

Sit in Seat Number \_\_\_\_\_

Name \_\_\_\_\_

Rec. Sec. \_\_\_\_\_

**PH2100**

**Answer Sheet - Exam II**

**Fall 2000**

**Multiple Choice**  
(Circle your answer)

1. A B C D E

2. A B C D E

3. A B C D E

4. A B C D E F G

5. A B C D E

6. A B C D E

7. A B C D E

8. A B C D

9. A B C D E

10. A B C D E

Sub Total \_\_\_\_\_

**Worked Problems**

11. A) \_\_\_\_\_

B) \_\_\_\_\_

12. A) \_\_\_\_\_

B) \_\_\_\_\_

C) \_\_\_\_\_

D) 1 2 3 4

13. \_\_\_\_\_

14. A) \_\_\_\_\_

B) \_\_\_\_\_

C) \_\_\_\_\_

15. A) \_\_\_\_\_

B) \_\_\_\_\_

16. \_\_\_\_\_

Sub Total \_\_\_\_\_

Total \_\_\_\_\_ - Sum of 3 Lowest \_\_\_\_\_ = Score \_\_\_\_\_

1. Put your name and recitation section number on your answer sheet.
2. An equation sheet is provided. You should *not* use one of your own and you should not use equations stored in your calculator.
3. If you need extra paper, pencils, or a calculator, contact your exam proctor.
4. Answers which are illegible or ambiguous will be graded as zero.
5. For numerical answers, supply your answer to three significant figures even if the data given has a different number of significant figures unless you are explicitly told to use a different number of significant figures.
6. There are 23 answers each worth 5 points. Your three lowest scores for individual answers will be dropped, giving a total possible on the exam of 100.
7. When you leave, turn in **ONLY YOUR ANSWER SHEET**. Keep the rest of the exam for reference and for review for the final.

## Recitation Sections

<u>Sect</u>	<u>Meets</u>	<u>Instructor</u>
1	8 am	Leckenby
2	9 am	Leckenby
3	10 am	Daavettila
4	11 am	Agin
5	noon	Leckenby
6	1 pm	Agin
7	2 pm	Daavettila

**Multiple Choice**

Circle the letter corresponding to your answer on the answer sheet.

1. Given vectors  $\vec{A} = 4.30 \mathbf{i} + 3.23 \mathbf{j}$  and  $\vec{B} = 1.28 \mathbf{i} - 0.781 \mathbf{j}$  what is  $\vec{A} \cdot \vec{B}$  (to three significant digits)?

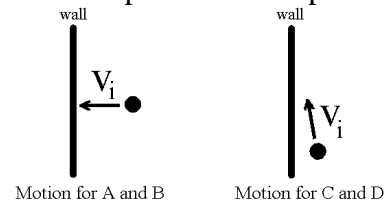
- A) 2.98    B)  $5.50 \mathbf{i} - 2.52 \mathbf{j}$     C) 8.02    D) 6.87    E)  $5.58 \mathbf{i} + 2.45 \mathbf{j}$

2. Given a vector  $\vec{A} = 6.52 \mathbf{i}$ , which is along the x-axis, and a vector  $\vec{B} = 1.85 \mathbf{i} + 1.07 \mathbf{j}$ , which makes an angle of  $30^\circ$  with the x-axis, what is the magnitude of  $\vec{A} \times \vec{B}$  (to three significant digits)?

- A) 12.1    B) 6.97    C) 13.9    D) 14.9    E) 29.8

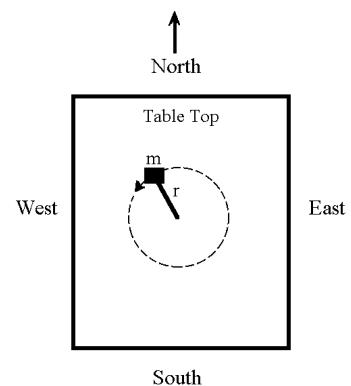
3. A small plastic ball of mass,  $m$ , initially traveling with speed,  $v_i$ , collides with a brick wall. For which of the following situations is the magnitude of the impulse (for the ball) the largest?

- A) The ball travels perpendicular to the plane of the wall and it undergoes a totally inelastic collision with the wall.  
 B) The ball travels perpendicular to the plane of the wall and it undergoes an elastic collision with the wall.  
 C) The ball just grazes the wall (that is, the ball's motion is almost parallel to the plane of the wall) and it undergoes a totally inelastic collision.  
 D) The ball just grazes the wall (that is, the ball's motion is almost parallel to the plane of the wall) and it undergoes an elastic collision.  
 E) The ball just happens to hit an electric outlet.



4. A mass tied to a string undergoes uniform circular motion on a frictionless, horizontal table top, as shown. The view is looking down on the table top from above, and for that view the mass is traveling counter-clockwise, as shown. The direction of the angular velocity of this mass is

- A) North    B) South    C) East    D) West  
 E) Up    F) Down    G) None of the above.



5. Two identical cars traveling 55 miles per hour in opposite directions have a head on collision.\* Which one of the following physics rules and/or principles can best be used to explain why the damage to each of the cars can be expected to be (nearly) identical.

- A) An object in motion will stay in motion, an object at rest will stay at rest.
- B) Conservation of mechanical energy for an elastic collision.
- C) Conservation of angular momentum for an inelastic collision.
- D) For every action, there is an equal and opposite reaction, and work is the average force times distance.
- E) The work-energy theorem for conservative forces and the definition of potential energy.

6. An object with mass,  $m$ , is at rest at  $t = 0$ . A force,  $F$ , is then applied to the object until a time,  $t = 2$  s. The total work done by  $F$  on  $m$  during this time is  $W = -6.79$  J. Based on this information alone, which one of the following statements must be true.

- A) The force  $F$  is nonconservative.
- B) There must have been at least one other force acting on  $m$  during this time.
- C) The kinetic energy of the object at time  $t = 2$  s is negative.
- D) The momentum of the mass at the time  $t = 2$  s is negative.
- E) The force  $F$  is conservative.

7. Two particles with masses  $m_1$  and  $m_2$  ( $m_1 \neq m_2$ ) are observed to have the same momentum. Which one of the following statements must be true.

- A) The particles have the same kinetic energy.
- B) The total momentum of the system of two particles is zero.
- C) The particles have the same speed.
- D) The center of mass velocity is the same as the velocity of one of the particles.
- E) The particles are traveling in the same direction.

8. A ball is thrown upwards at an angle of  $70^\circ$  from the horizontal. Which one of the following quantities will NOT be zero when the ball is at its peak height. (Ignore air resistance).

- A) The net torque on the ball computed for rotations about the ball's center of mass.
- B) The net torque on the ball computed for rotations about the ball's starting position.
- C) The net torque on the ball computed for rotations about a point directly beneath the ball.
- D) None of the above.

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\*Professional drivers on closed course, do not attempt this.

9. A wheel with a diameter of 0.132 m is rolling along a horizontal surface as shown. The center of mass velocity is measured to be 1.45 m/s to the right. How fast is the cylinder rotating (about its center of mass)?

- A) 11.0 rad/s      B) 0.191 rad/s      C) 0.0957 rad/s  
D) 22.0 rad/s      E) 1.45 rad/s



10. A first object is made of material X. A second object is constructed to have exactly the same size and shape as the first, but is made of material Y. The mass of the second object is  $\frac{1}{2}$  the mass of the first. If the same constant torque is separately applied to these two objects, then the ratio of the angular acceleration observed for the first object,  $\alpha_x$ , to the angular acceleration observed for the second object,  $\alpha_y$ , will be

- A) 4      B) 1/4      C) 2      D) 1/2      E) 1

### Problems

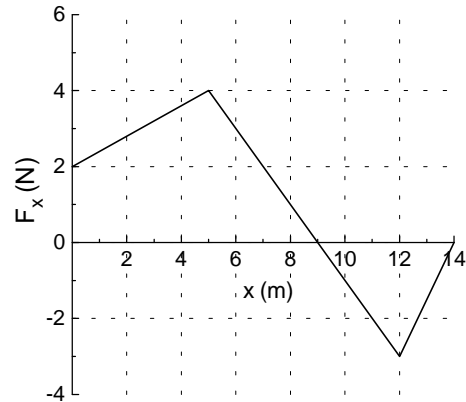
Write your answer in the appropriate space on the answer sheet. Include units, directions for vector quantities, and use three significant figures for numerical answers unless specified otherwise (2 significant figures *for problem 12 only*).

11. A block of mass,  $m = 3.50$  kg, initially at rest is pushed 5.30 m along a frictionless horizontal table by a constant force,  $F$ , directed  $35.0^\circ$  below the horizontal. After the mass has traveled 5.30 m, the work done by the force  $F$  on the mass is 65.7 J.

A) What is the speed of the mass after it has traveled 5.30 m?

B) What is the magnitude of the force,  $F$ ?

12. A single force along the x-axis,  $F_x$ , acts on a mass,  $m = 6.30$  kg, as the mass moves along the x-axis from  $x = 0$  to  $x = 14$  m. The force varies with position as is shown in the graph below. Express your numerical answers to two (2) significant figures for this problem. The velocity of the mass at  $x = 0$  is  $1.39$  m/s towards the  $+x$  direction.

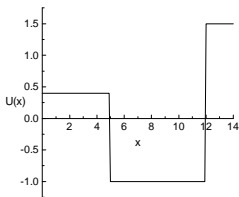


A) How much work was done by  $F_x$ , from  $x = 5.0$  m to  $x = 9.0$  m?

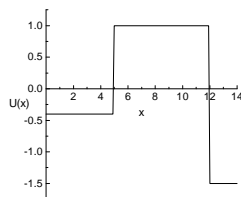
B) At what position, for the range of  $x$  shown on this graph, is the kinetic energy a maximum?

C) What is the kinetic energy of the mass when it is at  $x = 5.0$  m?

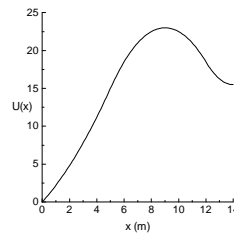
D) Assuming the force,  $F_x$ , is conservative, which graph below most accurately shows the shape of the potential energy,  $U(x)$ , associated with this force? Circle the corresponding number on the answer sheet.



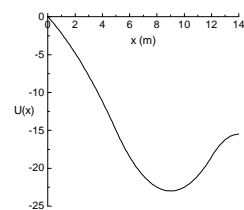
(1)



(2)



(3)



(4)

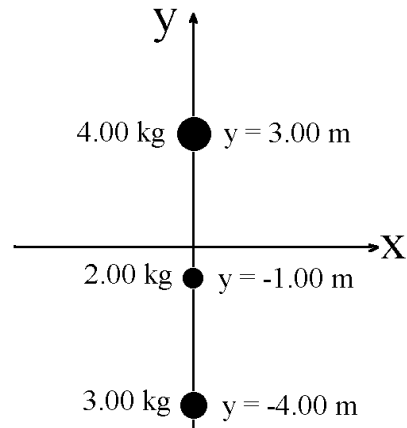
13. The potential energy associated with a particular (conservative) force is given by

$$U(x) = 3.40 x^2 - 5.20 y + 9.70$$

where  $U$  is in Joules and  $x$  and  $y$  are in meters. What is the force,  $\mathbf{F}$ , at  $x = 2.00$  m,  $y = 3.00$  m?

14. Three small masses are connected by rigid rods of negligible mass and are along the y-axis as shown.

A) Where is the center of mass for this system?

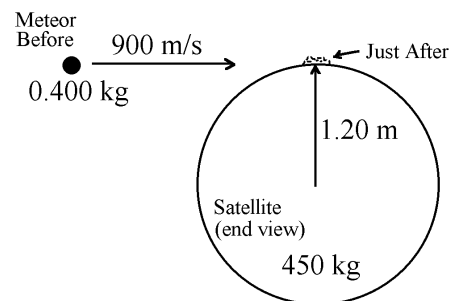


B) What is the moment of inertia for this system for rotations about the x-axis?

C) The system now begins rotating about the x-axis. What is the speed of the 4 kg mass when the system is rotating at 1.50 revolutions per second?

15. A satellite, which is in the shape of a solid disk, is in deep space and is struck by a meteor as illustrated below. The initial path of the meteor is tangent to the satellite's surface. The collision is totally inelastic, so the meteor remains stuck on the satellite. The moment of inertia for a solid cylinder (or disk) for rotation about its axis is  $I = (1/2) MR^2$ . Use the data shown below, assume the satellite is stationary before the impact, and assume that rotation of the meteor before the impact is negligible.

A) What is the (linear) speed,  $v$ , of the satellite's center of mass after the impact?



B) What is the rotational speed,  $\omega$ , of the satellite about its axis after the impact?

16. A small 20.0 g marble in the shape of a solid sphere of radius,  $r = 0.500$  cm, is placed on the inside surface of a large hemi-spherical surface (a bowl) with radius  $R = 50.0$  cm, and mass  $M = 3.00$  kg. The bowl is fixed to a horizontal table top. The bottom of the marble is initially 40.0 cm above the lowest point of the surface and the marble starts from rest. The marble is then released and it rolls without slipping. What is the speed of the center of mass of the marble when it reaches the lowest point on the spherical surface?

(For your reference, the moment of inertia of solid sphere about an axis through its center of mass is  $I_{cm} = (2/5) mr^2$ , and for a hollow sphere it is  $I_{cm} = (2/3) mr^2$ )

