## Answer on Question 73070, Physics, Mechanics, Relativity

## Question:

Titan, a satellite of Saturn, has a mean orbital radius of $1.22 \cdot 10^{9} \mathrm{~m}$. The orbital period of Titan is 15.95 days. Hyperion, another satellite of Saturn, orbits at a mean radius of $1.48 \cdot 10^{9} \mathrm{~m}$. Estimate the orbital period of Hyperion.

## Solution:

The third Kepler's law of planetary motion states that the square of the orbital period of a planet is proportional to the cube of the semi-major axis (mean distance) of its orbit:

$$
\frac{P_{T}^{2}}{a_{T}^{3}}=\frac{P_{H}^{2}}{a_{H}^{3}}
$$

here, $P_{T}$ is the orbital period of the Titan, $P_{H}$ is the orbital period of the Hyperion, $a_{T}$ is the mean distance of the Titan from the Saturn, $a_{H}$ is the mean distance of the Hyperion from the Saturn.

Then, from this formula we can find the orbital period of the Hyperion:

$$
P_{H}^{2}=a_{H}^{3} \frac{P_{T}^{2}}{a_{T}^{3}}
$$

$$
P_{H}=\sqrt{a_{H}^{3} \frac{P_{T}^{2}}{a_{T}^{3}}}=\sqrt{\left(1.48 \cdot 10^{9} m\right)^{3} \cdot \frac{(15.95 \text { days })^{2}}{\left(1.22 \cdot 10^{9} m\right)^{3}}}=21.3 \text { days. }
$$

## Answer:

$P_{H}=21.3$ days.

