Answer on Question #63389, Physics / Mechanics | Relativity

Question:

A satellite moves in a circular orbit around a planet at a speed of 4400m/s.
What is the orbital period?

Solution:

Let M is the mass of a planet, m — the mass of a satellite, r — the radius of satellite's orbit and v — circular speed of the satellite. According to Newton's equation $F_{gr} = G\frac{Mm}{r^2}$, where the gravitational constant $G \cong 6.67 \cdot 10^{-11}\ \frac{m^3}{kg \cdot s^2}$.

This force is equal to centrifugal force $F_{cf} = \frac{mv^2}{r}$, because the satellite's orbit is circular.

$G\frac{Mm}{r^2} = \frac{mv^2}{r}$ and we may calculate $r = \frac{GM}{v^2}$.

Orbital period:

$T = \frac{2\pi r}{v} = \frac{2\pi GM}{v^3} \cong \frac{2\pi \cdot 6.67 \cdot 10^{-11}}{4400^3} \cdot M = 4.92 \cdot 10^{-21} \cdot M$ sec, if the planet's mass is in kg.

Answer:

$T = 4.92 \cdot 10^{-21} \cdot M$ sec, if M is measured in kg.