

Answer on Question #72238-Physics-Classical Mechanics

Show the square of the period of revolution of any planet is proportional to the cube of the semi major axis of the orbit.

Solution

Centripetal force is equal to gravitational force:

$$\frac{mv^2}{r} = \frac{GmM}{r^2}$$

$$v^2 = \frac{GM}{r}.$$

The period is

$$T = \frac{2\pi r}{v} = \frac{2\pi r}{\sqrt{\frac{GM}{r}}}$$

The square of the period of revolution of any planet is proportional to the cube of the semi major axis of the orbit:

$$T^2 = \frac{(2\pi r)^2}{\frac{GM}{r}} = \frac{4\pi^2}{GM} r^3 \sim r^3.$$

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