Answer on Question #45670, Physics, Mechanics

A spaceship orbits the moon at height of 20000 m. assuming it to be subject only to the gravitational pull of the moon, find its speed and the time it takes for one orbit.

Solution

I assume moon's mass to be $M = 7.36 \cdot 10^{22}$ kg and moon's radius $R = 1.74 \cdot 10^6$ m. Let us find speed. We know that gravitational force is actually centripetal force here. Hence

$$G\frac{mM}{(R+r)^2} = m\frac{v^2}{(R+r)}$$

where $r = 0.02 \cdot 10^6$ height and m is mass of the spaceship. So we find

$$v = \sqrt{\frac{GM}{(R+r)}}$$

$$v = \sqrt{\frac{6.67 \cdot 10^{-11} \cdot 7.36 \cdot 10^{22}}{1.74 \cdot 10^6 + 0.02 \cdot 10^6}} \approx 1670.1 \, m/s$$

Knowing the speed and the length of orbit we find time for one orbit - the period

$$T = 2\pi(R+r)/v = 2\pi \cdot 1.76 \cdot 10^6/1670.1 \approx 6621.3 \, s \approx 1.8 \, hours$$