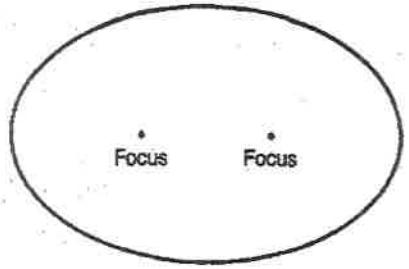
Please attach your ellipse diagrams! (15 pts)

Name: _____ Date: _____ Per: _____

Astronomy – History of the Universe
Lab Activity: Characteristics of Elliptical Orbits

The shape of the orbit of each planet in our solar system is also an ellipse. Unlike a circle, which is a curved shape drawn around a single point, an ellipse is a curved shape that is drawn around two points. Each of these points is called a focus; together they are called the foci of the ellipse. An ellipse is described as eccentric because it is not shaped like a circle. The more unlike a circle an ellipse becomes, the more eccentric the ellipse is said to be.

In this investigation you will draw an ellipse, calculate its eccentricity, and predict the shape of the Earth's orbit.



An Ellipse

Problem: What is the shape of the Earth's orbit?

Materials:
(Per Group)
- pencil
- sheet of paper
- 2 thumb tacks
- string (approximately 20 cm)
- piece of cardboard (25 cm x 25 cm)
- metric ruler

Procedure:

1. Fold a sheet of paper into thirds; then flatten it out. This Will help you properly space the ellipses that you are About to draw.

2. In the top third of the paper, make two dots 2 cm apart. In the middle third, make two dots 3 cm apart. In the bottom third, make 2 dots 4 cm apart (see fig. 1)

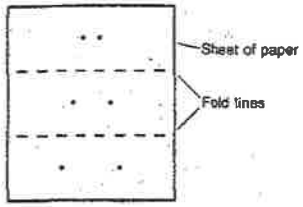


Figure 1

3. Place the sheet of paper on the piece of cardboard. Carefully push the two tacks through one set of points. Place the string loop around the tacks. Then use a pencil to draw an ellipse around the two foci, pulling the string tight against the tacks. (See fig. 2). Using the same procedure, draw an ellipse around each of the two remaining sets of points.

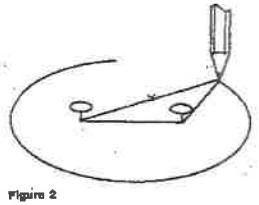


Figure 2

4. Because an ellipse is not a circle, it is said to be eccentric or "out of round." The eccentricity can be calculated and expressed as a number using the following equation

$$\text{Eccentricity} = \frac{\text{distance between the foci}}{\text{length of the major axis}}$$

Measure the distance between the foci and the length of the Major axis for each of the three ellipses you have just drawn. Using the equation above, calculate their eccentricities. Enter your data in the data table.

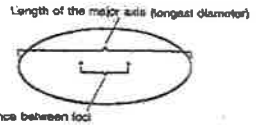


Figure 3

Observation:

Ellipse	Distance Between Foci (mm)	Length of Major Axis (mm)	Eccentricity
Top			
Middle			
Bottom			

Analysis and Conclusion:

1. If you were drawing an ellipse what would happen to its shape if you used the same sized loop but moved the foci farther apart?

2. The eccentricity of an ellipse can be expressed as a number. Does the eccentricity of an ellipse increase, decrease, or remain the same if its shape is changed to make it more nearly round.

Critical Thinking and Application:

1. The figure on the following page represents the Earth's orbit drawn to scale. The sun is located at one of the foci; there is nothing at the other. Measure the distance between the two foci and the major axis for the orbit drawn. Then calculate the eccentricity of the ellipse. Enter your data to the left of the figure.

2. Does the Earth's orbit look more or less eccentric than the three ellipses you drew on the sheet of paper?

Distance between the two foci

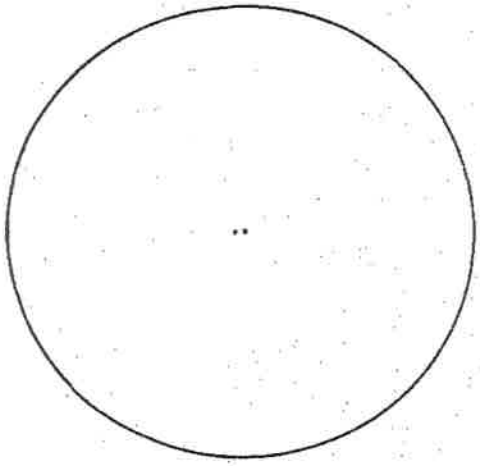
= _____ mm

Length of major axis

= _____ mm

Eccentricity

= _____ mm



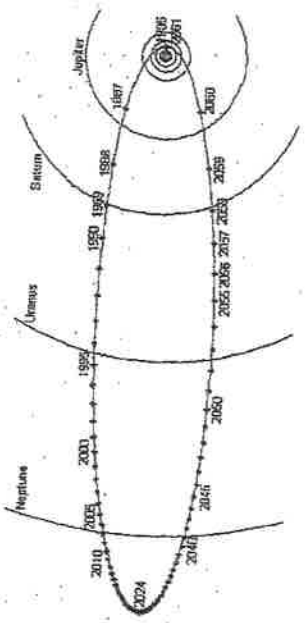
Going Further:

1. Use the list of planet orbit eccentricities to answer the following questions

Planet	Eccentricity
Mercury	0.21
Venus	0.01
Mars	0.09
Jupiter	0.05
Saturn	0.06
Uranus	0.05
Neptune	0.01
Pluto	0.25

a. Which planets have orbits that are more eccentric than the Earth's?

b. Which planets have orbits that are more nearly round?



8. In which part of the orbit (perihelion – nearest the sun) or Aphelion (farthest from the Sun) does it move fastest and slowest?

9. What role does gravity play in changing a comet's speed?