Answer on Question #37827- Physics – Astronomy | Astrophysics

Given:G= 6.67259×10E−11Nm2/kg2. A 1520 kg geosynchronous satellite orbits a planet similar to Earth at a radius 1.93×10E5 km from the planet's center. Its angular speed at this radius is the same as the rotational speed of the Earth, and so they appear stationary in the sky. That is, the period of the satellite is 24 h . What is the force acting on this satellite?

Solution

The orbit of satellite is stationary. Whence we get that the gravitational force $\frac{GMm}{r^2}$ is equal to sum of centrifugal force $m\omega^2 r$ and some force ***F***. Here $G = 6.67259 \cdot 10^{-11} \frac{m^3}{kg \cdot s^2}$ is gravitational constant, $M = 5{,}972 \cdot 10^{24}\, kg$ is mass of planet (mass of Earth), $r = 1.93 \cdot 10^5\, km = 1.93 \cdot 10^8\, m$ is radius of satellite's orbits, $\omega = \frac{2\pi}{T} = \frac{2\pi}{24h} = 7.272 \cdot 10^{-5} \frac{rad}{s}$ is angular speed of satellite on orbit, $T = 24h = 86400s$ is period of one revolution around Earth, $m = 1520kg$ is mass of satellite.

$$\frac{GMm}{r^2} = F + m\omega^2 r$$

$$F = \frac{GMm}{r^2} - m\omega^2 r$$

$$F = -1535.09N$$

Answer:

$F = -1535.09N$, force is acting to the center of planet.