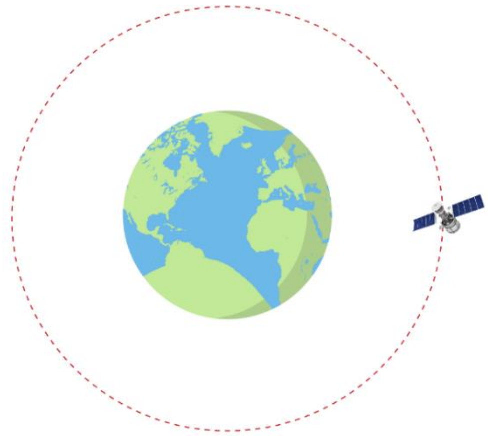
CONCEPT: Geosynchronous Orbit

● Geosynchronous orbit → satellite's orbital period *synchronizes* with Earth's rotation: **_______** = **________**

- The satellite stays above the same place on the surface!



SATELLITE MOTION	
$\mathbf{v_{sat}} = \sqrt{\frac{GM}{r}}$	$\mathbf{v_{sat}} = \frac{2\pi r}{T}$
$\mathbf{T^2_{sat}} = \frac{4\pi^2 r^3}{GM}$	$\mathbf{T_{sat}} = \frac{2\pi r}{v_{sat}}$

$r_{sync} =$ __________

- This is the *only* distance where a circular geosynchronous orbit is possible**.**

EXAMPLE**:** What is the height of Earth's geosynchronous orbit?

SATELLITE MOTION	GRAV. CONSTANTS
$\mathbf{v_{sat}} = \sqrt{\frac{GM}{r}}$ $\quad \mathbf{v} = \frac{2\pi r}{T}$	**G = 6.67×10^{-11}**
$\mathbf{T^2_{sat}} = \frac{4\pi^2 r^3}{GM}$ $\quad \mathbf{T_{sat}} = \frac{2\pi r}{v_{sat}}$	**M_E = 5.97×10^{24} kg**
$\mathbf{r_{sync}} = \sqrt[3]{\frac{GMT_p^2}{4\pi^2}}$	**R_E = 6.37×10^{6} m**

EXAMPLE: Calculate the period of Mars' rotation if a satellite in synchronous orbit around Mars travels at 1450 m/s.

SATELLITE MOTION	GRAV. CONSTANTS
$v_{sat} = \sqrt{\frac{GM}{r}}$ $v = \frac{2\pi r}{T}$ $T_{sat}^2 = \frac{4\pi^2 r^3}{GM}$ $T_{sat} = \frac{2\pi r}{v_{sat}}$ $r_{sync} = \sqrt[3]{\frac{GMT_p^2}{4\pi^2}}$	$G = 6.67\times10^{-11}$ $M_E = 5.97\times10^{24}$ kg $R_E = 6.37\times10^{6}$ m $M_{Mars} = 6.42\times10^{23}$ kg $R_{Mars} = 3.4\times10^{6}$ m

PRACTICE: You're on a satellite orbiting an unknown planet. The only property of this planet that you know is that days are 18 hours long. Your onboard sensors show that you're orbiting at 16,000 km above the surface, with a velocity of 3 km/s. You look down and notice that you're always above the same point on that planet as you orbit around it.
Calculate the mass of the planet.

SATELLITE MOTION	GRAV. CONSTANTS
$v_{sat} = \sqrt{\frac{GM}{r}}$ $v = \frac{2\pi r}{T}$ $T_{sat}^2 = \frac{4\pi^2 r^3}{GM}$ $T_{sat} = \frac{2\pi r}{v_{sat}}$ $r_{sync} = \sqrt[3]{\frac{GMT_p^2}{4\pi^2}}$	$G = 6.67\times10^{-11}$ $M_E = 5.97\times10^{24}$ kg $R_E = 6.37\times10^{6}$ m