Name: ______________ Eccentricity of Planetary Orbits

Block: ______________

CALCULATION SHEET FOR ELLIPSES

Objective: To create three different orbits with varying eccentricities by increasing the focal length.

Directions:

1.) Push the push pins down into the center of focal points A and B
2.) Wrap your string around the thumbtacks and pull the string until taunt with your pencil, but careful not to shift the pushpins
3.) Move your pencil along the string pulled taunt until a full orbit is drawn.
4.) Take the pushpins out and measure the distances between the centers of the focal points (d) to the nearest 10th.
5.) Measure the length along the major axis (L) by putting your ruler straight through the focal points and measuring out to both ends of the orbit to the nearest 10th.
6.) Calculate eccentricity to the nearest 1000th. All answers should be recorded on this answer key.
7.) Repeat steps 1-6 for ellipse CD, then Ellipse EF. Label each as AB, CD and EF on your constructed ellipses.

ELLIPSE AB

Distance between foci _________cm

Major axis length _________cm

Answer ________

ELLIPSE CD

Distance between foci ____________cm

Major axis length __________cm

Answer ________

ELLIPSE EF

Distance between foci _________cm

Major axis length __________cm

Answer ________

Analysis Questions:

1.) Which ellipse has the shortest distance between the focal points?

2.) Which ellipse has the longest distance between the focal points?

3.) As the distance between the foci in your experiment increased, how did the shape of your orbits change?

4.) As the distance between the foci in your experiment increased, how did the numerical values of your calculated eccentricities change?

5.) Which orbit has the greatest eccentricity? ________________
Is the eccentricity of Mercury greater or less than the eccentricity you calculated? ____________________
How do you know?

6.) What is the eccentricity of earth's orbit? _____________________ Which ellipse (A-B, C-D, E-F) most closely resembles that of the Earth's? ___________________

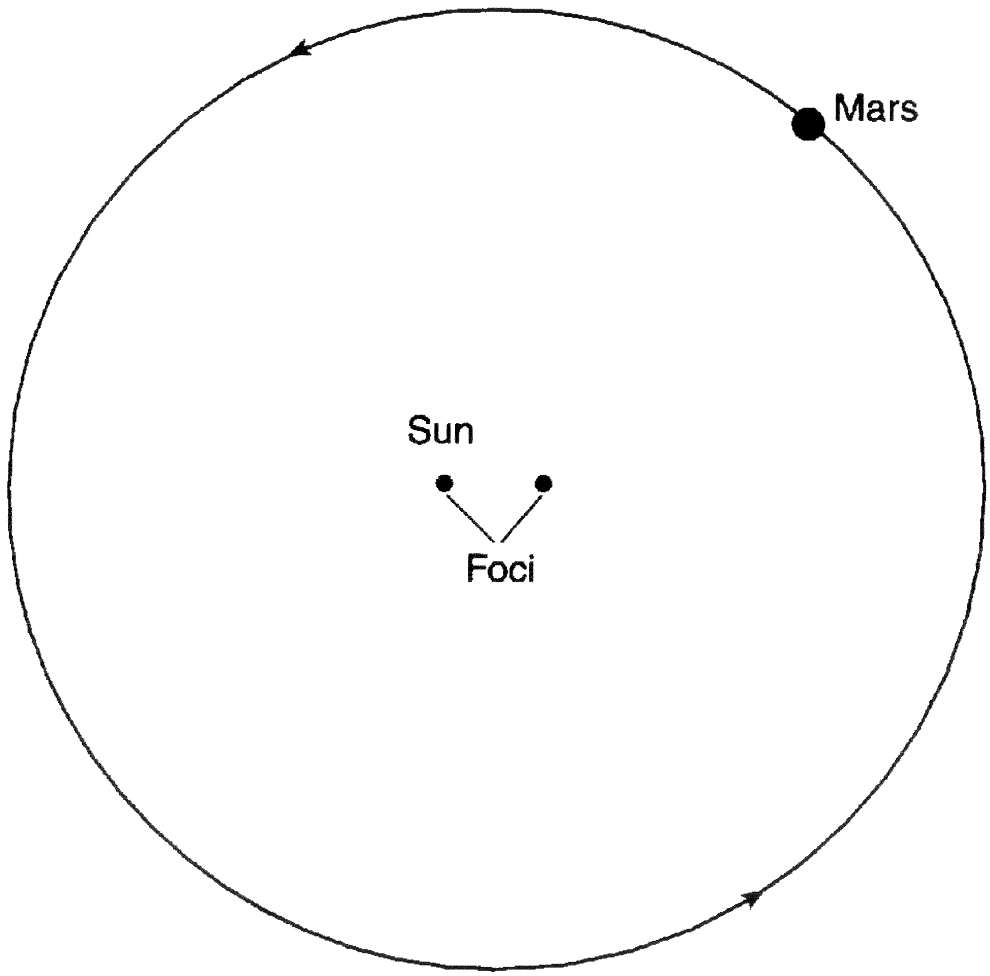
7.) Which two planets have the most circular orbits in our solar system?
   a.
   b.

8.) Which two planets have the most eccentric orbits in our solar system?
   a.
   b.

PART 3
ORBITAL VARIATIONS

PROCEDURE:

1. **Draw** and **label** the major axis for Mars orbit.
2. Place a **point** on Mars orbit and label it number **1** to represent the position where Mars orbital velocity would be fastest.
3. Place a **point** on Mars orbit and label it **2** to represent the position where Mar's orbital velocity would be slowest.



(Not drawn to scale)

LABORATORY QUESTIONS

1. Calculate the eccentricity of Mar's orbit based on the image above. (Show all work)

   Distance between foci _________cm

   Major axis length _________cm

   Answer ________

Conclusion Questions

1.) Explain why you chose the position on Mars orbit where you drew point 1 (fastest).

2.) At which numbered position is the force of gravity the greatest, 1 or 2? Why?

3.) What two factors affect the (1) force of gravity and (2) orbital velocity between any planet any the object it is orbiting around?

4.) If the mass of the sun were tripled, and the mass of Mars stayed the same, how would the force of gravity between them change, and by how much?

5.) If the sun were to expand into a red giant (and it will), and the distance between Mars and the Sun were to decrease by half, what would happen to the force of gravity between them, and by how much?

6.) Chiron, an celestial object located between the orbit of Neptune and Saturn has an eccentricity of 0.379. Based on the eccentricity calculated for Mars, how does Chiron's **SHAPE** differ than that of Mars?

7.) The true shape of Mars, and any planet in our solar system is described as being what?

Final Conclusion: Why is it important that we understand the nature of orbits in our solar system? The fact that any planet has an eccentric orbit means that it has varying velocity-how is this information imperative to space exploration?

Name: ______________________

LABEL Each Ellipse as
"AB"
"CD"
or
"EF"