Physics 206 – Exam II

Fall 2019 (all UP sections) **October 21st, 2019**

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 (4 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 two pages have 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 (and also on the extra sheets, which problem the work refers to) so the graders know to look at it!
5. Calculators of any type are **not allowed**. In the case of questions with numerical values, the math should be simple enough you will not need a calculator. For purely symbolic questions, ensure that all your answers are in terms of the known variables given in the question.
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. Unless explicitly stated otherwise in the question, all of the free-response problems in this exam require you show your work and reasoning. You do **not** need to show your work for the multiple-choice problems.
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

MAKE SURE YOU FILL OUT ALL THE BUBBLES ON THE NEXT PAGE TOO!!

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

Signature: ______________________ Section Number: ______________

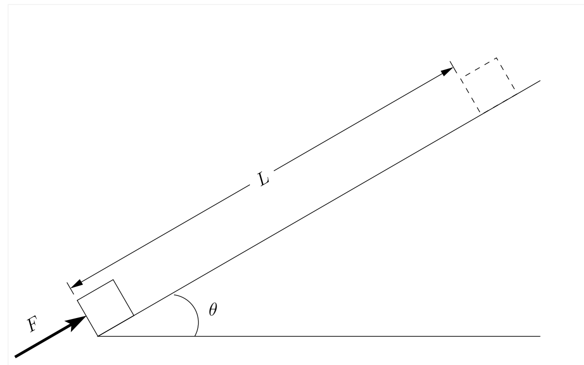
Instructor: (circle one) Kocharovsky Melconian

Short Problems:

A) A block of mass M starts from rest and is pushed up a frictionless ramp inclined at an angle θ above the horizontal by a constant force F parallel to the incline as shown in the figure below.

(i) Define a coordinate system and draw a free-body diagram for the block using the figure below.

(ii) Use Newton's 2^{nd} Law and the kinematic equations of motion to find the block's speed when it has made it a distance L up the incline. Your answer should be written in terms of M, θ, F, L and the acceleration due to gravity, g.



LO	S	U
9.1		
23.1		
26.1		
1.1		
5.1		
14.1		
15.1		
21.1		
23.2		
~~26.2~~		

B) As in Problem A above, a block of mass M starts from rest and is pushed up a frictionless ramp inclined at an angle θ above the horizontal by a constant force F. Use the work-energy theorem to find the block's speed after it has been pushed a distance L up the incline. Your answer should be written in terms of M, θ, F, L and the acceleration due to gravity, g.

LO	S	U
5.2		
32.1		
34.1		
38.1		
39.1		
40.1		

C) A particle of mass m, starting from rest, begins to move at $t = 0$ due to an applied constant force $\vec{F}$ along the horizontal $\hat{\imath}$ axis.

(i) Find the particle's instantaneous velocity (direction and speed) as a function of time.

(ii) Find the power delivered by the force, $\vec{F}$, as a function of time.

LO	S	U
6.1		
12.1		
13.1		
14.2		
15.2		
21.2		
2.1		
33.1		
21.3		
23.3		
26.3		
28.1		

(iii) If the particle's movement described above occured on top of a rough horizontal surface with a coefficient of kinetic friction, μ_k, what would be the magnitude of the force of friction?

Prob 1 A particle of mass m is initially located on the positive x axis at $x = x_0$ and is subject to a conservative force F_x. The potential-energy function of this force is $U = C/x$, where C is a positive constant. The particle is released from rest and allowed to move under the influence of the force. There are no other non-conservative forces (such as friction) acting on the mass.

(a) Find the magnitude <u>and</u> direction of the force as a function of position, x.

Ans: ________________________

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(b) Find the particle's acceleration as a function of x. It is constant or not?

Ans: ________________________

☐ Constant ☐ Not constant

(c) Find the work done by the force on the particle as a function of x. Is the work done positive or negative?

Ans: ________________________

☐ Positive ☐ Negative

(d) Find both the kinetic energy and the speed of the particle as $x \to \infty$ (*i.e.* gets very very large). Is the total mechanical energy conserved during the motion or not?

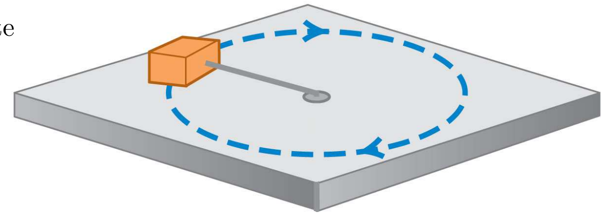
Ans: ________________________

Ans: ________________________

☐ Conserved ☐ Not conserved

LO	S	U
8.1		
36.1		
37.1		
15.3		
21.4		
32.2		
36.2		
37.2		
37.3		
6.2		
34.2		
39.2		
40.2		

Prob 2 A small object of mass m moves in a horizontal circle of radius R on a rough table. It is attached to a horizontal string fixed at the center of the circle. The speed of the object is initially v_0. After completing one full trip around the circle, the speed of the object is $v_f = v_0/\sqrt{2}$. Ensure that your answers to the following are expressed only in terms of the given quantities (m, R, v_0) and the acceleration due to gravity, g.



(a) What is the work done by friction during the object's first complete revolution around the circle?

Ans: ______________________

(b) What is the coefficient of kinetic friction?

Ans: ______________________

(c) At the moment the particle completed one full trip around the circle, what was its centripetal acceleration?

Ans: ______________________

(d) At the moment the particle completed one full trip around the circle, what was the instantaneous power being dissipated by friction?

Ans: ______________________

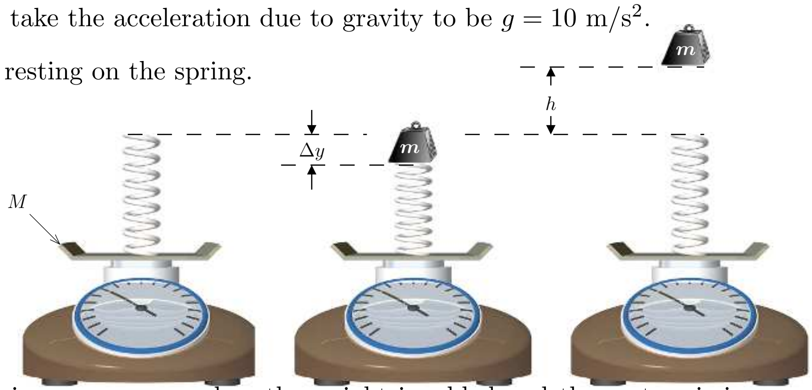
(e) How many more revolutions will the object make before friction brings it to rest?

Ans: ______________________

LO	S	U
32.3		
34.3		
39.3		
3.1		
16.1		
21.5		
23.4		
26.4		
28.2		
32.4		
36.3		
18.1		
3.2		
28.3		
33.2		
6.3		
34.4		
39.4		

Prob 3 The bottom end of a massless, vertical spring of force constant $k = 1$ N/cm is attached to a platform of mass $M = 1.5$ kg and rests on a scale (left picture below). A weight of mass $m = 0.2$ kg is gently placed on the top of the spring and eased down into an equilibrium position, Δy, below its uncompressed length, so that the system is at rest (does not oscillate; middle picture). In what follows, take the acceleration due to gravity to be $g = 10$ m/s^2.

(a) Draw a free-body diagram for the weight when resting on the spring.



(b) Find the distance Δy, the position that the spring compresses when the weight is added and the system is in equilibrium.

Ans: ____________________

(c) What does the scale read with the weight on top and the system is in equlibrium?

Ans: ____________________

(d) Find the elastic potential energy stored in the compressed spring at this equilibrium position.

Ans: ____________________

(e) If instead of being gently placed on the spring, the weight is dropped from a height $h = 3$ cm above the uncompressed spring (right picture). What is the maximum amount the spring compresses in this case? What is the magnitude of the spring force in this case?

Ans: ____________________

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LO	S	U
23.5		
25.1		
3.3		
10.1		
21.6		
23.6		
25.2		
3.4		
21.7		
23.7		
26.5		
38.2		
3.5		
5.3		
5.4		
9.2		
10.2		
25.3		
38.3		
38.4		
40.3		

Extra space:

Extra space (continued):