

A satellite with an orbital period of exactly 24.0 h is always positioned over the same spot on Earth. This is known as a *geosynchronous* orbit. Television, communication, and weather satellites use geosynchronous orbits. At what distance would a satellite have to orbit Earth in order to have a geosynchronous orbit?

 m

$$F_G = F_c$$

$$\vec{F}_c = m\vec{a}_c \quad \vec{a}_c = \frac{v^2}{r} \quad \vec{a}_c = \frac{4\pi^2 r}{T^2}$$

$$F_G = G \frac{m_1 m_2}{r^2}$$

$$G \frac{m_s m_E}{r^2} = m_s \left( \frac{4\pi^2 r}{T^2} \right)$$

$$\frac{GM_E T^2}{4\pi^2} = r^3$$



What is the distance from the Earth's center to a point outside the Earth where the gravitational acceleration due to the Earth is  $1/24$  of its value at the Earth's surface?

m

$r$

$$F \propto \frac{1}{r^2}$$

$$F = G \frac{m_1 m_2}{r^2}$$

$$F'_G = \left(\frac{1}{24}\right) F_G$$

$$\cancel{G} \frac{\cancel{m} \cancel{m}_E}{r^2} = \left(\frac{1}{24}\right) \cancel{G} \frac{\cancel{m} \cancel{m}_E}{r_E^2}$$

$$r^2 = 24 r_E^2$$

