Practice Exam #2
Physics 2425

Name:
ID#:
Section #:

PART I: MULTIPLE CHOICE QUESTIONS

Choose the best answer for each of Questions 1-3 below. Circle the letter corresponding to your answer. (5 pts each)

1. An object moves in a circular path with decreasing speed. Which of the following statements is (or are) correct?

   a) The acceleration vector has some component toward the center of the circular path.
   b) The acceleration vector has some tangential component in the direction of motion of the object.
   c) The acceleration vector has some tangential component in a direction opposite the direction of motion of the object.
   d) There is a net force acting *centrifugally* (i.e., away from the center of the path).
   e) Both (a) and (b) are correct.
   f) Both (a) and (c) are correct.
   g) (a), (b), and (d) are correct.
   h) (a), (c), and (d) are correct.

2. A marble moves along the *x* axis. The potential energy function is shown in Figure 1. At which of the labeled *x* coordinates is the net force on the marble zero? (Circle all that apply.)

   a) Point *a*
   b) Point *b*
   c) Point *c*
   d) Point *d*
   e) Point *O*

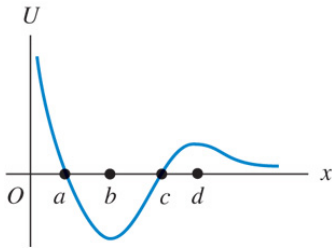

Figure 1

3. The position vectors of a 5-kg mass, a 7-kg mass, and an 8-kg mass are $\langle -8\text{ m},\ 2\text{ m}\rangle$, $\langle 0\text{ m}, 4\text{ m}\rangle$, and $\langle 5\text{ m}, -3\text{ m}\rangle$, respectively. What is the position vector of the center of mass of this system?

   a) $\left\langle \frac{5}{4}\text{ m}, \frac{21}{20}\text{ m}\right\rangle$
   b) $\langle 0\text{ m}, 3.1\text{ m}\rangle$
   c) $\langle 0\text{ m}, 0\text{ m}\rangle$
   d) $\left\langle 0\text{ m}, \frac{7}{10}\text{ m}\right\rangle$
   e) $\langle 0\text{ m}, -3.1\text{ m}\rangle$

PART II: FREE-RESPONSE ("SHOW-YOUR-WORK") QUESTIONS

For Questions 4-11, write your answers in the spaces provided. If you need additional space, ask your instructor for scratch paper. **Be sure to answer each part of the question completely and show all of your work in any calculations.**

4. Two blocks are connected by a string passing over a pulley, as shown in Figure 2. Block 1, with mass m_1, accelerates downward and Block 2, with mass m_2, accelerates up the incline. The coefficient of kinetic friction between m_2 and the incline is μ, as indicated in Fig. 2. Assume that the accelerations are the same in magnitude, as indicated in the figure. Also assume that the tension is the same everywhere in the string.

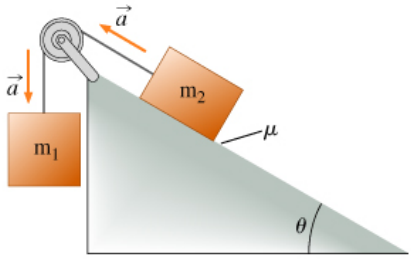

Figure 2

a) Find the ratio of the mass of Block 2 to Block 1. (That is, find m_2/m_1.) Your answer should be in terms of the variables a, μ, and θ. (5 points)

b) Find m_2/m_1 if the system is in *equilibrium*. (5 points)

5. A small metal cylinder of mass $m = 0.20$ kg sits on a rotating turntable, as shown in Figure 3. The coefficient of static friction between the metal cylinder and the turntable is $\mu_s = 0.800$. The cylinder is located 0.15 m from the center of the turntable. Find the maximum speed that the cylinder can have without skidding. (10 points)

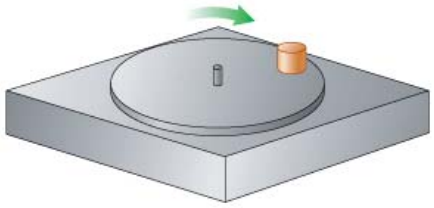

Figure 3

6. A 12-pack of Omni-Cola (mass 4.30 kg) is initially at rest on a horizontal floor. It is then pushed in a straight line for 1.20 m by a trained dog who exerts a constant horizontal force $F = 36.0$ N. The coefficient of kinetic friction between the 12-pack and the floor is 0.300.

   a) Calculate the work done by the dog. (3 points)

   b) Calculate the work done by the force of friction. (3 points)

   c) Find the final speed of the 12-pack. (4 points)

7. In an experiment, one of the forces exerted on a proton is $\vec{F} = \langle -\alpha x^2, 0 \rangle$, where $\alpha = 12$ N/m^2. Calculate the work done by this force as the proton moves along a straight-line path from the point $\vec{r}_i = \langle 0.10 \text{ m}, 0 \rangle$ to the point $\vec{r}_f = \langle 0.30 \text{ m}, 0.40 \text{ m} \rangle$. (10 points).

8. In preparation for shooting a ball in a pinball machine, a spring (k = 675 N/m) is compressed 0.0650 m from its relaxed length. The ball (m = 0.0585 kg) is at rest against the spring at Point *A*. When the spring is released, the ball slides (without rolling and without colliding with other objects) to Point *B*, which is 0.300 m higher than Point *A*. How fast is the ball moving at *B*? (Neglect all friction forces.) (10 points)

9. A person coasts on a bicycle up a hill with a height of 7.0 m. The combined mass of the person and the bicycle is 85 kg. If the bicyclist's speeds at the bottom and top of the hill are 12 m/s and 2 m/s, respectively, find the total work done by friction. (10 points)

10. A rubber ball with a mass of 0.040 kg is dropped from a height of 8.0 m above a floor. It bounces to a height of 3.0 m after being in contact with the floor for 0.080 s.

    a) Find the magnitude of the net impulse J_{net} acting on the ball during the time it is in contact with the floor. (5 points)

    b) Find the magnitude of the average force the floor exerts on the ball. (5 points)

11. (a) Two bumper cars have a head-on, elastic collision. Car #1 has a mass m and initial velocity $v_{1i} = 4.0$ m/s . Car #2 has mass $2m$ and is initially at rest. Find the velocity of Car #2 just after the collision. (5 points)

(b) You and your friends are doing physics experiments on a frozen pond that serves as a frictionless horizontal surface. Sam, with a mass of 80.0 kg, is given a push and slides eastward. Abigail, with a mass of 50.0 kg, is sent sliding northward. They collide and, after the collision, Sam is moving at 6.00 m/s in a direction 37.0° north of east, while Abigail is moving at 9.00 m/s in a direction 23.0° south of east. Find the speeds of Sam and Abigail just before the collision. (10 points)