# Lab 2: My Solar System

Name: \_\_\_\_\_\_\_\_\_\_\_

First replace the blank above and save this document. Click on the Link on your class Edline page named My Solar System. Select *Run Now*.

Elliptical Orbits

1. In the top blue window select Preset, Sun and Planet. Select Show Grid and click Start. Now change mass and/or initial velocity of the planet so that you get a nearly perfect circular orbit with very little solar perturbation. Hit Print Screen and past the image directly below. Use the stop watch to measure the period of revolution, T.

[Past image here: Remove the blue background (so as not to waste toner when you print) by clicking the image, then select the format tab, then Recolor, Set Transparency Color, then click anywhere on the blue background. It should turn white. Also use the Crop tool to cut out extraneous stuff but keep the initial settings visible.]

1. See what happens to the path if you increase the initial velocity by 10%? (10% greater than the circular orbit you had in step 1.)

[Print Screen and Paste in below, then edit as before.]

1. Now see what happens to the path if you decrease the initial velocity by 10%. (10% less than the circular orbit you had in step 1.)

[Print Screen and Paste in below, then edit as before.]

Conservation of Angular Momentum and Energy

1. Increase the velocity again to make a more eccentric orbit but remains on the screen. Stop at exactly half way around. If you put your cursor over the planet you will see the instantaneous velocity and position vectors displayed at the lower right. Record these. Use your data to calculate the angular momentum and total energy at perigee and at apogee and one other point in between. [Both momentum and energy should be conserved.]

[Show your work on your print out--You’ll probably do this part at home and you’ll need your result for G in the next experiment below..]

Kepler’s 3rd Law and determining big G.

1. In the top blue window named *Select Preset*, choose *Ellipses*. Change the mass of body 1 to 200 units. Select Show Grid and click Start. For each of the 3 elliptical paths determine the period of revolution, T, and the semi-major axis, a. (Try using the Tape Measure tool) Type your results into the table and also past the image directly below.

[screen shot]

|  |  |  |
| --- | --- | --- |
|  | T | a |
| Body2 |  |  |
| Body3 |  |  |
| Body4 |  |  |

1. Next, use a spreadsheet program such as Excel to make a graph of T2 versus R3 (use R = semi-major axis for the elliptical orbits, also include the data from experiment 1 for a total of 4 data points). Print out the graph and then draw a best fit line through the points and find the slope. Use the slope result to compute the value of G. (Show your work on the printout.) You may wonder why G is other than 6.67 x 10-11. You will need this result for the calculations that follow.

[paste graph here, or attach as separate sheet]

1. Binary Star. Set up a 2 body system each 200 mass units at a distance of 200 units apart. Experiment with the initial velocities until you get the stars to follow concentric circular orbits. (Hint: the velocities will be equal but opposite.) Then measure the period of revolution. Hit Print Screen and Past the screenshot below. Use your result for G to calculate a theoretical value for T and find % error.

[Screen shot & calculations on this printout]

1. Attraction from rest. Set body 1 to 200 and body 2 to 100 units. Start them 400 distance units apart with initial speed zero. Click stop when they are about 100 units apart. Move the mouse over each body to get their final velocities. Use your result for G in step 2 to calculate the final velocities. [Hint: you’ll need 2 equations to solve for the 2 unknowns; think conservation of momentum and energy.] Find %error.

[Screen shot & calculations on this printout]

1. Maximum Altitude. Set the mass of body 1 to 200 and body 2 to 0.01 units. Start body 1 at x = 80 units (pretend this is the radius of the planet), y = 0, and velocity = 0,0. Set body 2 at position 0,0 with initial velocity vx = -200, vy = 0 units. Use the measuring tape tool to measure the maximum altitude, h, as shown by the trace. Use your result for G in step 2 to calculate a theoretical value for h. Find %error.

[Screen shot & calculations on this printout]

1. Now do some experimenting of your own. Describe your most interesting experiment and paste in at least one screen shot showing what you did. Go ahead and explore the other Presets to give you some ideas but your own experiment should not be identical to any Presets or your classmates’.

Print this out, then add in your calculations. This lab due on Friday, Jan 13.