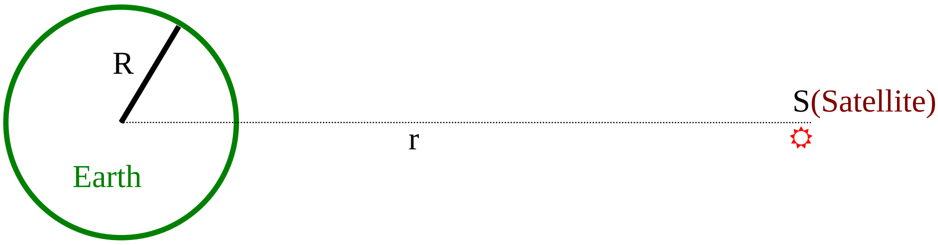
HOW HIGH ABOVE THE EARTH IS A SATELLITE IN STATIONARY ORBIT?



The radius of the Earth $R = 6.37 \times 10^6$ metres, Let the mass of the Earth = M and the mass of the satellite at S be m. The distance of the satellite from the Earth's centre = r.
The universal constant of gravitation = G

For a mass at the Earth's surface $mg = \dfrac{GmM}{R^2}$

This states that : weight = gravitational force.

Rearranging, we get $gR^2 = GM$

The force required to keep S in circular orbit is $\dfrac{mv^2}{r}$

and this must be provided by the gravitational force of $\dfrac{GmM}{r^2}$

Therefore $\dfrac{mv^2}{r} = \dfrac{GmM}{r^2}$

** Rearranging we get $v^2 = \dfrac{GM}{r} = \dfrac{gR^2}{r}$ (substituting $gR^2 = GM$)

If the satellite rotates at the same rate as the Earth so that it appears to be stationary above a particular place on the equator, then it travels a distance of 2π r metres in 24 hours.

Therefore $v = \dfrac{2\pi r}{24\times60\times60}$ metres/sec

Substituting in the equation above marked ** we get :

$$\frac{(2\pi r)^2}{(24\times60\times60)^2} = \frac{g R^2}{r}$$

Rearranging we get $r^3 = \dfrac{g R^2 \times 24^2 \times 60^4}{4\pi^2}$ metres

so r = 42,200,000 metres = 42,200 Km

Subtracting the radius of the Earth we get the distance of the satellite from the surface of the Earth is 35,800 Km approximately.

(It is travelling at just over 11,000 Km/hour)

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