UNIVERSITY OF OTTAWA
Principles of Physics
PHY1321/1331 FALL 2012
Dr. A. Czajkowski

CLASS: PHY____

STUDENT #: _____

NAME: _____

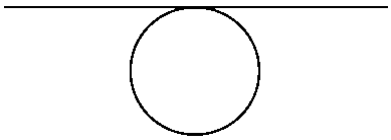
Duration 10:00-11:50
(105 minutes)
PART I (48%)
In the Scantron answer to all MC questions below.

1 A 4.0-kg particle is moving horizontally with a speed of 5.0 m/s when it strikes a vertical wall. The particle rebounds with a speed of 3.0 m/s. What is the magnitude of the impulse delivered to the particle?
a. 24 Ns b. 32 Ns c. 40 Ns d. 30 Ns e. 8.0 Ns

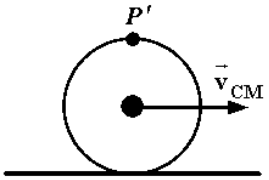
2. The center of gravity of an object is at the same position as the center of mass when
a. $\vec{\mathbf{g}}$ is the same at both ends of the object.
b. the object is located in a region where $\vec{\mathbf{g}}$ is uniform over the entire object.
c. the object is as large as the body that exerts the gravitational force on it.
d. any of the conditions above is satisfied.
e. either (a) or (b) above is satisfied.

3. At t = 0, a wheel rotating about a fixed axis at a constant angular acceleration of -0.40 rad/s2 has an angular velocity of 1.5 rad/s and an angular position of 2.3 rad. What is the angular position of the wheel at t = 2.0 s?
a. 4.9 rad b. 4.7 rad c. 4.5 rad d. 4.3 rad e. 4.1 rad

4. A uniform sphere of radius R and mass M rotates freely about a horizontal axis that is tangent to an equatorial plane of the sphere, as shown below. The moment of inertia of the sphere about this axis expressed as multiples of MR^2 is
a.2/5
b 2/3
c 5/7
d 7/5
e3/2

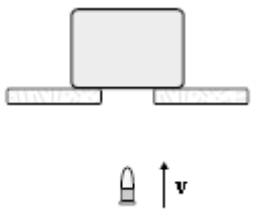


5. When the center of a bicycle wheel has linear velocity $\vec{\mathbf{v}}_{CM}$ relative to the ground, the velocity relative to the ground of point *P'* at the top of the wheel is
a. 0.
b. $\vec{\mathbf{v}}_{CM}$.
c. $2\vec{\mathbf{v}}_{CM}$.
d. $-\vec{\mathbf{v}}_{CM}$.
e. $-2\vec{\mathbf{v}}_{CM}$.



6. A solid cylinder of radius R = 1.0 m and mass 10 kg rotates about its axis. When its angular velocity is 10 rad/s, its angular momentum (in kg×m2/s) is
a. 50. b. 20. c. 40. d. 25. e. 70.

7. A 10-g bullet moving 1 000 m/s strikes and passes through a 2.0-kg block initially at rest, as shown. The bullet emerges from the block with a speed of 400 m/s. To what maximum height will the block rise above its initial position
a. 78 cm b. 66 cm c. 56 cm
d. 46 cm e. 37 cm



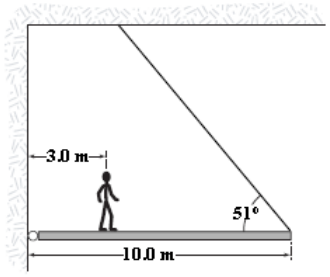
PART II

In your exam booklet solve 4 out of 5 problems below. Indicate clearly which questions are to be marked.

Each question has the same weight (13 points)

Quality of the solution (clarity, communication, and neatness) will be factored in the final grade

1. The figure shows a uniform, horizontal beam (length = 10 m, mass = 25 kg) that is pivoted at the wall, with its far end supported by a cable that makes an angle of 51° with the horizontal. If a person (mass = 60 kg) stands 3.0 m from the pivot, what is the tension in the cable?



2 A full disk of radius R=20cm and mass M=1kg is centered at the origin of the coordinate system (in the x-y plane) has a circular part of it cut out as shown (r=10cm).

a) Find the CM of this new system

b) find the Moment of Inertia of this system when it rotates about z axis

c) Find the Rotational energy of it when the angular velocity is equal 1rad/s

d) Find the Angular Momentum when angular velocity is 2 rad/s

3 A cylinder of mass 10.0 kg rolls without slipping on a horizontal surface. At a certain instant its center of mass has a speed of 10.0 m/s. Determine

(a) the translational kinetic energy of its center of mass,

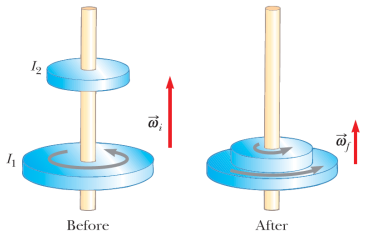
(b) the rotational kinetic energy about its center of mass, and

(c) its total energy.

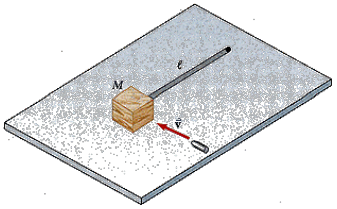
4. A cylinder with moment of inertia I_1 rotates about a vertical, frictionless axle with angular speed ω_i. A second cylinder, this one having moment of inertia I_2 and initially not rotating, drops onto the first cylinder . Because of friction between the surfaces, the two eventually reach the same angular speed ω_f.

(a) Calculate ω_f.

(b) Show that the kinetic energy of the system decreases in this interaction and calculate the ratio of the final to the initial rotational energy



5. A wooden block of mass M resting on a frictionless, horizontal surface is attached to a rigid rod of length script i and of negligible mass. The rod is pivoted at the other end. A bullet of mass m traveling parallel to the horizontal surface and perpendicular to the rod with speed v hits the block and becomes embedded in it.



a) what is the angular momentum of the bullet-block system

b) what fraction of the original kinetic energy is converted into internal energy in the collision