MECHANICAL ENERGY CONSERVATION Unit 10,11

Dr. John P. Cise, Professor of Physics, Austin Com. College, 1212 Rio Grande St., Austin Tx. 78701 & New York Times
May 3, 2017 by Kenneth Chang. Dedicated to my Xavier University Physics professor…..John A Heart

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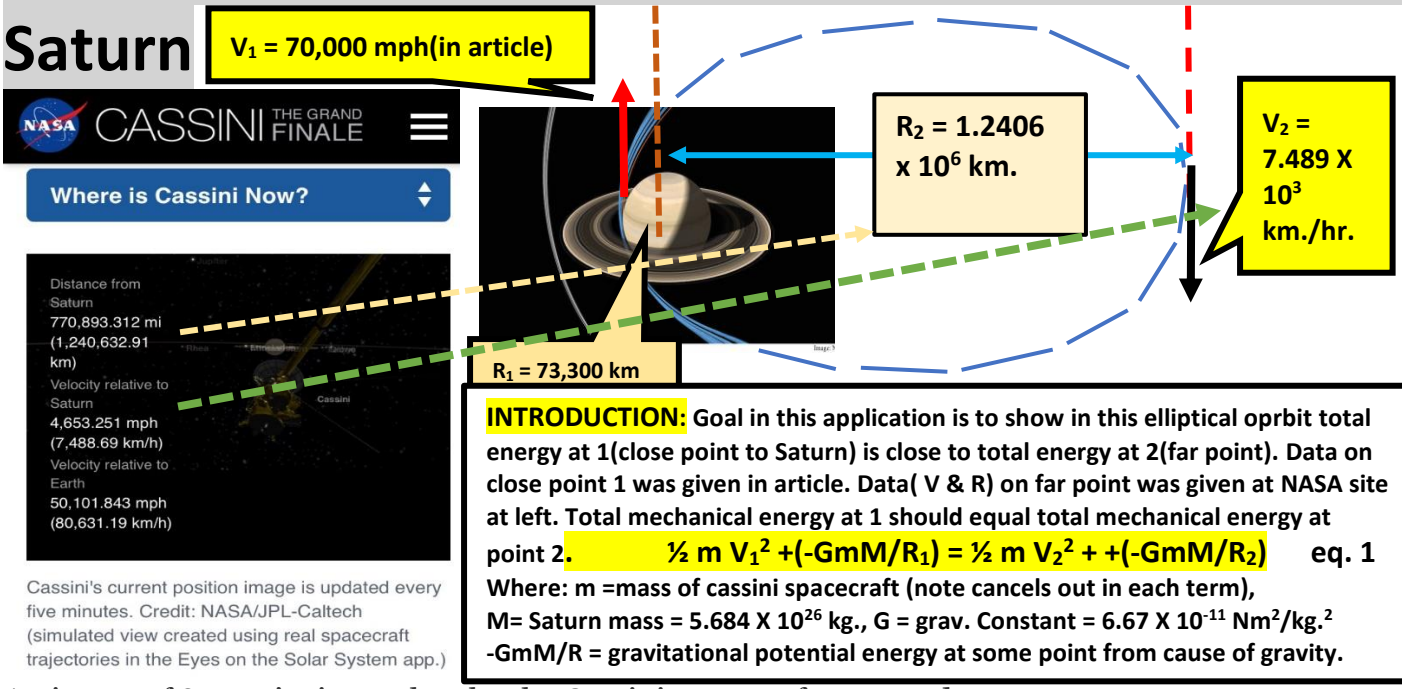
The 'Sounds' of Space as NASA's Cassini Dives by Saturn



Cassini's current position image is updated every five minutes. Credit: NASA/JPL-Caltech (simulated view created using real spacecraft trajectories in the Eyes on the Solar System app.)

INTRODUCTION: Goal in this application is to show in this elliptical oprbit total energy at 1(close point to Saturn) is close to total energy at 2(far point). Data on close point 1 was given in article. Data(V & R) on far point was given at NASA site at left. Total mechanical energy at 1 should equal total mechanical energy at point 2. $\frac{1}{2} m V_1^2 + (-GmM/R_1) = \frac{1}{2} m V_2^2 + (-GmM/R_2)$ **eq. 1**

Where: m =mass of cassini spacecraft (note cancels out in each term),
M= Saturn mass = 5.684 X 10^{26} kg., G = grav. Constant = 6.67 X 10^{-11} $Nm^2/kg.^2$
-GmM/R = gravitational potential energy at some point from cause of gravity.

An image of Saturn's rings taken by the Cassini spacecraft on Monday.

The recording starts with the patter of a summer squall. Later, a drifting tone like that of a not-quite-tuned-in radio station rises and for a while drowns out the patter. These are the sounds encountered by NASA's Cassini spacecraft as it dove through the gap between Saturn and its innermost ring on April 26, the first of 22 such encounters before it will plunge into Saturn's atmosphere in September. Cassini Crossing Saturn's Planet-Ring Gap (April 26, 2017) What Cassini did not detect were many of the collisions of dust particles hitting the spacecraft as it passed through the plane of the rings. "You can hear a couple of clicks," said William S. Kurth, a research scientist at the University of Iowa who is the principal investigator for Cassini's radio and plasma science instrument. The few dust hits that were recorded sounded like the small pops caused by dust on a LP record, he said. What he had expected was something more like the din of "driving through Iowa in a hailstorm," Dr. Kurth said. Since Cassini had not passed through this region before, scientists and engineers did not know for certain what it would encounter. **Cassini would be traveling at more than 70,000 miles per hour as it passed within 2,000 miles of the Saturn cloud tops(73,300 km. from center of Saturn), and a chance hit with a sand grain could be trouble.** When Cassini passed through a faint Saturn ring in December, the dust impacts numbered in the hundreds per second.

QUESTIONS: (a) Convert 70,000 mph to m./s.?, (b) Convert 7,489 km./hr. to m./s., (c) After cancelling out m in Eq. 1, compute the energy on left and right side of eq.1……which corresponds to total energy at near point 1 vs. far point at 2?, (d) How well does total energy at point 1 compare to total energy at point 2?
HINTS: 0.447 m./s. = 1 mph, 1000 m. = 1 km.,
ANSWERS: (a)V_1 = 3.129 X 10^4 m./s., (b) V_2 = 2.080 X 10^3 m./s., (c) -27.19 X 10^6 ~ ~ -28.47 X 10^6
(d) Since in the computation…. the m was cancelled out to make solution simplified, if the mass of cassini spacecraft(2,523 kg.) is replaced back on each side of eq.1…… the procedure would yield both sides of eq. 1 in units of energy as such….. -68.6 X 10^9 Joules = ~- 71.83 X 10^9 joules quite close, thus energy is conserved.