

## Answer on Question #68081, Physics / Astronomy | Astrophysics

### Question:

One of Saturn's moons has an orbital distance of  $1.87 \times 10^8$  m. The mean orbital period of this moon is approximately 23 hours. Use this information to estimate a mass for the planet Saturn.

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### Solution:

According to Kepler's 3<sup>rd</sup> law

$$\frac{a^3}{T^2} = \frac{G\mathfrak{M}_{Sat}}{4\pi^2},$$

where  $a$  — moon's mean orbital distance;

$T$  — mean orbital period of the moon;

$G$  — gravitational constant;

$\mathfrak{M}_{Sat}$  — Saturn's mass.

Therefore  $\mathfrak{M}_{Sat} = \frac{4\pi^2 a^3}{GT^2}$ .

$$a = 1.87 \times 10^8 \text{ m}$$

$$T = 23 \text{ h} = 82800 \text{ s}$$

$$G = 6.67408 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$$

$$\mathfrak{M}_{Sat} = \frac{4\pi^2 (1.87 \times 10^8)^3}{6.67408 \times 10^{-11} 82800^2} = 5.64 \times 10^{26} \text{ kg}$$

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### Answer:

$$5.64 \times 10^{26} \text{ kg}$$

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