

Question #61089, Physics / Astronomy / Astrophysics

The mean distance of Mars from the Earth is 0.5 A.U. and its orbital period is 687 days. Calculate the orbital period of Jupiter given that its mean distance from the Earth is 4 A.U.

Solution

In astronomy, the semi-major axis is one of the most important orbital elements of an orbit, along with its orbital period. For Solar System objects, the semi-major axis is related to the period of the orbit by Kepler's third law (originally empirically derived):

$$\frac{T_1^2}{T_2^2} = \frac{(a_1 + 1)^3}{(a_2 + 1)^3};$$

$$T_1^2(a_2 + 1)^3 = (a_1 + 1)^3 T_2^2;$$

$$T_2 = T_1 \sqrt{\frac{(a_2 + 1)^3}{(a_1 + 1)^3}};$$

$$T_2 = 1.882 \sqrt{\frac{125}{3.375}} = 11.5 \text{ years.}$$

Answer the question: $T_2=11.5$ years the orbital period of Jupiter