Baptist Lui Ming Choi Secondary School
F. 6 Physics (Gravitational Field 2 : Kepler's Laws)
WORKSHEET

Name : ___________________

Class : F. 6 ____ (   )   Grade : __________

KEPLER' S LAWS

(A) **INTRODUCTION – Planet Motion in Solar system??**

Based on what we know of ancient civilizations, it seems that the study of the motion of celestial objects was considered of great importance. Before the invention of the telescope in the seventeen century, observations were made with the naked eye. Nonetheless, with great patience and ingenuity, astronomers were able to chart the motion of many stars and planets across the sky.

Tycho Brahe, a Danish astronomer (1546-1601), was credited to have made very careful observations of the motion of planets in the sky. Originally Tycho thought that planets went around the Sun in circles with the Sun slightly off center. One of his assistants, Johannes Kepler (1571-1630), carefully studied the tables of the positions of Mars in the sky, and came up with three laws, which is known as the famous Kepler's Laws.

(B) In this lesson, we are going to understand the Kelper's laws and verify them. Now, please go to http://drive.to/PhysicsSpace > Multimedia Notes > F. 6 > Kelper's 2nd law (2)

Read the "**historical perspective**"and fill in the following blanks.

First Law : Planets move around the Sun in ______________ orbits.

Second Law : The line joining a planet with the Sun
_____________________________________.

Third Law : The ___________________________of planet orbiting around the Sun are proportional to the cube of the major semiaxis of their respective orbits.

(C) **Kelper's First Law**

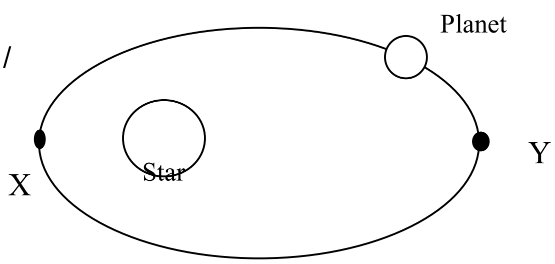
Open the interactive applet. Adjust the Star's mass as 1.000, semimajor as 0.650 and eccentricity as 0.502, and choose to observe the velocity, acceleration (gravitational force) and the orbit by pressing appropriate buttons. Press the button "continue" to start the motion.

The path is an ___________________. The acceleration / gravitational force is always pointing

____________________________.

According to the following diagram, at point (X or Y)________ the earth move with the fastest speed.

Draw the gravitational force by the Star on the planet on it.



Also, at point (X or Y)_______, the gravitational force / acceleration is greater.

END

State whether there is a change in the following physical quantities of the planet in the motion? Tick "√ "the one that is **changing** all the time. Cross "X" the one that is **unchanged**.

Linear Speed [ ] Magnitude of Gravitational force [ ]

Angular velocity [ ] Kinetic energy of the planet [ ]

Linear Momentum [ ] Moment of inertia of the planet about the star [ ]

Angular Momentum [ ] Total energy of the planet [ ]

(D) Kelper's Second Law

Now we are going to see if the rate of sweeping area by the line joining the two interacting object (the Sun and the planet) is constant or not.

For Star's Mass = **1.000**, Semimajor = **0.650** and Eccentricity = **0.502**

Sweep out area in random time of interval four times by pressing the button "continue" followed by the "Start sweeping" and "Stop sweeping". Copy the result to the below table:

Trial	1	2	3	4
Time interval				
Area				
Area / time				

For Star's Mass = **2.000**, Semimajor = **0.90** and Eccentricity = **0.742 (or 0.750)**

Trial	1	2	3	4
Time interval				
Area				
Area / time				

In this model, it is found that the line joining the star (sun) and the planet sweep out ________ area in a unit time.

(E) Kelper's Third Law

Now, adjust the Star's mass to **1.000** and Eccentricity to **0.000** (i.e. simply consider circular motion).

The Semimajor presents the radius of circular path in this case. Vary the semimajor (radius r) to yield circular motions of different period. Complete the following table.

Radius r				
Period T				
r^3				
T^2				

Plot a graph of r^3 vs T^2 to verify the Kelper's Third law. (you may use excel or any graph plotting program)

Slope = ________________

Repeat the experiment with Star 's Mass = **2.000** and plot this r^3 vs T^2 on the same graph.

Radius r				
Period T				
r^3				
T^2				

Slope = _________________

Result :

____

____

____