Name _____ Class _____ Date _____

Skills Practice Lab

DATASHEET A

Galilean Moons of Jupiter

Kepler's third law of motion is called the *law of periods*. It explains the relationship between a planet's distance from the sun and the planet's period. (A period is the time the planet takes to make one revolution around the sun.) According to the law of periods, the cube of the average distance of the planet from the sun is proportional to the square of the planet's period. Kepler's third law can be written as $K \times a^3 = p^2$. In this formula, the letter a is the average distance from the sun. The letter p is the period, and the letter K is a constant. Kepler's third law also works for moons orbiting a planet. In this case, the letter a is the average distance of a moon to the planet. The letter p is the moon's period. In this activity, you will show that the motions of Jupiter's moons obey Kepler's third law.

OBJECTIVES

Calculate the value of a constant, K.

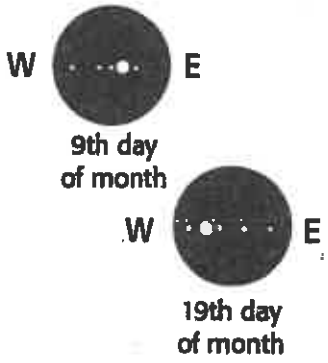
Explain how Kepler's law of periods explains orbits of moons of Jupiter.

MATERIALS

- calculator
- metric ruler

PROCEDURE

1. Two telescope eyepiece views at the right show how Jupiter and its four largest, or Galilean, moons appear through a telescope on Earth at midnight on the 9th and 19th day of a month.



   - Compare these illustrations with the chart on the next page. The chart shows the path of each moon as it orbits Jupiter during the same month.

   a. List the days when each of Jupiter's moons crosses in front of the planet.

Io (17 days): _____

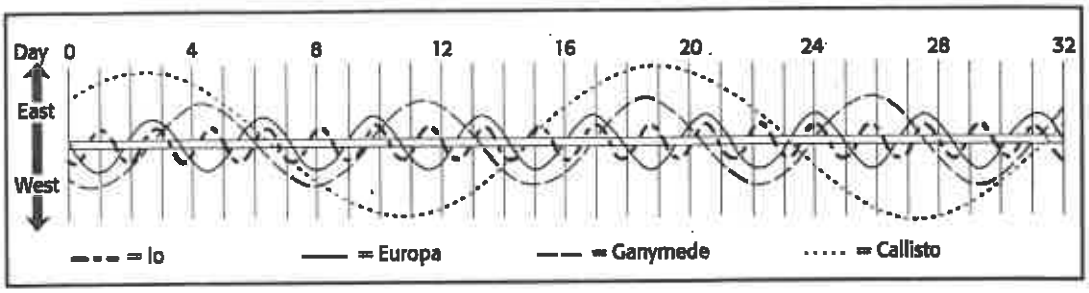
Europa (10 days): _____

Ganymede (4 days): _____

Callisto (2 days): _____

Step 1 The central horizontal band on the chart below represents Jupiter.

- When a moon's path crosses in front of this band, the moon is in front of the planet.
- When a moon's path crosses behind this band, the moon is behind Jupiter.



b. List the days when each of the moons is behind Jupiter.

Io (18 days): _____

Europa (9 days): _____

Ganymede (5 days): _____

Callisto (2 days): _____

2. Use the data in the table below to test Kepler's third law.
   - Calculate a^3 for each of the following planets.
   - Record your results in the table.
   - Calculate p^2 for each of the planets in the table.
   - Record your results in the table.
   - Calculate K for each planet by using Kepler's third law, $K = \frac{p^2}{a^3}$.
   - Record your results in the table.

KEPLER'S THIRD LAW

Planet	*p* (in Earth years)	*a* (in billions of km)	p^2	a^3	*K*
Mercury	0.24	0.058			
Venus	0.62	0.108			
Earth	1	0.150			
Mars	1.88	0.228			
Jupiter	11.86	0.778			
Saturn	29.46	1.427			
Uranus	83.8	2.871			
Neptune	163.7	4.497			

3. Draw Jupiter and its moons as they would look from Earth at midnight on the 2nd of the month.

- Draw Jupiter and its moons as they would look from Earth at midnight on the 26th of the month.

4. Draw Jupiter's moons on the first day of the month that all four moons are on the same side of the planet.

- Which day of the month is it?

_____

5. Give a date when only two moons can be seen from Earth. (Hint: There are six dates when this will happen.)

_____

- Name the two visible moons.

_____

6. Follow each moon's motion on the chart. Find the period for each moon. This is the length of time, in Earth days, needed for the moon to go all the way around Jupiter.
   - To do this, find two points when the moon is in exactly the same position on the same side of Jupiter.
   - Measure the time between these two points.
   - Record your answers in the table on the next page for *p* (in Earth days).

7. Measure the scale distance in millimeters between the highest point on the path of each moon and the center of the horizontal band.
   - Record your answers in the table below for a (in mm).
8. Square each period measurement.
   - Record your answers in the table below for p^2.
   - Cube each distance measurement.
   - Record your answers in the table below for a^3.
9. Use your results to test Kepler's third law.
   - Because $K = p^2/a^3$, divide p^2 by a^3 for each moon to find K.
   - Record your results in the table below for K.

Moon	p (in Earth days)	a (in mm)	p^2	a^3	K
Io					
Europa					
Ganymede					
Callisto					

ANALYSIS

1. **Analyzing Events** Will you see all four of Jupiter's largest moons each time you look at Jupiter through a telescope or binoculars? Explain your answer.

2. **Making Inferences** If you look at Jupiter's moons through a telescope, they look like dots. If you had no charts, how could you name each moon? (Hint: What could you find out about each moon by looking at it for several days?)

3. **Drawing Conclusions** After you find K for each moon, study your results. Is K a constant for the moons of Jupiter? Explain your answer.