Lab 6: Kepler's Laws

Names:_____

6.3 Kepler's Laws

Exercise #1:
Confirm that the sum of the distances between the two foci to any point on the ellipse is always the same. Show your work. (2 points)

Exercise #2:
Confirm that these are not the foci of this ellipse. (2 points)

Exercise #3:
Describe the results that are displayed in the right hand panel. (2 points)

Describe what the ellipses look like. Do the vectors still add up to a constant? (3 points)

What is happening here? Where are the two foci located? What is the distance between the focus and the orbit equivalent to? (4 points)

Exercise #4:
Describe what is happening here. Does this confirm Kepler's second law? How? When the planet is at perihelion, is it moving slowly or quickly? Why do you think this happens? (4 points)

If R = 1, what does $1/R^2$ = _____?

If R = 2, what does $1/R^2$ = _____?

If R = 4, what does $1/R^2$ = _____?

What is happening here? As R gets bigger what happens to $1/R^2$? Does $1/R^2$ decrease/increase quickly or slowly? (2 points)

Does the force of gravity felt by the body get larger, or smaller? Is the force of gravity stronger at perihelion, or aphelion? Do you think the planet will move faster, or slower when it is closest to the Sun? Test this. Does this explain Kepler's second law? (4 points)

What do you think the motion of a planet in a circular orbit looks like? Is there a definable perihelion and aphelion? Make a prediction for what the motion is going to look like – how are the triangular areas seen for elliptical orbits going to change as the planet orbits the Sun in a circular orbit? Why? (3 points)

Run a simulation for a circular orbit. What happened? Were your predictions correct? (3 points)

If an asteroid has an average distance from the sun of 4 AU, what is its orbital period? Show your work (2 points)

Run a simulation. Did your calculation agree with the simulation? Describe your results. (2 points)

Fill in the table. (3 points)

Planet	**a (AU)**	**P (year)**
Mercury	0.39	0.24
Venus	0.72	
Earth	1	1
Mars	1.52	
Jupiter	5.2	
Saturn	9.54	29.5
Uranus	19.22	84.3
Neptune	30.06	164.8
Pluto	39.5	248.3

How many orbits (or what fraction of an orbit) have Neptune and Pluto competed since their discovery? (3 points)

6.4 Going Beyond the Solar System

Exercise #5:
Describe the simulation. What are the shapes of the two orbits? Where is the center of mass located relative to the orbits? What does q=1.0 mean? Describe what is going on here. (4 points)

Run the simulation. Describe what is happening in this simulation. How are the stars located with respect to the center of mass? Why? (4 points)

Run the simulation. Describe what is happening. When do the stars the fastest? The slowest? Does this make sense? Why/why not? (4 points)

Describe the simulation – what happened to the planet? Why do you think this happened? (4 points)

Run the simulations. Compare them to the simulation with q = 0.5. What happens as q gets larger, and larger? What is increasing? How does this increase affect the force of gravity between the star and its planet? (4 points)

Find the value of q at which larger values cause the planet to “stay home”, while smaller values cause it to (eventually) crash into one of the stars. (2 points)

Run the simulations. What happened? Did the planet wander away from its parent star? (4 points)