

Physics 131: FINAL

1:30 - 3:18 pm, Wednesday, December 9, 1998

Fall 1998

Professor Frank De Lucia

2:30 Section

Name (1 pt): _____

Recitation Instructor (1 pt): _____

There are 7 pages to this exam (plus this page). It is important that you write your name on each page and the name of your recitation instructor on the first page. Each name is worth one point.

Be sure to include the proper units in your answers.

$$a = \frac{v^2}{r}$$

$$P = \frac{dW}{dt}$$

$$g = 9.8 \text{ m/s}^2 = 32 \text{ ft/s}^2$$

$$G = 6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2$$

$$F_g = \frac{GMm}{r^2}$$

$$U_g = mgh$$

$$U_g = -\frac{GMm}{r}$$

$$I = m_i r_i^2$$

$$f_{s,\max} = \mu_s N$$

$$f_k = \mu_k N$$

$$F_s = -kx$$

$$U_s = \frac{1}{2} kx^2$$

Name (1 pt) _____

Section I - short problems (10 pts each)

I-1 An outfielder throws a baseball (mass = 0.25 kg) with an initial speed of 30 m/s. Just before an infielder catches the ball at the same height, its speed is 25 m/s. How much of the ball's mechanical energy is dissipated by the air drag acting on the ball during its flight?

I-2 An instructor stands on a platform that is rotating without friction with an angular velocity of 2 rev/s. Because his arms are outstretched and he holds a weight in each hand the rotational inertia of the system is 10 kg m^2 . By moving the weights he reduces the rotational inertia of the system to 5 kg m^2 . What is the new angular velocity?

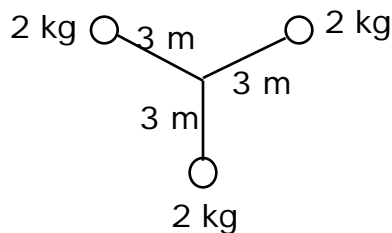
I-3 A 250 kg bear slides, from rest, 12 m down a pine tree, attaining a speed of 6 m/s just before hitting the ground. What is the average frictional force that acts on the bear?

Name (1 pt) _____

I-4 A 5 kg block is accelerated by a compressed spring whose spring constant is 600 N/m. After leaving the spring at the spring's relaxed length, the block travels over a horizontal surface, with a coefficient of kinetic friction of 0.25, for a distance of 8 m before stopping. The surface over which the block moves while in contact with the spring is frictionless. Through what distance was the spring compressed before the block began to move?

I-5 Two masses rest on a frictionless surface. One is stationary and has a mass of 10 kg and the second has a mass of 5 kg and an initial velocity toward the first of 20 m/s. If they collide and stick together, what is their speed after the collision?

I-6 Three masses are arranged as shown in the diagram. What is the rotational inertia of this system about its center?



Name (1pt) _____

I-7 A uniform beam of length 12 meters and mass 40 kg rests horizontally on scales placed under each of its ends. If a 100 kg mass is placed 3 meters from the left end, how much does each scale read?

I-8 A mass of 5 kg on a frictionless table is attached to a hanging mass of 2 kg by a cord through a hole in the table. The 5 kg mass is following a circular path of radius 2 m. What speed must the 5 kg mass have to maintain this circular motion?

Section II - Problems

II-1 (20 pts) A flag pole (a long thin rod) of length L stands vertically in a flat field. If it falls by rotating about its end, what is the acceleration of the top of the pole as it hits the ground?

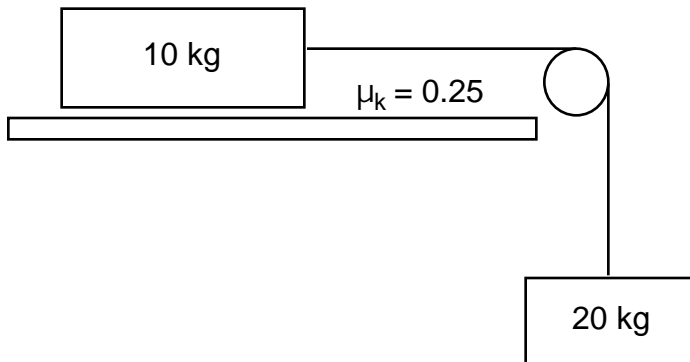
$$(I_{\text{rod about end}} = (1/3)ML^2)$$

Name (1 pt) _____

II-2 (20 pts). A table is located in an elevator which is accelerating upward at 8 ft/s^2 . A ball rolls horizontally off the edge of the table, which is 5.0 ft above the floor of the elevator. It strikes the floor at a point 6.0 ft horizontally away from the edge of the table. What was the speed of the ball at the instant it left the table?

Name (1pt) _____

II-3 (24 pts) Two blocks are connected by string and a massless pulley as shown in the figure. The block on the table has a mass of 10 kg and a coefficient of kinetic friction with the table of 0.25. The hanging block has a mass of 20 kg. If the blocks start from rest, what is their velocity after the blocks move 5m?



Name (1 pt) _____

II-4 (24 pts) Two masses, $m_1 = 2$ kg and $m_2 = 4$ kg are connected by a massless string and are sliding down a 30° incline plane, with m_1 ahead of m_2 . The coefficient of kinetic friction between m_1 and the incline is 0.2 and between m_2 and the incline 0.3. What is the acceleration of the system?

Name (1pt) _____

III-5 (24 pts) A mass of 5 kg and a mass of 10 kg are attached to a massless string and hung over a 2 kg pulley (assume that it has the shape of a solid disk). If the masses are released from rest, how long does it take the 10 kg mass to fall 10 m?

($I_{\text{disk}} = (1/2)MR^2$)

