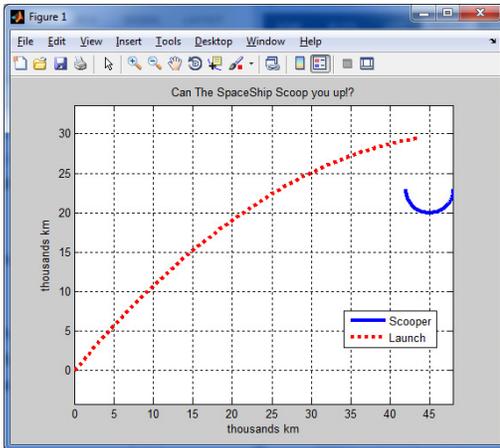**Name:** _____ **SECTION:** _____ (CRUCIAL. ALL MIXED!!!)

Practice for exam1. Spring 2016. VersionB.

Well, you've found your sensor on Mars and you've found a way to launch yourself at a given angle and velocity. However, your "fuel time" is limited. Hopefully, by the time you run out of fuel, you'll be above the gigantic scooper NASA set up in space, so you can just "fall" back into it!

Note: all this is entirely made up. ☺ Don't try to figure physics out of all this, just fun math and plotting. Even the units are far-stretched. Consider the distances in thousands of kilometers. ☺

I DO NOT ANSWER QUESTIONS RELATED TO THE PROBLEM OR THE CODE. YOU CAN TRY STUFF, SEE IF IT WORKS, OR DOESN'T. DO YOUR BEST. COMMENT WHEN IT CRASHES. NO CODE SHOULD CRASH.

DO NOT STAY STUCK. CODE EVERYTHING RELATED TO THE PLOT FIRST AND COMMENT IT OUT. I CAN GIVE POINTS THAT WAY.

The scooper

The scooper is a half circle placed in space. As a NASA scientist, you can control the following **givens**: radius R, x_{center} and y_{center} points. Create a variable for each so you can change those easily. All are scalars.

To plot it, the scooper's (x,y) coordinates are defined by the following equations that are dependent on angles:

$$x(\emptyset) = R * \cos(\emptyset) + x_{center}$$
$$y(\emptyset) = R * \sin(\emptyset) + y_{center}$$

Since the scooper is only a half circle, use a lot of angles going from 180° to 360°. (Feel free to use π to 2π instead).

The astronaut's trajectory

You know how much time the fuel will last (t_{max}) , a launch angle β in degrees, and an initial velocity v_o you'll take off at (don't worry about units too much). Again, create variables so you can change their values easily. All are scalars.

The equations to plot are based on time t which needs to go from zero to t_{max} so you can plot the trajectory:

$$x(t) = v_o * \cos(\beta) * t$$
$$y(t) = -1.1\, t^2 + v_o * \sin(\beta) * t$$

Your goal is to plot both the scooper (y vs. x) and the astronaut (y vs. x) on the same figure, and play with each given to save the astronaut by setting the max fuel time perfectly so all engines cut off anywhere **above** the scooper! Fill in the blanks in the table below by reusing your code over and over:

Radius: R	x_{center}	y_{center}	Fuel time: t_{max}	Launch angle: β	v_o	Are you right above the scooper when all engines are off? Answer YES or NO if blank
3	45	23	4.5	50	15	
5	**20**	23		**80**		YES
50			**40**	**15**	**22.5**	YES

The engineering process is partially completed.

Fill in Step1 yourself: (5pts)

Step2: plot already done. See front of cover sheet.

Step3: ALL equations in front of the cover sheet. No need for additional ones.

Step4: no assumptions need to be made to simplify the problem.

Step5/Step6: mmm.. good luck doing this analytically. NOT TODAY!

Step7: ALL of step7 is done in the code as usual. The algorithm should be your comments as usual.

There is no output in this code. Suppress the output of absolutely all calculations. NO proof of testing possible!

Format the plot fully as shown in the figure in the front page. Make sure to use different line types to differentiate scooper from trajectory.

In the legend() command, the LAST TWO words before the end should be as: ………, `location', `best');
This will make sure the box isn't on top of your trajectory if possible.

Bonus: indicate the word 'Landing Site' at the 'center' location of the scooper!

Rubric (100pts):

Step1 filled in   4pts
Table completed   2pts
In script:
      Name, section, description   3pts
      All clean up commands   3pts
      Spacing of code – skip lines   5pts
      No indenting of any kind   5pts
      Comments/algorithm   10pts
      Good variables names   5pts
      Variables hardcoded/easy to change   5pts
      Vectors to plot the scooper   5+5+5pts
      Vectors to plot the astronaut   5+5+5pts
      Correct use of element per element operator   5pts
      No extra/useless parentheses   5pts
      Proper use of semi-colons   5pts
      Proper plot command/setup   5pts
      All plot formatting   8pts

5pts penalty if code crashes. Comment stuff out!

Bonus:
      What is the difference between operating system and an application?