PHYS 301
COMPUTER PROJECT

Due : Via email and/or in my office by 5 pm on April 23, 2012

Consider a large ferris wheel that is built in Lake Michigan. The wheel is 30 meters in radius and its center stands 80 meters above the lake level. At t = 0, a stunt person stands on the top of the ferris wheel which is rotating at a constant angular velocity of 0.2 rad/s. At t = 0, a rescue boat is 150 m from the vertical center line of the ferris wheel traveling toward the ferris wheel at a constant speed of 10 m/s.(In other words, if the center of the wheel has coordinates (0, 80) and the initial coordinates of the person are (0,110), the initial position of the front of the boat is (150, 0)). We are interested in determining the conditions under which the stunt person could step off of the ferris wheel and land in the boat. Assume the person has no initial velocity other than that of the rotating wheel; assume also that there are no sources of friction in this problem.Assume the boat is one meter in length and the long axis of the boat is moving directly toward the Ferris wheel. The Ferris wheel is rotating toward the incoming boat.

Your assignment will be to write a Mathematica program to model this situation.

This assignment will consist of the Mathematica program and a written explanation of the physics equations you have solved, as well as a clear prose description of the reasoning you have used in your program.

1. The written explanation must describe how you are setting up the physics and the equations that you are solving as well as provide a detailed explanation of the logic you are using in your program. This explanation must also clearly indicate what variables you are using and must explicitly define those variables so I can follow your reasoning. You may write this document by hand and submit in hard copy, type as a .doc (or .docx) or .pdf file and submit either as hard copy or electronically, or submit as a .nb file. Note that if you choose to use diagrams to aid in your explanations, it might be time consuming to try to draw these diagrams in Mathematica if you are not already fluent in Mathematica graphics. (It might be time consuming even if you are fluent in graphics.) Submitting hand drawn diagrams is fine; to emphasize, the written explanation of your program can be submitted in many forms.

2. The Mathematica program must be submitted electronically as a .nb file since I will execute your programs to verify results. Your program must determine when the stunt person can step off the Ferris wheel and land in the boat. Since the boat is one meter in length, make sure you determine the range of angles that will allow the person to land in the boat. Use a coordinate system such that the initial position of the person is $\theta = 0$ at t = 0 (at the top of the wheel). Your program should also

show the earliest and latest times when the person can step off the wheel to land in the boat. Finally, you should determine how far down range the person is when he/she lands in the boat.

There are many ways to model this problem; you only need to find one viable solution. However, all answers must be determined only through your Mathematica program.

SCORING RUBRIC

This assignment will represent 5 % of your total semester average. I will assign grades according to the following rubric :

5 PTS : Program executes and outputs correct answers. The physics is correct and is clearly described. The explantion of the logic of the program is clear, complete and correct.

4 PTS : Program executes and produces output. Full credit is not given due to ONE of the following : Physics is not fully correct OR is not described clearly OR the explanation of the program is not correct, clear and complete.

3 PTS : Program executes and produces output. Explanations are not clear or are incorrect AND/OR results of program differ significantly from the correct answers.

2 PTS : Program does not execute but physics is correct and explanation of logic is clear and mostly correct and complete.

1 PT : Program does not execute and physics is incorrect and/or explanation is unclear, incorrect or incomplete.

0 PTS : Program does not execute and physics and explanation are poor OR the assignment is submitted after 5 pm on 23 April OR program is not the result of your own independent effort.

NOTES :

1. I strongly urge you to begin on this problem this week and work consistently on it until it is due. If you wait until the last week, or even the last two weeks, you will likely not have sufficient time to complete the assignment.

2. Check your program by comparing intermediate results with calculations that you can do easily by hand. For instance, it should be relatively simple for you to calculate the trajectory of the stunt person if he/she steps off at the top of the wheel; or if the person steps off at $\pi/2$. Where do you calculate the boat to be at those times? Are these the results your program gives? Can you use these intermediate results to give you an idea of what the "launch angle" must be in order to land in the boat?

3. Make sure you are well versed in solving equation in Mathematica and understand various loop controls such as Do, For, While, Catch, and Throw.

4. I may add updates to this assignment as you ask questions, so please keep checking the course website.