PY211 Spring 2020 Problem Set 4
Due: Friday, 28 February 2020 at 5:00 pm

Student Name_____

Discussion Session _____

Print the homework and work on the problems in the area allocated. You may add additional paper if needed. Use enough space to be clear in what you are doing; write comments and explanations and draw helpful diagrams. Staple your pages. Don't hand in a sheet with messy edges torn from a spiral bound notebook. Try not to use a calculator.
Clearly indicate your final answers and make sure your answers include units!

Problem 1 [10 points] In Francois Truffaut's classic film "The 400 Blows" there is a scene where the protagonist, a small boy named Antoine (m = 50 kg), is on a carnival ride that spins him inside a drum in a horizontal circle. If the diameter of the drum to be 5.0 meters and the angular velocity to be 33 revolutions per minute,

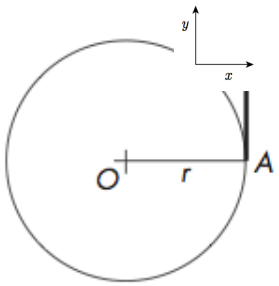
(a) Find the acceleration experienced by Antoine, express in units of G's.

(b) Identify the force responsible for centripetal acceleration and find its magnitude.

(c) Find the minimum coefficient of friction for the carnival ride to work, i.e. such that the boy does not slip down.

(d) Does your result for (c) depend on the mass of the passenger? Explain.

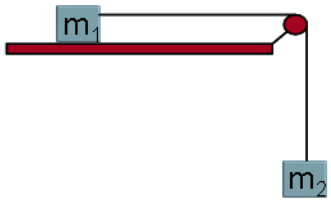
Problem 2 [10 points] A train is moving counterclockwise with uniform speed of 10 m/s along a circular track of radius $r = 100$ m. Give decimal answers with units to these questions.



(a) Find the time it takes to travel around the circular track.

(b) Find the position, velocity, and acceleration vectors (direction and magnitude) when the train is at point *A*. Take the origin to be point *O*, the center of the track. Express your vectors in component notation, ideally numerical constants times unit vectors $\hat{\imath}$, $\hat{\jmath}$, and $\hat{k}$.

Problem 3 [10 points] Two masses, m_1 and m_2 are connected by a string passing over a massless pulley, as shown. The mass m_2 falls a distance d to the floor, ending the motion under consideration when it lands. Answer (a)-(c) symbolically, show your work.



(a) Find the work done by gravity on the two block system.

(b) Find the final speed of the two blocks.

(c) Find the work done by the tension force on m_1.

(d) List all forces for m_1 and m_2 and state whether the sign of the work done by each force was positive, zero, or negative.

Problem 4 [10 points] Use the work–energy theorem to solve each of these problems.

(a) A skier moving at 6.0 m/s encounters a long, rough, horizontal patch of snow having a coefficient of kinetic friction of 0.20 with her skis. How far does she travel on this patch before stopping?

(b) At the base of a frictionless icy hill that rises at angle of 30.0° (above the horizontal), a toboggan has a speed of 20 m/s. How high vertically above the base will it go before stopping?

Problem 5 [10 points] A luggage handler pulls a 20.0 kg suitcase up a ramp inclined at 30.0° above the horizontal by a force $\vec{F}$ of magnitude 150 N that acts parallel to the ramp. The coefficient of kinetic friction between the ramp and the incline is 0.25. The suitcase travels 5.0 m along the ramp.

(a) Draw a picture and a free body diagram

(b) Calculate the work done on the suitcase by $\vec{F}$.

(c) Calculate the work done on the suitcase by the gravitational force.

(d) Calculate the work done on the suitcase by the normal force.

(e) Calculate the work done on the suitcase by the friction force.

(f) Calculate the total work done on the suitcase.