Kepler's Rules

Pre-Lecture Questions

Problem Set #37 (due next time)

Lecture Outline

1. Kepler's Rules
2. The Law of Gravitation

Pre-Class Summary:

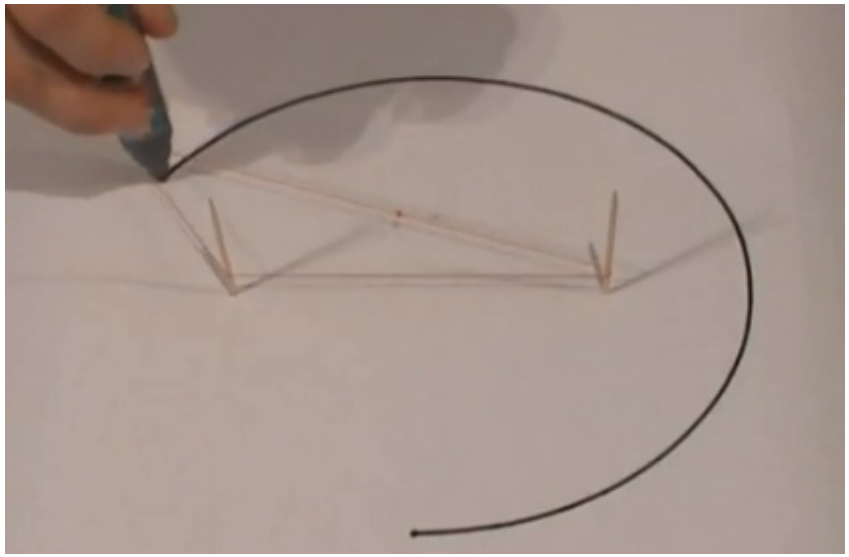
Kepler's Rules

- First Rule: Planets move in elliptical orbits with the Sun at a focus.
- Second Rule: A line joining any planet to the Sun sweeps out equal areas in equal times.
- Third Rule: The square of the period of any planet about the Sun is proportional to the cube of the semi-major axis of the orbit.

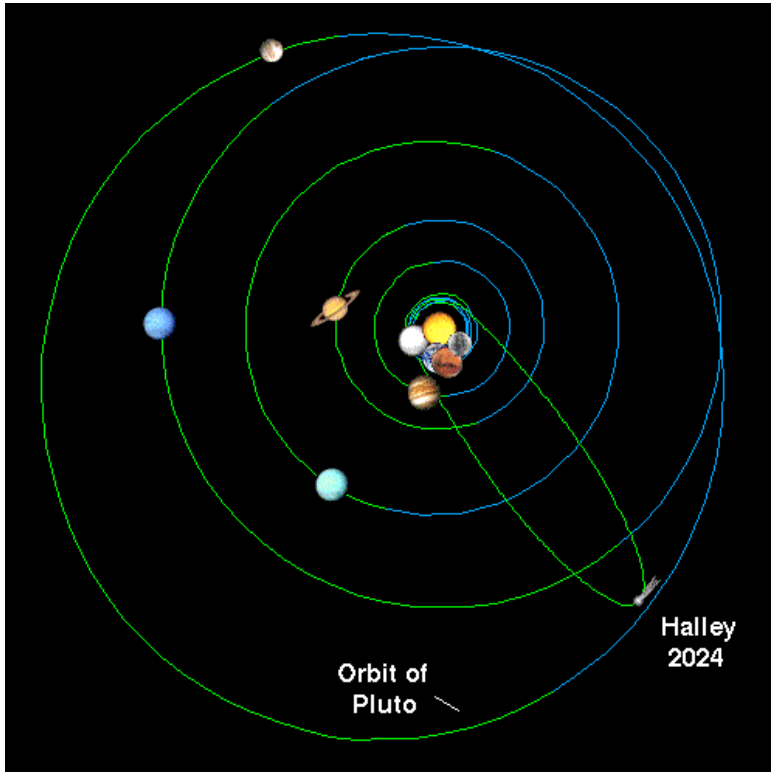
These three rules together with Newton's Laws of Motion required the form of the gravitational force to be described by,

The Law of Universal Gravitation $\vec{F}_g = G\frac{m_1 m_2}{r^2}\hat{r}$.

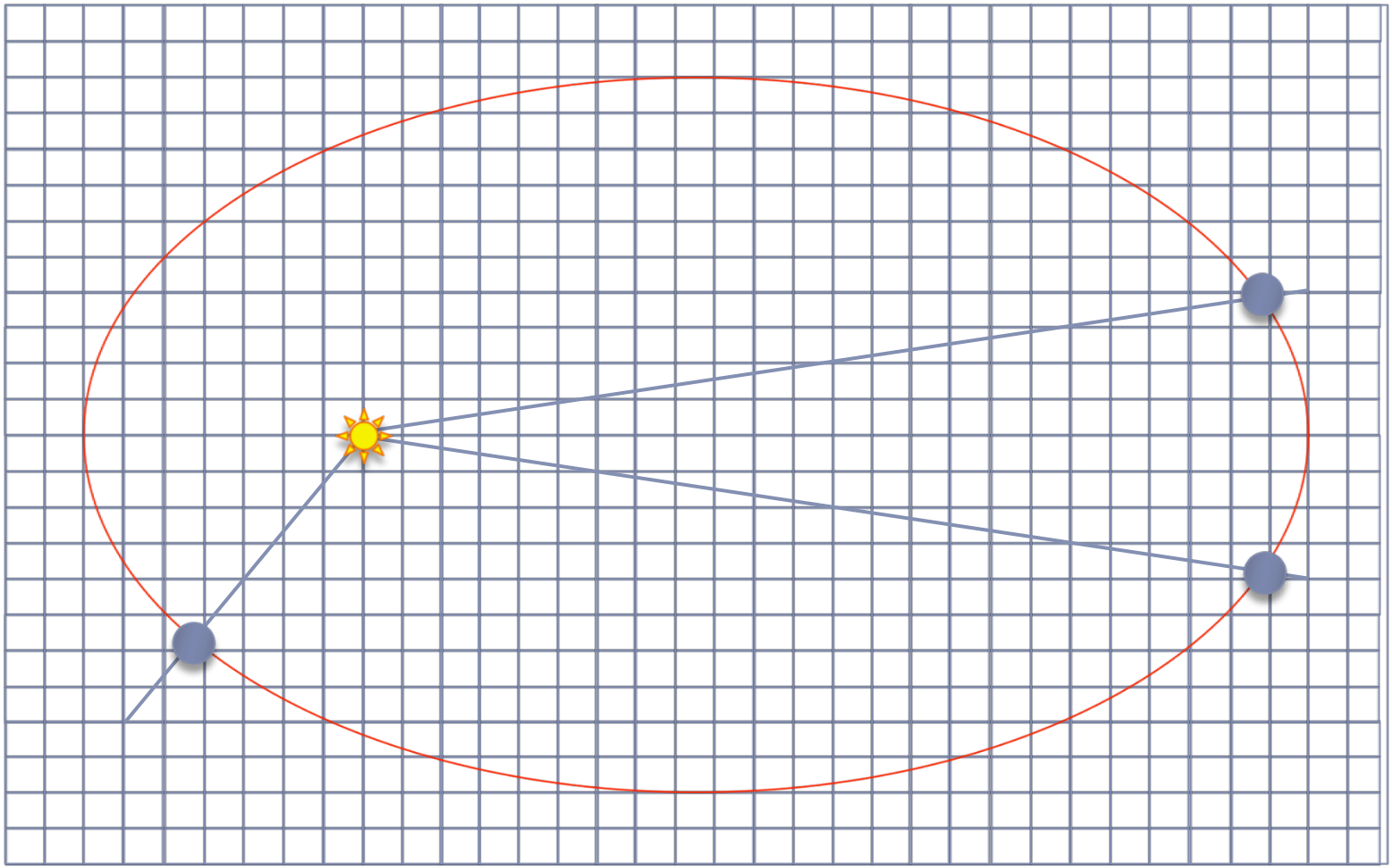
where the gravitation constant turns out to be, $G = 6.67x10^{-11}\ \frac{N \cdot m^2}{kg^2}$.



http://www.youtube.com/watch?v=7UD8hOs-val

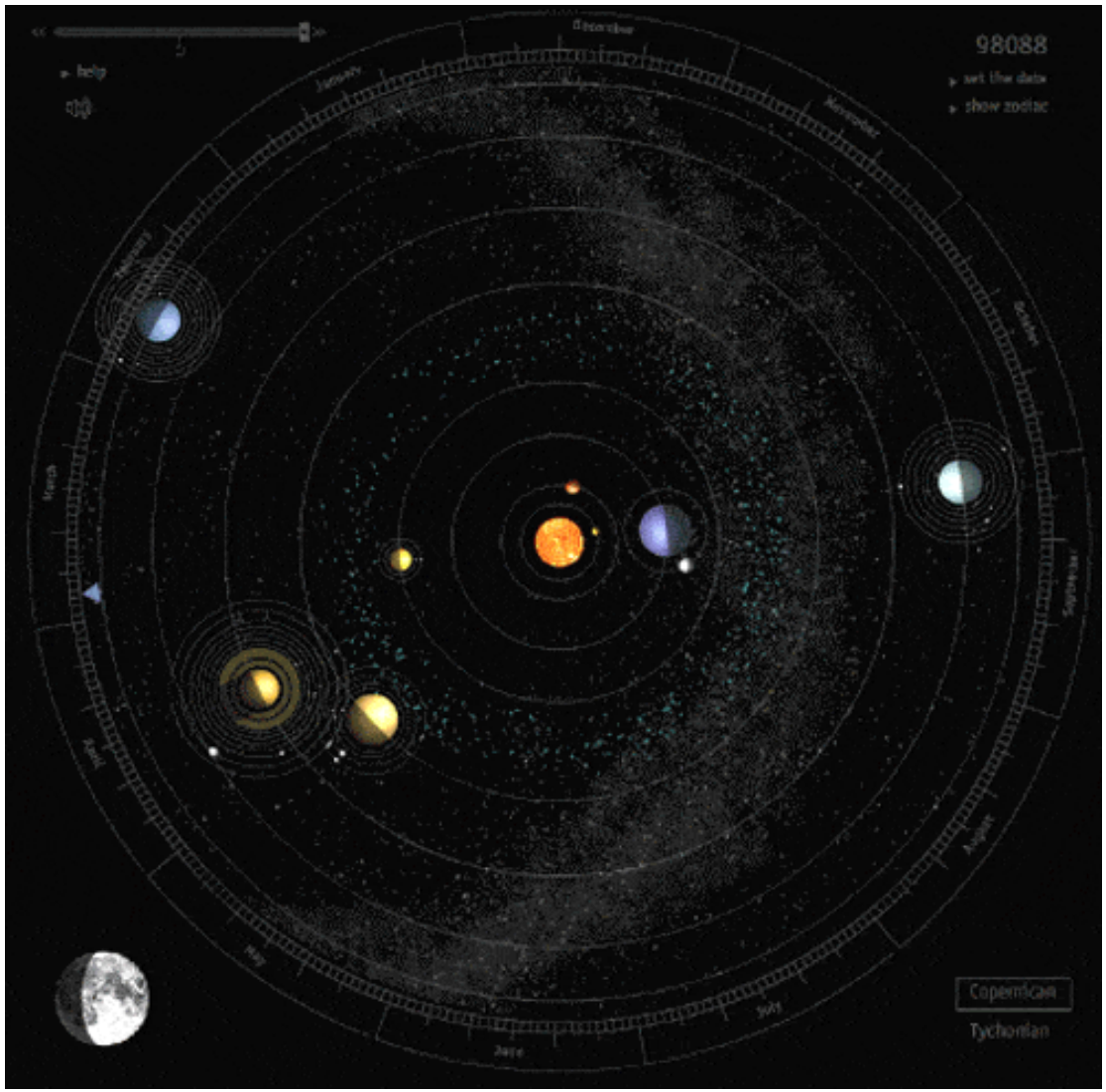


The asteroid shown goes in a clockwise orbit. The time between the two locations at the right is one year. Find the location of the satellite one year after its position shown at the left.

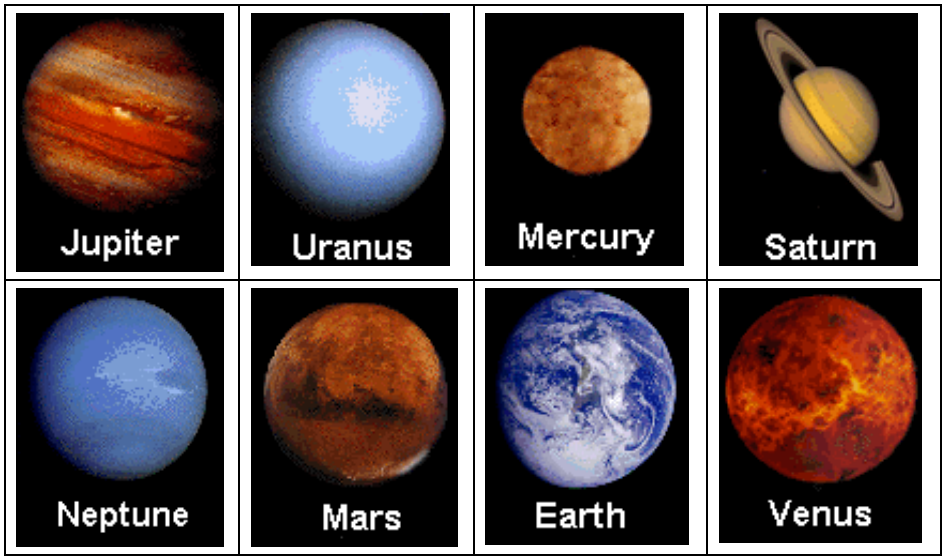


Example 1: NASA tracks near Earth asteroids so that we will get some warning in the event of a collision. Object 2013 GH84 has a perihelion distance of 0.983AU and a aphelion distance of 2.15AU. The speed at perihelion is 35.2km/s. Find the speed at aphelion.

$$\frac{T^2}{r^3}$$



Put The Planets In Order



1. Without looking it up, put the planets in order by distance from closest to the farthest away.
2. Put the planets in order by orbital speed from slowest to fastest.

closest	slowest
farthest	fastest

Example 2: Find the time for Earth to complete an orbit of the sun using the Law of Gravitation.

Example 3: Show that measuring the acceleration due to gravity, you are actually weighing Earth.

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