Physics 218: Exam 2
March 23rd, 2016.

Please read the instructions below,

Do not open the exam until told to do so.

Rules of the Exam:

1. You have 75 minutes to complete the exam.
2. Formulae are provided on a separate colored sheet. You may NOT use any other formula sheet.
3. You may use SAT approved handheld calculator. However, you MUST show your work. If you do not show HOW you integrated or HOW you took the derivative or HOW you solved a quadratic or system of equations, etc you will NOT get credit.
4. Cell phone and any other internet connected device use during the exam is strictly prohibited.
5. Be sure to put a box around your final answers and clearly indicate your work.
6. Partial credit can be given ONLY if your work is clearly explained and labeled. No credit will be given unless we can determine which answer you are choosing, or which answer you wish us to consider. If the answer marked does not follow from the work shown, even if the answer is correct, you will not get credit for the answer.
7. You do not need to show work for the multiple choice questions.
8. Have your TAMU ID ready when submitting your exam to the proctor.
9. Check to see that there are a total of 5 problems (4 multiple choice questions count as one).
10. If you need extra space, use the reverse side of the last page of the exam. Make sure to indicate on the main page of the problem that you are continuing on the last page. You may ask for extra space (scratch paper).
11. DO NOT REMOVE ANY PAGES FROM THIS BOOKLET.

Sign below to indicate your understanding of the above rules.

Name (in CAPS) : _________________________ Section Number: ______________________

UIN: ____________________________________

Instructor’s Name:_______________________ Your Signature: _____________________
### Short Problems (Circle the correct option) [NO Partial Credit] [20 Points]

**A) [5 points]** Two blocks on a frictionless surface are pushed to the right with a force $F$ as shown in the figure. The boxes move with constant acceleration. Rank the forces exerted on the blocks.

- i) $F > F_{A \text{ on } B} > F_{B \text{ on } A}$
- ii) $F > F_{A \text{ on } B} = F_{B \text{ on } A}$
- iii) $F = F_{A \text{ on } B} = F_{B \text{ on } A}$
- iv) $F = F_{A \text{ on } B} < F_{B \text{ on } A}$
- v) $F = F_{A \text{ on } B} > F_{B \text{ on } A}$
- vi) $F < F_{A \text{ on } B} = F_{B \text{ on } A}$

![Diagram of two blocks](image)

**B) [5 points]** A block of mass $m=40$ kg is pulled horizontally a distance of 2.0 m to the right by a constant force of $F=300$ N applied at an angle 40° with respect to the horizontal as shown. Find work done on the block by the force of gravity.

- i) 784 J
- ii) 600 J
- iii) 504 J
- iv) 460 J
- v) 386 J
- vi) 0 J
- vii) None of the above

![Diagram of block](image)
C) [5 points] Shown is a graph of potential energy of a system, U, as a function of position, x. Only conservative forces are exerted on the system. At which point(s) is/are the net force zero?

![Graph of potential energy](image)

- i) O only.
- ii) M and J.
- iii) M, O, and J.
- iv) N and P.
- v) J only
- vi) L and K.
- vii) Not enough information is given

D) [5 points] A worker is trying to slide a large box of mass 60.0 kg horizontally. The box is resting on a surface with a coefficient of static friction equal to 0.40 and a coefficient of kinetic friction equal to 0.35. The maximum horizontal force the worker can apply is 210 N. What is the force of friction between the surface and the box?

- i) 235 N
- ii) 210 N
- iii) 206 N
- iv) 84 N
- v) 74 N
- vi) 0 N
Problem 2 (20 points)

Two blocks are connected by a massless cord passing over a small, frictionless pulley as shown. The mass of each block is $M$. The two sided ramp has an identical rough surface everywhere.

a) Draw two free-body diagrams, one for each block assuming that the system is at rest (make sure that ALL forces and coordinate axes are shown).

b) What is the minimum coefficient of static friction needed to keep the system at rest?

c) Say the blocks are set in motion; what would be the magnitude of acceleration of the blocks, assuming that the coefficient of kinetic friction is $\mu_k = 0.9\mu_s$, where $\mu_s$ is the minimum coefficient of static friction that is required to keep the system at rest (i.e. the answer to part b).
Problem 3 (20 points)

Three crates with masses \( m_1, m_2 \) and \( m_3 \) are being lifted vertically by a helicopter as shown. They are attached to each other and to the helicopter by massless cords. The vertical acceleration of the helicopter is constant and has magnitude of \( a \).

a) What is the tension force in each of the cords? Express your answer in terms of the known parameters \( m_1, m_2, m_3, a \) and \( g \) (not all may be necessary.)

b) Let \( t = 0 \) corresponds to when the 3rd crate is still on the ground but all three cords are fully stretched and the mass of the helicopter be \( M \). What is the power being generated by the helicopter at a time \( t \)? Express your answer in terms of the known parameters \( m_1, m_2, m_3, M, a, t \) and \( g \) (not all may be necessary).
Problem 4 (20 points)

A roller coaster car starts from rest at point A and slides down a frictionless track as shown. The height of point A is 30.0 m above the ground.

a) As indicated, point B is located at the bottom of a circular arc of radius $R = 10.0 \text{ m}$ and is 6.00 m above the ground. What is the normal force exerted by the track on the 400 kg car at this point?

b) Due to wear-and-tear, a patch of friction developed on the part of the track between points C and D. An engineer discovered this defect by repeatedly measuring the car’s speed at point E, and found that it was consistently 5.0% less than the value expected if the entire track was frictionless. What is the coefficient of kinetic friction over this rough patch if it makes $25^\circ$ with the horizontal?
Problem 5 (20 points)

A 800. kg car is rolling slowly at 2.5 m/s across a level surface, heading towards a group of ducks crossing the road. An effective coefficient of rolling friction is \( \mu_r = 0.05 \) (\( f_{\text{rolling}} = \mu_s N \)). You attempt to stop the car by getting in front of it and pushing on the hood at an angle of \( 35^\circ \) below the horizontal when it is 1.50 m away from hitting the ducks.

a) Assuming you pushed just hard enough, what was the total work done on the car from when you started pushing until it came to a complete stop?

b) Using work and energy (not Newton’s laws), determine how hard you must push to stop the car before it hits the ducks.

c) Of the total work done in part a), how much was done by you?
Extra Space
– make sure you indicate on the main page of the problem that you are continuing here –