(6 pts) 1. A thin-walled hollow sphere \( I = \frac{2}{3} MR^2 \) is rolling without slipping on a horizontal surface. The mass of the sphere is 0.600 kg. If the total kinetic energy of the sphere is 32.0 J, what is the translational speed of its center of mass?

(a) 64.0 m/s
(b) 12.6 m/s
(c) 7.30 m/s
(d) 8.00 m/s
(e) 10.3 m/s
(f) none of the above answers

(6 pts) 2. A uniform solid cylinder \( I = \frac{1}{2} MR^2 \) rolls without slipping up a ramp that is inclined at 30.0° above the horizontal. As the cylinder rolls up the ramp, what is the direction of the static friction force that the surface of the ramp exerts on the cylinder?

(a) parallel to the surface of the ramp and directed up the incline
(b) parallel to the surface of the ramp and directed down the incline
(c) perpendicular to the surface of the ramp
(d) the static friction force is zero

(6 pts) 3. A force \( F = 8.50 \) N acts at the rim of a disk as shown in the sketch. The radius of the disk is \( R = 0.120 \) m. What is the magnitude of the torque due to \( F \) for an axis at the center of the disk?

(a) zero
(b) 6.80 N•m
(c) 1.02 N•m
(d) 0.816 N•m
(e) 0.612 N•m
(f) none of the above answers
(6 pts) 4. A block with mass 0.60 kg is attached to a spring and is moving with simple harmonic motion on a horizontal frictionless surface. The spring has force constant 80.0 N/m. The amplitude of the motion is 0.28 m and the period is 0.400 s. What is the period if the amplitude of the motion is increased to 0.56 m?

(a) 0.070 m
(b) 0.28 m
(c) 0.44 m
(d) 0.56 m
(e) 1.12 m
(f) none of the above answers

(6 pts) 5. A man holding a heavy object in each hand stands on a small platform that is free to rotate about a vertical axis. Initially he is standing with his arms outstretched and he and the platform are rotating with an angular speed of 1.20 rad/s. With his arms outstretched, the moment of inertia of the system (man + platform + object) is 5.00 kg·m². Then he pulls the objects in close to his chest, and the moment of inertia of the system becomes 4.00 kg·m². After he pulls in the weights, what is the kinetic energy of the system (man + platform + objects)?

(a) 4.50 J
(b) 3.60 J
(c) 2.40 J
(d) 1.50 J
(e) zero
(f) none of the above answers

(6 pts) 6. A light beam with negligible mass and length 6.0 m is attached to a wall by a small hinge. The beam is held in a horizontal position by a light rope that has one end attached to the wall and the other end attached to the center of the beam. A 2.0 kg block is suspended from the beam at a point that is 5.0 m from the hinge. The force that the hinge exerts on the beam has components that are

(a) upward and to the right
(b) upward and to the left
(c) downward and to the right
(d) downward and to the left
On the following problems show all your work. Partial credit will be given, if earned. Write your answers in the blanks provided. All answers must include the correct plus or minus sign and the correct units.

(16 pts) 7. A wheel with radius 0.150 m starts from rest at $t = 0$ and then starts to rotate clockwise with a constant angular acceleration of $3.00 \text{ rad/s}^2$.

a) How much time does it take the wheel to turn through 9.00 revolutions. Ans. ___________

b) After the wheel has turned through 9.00 revolutions, starting from rest, what is the tangential speed of a point on the rim of the wheel?

Ans. ___________

c) After the wheel has turned through 9.00 revolutions, starting from rest, what is the magnitude of the resultant acceleration of a point on its rim?

Ans. ___________
(16 pts) 8. One end of a uniform bar is attached to a wall by a frictionless hinge. The bar is held in a horizontal position by a light rope that is attached at the other end of the bar. The rope makes an angle of $36.9^\circ$ with the wall and the tension in the rope is 50.0 N.

a) What is the weight of the bar?  
Ans. 

b) What is the magnitude of the vertical component of the force that the hinge exerts on the bar? Is this component upward or downward?

Ans. magnitude 

direction 

(16 pts) 9. A large wheel with radius 0.300 m is mounted on a frictionless axle that passes through the center of the wheel. A light rope is wrapped around the wheel and a block of mass 6.00 kg is suspended from the free end of the rope. The system is released from rest and the block moves downward with an acceleration of 4.00 m/s².

\[ \text{R} \]

\[ \text{Box} \]

a) As the block descends, what is the tension in the rope?  
Ans. ____________

b) What is the angular acceleration of the wheel?  
Ans. ____________

c) What is the moment of inertia of the wheel, for an axis at its center?  
Ans. ____________
10. A block with mass \( m = 0.400 \) kg is attached to one end of a horizontal spring that has force constant \( 250 \) N/m. The other end of the spring is attached to a wall. The block moves in simple harmonic motion on a horizontal frictionless surface. The amplitude of the block's motion is \( 0.300 \) m

a) What is the maximum speed of the block during its motion? Ans. ____________

b) What is the magnitude of the acceleration of the block when the block is \( 0.200 \) m to the right of its equilibrium position? Is the acceleration at this point to the right or to the left?

Ans. magnitude ____________

direction ____________

c) What is the speed of the block when it is \( 0.200 \) m to the right of its equilibrium position?

Ans. ____________