Ellipses and Kepler's Laws of Planetary Motion Name:_____

Materials needed:

3 sheets of paper, 1 metric ruler, 2 straight pins, 1 piece of cardboard, 1 loop of string.

We will construct three ellipses on three separate sheets of paper.

Procedure

Page 1

Place a piece of paper over the cardboard and insert the two straight pins into the cardboard to represent the two foci of the ellipse. For the first ellipse, place the foci 8 cm apart.

Tie a string into a closed loop and place it over the bottom of the two pins. Carefully draw the ellipse by stretching the string so it is taut, but try not to pull the pins out of the cardboard.

Choose one focus and draw the Sun at that focus.

On this **first** ellipse, pick one point near the Sun and one point far from the Sun. At these points, draw *straight arrows* to represent both the force of the Sun's gravity at that point *and* a *straight arrow* to represent the speed of a particular planet at that point. (Longer arrows for greater force and greater speed) Ask your teacher for assistance if you are unsure.

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Now for the **second** ellipse, change the distance between the foci to 6 cm and trace the ellipse.

Choose one focus and draw the Sun at that focus.

Pick a point on the ellipse and draw a line connecting that single point to each focus. Measure the length of these lines and label the lengths on your paper (include units). Add these two distances and get a total for this particular point on the ellipse—also list this on your paper.

Repeat the previous step on the same ellipse and see how those total distances compare. (How should they compare?)

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On the **third** ellipse, change the distance between the foci to 4 cm and trace the ellipse.

Choose one focus and draw the Sun at that focus.

On this 3rd ellipse, label *aphelion* (the point farthest from the Sun) and *perihelion* (the point closest to the Sun.

Staple all three pages together with this page on top and answer the following:

Questions:

1. How does changing the focal length affect the *shape* (not the size) of the ellipse?

2. Where in the planet's orbit (on the ellipse) is its speed the greatest?