Earth Science Regents Ellipse Review

Name_____________________

Period ______

The ellipse is the geometric shape of most orbits. In this activity, you'll construct 2 ellipses, and examine and measure them to determine some of the fundamental properties of ellipses.

Follow the directions below, making sure you draw and measure carefully along the way. When you have completed the construction and measurement of your ellipses, carefully and thoughtfully answer the questions posted at the end of this activity.

1. Gather up the materials you need to complete this activity (See Fig. 1):
   - ❑ A piece of cardboard
   - ❑ 2 sheets of clean white paper
   - ❑ 2 push pins
   - ❑ A 30 cm (or so) length of string
   - ❑ A metric ruler/straight edge
   - ❑ A pen or sharp pencil

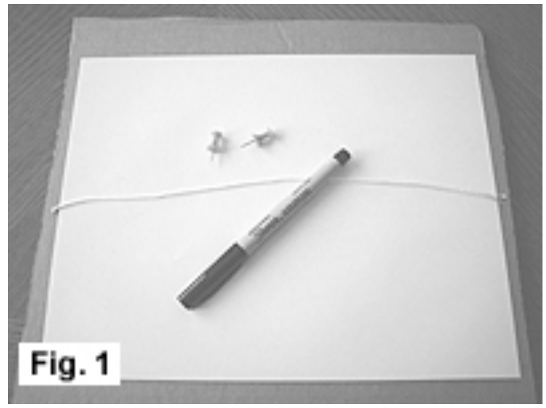


Fig. 1

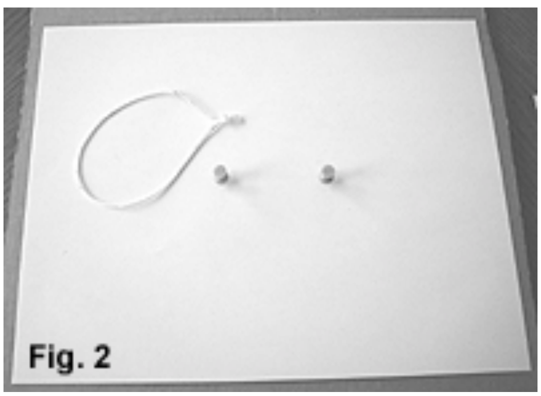


Fig. 2

2. Tie your string into a loop. The loop, when stretched tight, should be 12 cm or so long (anything between 10 and 13 cm will work fine) (See Fig. 2)

2A. Place one sheet of paper on the cardboard, and place the 2 push pins horizontally about **6 cm** apart near the center of your paper as shown in Fig. 2.

3. Place your loop of string around the 2 push pins, and, keeping the string tight, use the string as a guide to carefully draw an ellipse around the push pins. (See Fig 3.) Be patient - you may have to try it a few times before you get the hang of it!

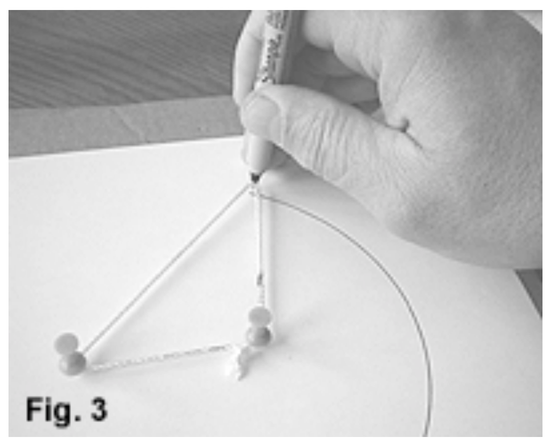


Fig. 3

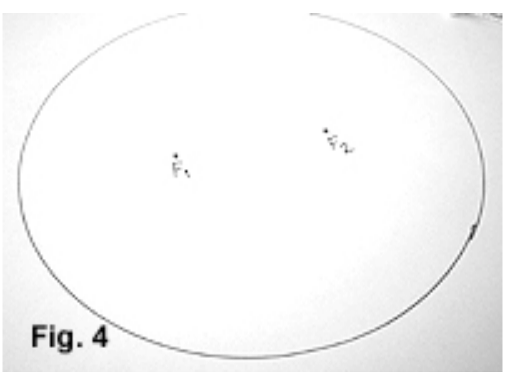


Fig. 4

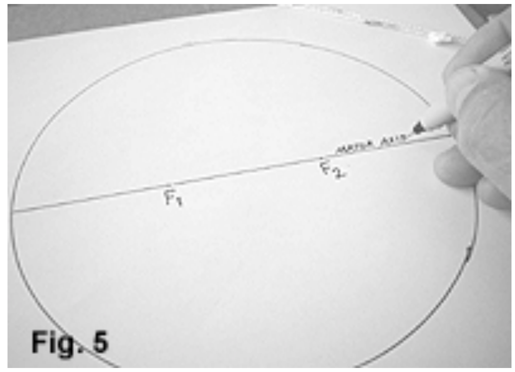
4a. After you've drawn your ellipse, remove the push pins (it's probably a good idea to stick them in the margin of cardboard so they don't roll away). The 2 pinholes are called the *foci* of the ellipse (each one is called a *focus*). Label the 2 foci F_1 and F_2 as indicated in Fig.4.

<u>IMPORTANT NOTE</u>: When considering our solar system, remember that one of the two foci is our Sun. The other focus is an imaginary point in space – its location depends on the eccentricity of the ellipse.

4b. Select ***either*** focus, and label it the **Sun**. *Remember that the path of the orbit that you have drawn is imaginary.*

5. While looking at the location of the Sun you drew in step 4b, place an "X" where the planet, satellite, comet (any object traveling in an elliptical path…) would have the greatest speed.

6. Carefully draw a straight line across the ellipse so that it passes **exactly** through the foci. That line, which is the longest one you can draw in the ellipse, is called the *major axis* of the ellipse. Label it on your diagram. (See Fig. 5)



6. On your ellipse, make all the measurements listed below. Record them to the nearest tenth of a cm. on this sheet **and label them on your diagram**. **Don't forget to record the units of measurement as well.**

Length of the major axis = ____________

Distance between the foci = ____________

7. The eccentricity of an ellipse tells us how "out of round" it is. Use this formula:

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

to calculate the eccentricity of your ellipse. **Round your answer to the nearest tenth**, and record it on this sheet **and record and label it on your ellipse drawing as well**. (Notice what happens to the units when you do your division!)

Eccentricity = ____________

8. Using a second sheet of white paper, repeat steps 2 through 5 of this activity, ***only this time place the push pins 9 or so cm apart.***

9. On your new ellipse, make all the measurements listed below. Record them to the nearest tenth of a cm. on this sheet **and label them on your diagram**. Finally, calculate the eccentricity for your ellipse as you did for your first ellipse in steps 6 & 7. **Don't forget to record the units of measurement as well.**

Length of the major axis = ____________

Distance between the foci = ____________

Eccentricity = ____________

10. Which one has the greater eccentricity (the 9 cm or 6 cm ellipse)?

____

11. Complete this statement in a way that indicates that you know what eccentricity measures:

"The greater the eccentricity of an ellipse, the ____

12. Compare the eccentricities of your 2 ellipses with the eccentricity of Earth's orbit (ESRT p. 15). Which of the 3 is more nearly circular?

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How do you know that?

____

____

13. Which planet in the solar system has the most eccentric orbit? ________________

How does the eccentricity of that orbit compare with the eccentricities of your ellipses?

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