Kepler's Third Law - Exercise

Student Name: _____

Step 1.

A. Start Stellarium. It should be in the default configuration you setup in the Using Stellarium exercise. You should be viewing to your South and set the program to full screen.
B. From your home location, bring up the Date/Time Window and set the date to 2010/03/01 and time to 06:00:00.
C. Leave the Date/Time Window open and in the upper right hand corner.
D. Turn off both the Landscape button and the atmosphere button. Use the Sky viewing window to Show Plaet Orbits.

Step 2.

E. Use the Location Window to select the "Solar System Observer".
F. Use the Search Window to locate the Sun.
    - This will place you above the Sun's North Pole, unlike Tycho and Kepler who had to observe from the Earth.
G. Zoom in until the FOV is about 3 to 4°.
    - The inferior planets and Earth should be visible (with white circles around them and their names visible to the upper right of each planet)

Step 3.

<u>INFERIOR PLANETS</u>

H. While watching Mercury, use the Date/Time Window to increase the month value until Mercury has made one complete orbit.
I. Recall (or lookup) the number of days in each of the months that have passed and total them.
    - You can fine tune your answer by adjusting the day value in the Date/Time Window to get the planet closer to its original location and add/subtract the adjustment days.
J. Record the number days for the complete orbit in Table 1.
K. Reset the date to 2010:03:01 and time to 06:00:00 and repeat Step 3, sub steps A through C, for the planet Venus

Step 4.

SUPERIOR PLANETS

L. Zoom out about a factor of about 2, until the FOV is about 0.040 to 0.050°.
    - Mars should be visible (with a white circle around it and its name visible to the upper right)

M. Reset the date to 2010:03:01 and time to 06:00:00 and repeat Step 3, sub steps A through C, for the planet Mars
    - You can estimate partial years by eye, or make slight adjustments by changing the month value. For this estimate, counting each month as 1/12 of a year is fine.

N. Zoom out about a factor of about 5, until the FOV is about 0.170 to 0.200°.
    - Jupiter and Saturn should be visible (with white circles around them and their names visible to the upper right of each planet) O. Reset the date to 2010:03:01 and time to 06:00:00.

P. While watching Jupiter and/or Saturn, use the Date/Time Window to increase the year value until each one has made one complete orbit.
    - Record the number of years for one complete orbit in Table 1.
    - You can estimate partial years by eye, or make slight adjustments by changing the month value. For this estimate, counting each month as 1/12 of a year is fine.

Step 5.

Q. Convert P for Mercury and Venus into years (#days/365.25) and record in Table 1.

R. Calculate P^2 for all of the planets and record in Table 1.

S. Calculate the semimajor axis (a) for planets and record in Table 1.
    - Recall that for planets orbiting the Sun:
    - $P^2 = a^3$ or $a = (P^2)^{1/3}$

T. Calculate the % ERROR using the Actual values for the semimajor axis (a) for each planet and record in Table 1.
    - The % ERROR is:
    - **((Measured value - Actual value)/Actual value) x 100%**

U. Once you have finished filling in Table 1, answer the following questions:

- **Question 1:** Does the semimajor axis of a planet increase or decrease as its period gets larger? _____

V. The planets Uranus and Neptune are farther from the Sun than the planets in Table 1. :

- **Question 2:** Would thier periods (P) be longer or shorter than Saturn's? _____

Planet	P (days)	P (years)	P^2	a (A.U.)	Actual a (A.U.)	% ERROR
Mercury					0.387	
Venus					0.723	
Earth	365.24	1.00	1.00	1.00	1.00	0.00
Mars	--X--				1.523	
Jupiter	--X--				5.204	
Saturn	--X--				9.582	

Table 1.