Physics 218 – Exam III

Fall 2016 (all sections) **November 16th, 2016**

Please fill out the information and read the instructions below, but **do not open the exam** until told to do so.

Rules of the exam:

1. You have 90 minutes (1.5 hrs) to complete the exam.
2. Formulae are provided to you with the exam on a separate sheet. Make sure you have one before the exam starts. You may *not* use any other formula sheet.
3. Check to see that there are 8 numbered (four double-sided) pages in addition to the scantron-like cover page. **Do not remove any pages**.
4. If you run out of space for a given problem, the last page has been left blank and may be used for extra space. Be sure to indicate *at the problem under consideration* that the extra space is being utilized so the graders know to look at it!
5. You may use any type of handheld calculator. However, you **must** show your work. If you don't show *how* you integrated or *how* you took the derivative or *how* you solved a quadratic of system of equations, etc., you will **not** get credit.
6. Cell phone use during the exam is strictly prohibited. Please turn off all ringers as calls during an exam can be quite distracting.
7. Be sure to put a box around your $\boxed{\text{final answer(s)}}$ and clearly indicate your work. Credit can be given **only** if your work is legible, clearly explained, and labelled.
8. All of the questions require you show your work and reasoning.
9. Have your TAMU ID ready when submitting your exam to the proctor.

Fill out the information below and sign to indicate your understanding of the above rules

Name: _____ UIN: _____
(printed *legibly*)

Signature: _____ Section Number: _____

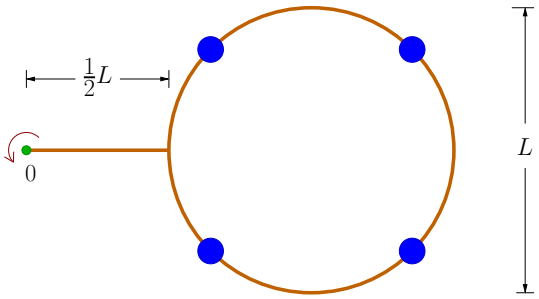
Instructor: Akimov Eusebi Mahapatra Melconian Rapp Rogachev Webb
(**circle one**)

Short Answers:

A) A baseball bat can impart an impulsive force during its swing at a pitched ball. If the bat can transfer an impulse of 1.70×10^4 N for a period of 0.700 ms when a ball of 0.145 kg is thrown at a speed of 40.0 m/s toward the batter. Find the speed of the ball after it has been hit.

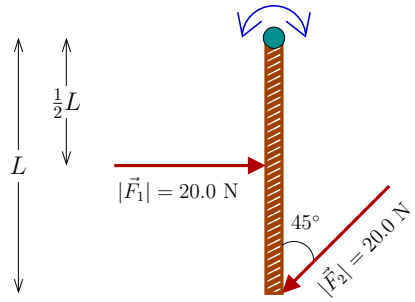
LO	S	U
51.1		
52.1		

B) A system of four identical point-like particles, each of mass m, are connected in a circle of diameter L via stiff massless wires as shown. Find the moment of inertia of this system about the axis of rotation at point O.



LO	S	U
3.1		
55.1		
56.1		
57.1		

C) Two people push from opposite sides of an 80-kg door as shown in the top view of the figure below. The width of the door is $L = 1.2$ m. Calculate the angular acceleration of the door, including the direction (clockwise or counter-clockwise), about the axis shown.



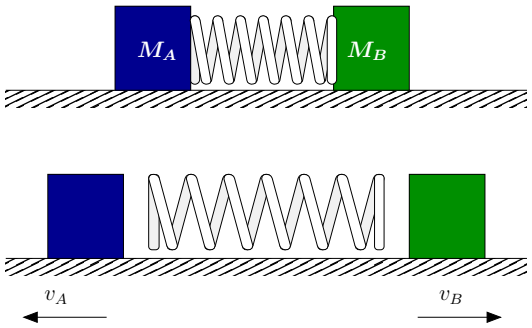
LO	S	U
58.1		
60.1		

D) A small decorative turntable of mass M and radius R is covered with sticky fly paper and is rotating at ω radians per second. A fly of mass m with a velocity of v flying horizontally and tangent to the turntable collides with and sticks on the edge of the turntable. If the fly is flying in the same direction that the turntable was rotating when it collides, find the new angular speed of the turntable-plus-fly system.

LO	S	U
3.2		
62.1		
63.1		

Prob 1 Two blocks are connected by a massless spring with a spring constant k compressed by a distance of d from its equilibrium length and sitting on a horizontal frictionless surface. The block to the left has a mass of M_A and the block to the right has a mass M_B as shown in the figure. Find the following in terms of the quantities given:

(a) The acceleration of each of the masses at the instant that the spring is released and begins pushing the two masses apart.

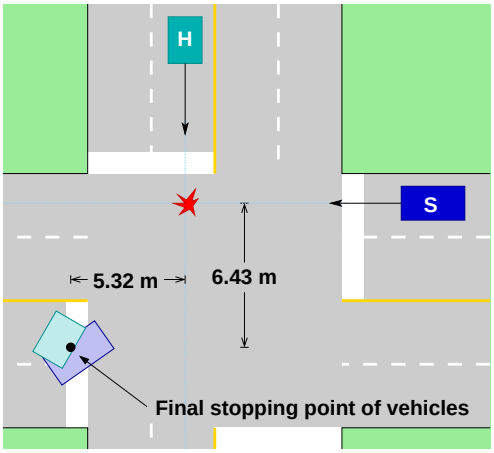


(b) The final speed of each block after they lose contact with the spring.

LO	S	U
22.1		
23.1		
27.1		
43.1		
53.1		

Prob 2 A 1500 kg hatchback is heading south on a north-south street and runs into an SUV of mass 2200 kg heading west through the same intersection. At the time of the crash, the two vehicles stick together and go off together. The coefficient of kinetic friction between the tires and the street is given to be 0.750. The policeman arriving on the scene of the accident finds that the two vehicles slid 6.43 m south and 5.32 m west of the impact point before coming to rest.

(a) How much work was done by friction in stopping the vehicles after the collision?

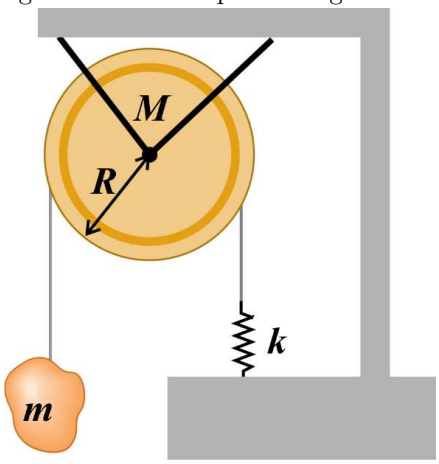


(b) Find the initial velocities of each of the vehicles just before the crash.

LO	S	U
1.1		
33.1		
37.1		
43.2		
51.2		
53.2		

Prob 3 A stone of mass m is connected to a massless rope. The other end of the rope is connected to a massless spring with elastic coefficient k via a pulley of mass M and radius R as shown in the figure. The pulley is a uniform solid disk that can rotate around its axis without friction. Initially the stone is held such that there is no tension in the rope and the spring is at its equilibrium length (unstretched). Answer the following in terms of the quantities given:

(a) Find maximum displacement of the stone downwards from its starting point once it is released.



(b) Find angular acceleration of pulley at the moment determined in part (a).

(c) Where in the process is the angular velocity of the system a maximum, and what is its magnitude at that point?

LO	S	U
3.3		
3.4		
3.5		
26.1		
27.2		
39.1		
43.3		
58.2		

Prob 4 A merry-go-round, which may be approximated as a solid disk of mass 90.0 kg and radius 2.00 m, is originally at rest but free to rotate in the horizontal plane about its center. A child applies an external force of 20.0 N tangentially to the outer edge of the merry-go-round, for a duration of 15.0 s.

(a) What is the final angular velocity of the merry-go-round?

(b) What is the average power supplied by the child in the process?

(c) After getting it going, the 45-kg child steps, with negligible velocity, on the outer edge of the merry-go-round. What is the new angular velocity of the child plus merry-go-round system?

(d) Is kinetic energy conserved in the process of part (c)? Justify your answer.

LO	S	U
39.2		
43.4		
58.3		
60.2		
61.1		
63.2		

Extra Space: