Physics 218 – Exam II

Spring 2017 (all sections) March 20th, 2017

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 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

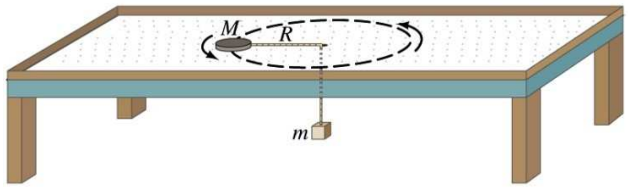
Name: ______________________ UIN: ______________________
(printed legibly)

Signature: ______________________ Section Number: ______________

Instructor: Akimov Eusebi Dierker Kocharovsky Mahapatra Teizer Rapp Ulmer
(**circle one**)

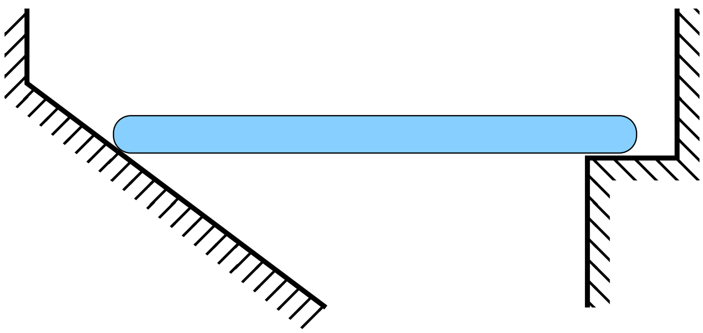
Short Problems:

A) A flat puck of mass M rotates in a circle with a constant radius R on a frictionless table top, and is held in this orbit by a light cord which is connected to a dangling weight of mass m through the central hole as shown. Derive the formula for the speed of the puck in terms of the masses, radius of circular motion, and the acceleration due to gravity.



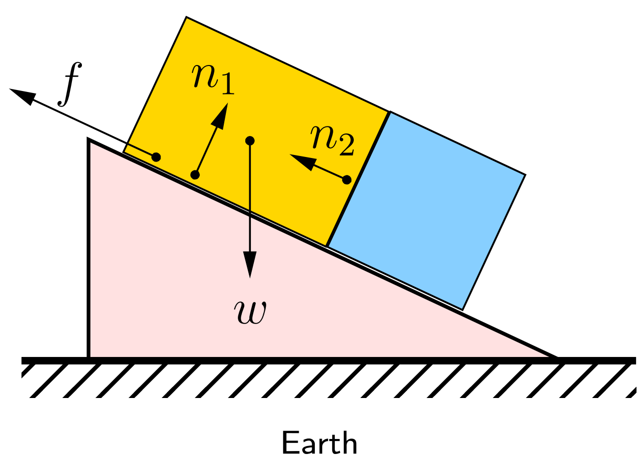
LO	S	U
3.1		
18.1		
21.1		

B) The block shown in the figure below is in equilibrium, and all surfaces have friction. Identify and draw all normal forces acting on the object.



LO	S	U
26.1		
26.2		

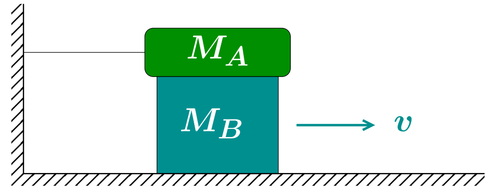
C) Two blocks are at rest on the rough surface of an incline as shown. Also shown are all the forces acting on the upper block. Draw and label all action-reaction pairs for the forces shown, clearly indicating which object they act on.



LO	S	U
22.1		
22.2		
22.3		
22.4		

D) Block B is moving to the right along the $+x$-axis at constant speed as shown. Block A rests on top of B, but is stationary since it is tethered to the wall by a rope. The surface of the table is smooth, but there is friction between blocks A and B where the coefficient of kinetic friction is μ_k.

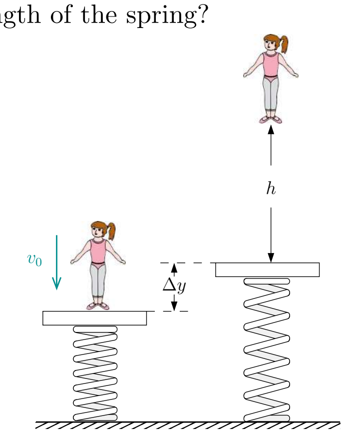
(a) Compute the magnitude of the force of friction acting on block B.



(b) Draw the direction of this frictional force acting on block B in the figure.

LO	S	U
26.3		
28.1		
28.2		

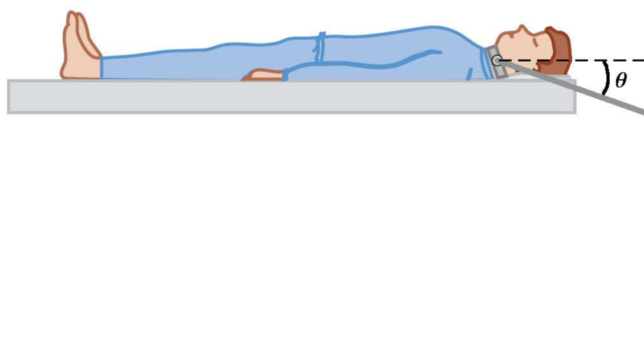
E) A 50.0-kg acrobat is doing tricks using a spring-loaded platform which has a spring constant of 150×10^3 N/m. As shown, at one point she has compressed the spring by an amount $\Delta y = 0.100$ m and is moving downward with a speed $v_0 = 4.00$ m/s. What is h, the maximum height she reaches above the natural length of the spring?



LO	S	U
34.1		
38.1		
38.2		
39.1		

Prob 1 In the treatment of spine injuries, it is often necessary to provide tension along the spinal column to stretch the backbone. One device for doing this is the "Stryker frame" where a weight W is attached to a patient whose weight is $8W$. Friction between the person's body and the bed prevents the patient from sliding. In the following, take the patient to be a point-like object.

(a) Clearly draw two free-body diagrams: one for the patient, and one for the weight.



(b) Find the force of friction keeping the patient stationary given that the coefficient of static friction between the patient's body and the bed is $\mu_s = 1/4$.

LO	S	U
23.1		
23.2		
24.1		
24.2		
26.4		
29.1		
1.1		
3.2		
21.2		
29.2		

Prob 2 A crate is being transported in the horizontal bed of a pick-up truck.

(a) When the truck reaches a speed of 31.0 m/s as it is taking a turn on a horizontally flat part of the highway which has a radius 250 m, the crate starts sliding sideways. Calculate the coefficient of static friction between the crate and the truck bed.

(b) This time the truck is carrying another box which has a coefficient of static friction of $\mu_s = 0.200$.

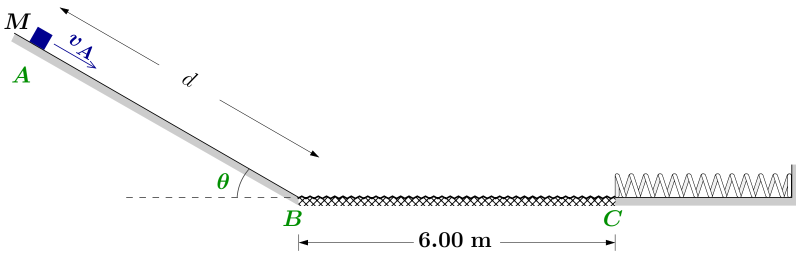
i. What is the fastest time the truck can accelerate in a straight line from 13.5 m/s to 27.0 m/s on a horizontal road without the crate starting to slide backwards?

ii. The truck starts to go up a road which is inclined at an angle of 20.0° above the horizontal. What is the maximal acceleration the truck can have before the crate starts sliding backwards?

LO	S	U
3.3		
18.2		
21.3		
29.3		
3.4		
14.1		
21.4		
21.5		
23.3		
26.5		
29.4		

Prob 3 A box of mass $M = 1.00$ kg is moving down the incline with a speed of $v_A = 2.50$ m/s at point A. AB is a frictionless plane inclined at $\theta = 30°$ with respect to the horizontal. There is 6.00 m of rough horizontal surface between B and C where the coefficient of friction is 0.450. At point C the box makes contact with an uncompressed, ideal spring. Once the mass makes contact with the spring, the horizontal surface is again frictionless.

(a) At point B, the speed of the box is 7.50 m/s. Use the work-energy theorem to determine d, the distance along the inclined plane between points A and B.



(b) What is the work that friction does on the box during the motion from B to C?

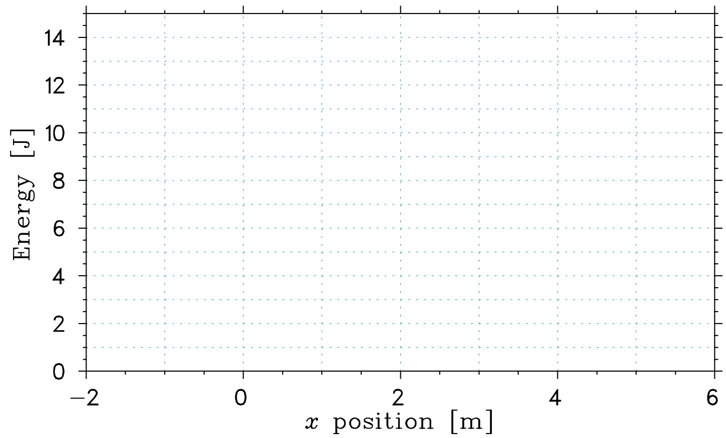
(c) Using the work-energy theorem, find the kinetic energy of the box at point C.

(d) How much would the spring, which has a spring constant of $k = 480$ N/m, have to be compressed to bring the box to rest?

LO	S	U
39.2		
28.3		
32.1		
34.2		
39.3		
38.3		
39.4		

Prob 4 A mass, $M = 0.20$ kg, moves in one dimension, subject to a single force whose potential energy function is $U(x) = (x - 2.00\text{ m})^2\text{J/m}^2 + 5.00$ J. If the object starts out at $t = 0$ with $x = 0$ and a velocity $v_0 = 7.00$ m/s in the x-direction, answer the following:

(a) Sketch the kinetic, potential and total energy diagrams associated with this particle's motion for the whole range of particle's movement.



(b) Find the kinetic and potential energies of the mass at $x = 3.00$ m. (Do not just estimate it from the graph; calculate it numerically).

(c) What is the maximum x position that the particle will travel under these conditions?

(d) Find the force as a function of position associated with this potential energy function, and explain (in 1–2 short sentences) how you know this force is either conservative or non-conservative.

LO	S	U
41.1		
41.2		
41.3		
34.3		
37.1		
40.1		
43.1		
8.1		
37.2		

Extra Space: