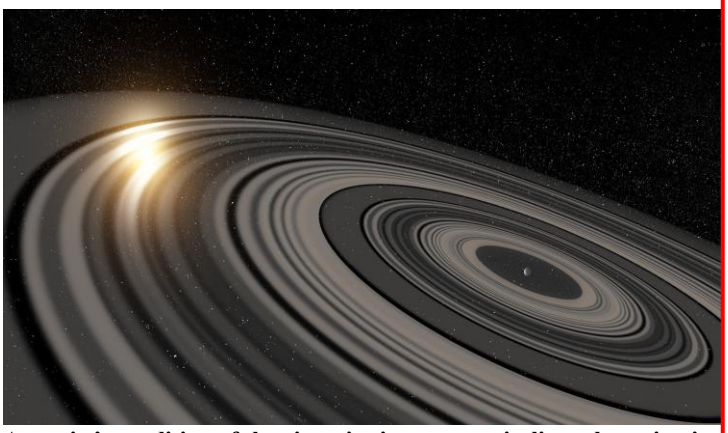
CENTRIPETAL FORCE FROM GRAVITY

Unit 14 Dr. John P. Cise

Professor of Physics, Austin Com. College, 1212 Rio Grande St., Austin Tx. 78701 jpcise@austincc.edu & New York Times October 13,2016 by Nicholas St. Fleur, Dedicated to Johannes Kepler, born Dec. 27, 1571 in Weil , Germany. Replaced Tycho Brahe in Prague , Czechoslovakia in 1600. Prepared Brahe's collection of astronomy studies for publication 1601 -1602.

Distant Ringed Object Could Be 'Saturn on Steroids'



An artist's rendition of the gigantic ring system circling what scientists think may be a giant planet or brown dwarf called J1407b.

INTRODUCTION: The goal here is to find the time for J1407b's (a planet with rings) outer ring (diameter = 75 million miles..see article) to complete one orbit about it's mother planet. Space.com states the mass of planet j1407b's is between 10 – 40 $M_{JUPITER}$. We will take M_{J1407B} = 25 $M_{JUPITER}$. $M_{JUPITER}$= 1.9 x 10^{27} kg. From Kepler's third law: $M_{j1407b} = (4\pi^2/G)(R^3/T^2)$ G = gravitational constant = 6.67 X 10^{-11} N m^2/kg^2

QUESTIONS: (a) Find radius of outer ring of j1407b ? (in meters). (b) Find mass of j1407b?, (c) Find period (T) of outer ring using Kepler's 3rd law? Find T in s., Days, and years.

HINTS & ANSWERS ARE BELOW

About 400 light years from our solar system, there is a celestial body that looks like Saturn on steroids. Its rings are about 200 times larger than its counterpart here, measuring about 75 million miles in diameter. The ring system is so large, in fact, that scientists aren't sure why **it doesn't get ripped apart by the gravity of the star it orbits.** One reason the rings might stay intact has to do with the direction in which they spin around the object at their center, called J1407b. **Scientists are not sure whether J1407b is a gigantic planet that measures many times larger than Saturn, or a failed star called a brown dwarf.** There is a point in J1407b's lopsided orbit when it comes close to its sunlike star, which should disrupt the rings. But the rings remain unscathed for the most part because they spin around J1407b in the opposite direction that the object orbits around its star, according to a paper accepted in the journal Astronomy & Astrophysics and posted online on Tuesday. "We ran a lot of simulations of possible orbits for the planet to see if they could survive or not," said Steven Rieder, an astronomer at the Riken Institute in Japan and lead author of the paper. "If you have the planet moving clockwise and the rings moving counterclockwise, that is much more stable than if they move in the same direction, clockwise," he said. The team realized that if the object and its rings spin out of sync with each other, the ice and debris that make up the ring system are never too close to the sun for too long, which makes them more stable. That means they can stay together in a ring formation in the face of the star's intense gravity.

HINT1S: R = (diameter)/2 , 1609.34 meters = 1 mile , 3600 s./hr., 24 hr./day, 365 days/year

ANSWERS: (a) R = 60.35 X 10^9 m., (b) M_{j1407b} = 47.5 X 10^{27} kg., (c) T = 5.2335 X 10^7 s., 605.73 days, 1.66 years

COMMENT: Astronomy sites have listed the period T of j1407b's rings to be in the range of 1 to 3 days. Thus, the computation here fits in that acceptable range.