PHYSICS 141 **Name:**
Summer 2007
Exam 3

The multiple choice questions are 2 points each. **(24 pts)**

1. What are the concepts involved when a person jumps from an height h on to the floor. Understand - impulse

2. The following objects of the same mass are released at the same time from the top of an inclined plane. Which of the following objects has the maximum linear velocity?
a) A ring ($I = MR^2$)
b) A cylinder ($I = (1/2)\ MR^2$)
c) A sphere ($I = (2/5)\ MR^2$)

3. What are the dimensions of torque?

4. If the speed of a particle is doubled, the momentum
a) doubles b) quadruples c) remains the same d) is halved

5. In a ballistic pendulum experiment,
a) The linear momentum of the bullet and the block is individually conserved
b) Kinetic energy of the bullet and the block is individually conserved.
c) Kinetic energy of the system is conserved
d) The linear momentum of the system (bullet +block) is conserved

6. Which of the following is true in simple harmonic motion of a mass attached to a horizontal spring?
a) Position and velocity are always opposite to each other.
b) Position and velocity can never have the maximum (absolute values) at the same instant of time.
c) Position and acceleration can never have the maximum (absolute values) at the same instant of time.

7. What happens to a clock based on a pendulum when it is taken in an elevator that is accelerating upward?
a) It runs slower b) It runs faster c) It maintains the same time

8. A man is spinning on a light frictionless turntable. Understand what happens to each physical quantity (angular momentum, angular velocity, rotational kinetic energy) involved as the person stretches his arms.

9. In simple harmonic motion, understand how each of the physical quantity behaves at the extreme, middle and some intermediate positions. (displacement, velocity, acceleration, kinetic energy, potential energy, force)

10. In case of a horizontal spring, understand what happens to omega, period, frequency, maximum kinetic energy, maximum potential energy, maximum acceleration, maximum velocity if
a) the amplitude is doubled.
b) if the mass is doubled.
c) if the spring is stiffer by a factor of two.

11. Understand how many times each of the physical quantities (displacement, acceleration, velocity, kinetic energy, potential energy, total energy) reach their maximum values (absolute values) during one cycle.

12. A bicycle pedal system is made up of two wheels that are connected to each other by a chain. What is common to both the wheels?
a) Angular acceleration
b) linear acceleration
d) The angle covered in a given time

Problem 1 (24 points)

This problem is based on problem # 9-20	

a) Using the principle of conservation of energy, find calculate the velocity of m_1 just before its collision with m_2. Make sure to identify the forces involved and classify them into conservative and non-conservative. Why is it ok to use energy conservation?

b) Using momentum conservation, and an easier equation for 1D elastic collision $V_{1i}-V_{2i}= -(V_{1f}-V_{2f})$, calculate the velocity of m_1 and m_2 after the collision

c) Find the kinetic energy of the system before and after collision. Is is conserved?

d) Find the maximum height to which m_1 rises after the collision. Is the momentum of m_1 conserved during the collision? What about m_2 ? Explain or show using calculations

Problem #2 (22 pts)

This problem has to do with 12.43	

a) Draw a free body diagram of the beam showing all the forces acting on it. (2)

b) Write the expressions showing how the forces balance in the x and y directions. Find the tension in the string when the bear is at x=1.0 m.(4)

c) Find the maximum distance the bear can walk before the wire breaks (when it reaches a tension of 900 N.)Explain why you choose a particular point as your axis). (10)

d) Find the x and y components of the reaction force at the hinge. Find the magnitude and direction.

Problem # 3
Problem 11-50

a) What is the angular momentum of the mass m when it is a distance d away from the rod?

b) What is the angular momentum of the mass m just before it hits the rod?

c) What is the angular speed of the system right after the collision?

d) Determine the mechanical energy before and after collision? What is the fractional loss in mechanical energy?

Other problems to look at:
How to use angular kinematic equations?
How to find the angular acceleration in a mass pulley system.
How to find the velocity of a mass coming down an incline/