Answer on Question #42080, Physics, Mechanics | Kinematics | Dynamics

The planet earth is 1.5 10^{11} m from the sun and orbits the sun in one year. The planet Pluto takes 248 years to orbit the sun. How far is Pluto from the sun?

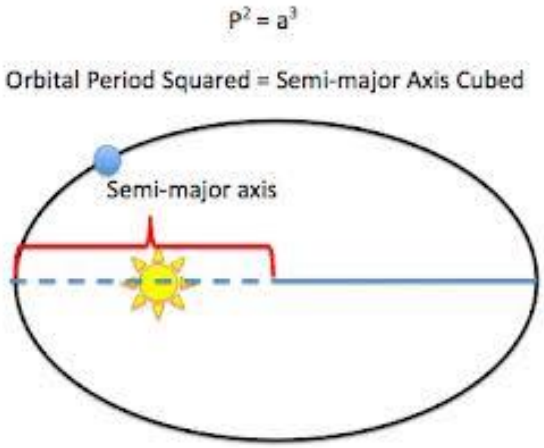
Solution:

Given:

$a_{Earth} = 21.5 \cdot 10^{11}$ m

$P_{Pluto} = 248$ years

$a_{Pluto} = ?$



The third Kepler law captures the relationship between the distance of planets from the Sun, and their orbital periods.

"The square of the orbital period of a planet is directly proportional to the cube of the semi-major axis of its orbit."

Mathematically, the law says that the expression P^2/a^3 has the same value for all the planets in the solar system, where P is period and a is distance from the Sun.

$$\frac{P_{Earth}^2}{a_{Earth}^3} = \frac{P_{Pluto}^2}{a_{Pluto}^3}$$

$$a_{Pluto} = a_{Earth} \sqrt[3]{\frac{P_{Pluto}^2}{P_{Earth}^2}}$$

$$a_{Pluto} = 1.5 \cdot 10^{11} \sqrt[3]{\frac{248^2}{1^2}} = 1.5 \cdot 10^{11} \cdot 39.473 = 59.2 \cdot 10^{11} \text{ m}$$

Answer. $a_{Pluto} = 59.2 \cdot 10^{11}$ m