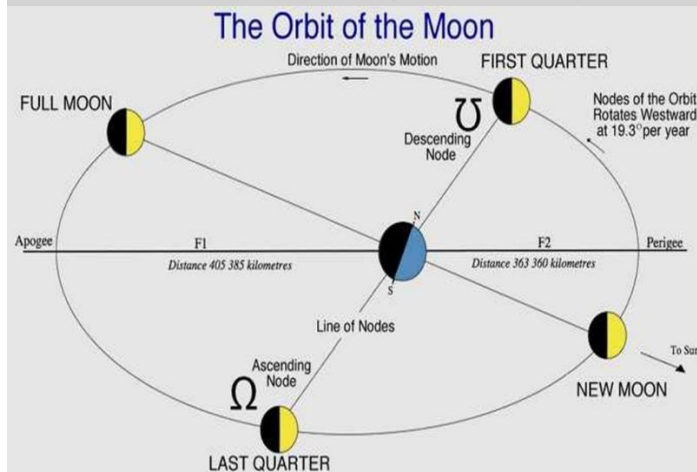


CENTRIPETAL FORCE FROM GRAVITY Unit 14 & 8

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Scientists Chip Away at Mysteries of the Moon



INTRODUCTION: Gravity provides the centripetal force to hold moon in orbit around the earth. $G m M/r^2 = m v^2/r$ where $v = r \omega = r 2\pi/T$
Thus: $G m M/r^2 = m 4 \pi^2 r^2 / rT^2$

$M = (4 \pi^2 / G) [r^3 / T^2]$ Kepler's 3rd Law
From below in article r & T are given.

QUESTIONS: (a) Find moon's radius of orbit r about earth in meters ?, (b) Find period of moon in seconds?, (c) Find mass M of earth which moon rotates about ?, (d) How does computed value compare with NASA's earth mass: 5.97×10^{24} kg. ?

HINTS: 24 hrs./day, 60 min./hr., 60 s./min., 1610 m./mile, G = gravitational constant = 6.67×10^{-11} Nm²/kg.²

ANSWERS: (a) $r = 3.8318 \times 10^8$ m., (b) 2.3606×10^6 s.
(c) $M_{\text{EARTH}} = 5.98 \times 10^{24}$ kg., (d) Quite close !

COMMENT: Kepler was a German who lived in upper Austria just north of the Danube River.

The Moon is slightly squashed, as if someone had held it at the poles between thumb and forefinger and squeezed, flattening it around its equatorial midsection. That is not surprising. The Moon spins, and the outward centrifugal force should indeed have generated a bulge as the molten magma of a young moon cooled to solid rock eons ago. But as far back as 1799, the mathematician Pierre-Simon Laplace noticed a back-and-forth wobbling because of the Moon's deformed shape. Although the flattening was slight — the Moon's width, 2,159 miles, is about 2.5 miles greater than its pole-to-pole height — it was still greater than would be expected for its **current rotation period of 27 days 7 hours 43 minutes and 11.5 seconds.** "The puzzle had been the Moon was too flat," said Maria T. Zuber, a professor of geophysics and planetary sciences at the Massachusetts Institute of Technology. Space probes of the 1960's and 1970's found a second deformity of the Moon: it is slightly elongated along the Moon-Earth axis. Under the prevailing theory that the Moon formed after something the size of Mars slammed into Earth, scientists believe that the **Moon initially orbited** very close, perhaps just 16,000 miles from Earth (compared with **roughly 238,000 miles today**) before moving outward. David J. Stevenson, a professor of planetary science at Caltech, said the evidence for the collision theory was solid. Then he stopped. He said instead, "The argument against the alternatives is strong." In the past, scientists have suggested that the Moon is somehow captured gravitationally or that it formed out of material spun off from the Earth. The mysteries have persisted because little new data have been collected. In the three decades since the Apollo Moon landings, NASA has sent only one probe, a bargain-basement one, to the Moon, the [Lunar Prospector](#) that orbited it in 1998 and 1999. NASA's push to send astronauts back has led to robotic missions as well, including the [Lunar Reconnaissance Orbiter](#), scheduled for launching in 2008. India, Japan and China are also planning robotic missions. And that, scientists say, could lead to a scientific renaissance in the study of the Moon.