**NAME: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ PERIOD: \_\_\_ DATE: \_\_\_\_\_\_\_\_\_\_\_\_\_**

**KEPLER’S LAWS OF PLANETARY MOTION**

Record all responses on a separate sheet of paper.

**1. You can access the Eccentricity Demonstrator from my website or us the link below.** [**http://astro.unl.edu/naap/pos/pos\_background1.html**](http://astro.unl.edu/naap/pos/pos_background1.html)

a. State Kepler’s 1st Laws using your own words and draw an illustration.

b. How is an ellipse defined?

c. Describe eccentricity in your own words.

d. According to the Eccentricity Demonstrator, what do the red line labeled c and blue line labeled a represent?

e. How is eccentricity calculated?

f. State Kepler’s 2nd Law in your own words and draw an illustration.

g. Describe perihelion and aphelion.

**2. Click on the NAAP Eccentricity Demonstrator link to complete the work below. Use the sliders to adjust the “a” and “c” values.**

a. If the “a” value is kept constant, what happens to eccentricity as the “c” value approaches zero and its highest value?

b. If the “c” value is kept constant, what happens to eccentricity when the “a” value approaches its smallest and largest value?

**3. You can access the Planetary Orbit Simulator from my website or use the link below.** [**http://astro.unl.edu/naap/pos/animations/kepler.html**](http://astro.unl.edu/naap/pos/animations/kepler.html)

a. What is the eccentricity for Mercury?

**Check off the boxes to show empty focus, center, and radial lines. Start the animation.**

b. What happens to r1 and r2 as the planet orbits the Sun?

c. What happens to the motion of the planet as the r1 approaches its smallest and largest value?

d. Why does the motion of the planet change as it orbits the Sun?

**Select the parameters for Earth.**

e. What is the eccentricity for Earth and how is it different from Mercury’s?

**Start the orbit animation for Earth.**

f. How are the changes in r1 and r2 values of Earth different than the changes in r1 and r2 values for Mercury? Why?

**4. Switch back to Mercury, click on the reset button and Kepler’s 2nd Law, and check the sweep continuously box. Start the animation and click once on the start sweeping button.**

a. How are the triangles on the right of the ellipse different from the ones on the left?

b. According to Kepler’s 2nd Law, what can be said about the areas of the triangles to the right and left of the ellipse?

c. Contrast the motion of the planet as it sweeps past the triangles to the right to the motion of the planet as it sweeps past the triangles to the left. Why does this difference in motion occur?

**5. Switch to Earth, click the reset button and Kepler’s 2nd Law, and check the sweep continuously box. Start the animation and click once on the start sweeping button.**

a. Compare and contrast the triangles formed by Earth’s sweep with the ones formed by Mercury’s orbit.

b. Why are the triangles formed by Earth’s orbit different from the ones formed by Mercury’s orbit?

c. Why is Earth’s semimajor axis (AU) value larger than Mercury’s?

**6. Write a brief summary of what you have learned about a planet’s motion relative to the star it orbits.**