NAME: _____ PERIOD: _____ DATE: _____

PARTNERS: _____ Lab # _____

ECCENTRICITY OF PLANETARY ORBITS INTRODUCTION

INTRODUCTION

Our sun is not exactly in the center of the orbits of the planets, and therefore the planetary orbits are not circular. They are actually a curved figure known as an ellipse. The purpose of this laboratory is to learn more about the earth's orbit by experimenting with ellipses of different proportions. You will also study some characteristics of the sun that support the concept of an elliptical orbit.

OBJECTIVES

During this laboratory investigation you will:

1. Draw ellipses of different proportions.
2. Calculate eccentricity from ellipse measurements.
3. Compare the eccentricity of the planets in our solar system.
4. Relate the changes in the sun's apparent diameter to the earth's elliptical orbit.

MATERIALS

Pencil
Two thumbtacks
25 cm strong thread
Cardboard (9 x 11 inches)
Graph paper

APPROXIMATE TIME 1-2 Periods

PART 1

PROCEDURE

1. Form a loop by tying the ends of a piece of thread 25 centimeters long. When the loop is held taut, it should be 11 centimeters long.
2. On the sheet containing the ellipse points, set the two thumbtacks into points A and B. Place the loop over the thumbtacks. Insert the sharp point of the pencil inside the loop. While keeping the loop taut around both thumbtacks, draw a curve around the two centers.
3. Repeat the same procedure using points C and D for the next ellipse. Then use points E and F to make another ellipse.
4. In an ellipse, each of the two central points is called a focus (they are both known as foci). Label the sets of point's foci.
5. The eccentricity (or amount of flattening) is determined by the ratio of the distance between the foci and the length of the major axis. The formula is in your earth science reference tables. Using the formula, calculate the eccentricity of each of the three ellipses that you drew. Record your answers in the spaces below.

Ellipse AB_____ Ellipse CD_____ Ellipse EF_____

LABORATORY QUESTIONS

1. As the distance between the foci increases, how does the shape of the ellipse change?

_____

2. As the distance between the foci increases, how does the eccentricity of the ellipses change?

_____

3. The major axis of the earth's orbit is 186,000,000 miles in length. The distance between the sun and the second focus is 3,000,000 miles. What is the eccentricity of the earth's orbit? SHOW ALL WORK.

4. Which of the three ellipses that you drew do you think most closely represents the earth's orbit.

_____

Why? _____

PART 2

For the following three questions, use the chart below which gives information on the eccentricity of the planets in our solar system.

PLANET	MAJOR AXIS (MILES)	ECCENTRICITY
Mercury	72,000,000	0.206
Venus	134,000,000	0.007
Mars	284,000,000	0.093
Jupiter	966,000,000	0.048
Saturn	1,772,000,000	0.056
Uranus	3,560,000,000	0.047
Neptune	5,580,000,000	0.008

1. Which planets have almost circular orbits? _____ _____
2. Which planets have the most eccentric orbits? _____ _____
3. How does the eccentricity of the earth compare with the eccentricity of the other planets?

_____

CALCULATION SHEET FOR 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

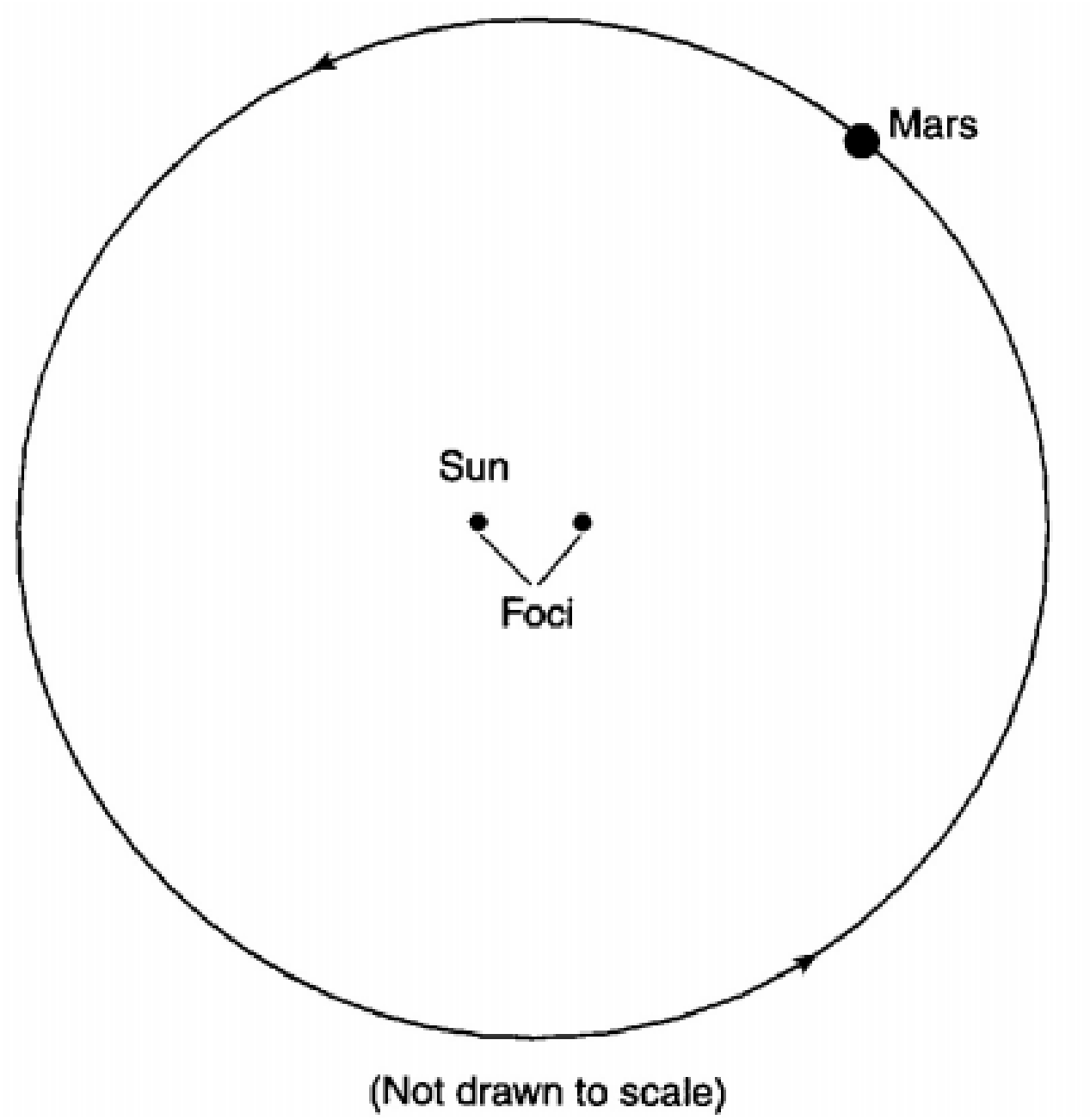
Answer _____

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.



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 _____

2. Explain why you chose the position on Mars orbit where you drew point 1.

_____
_____
_____

3. At which numbered position would the force of gravity between the sun and Mars be the greatest? Explain why you chose that point? _____
_____

4. What two factors affect the force of gravity and the orbital velocity of Mars?

_____

5. If the mass of the sun were tripled what would happen to the gravitational force on the planet Mars?

_____

6. Chiron is a planetoid located in the outer solar system. It has an eccentricity of 0.379. Based on the eccentricity you calculated for the planet Mars, compare the shape of Chiron's orbit to that of Mars.

_____
_____

7. Describe the true shape of Mars orbit.

_____
_____

LABORATORY CONCLUSION REPORT

Name _____ Date: ____/___/____

Instructions: Write a detailed, one page summary of this investigation. Refer to your data to help you analyze some key ideas you may have observed or learned.

SUMMARY: **LAB TITLE:** _____

WHAT HAPPENED? (TRENDS) (20 PTS.)	_____ _____ _____ _____ _____ _____ _____ _____
HOW DOES YOUR DATA SUPPORT THE TREND(S)? (QUANTITATIVE AND QUALITATIVE OBSERVATIONS) (20 PTS.)	_____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____
WHY DID IT HAPPEN (HOW ARE YOU USING YOUR CONTENT KNOWLEDGE SUPPORT YOUR CONCLUSION?) (20 PTS.)	_____ _____ _____ _____ _____ _____ _____ _____

LABORATORY CONCLUSION REPORT

Name _____ Date: ____/___/____

Instructions: Write a detailed, one page summary of this investigation. Refer to your data to help you analyze some key ideas you may have observed or learned.

WHAT ARE SOME SOURCES OF ERRORS AND/OR RELATED FUTURE EXPERIMENTS? (20 PTS.)	_____ _____ _____ _____ _____ _____ _____ _____
HOW DOES THIS INVESTIGATION APPLY TO A REAL-LIFE EVENT? (20 PTS.)	_____ _____ _____ _____ _____ _____ _____ _____
SCORE	_____ / 100

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