GRAVITY & CENTRIPETAL FORCE

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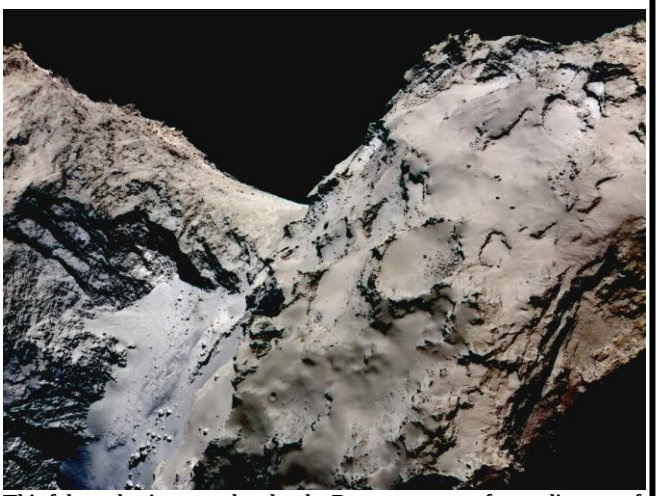
For Rosetta, a Landing and an Ending on a Comet



This false-color image, taken by the Rosetta spacecraft at a distance of 45 miles, shows the smooth region that connects the two lobes of Comet 67P/Churyumov-Gerasimenko.

INTRODUCTION: 67P comet was held in orbit around sun (R) by gravity supplied by the sun (M_s).

$G\ m\ M_e/R^2 = m\ v^2/R$ where $v = R\ \omega = R\ 2\pi f = R\ 2\pi/T$

Where T = period of orbit in seconds, thus…..

$G\ m\ M_e/R^2 = m\ R^2\ 4\pi^2/T^2R$ produces

$$M_s = [4\pi^2/G](R^3/T^2)$$ Kepler's 3rd Law

Where G = gravitational constant = 6.67×10^{-11} N $m^2/kg.^2$

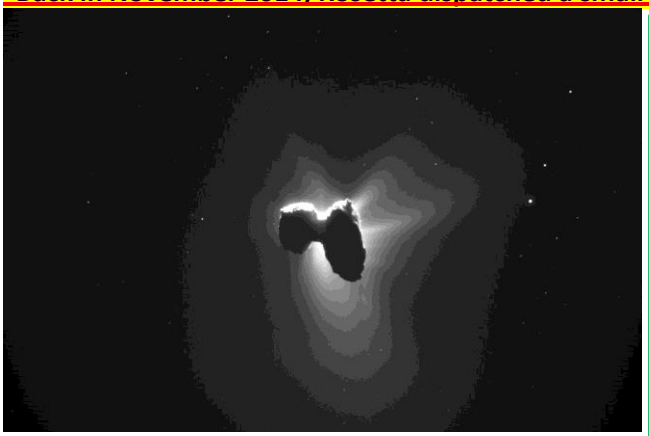
Jupiter is 778.3×10^9 m from sun, and earth is 140×10^9 m from sun. Article below states 67P's orbit is as close as earth and as far out as Jupiter. R is average orbit radius which is the semi major axis = average of those close and far distances.

QUESTIONS: (a) Convert 6.5 year period T to seconds? (b) Find R for 67P about sun?,(c) Find M_S from Kepler's 3rd?

For two years, the Rosetta spacecraft has been playing around with a comet shaped like a rubber ducky. When the spacecraft makes a gentle belly flop onto the comet on Friday, it will bring to an end to the most ambitious mission ever for the European Space Agency. Since its arrival in August 2014 at Comet 67P/Churyumov–Gerasimenko, Rosetta has been sending reams of data and exquisite photographs of the comet, providing insights and surprises about one of the fragments left over from the formation of the solar system four and a half billion years ago.

On impact, Rosetta will switch off its radio transmitter, leaving silence at the end of its 12-year journey.

"Back in November 2014, Rosetta dispatched a small lander, Philae, to the surface of Comet 67P.



An image of Comet 67P/C-G from March 2016, about 200 miles away.

HINTS: See introduction + ,365 days = 1 year , 24 hrs./day 3600 s./hour. Since 67P's orbit is said in article to be outside earth's orbit we will take the closest distance from sun as 186×10^9 m and the far out distance into the Kuiper belt beyond Jupiter at 850.15×10^9 m. Use these two Rs to find semi major axis R for Kepler's 3rd.

ANSWERS: (a) T = 2.05×10^8 seconds, (b) R = 518×10^9 m. (c) $M_{sun} = 1.9586 \times 10^{30}$ kg.

COMMENT: NASA lists $M_{SUN} = \sim 2.0 \times 10^{30}$ kg. , so calculations close.

Comets Can Stick Together

Exposed plateaus on the surface provide an important clue that **Comet 67P was originally two comets.** ..**it's clear this has to be two objects that have collided."**

The current six-and-a-half-year orbit of Comet 67P takes it as far out as Jupiter and even at its closest approach to the sun, it is still outside Earth's orbit. Planetary scientists are sure Comet 67P originated much farther away, beyond Neptune's orbit, in what is known as the Kuiper belt, and was nudged into the inner solar system, probably by a collision or close gravitational interaction with another object.