

NAME:

DATE:

CLASS:

KEPLER'S THIRD LAW

BACKGROUND:

You understand that all of the planets in our solar system have different orbital shapes. For Example, Venus and Neptune have nearly circular orbits, whereas the Dwarf Planet Pluto has an *eccentric* orbit. Kepler's third law of planetary motion states: "...that the squares of the periods of the planets (p^2) equals the cubes of their distances (a^3) from the Sun."

OBJECTIVE:

To demonstrate that Kepler's third law works regardless of the shape of the planet's orbit.

MATERIAL:

Calculator (capable of determining cube root) Writing utensil

PROCEDURES:

A) Fill in the following chart.

⇒ In the TERM a^3 , the exponent shows that the base (a) is used as a factor three times. (a X a X a). In p^2 , the base (p) is used as a factor twice (p X p)

PLANET NAME	p (time of orbits in years)	a (ave. distance from Sun in A.U.)	p^2	a^3
Mercury ♀	0.24085	0.3871		
Venus ♀	0.61521	0.7233		
Earth ♂	1.00	1.00		
Mars ♂	1.8809	1.5237		
Jupiter ♃	11.86	5.2028		
Saturn ♄	29.46	9.5388		
Uranus ♅	84.07	19.191		
Neptune ♆	164.82	30.061		
Pluto* ♇	248.53	39.529		

*=considered a Dwarf Planet; not a major planet

1) Did the squares of the periods equal the cubes of the distance on your chart?

YES

NO

NAME:

DATE:

CLASS:

B) Given the period, fill in the following distances on the chart.

⇒ For example, given that the orbital period of the planet GARGOLITH is eight years, calculate the average distance of the planet from the Sun. Substitute 8 for **P** in the formula.

$$p^2 = a^3$$

$$8^2 = a^3$$

$$(8 \times 8) = 64 = a^3$$

$$\sqrt[3]{64} = \sqrt[3]{a^3}$$

$$4 = a$$

⇒ Therefore, **a = 4 A.U.**

C) Complete the following data table. Show ALL work

PLANET NAME	Orbital Period (p)	Average distance in A.U. (a)
Aleph	5.196	
Beth	4.000	
Gimel	3.000	
Daleth	2.828	
Earlith	1.000	

SHOW WORK here

NAME:

DATE:

CLASS:

- 1) Did the average distance from the sun INCREASE or DECREASE as the period length shortened?
- D) Fill in the orbital periods on the following chart, given the average distance from the Sun. For example, given that the average distance from the Sun to the planet Gargolith is 4 A.U., calculate the planet's orbital period in years.
- ⇒ Substitute 4 for **(a)** in the formula

$$p^2 = a^3$$
$$p^2 = 4^3$$
$$p^2 = 4^3$$
$$p^2 = 64 = (4 * 4 * 4)$$
$$\sqrt{p^2} = \sqrt{64}$$
$$p = 8$$

PLANET NAME	Orbital Period (p)	Average distance in A.U. (a)
Morris		0.241
Volus		0.615
Excel		1.000
Maxcus		1.88
Jovan		11.862

SHOW WORK here

ANSWER QUESTIONS ON THE NEXT PAGE

NAME:

DATE:

CLASS:

1) Did the orbital period LENGTHEN or SHORTEN as the average distance from the sun increased?

LENGTHEN

SHORTEN

2) Did Kepler's third law hold TRUE regardless of the shape of the orbit?

YES

NO

3) Can you logically conclude from this Lab activity that the farther a planet is from the Sun, the longer it takes the planet to complete one orbit?

4) Explain in your OWN words how is Kepler's third law useful in astronomy today?