

Name (printed) \_\_\_\_\_

Name (signature as on ID) \_\_\_\_\_

Lab Section \_\_\_\_\_

Exam III Chaps. 9–11 in Young& Geller

Circle the correct answer. No partial credit will be given.

(5pts) 1. A thin-walled hollow sphere with mass  $M = 5.0$  kg and radius  $R = 0.10$  m is rolling without slipping on a horizontal surface. The center of mass of the sphere has translational speed 6.0 m/s. The moment of inertia of the sphere for an axis through its center is  $I = \frac{2}{3}MR^2$ . What is the total kinetic energy of the sphere?

- (a) 60 J
- (b) 90 J
- (c) 150 J
- (d) 250 J
- (e) none of the above

(5 pts) 2. A uniform solid sphere is released from rest at the top of an incline and rolls without slipping down the incline. When the sphere reaches the bottom of the incline, the translational speed of its center of mass is 16.0 m/s. For a uniform sphere and an axis through its center,  $I = \frac{2}{5}MR^2$ . If a second uniform sphere with twice the mass and twice the radius of the first sphere is released from rest at the top of the same incline and rolls down the incline without slipping, its translational speed at the bottom of the incline is

- (a) 2.0 m/s
- (b) 8.0 m/s
- (c) 16.0 m/s
- (d) 32.0 m/s
- (e) 128.0 m/s

(5 pts) 3. An object with mass 4.0 kg is attached to a horizontal spring and moves on a horizontal frictionless surface. The object is moving in simple harmonic motion with amplitude  $A = 0.20$  m and period 1.2 s. If the amplitude is changed to 0.40 m, what is the period of the motion?

- (a) 0.6 s
- (b) 1.2 s
- (c) 2.4 s
- (d) none of the above

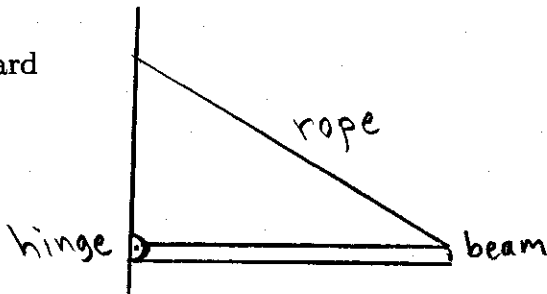
(5 pts) 4. A force  $F$  is applied to one end of a rod. The force has magnitude 10 N, the rod is 5.0 m long and the force makes an angle of  $36.9^\circ$  with the rod, as shown in the sketch. For an axis at point  $A$ , at the other end of the rod, the magnitude of the torque due to  $F$  is

- (a) zero
- (b) 30 N·m
- (c) 40 N·m
- (d) 50 N·m
- (e) 100 N·m
- (f) none of the above



(5 pts) 5. A uniform beam that weighs 500 N is attached to the wall by a hinge and held in a horizontal position by a rope that is attached to the other end of the beam. The vertical component of the force that the hinge exerts on the beam is

- (a) upward
- (b) downward
- (c) zero



(5 pts) 6. A woman stands on a turntable that is free to rotate about a vertical axis. She holds a heavy object in each hand. With her arms outstretched she is rotating at 3.0 rad/s and the moment of inertia of the system (woman, weights, platform) is  $12.0 \text{ kg}\cdot\text{m}^2$ . She pulls her arms in and the moment of inertia of the system becomes  $6.0 \text{ kg}\cdot\text{m}^2$ . What is her angular speed after she pulls her arms in?

- (a) 0.75 rad/s
- (b) 1.50 rad/s
- (c) 3.0 rad/s
- (d) 6.0 rad/s
- (e) 12.0 rad/s
- (f) none of the above

On the following problems show all your work. Partial credit will be given if earned. Write your answers in the blanks provided.

(17 pts) 7. A wheel with radius 0.20 m starts from rest and turns through 8.0 revolutions in 5.0 s. At  $t = 5.0$  s what is

a) the tangential acceleration of a point on the rim of the wheel?

Ans. \_\_\_\_\_

b) the radial acceleration of a point on the rim of the wheel?

Ans. \_\_\_\_\_

(18 pts) 8. A block with mass 4.0 kg is attached to a horizontal spring and moves in simple harmonic motion. The force constant of the spring is 200 N/m. At  $t = 0$  the object is 0.10 m to the right of its equilibrium position and is moving to the left with a speed of 0.80 m/s.

a) What is the amplitude of the motion of the block?

Ans. \_\_\_\_\_

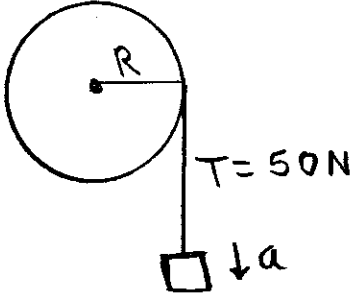
b) During its motion, what is the magnitude of the maximum acceleration of the block?

Ans. \_\_\_\_\_

c) During its motion, what is the maximum speed of the block?

Ans. \_\_\_\_\_

(17 pts) 9. A wheel of radius  $R = 0.20$  m is mounted with frictionless bearings about an axle through its center. A light rope is wrapped around the wheel and an object is suspended from the free end of the rope. When the system is released from rest, the object descends with linear acceleration  $a = 3.0$  m/s<sup>2</sup> and the tension in the rope is 50 N.



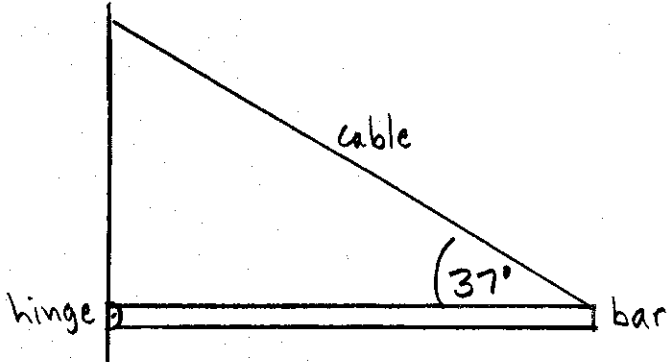
a) What is the angular acceleration of the wheel?

Ans. \_\_\_\_\_

b) What is the moment of inertia of the wheel for rotation about the axis through its center?

Ans. \_\_\_\_\_

(18 pts) 10. One end of a uniform bar that has weight  $w$  is attached to a wall by a frictionless hinge. The bar is held in a horizontal position by a cable that makes an angle of  $37^\circ$  with the bar. The tension in the cable is  $80.0\text{ N}$ .



a) What is the weight of the bar?

Ans. \_\_\_\_\_

b) What is the vertical component of the force the hinge exerts on the bar?

Ans. \_\_\_\_\_