Homework #2: Planet Orbits

ASTR/PHYS 1060, The Universe, Dan Wik
Due Monday, September 17th at the beginning of class

In this exercise you will use the "Planetary and Orbit Simulator" available at:
`http://wwnorton.com/college/astronomy/understanding-our-universe2/simulations.aspx`
You will turn a hard copy of your answers to all questions listed below. Please either type or write up your answers clearly.

Part A: Phases of Venus

In the Nebraska Simulations under Chapter 3, watch/explore the simulations of the phases of Venus in the Ptolemaic (geocentric) and Copernican (heliocentric) models—the latter case is shown under the "Phases of Venus" link. Imagine you're an astronomer who has heard of a telescope but hasn't used one yet.

A1) What changing properties of Venus are you able to record through a telescope?

A2) When are these properties similar in the two models (Ptolemaic vs. Copernican)?

A3) When are these properties different in the two models?

A4) A "crucial experiment" is an observation or experiment that can decisively rule out one theory or model in favor of another; in other words, two theories make opposing predictions in a given situation, so creating or observing that situation can distinguish which model is correct. Based on these animations, give an example of a situation in which the models predict different results.

A5) Had Galileo seen only crescent/new phases of Venus, which model would he have concluded was correct?

Part B: Kepler's Laws Exploration on p. 51 of your book.

In the Nebraska Simulations under Chapter 3, open the "Planetary Orbit Simulator." *Be especially careful to always select Mercury any time you reset the simulation by clicking the "OK" next to Mercury.*

Click on "Kepler's 1st Law."

B1) How would you describe the shape of Mercury's orbit?

B2) If you change the eccentricity, what properties of the orbit do **NOT** change?

Click on "Kepler's 2nd Law." The "start sweeping" button will fill in the area of the orbit that

the planet travels over some amount of time (given as a fraction of the period of the orbit). Click the "sweep continuously" button.

B3) Using a ruler, estimate the area of 2 same-colored areas, one fat and one skinny, by approximating their shapes as triangles. (Hint: go to `www.google.com` and search for "area of a triangle" to see a formula and diagram—it will calculate the area for you as well!) How similar are the areas? Is this what you should expect?

Click on "Kepler's 3rd Law" and change the semimajor axis slider.

B4) What happens to the period when you make the semimajor axis smaller?

B5) What happens when you make it larger?

B6) What does this tell you about the dependence of the period on the semimajor axis?

Part C: Newtonian Features Exploration on p. 71 of your book.

Work your way through each step of the exercise, paying close attention to the instructions given. Do all the steps and answer all of the questions. Please only turn in your answers to the following questions: **Questions 1, 2, 3, 5, 6, 7, 8 and answer the revised versions of questions 11, 12 and 13 given below**. Label these C1, C2, C3 etc.

C11 [revised]) What are the smallest and largest velocities of a planet with a semi-major axis of 0.8 AU (please keep the eccentricity the same as Mercury). How do these compare to your answers for Mercury?

C12 [revised]) What are the smallest and largest velocities of a planet with a semi-major axis of 0.1 AU (please keep the eccentricity the same as Mercury). How do these compare to your answers for Mercury?

C13 [revised]) How does the velocity of a planet change as it moves farther away from the Sun? Explain why this happens in terms of Newton's Law of Gravity.