Homework # 2

Name_____
DUE: September 17 (at the start of class)

Your homework grade depends not only upon your getting the correct answer but also grammar, spelling and punctuation, particularly in questions that require explanations. Obviously numerical answers to problems do not need to be written in complete sentences. You will also be graded on the use of significant figures, proper units of measure and proper scientific notation. Partial credit may be given for showing your work even if your result is incorrect. You may work with others in determining the answers to the questions, but what you write should be in your own words – any homework assignments that look too similar to that of other students will receive no credit. Unless otherwise noted, all questions are worth 1 point.

1. (5 points) A great deal of work in understanding the motion of the planets and gravity involved watching how other objects moved in the sky. What impact would there have been in the understanding of astronomy if there were no other planets in our solar system besides the Earth? In other words, what discoveries may have never happened, or would have been very difficult without the existence of other planets in our solar system? Make sure you explain not only what was affected but also how it was affected.

2. (10 points total) Isaac Newton once described a method for using a cannon to put a cannonball (or whatever you load into the cannon) into orbit. In Newton's setup, the cannon is located on top of a tall mountain and fired straight out (parallel to the surface of the Earth). Gravity will pull the cannonball down, but over a great distance the curvature of the Earth will allow for the cannonball to *not* hit the surface. To see how this happens, follow the link at the course website and play around with the simulation. In this simulation the projectile is located at a height of 1000 km above the surface of the Earth, which is much higher than any Earth mountain, but makes the simulation work much better. You can change the velocity of the projectile and start and stop the program to show how the object moves.

a. At what minimum velocity is the projectile able to get all the way around the Earth?

b. Approximately at what velocity does the projectile travel in a perfectly circular orbit around the Earth?

If you click on the "Show Full Orbit" box, the projectile will actually go through the Earth for the low velocities, so you can see how it would have moved if the Earth weren't in the way.

c. (2 points) Set the velocity to 3.0 km/s and make sure the "Show Full Orbit" is checked. Does the projectile obey Kepler's Second law of planetary motion? Describe how the motion does or doesn't follow the Second law of planetary motion.

d. Regardless of the velocity, the object is in orbit about the center of the Earth – which means that one of the orbit foci would be located at the center of the Earth. The location of the foci will be used to help determine the eccentricity of the orbit. Set the velocity to 8.5 km/s. Using the Earth as a scale, what is the size of the longest axis of the object's orbit (basically top to bottom) in km? We'll call this distance "B".

B = _____ km

e. Again, using the Earth as a scale, what is the distance from the start of the orbit to the center of the Earth – we'll call this distance "C"?

C = _____ km

f. The eccentricity of the orbit can be found by using the following relationship –
Eccentricity = (B-2C)/B

Determine the value for the orbital eccentricity.

Eccentricity = _____

g. If you increase the velocity does the eccentricity get larger or smaller?

h. (2 points) Let's say you have a ball made out of neutrinium – this is a wonderful substance that passes through all matter (which makes it sort of difficult to hold on to). You have special gloves that allow you to hold onto the neutrinium, but without the gloves the neutrinium would pass right through your hands and all other matter. One day you are fooling around in the lab and you toss the ball of neutrinium across the room to your friend (who does NOT have any gloves). As usual the ball passes through your friend and disappears into the floor. Describe the motion of the ball of neutrinium over time.

3. (5 points total) Below is a table with some objects that have been discovered in the Universe and the wavelengths at which they emit the majority of their light. Determine the temperature of each object based upon the rules for black bodies and the type of light that is emitted (x-ray, infrared, visible, etc.)

Object	Peak Emission Wavelength	Corresponding Temperature	Type of light
Argala Habitat	1.15×10^{-5} m		
Praxillus	0.48 cm		
Sirius B core	0.112 Å		
Ocampa	498. nm		

Which of these objects produce the majority of their light at wavelengths that would be visible to your eyes?