Answer on Question #69194 Physics / Other

Obtain the expression for the period of rotation of the Earth's satellite at a height h above the Earth.

Solution:

Let us denote

M- mass of Earth, R-radii of Earth, G-gravity constant, m-mass of satellite.

The gravitation force

$$F = G\frac{mM}{(R+h)^2}$$

The centripetal acceleration

$$a = \frac{v^2}{R+h}$$

Newton's second law

$$ma = F$$

Thus

$$\frac{mv^2}{R+h} = G\frac{mM}{(R+h)^2}$$

The speed of satellite

$$v^2 = G\frac{M}{R+h}, \qquad v = \sqrt{G\frac{M}{R+h}}$$

The period of rotation

$$T = \frac{2\pi(R+h)}{v},$$

$$T = \frac{2\pi(R+h)}{\sqrt{G\frac{M}{R+h}}} = \frac{2\pi(R+h)^{\frac{3}{2}}}{\sqrt{GM}}$$

Answer: $T = \frac{2\pi(R+h)^{\frac{3}{2}}}{\sqrt{GM}}$.

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