius of 5 cm. If a cord with a 60 N tension in it is wrapped clockwise around the small disk and one with a tension of 20 N is wrapped counter-clockwise around the larger disk, what is the net torque acting on the unit?

### Example 2:

A cord is wrapped around a horizontal cylinder ( $R = 5$  cm and  $M = 4$  kg). A 10 kg bucket hangs from the cord's loose end. What is the tension in the cord as the cord unwinds and the bucket falls?

### Example 3:

A 12 kg block rests on smooth horizontal tabletop. It is attached to an 18 kg block which hangs over a pulley at the edge of the table. The pulley is shaped like a hoop with a radius of 5 cm and a mass of 2 kg. What is the acceleration of the 12 kg block?

### Example 4:

A 5 kg block rests on a smooth  $30^\circ$  incline. It is attached to a 4 kg block that hangs over a pulley at the top of the incline. The pulley is shaped like a disk with a radius of 10 cm and a mass of 1.5 kg. What is the acceleration of the 5 kg block?

### Example 5:

A sphere, a hoop and a disk race down an inclined ramp. Which will get to the bottom first?

### Example 6:

A small sphere of mass,  $m$ , and radius,  $r$ , rolls down a loop de loop track whose loop has a radius,  $R$ . How high above the bottom of the loop must the ball be released if it just barely can make it around the loop?

### Example 7:

A ball of mass,  $m$ , and radius,  $r$ , is released from the very edge of a hemispherical bowl of radius,  $R$ . What is the speed of the center of the ball when it gets to the bottom of the bowl.

### Example 8:

A 1 kg, 20 cm radius turntable is freely turning at  $33 \frac{1}{3}$  RPM. It has a 200 gram, 20 cm record which is initially not rotating dropped on it. What is the final angular speed of the combination?

### Example 9:

A child sits on a stool that is free to rotate. The child holds two 2.0 kg masses 0.85 m from the rotation axis of the stool. The child-stool combination has a rotational inertia of  $2.4 \text{ kg m}^2$  (excluding the masses) and the combination is initially rotating at 0.35 rad/s. What is the rotational speed after the child pulls the masses in to 0.3 m from the rotational axis?

### Example 10:

A 20 gram, 300 m/s bullet strikes and sticks to the very edge of a 2 kg, 20 cm radius sphere which is initially not rotating. What is the angular speed of the combination just after the collision? The sphere rotates about a fixed axis.

**Example 11:**

A 30 kg child is initially standing 1 m from the center of a merry go round that has a 100 kg mass and a 3 m radius. If they both start from rest what is the angular speed of the merry go round with respect to the ground when the child walks at 2 m/s counter-clockwise with respect to the merry go round?