PHYS 172/spring2012-PRACTICE

Test/Quiz Number: 10

Your Name:

DO NOT OPEN YOUR EXAM UNTIL TOLD

PRACTICE Exam III, Phys 172, Spring 2012

April, 2012

*1. Write your name on the line above and record it on your **scantron** form.*

*2. Record your two-digit Test/Quiz Number on your **scantron** form. The number is shown at the top of this page.*

*3. Record your PUID number in the respective field on your **scantron** form.*

Do not use other paper. Write on the back of this test if needed.

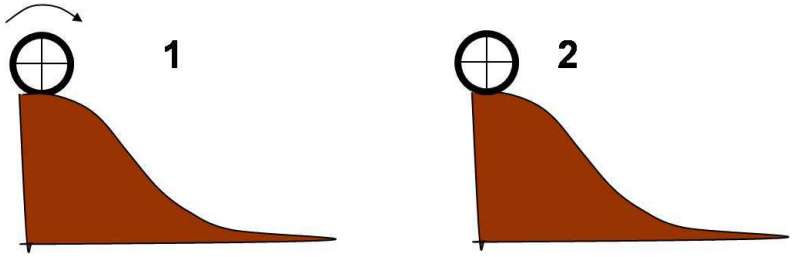
A page with major equations is provided at the back of this exam.

*Circle your answers here and on the **scantron** form. At the end of the exam, or if you finish earlier, please remain seated, raise your hand and a TA will come to you to collect your **scantron** form and this printout.*

Problem 1: We attach two identical, thin, uniform rods of length *L* together end-to-end such that the rods make a right angle. In our coordinate system the joint is at the origin, while the members are along the positive *x* axis and positive *y* axis, respectively. The center of mass of this L-shaped object is at

A) $x = L, y = L$
B) $x = L/2, y = L/2$
C) $x = 0, y = 0$
D) $x = L/4, y = L/4$
E) $x = L/2, y = L/4$

Problem 2: Wheel 1 of mass *M* rolls down a slope. Wheel 2 of the same mass *M* slides down the same slope (ignore friction). Which one of the following statements is CORRECT?

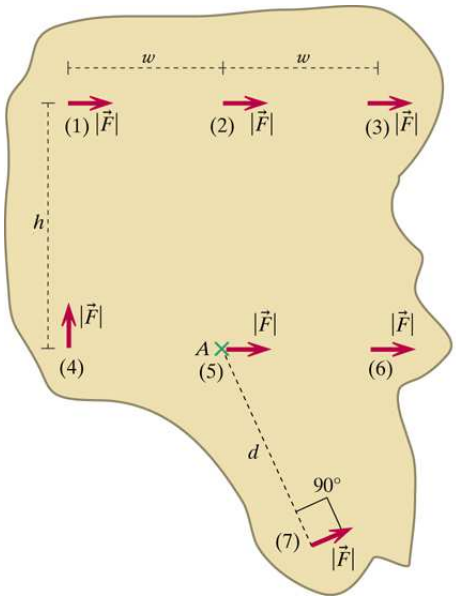


A) The translational kinetic energy of Wheel 2 is equal to the rotational kinetic energy of Wheel 2 at the bottom.
B) Wheel 1 (rolling) will get down first.
C) Wheel 2 (sliding) will get down first.
D) The translational kinetic energy of Wheel 1 is larger than the rotational kinetic energy of Wheel 1 at the bottom.
E) Both wheels will get down at the same time.

Problem 3: Two identical cars of mass m =1000 kg move toward each other with speeds $v_1 = v_2 = 30$ m/s, collide head-on and stick together. Which one of the following statements is INCORRECT?

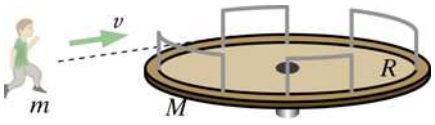
A) The center of mass is at rest at all times during this process.
B) The final speed of the cars moving together is zero.
C) Total momentum of the system is conserved.
D) The energy released as heat in the process is enough to heat half a gallon of water to boiling point.
E) The total kinetic energy of the two cars is conserved.

Problem 4: Seven forces, all with magnitude $|\vec{F}|$ = 29 N, are applied to the irregularly shaped object shown in the figure below. Each force is applied at a different location on the object, indicated by the tail of the arrow; the directions of the forces differ. The distances shown in the figure have these values: w = 11 m, h = 17 m, and d = 16 m. Relative to location A, what is the z component of the net torque acting on this object**?** (The z axis points directly out of the page.)



A) -1330 Nm
B) 1330 Nm
C) -493 Nm
D) 493 Nm
E) 319 Nm

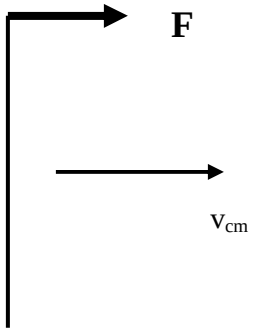
Problem 5: A playground ride consists of a disk of mass M = 43 kg and radius R = 2.4 m mounted on a low-friction axle. A child of mass m = 16 kg runs at speed v = 2.7 m/s on a line tangential to the disk and jumps onto the outer edge of the disk. Consider the system consisting of the child and the disk, but not including the axle. Which one of the following statements is FALSE, for the time interval from just before to just after the collision? (Measure torque about the middle of the disk.)



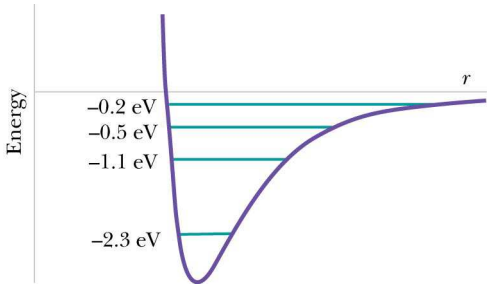
A) The axle exerts a force on the system but nearly zero torque.
B) The momentum of the system does not change.
C) The angular momentum of the system about the axle hardly changes.
D) The momentum of the system changes.
E) The torque exerted by the axle is nearly zero.

Problem 6: consider a meter stick of mass 300 grams lying on ice. You pull at one end of the meter stick, at right angles to the stick, with a force of 25 N, causing the stick to rotate clockwise. Assume that friction with the ice is negligible. What is the rate of change of the angular speed ω, i.e. $d\omega/dt$? The moment of inertia of a rod of mass M and length L about its center of mass is $ML^2/12$.

A) 200 radians/s^2
B) 300 radians/s^2
C) 500 radians/s^2
D) 60 radians/s^2
E) 100 radians/s^2



Problem 7: The figure below shows all of the quantized energies (bound states) for a molecule. The energy for each state is given on the graph, in electron volts. At high enough temperatures, in a collection of these molecules there will be at all times some molecules in each of these states, and light will be emitted. What are the energies in electron volts of the emitted light?



A) 0.3 eV, 0.6 eV, and 1.2 eV
B) 0.3 eV, 0.6 eV, 0.9 eV, 1.2 eV, 1.8 eV, and 2.1 eV
C) 0.3 eV, 0.9 eV, and 2.1 eV
D) 0.2 eV, 0.5 eV, 1.1 eV, and 2.3 eV
E) 0.2 eV, 0.7 eV, 1.3 eV, 1.6 eV, 2.5 eV, 2.8 eV, and 3.4 eV

Problem 8: Particle 1 of mass *m* moving with speed *v* in the *+x* direction has an elastic collision with particle 2 of mass 3*m* which was originally at rest. After the collision, particle 2 is moving in the *+x* direction. What is its speed?

A. $\frac{2}{5}v$

B. $\frac{1}{3}v$

C. $\frac{2}{3}v$

D. $\frac{1}{2}v$

E. $\frac{2}{7}v$

Problem 9: A ball of mass *m* = 1.5 kg is falling straight down. At the instant shown, it is a height *h* = 4.0 m above the floor and has a speed of 5 m/s. Consider point P at position $\vec{r}_P = -3.0\hat{x}$ m . What is the angular momentum of the ball about point P?

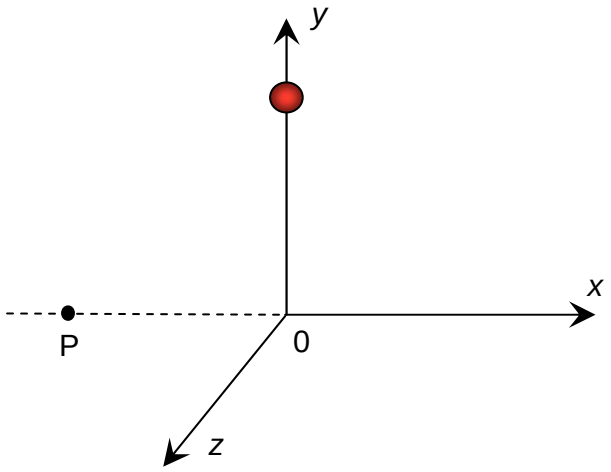
A. 0

B. $22.5\ \hat{z}\ \ \mathrm{kg \cdot m^2 / s}$

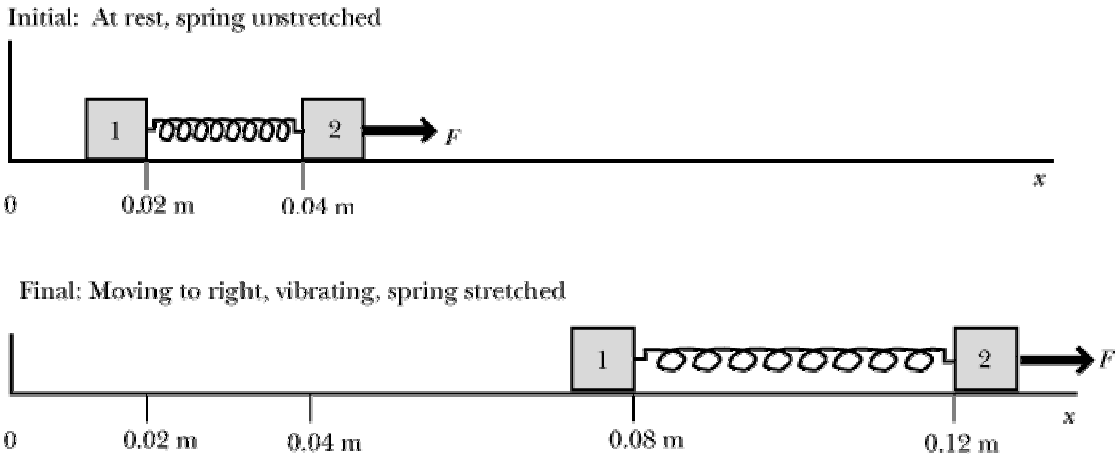
C. $-22.5\ \hat{z}\ \ \mathrm{kg \cdot m^2 / s}$

D. $15\ \hat{y}\ \ \mathrm{kg \cdot m^2 / s}$

E. $-15\ \hat{x}\ \ \mathrm{kg \cdot m^2 / s}$

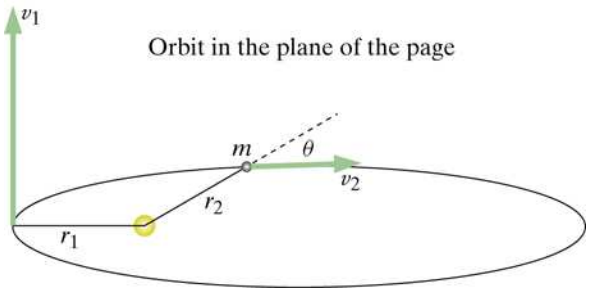


Problem 10: Two identical masses are on a horizontal, frictionless surface. The masses are connected to each other with a spring of stiffness 2500 N/m. Initially, the spring is at its equilibrium length and the masses are at rest. We then pull the rightmost mass with a constant force of 40 N to the right. The initial and final configurations of the masses are shown below. What is the vibrational kinetic energy of the masses+spring system in the final configuration?



A) 0.1 J
B) The motion described could not have occurred (it violates the laws of physics).
C) 2.8 J
D) 3.2 J
E) 0.5 J

Problem 11: A certain comet of mass $m = 1.2 \times 10^{15}$ kg at its closest approach to the Sun is observed to be at a distance $r_1 = 1.4 \times 10^{12}$ m from the center of the Sun, moving with speed $v_1 = 27600$ m/s. At a later time the comet is observed to be at a distance $r_2 = 6.3 \times 10^{12}$ m from the center of the Sun, and the angle between $\vec{r}_2$ and the velocity vector is measured to be $\theta = 14.34°$. What is v_2? (The figure is not necessarily to scale.)



A) 24800 m/s
B) 32700 m/s
C) 14300 m/s
D) 95000 m/s
E) 5230 m/s