

## **Answer on Question 55243, Physics / Astronomy | Astrophysics**

### **Question:**

Using Kepler's three laws, Newton's three laws of motion, and Newton's Universal law of gravitation, explain how and why the planets orbit the Sun.

### **Solution:**

- Kepler's first law: The orbit of a planet is an ellipse with the Sun at one focus.
- Kepler's second law: A line joining a planet and the Sun sweeps out equal areas in equal intervals of time. Perihelion (closest to Sun) and aphelion (furthest from Sun) . A planet moves most rapidly when it is nearest the Sun and most slowly when it is farthest from the Sun.
- Kepler's third law: The square of a planet's sidereal period around the Sun is directly proportional to the cube of the length of its orbit's semimajor axis.
  - Kepler determined that planets have elliptical orbits.
  - Kepler's laws accurately described how planets move.
  - So, planets do not travel at constant speeds, do not orbit in circles and do not orbit the Sun at the same speed.
  - Most planets have a low eccentricity. 0 to 1 (0 is a circle, 1 is flat).
  - Kepler's laws apply to all orbiting objects.
- Newton's 1st law: There must be an outside force acting on planets to keep them from moving in a straight line (change direction and stay in orbit)
- Newton's 3rd Law: Planets pulling on each other will pull with the equal and opposite force.
- Newton's 2nd Law: Planets with the smaller mass will be more easily accelerated than the larger mass( $F = ma$ )

-- The force required to cause the planets to orbit the Sun is called gravity (the force of attraction of one object to another).

Newton universal law of gravitation: Two bodies attract each other with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

-- The speed of the orbiting planet is just fast enough to keep from falling into the Sun and just slow enough to keep from moving in a straight line (no escape velocity).

-- Newton's precise description of the action gravity accounts for Kepler's findings. It provides an explanation of why the planets orbit the Sun.

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