CENTRIPETAL FORCE FROM GRAVITY, g on Bannu

Unit 14 , 8 , Dr. John P. Cise, Professor of Physics, Austin Com. College, 1212 Rio Grande St., Austin Tx., 78701
jpcise@austincc.edu & New York Times , Sept. 6, 2016 by Kenneth Chang

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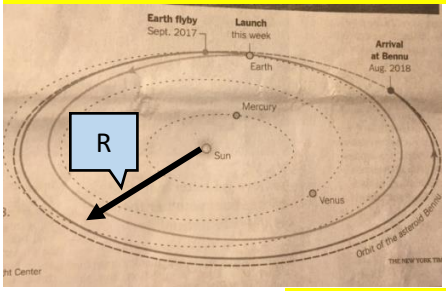
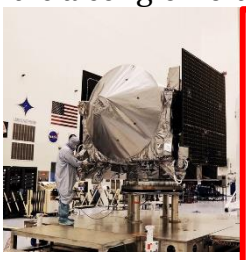
NASA Aims at an Asteroid Holding Clues to the Solar System's Roots



INTRODUCTION 1: **Gravity: GmM/R^2 supplies needed centripetal force: $m v^2/R$ to keep Asteroid Bennu in orbit about sun. Thus, $M = [4\pi^2/G](R^3/T^2)$ where G = gravitational constant = 6.67 X 10^{-11} N m^2/kg^2 . R(Bennu to sun)= 1.685X10^{11} m. T(period as stated below) = 14 mo.**
QUESTIONS: (a) Convert 14 mo. to seconds? (b)Find mass of sun M?
HINTS: 12 mo./yr., 365 days/yr., 24 hrs./day, 3600 s./hr. ANSWERS: (a) T = 3.6792 X 10^7 s. , (b) M_{SUN} = 2.09 X 10^{30} kg. COMMENT: The listed NASA mass of earth is ~ 2 X 10^{30} kg., thus using Bennu's orbit period T and radius about sun R, computed and reality are CLOSE.

For the next two years, **NASA's latest robotic spacecraft will be chasing down an asteroid near Earth in the hopes of scooping up some of the most primordial bits of the solar system.** The premise of the mission for the spacecraft, Osiris-Rex, is simple: Fly to an asteroid, grab some of the rock and bring it back to Earth, where scientists will study some of the pristine ingredients that went into the making of the solar system, including possibly the building blocks of life.

"It's 500 meters or so in size, about the height of the Empire State Building," Dr. Green said. Discovered in 1999, Bennu is a carbon-rich, almost black asteroid. Scientists believe that it is a conglomeration of leftovers, largely unchanged over the last 4.5 billion years.



INTRODUCTION 3: **Below in article the robotic spacecraft will hit Bennu surface at ¼ mph. QUESTIONS: (a) Convert ¼ mph to m,/s.?, (b) At what height above Bennu was robot spacecraft released from orbiting satellite? HINTS: 0.447 m./s = 1 mph., V_o = 0**
ANSWERS: (a) V = 0.1118 m./s.
(b) ~ 62.45 m., about 210 ft.

INTRODUCTION 2: **Almost NO gravity exists on Asteroid Bennu since it's mass is just 7.8 X 10^{10} kg. (from NASA or Wikipedia site). The radius of Bennu is about half the 500 m. diameter mentioned in the article. R = 246 m. weight = m g = G Mm/R^2 , Thus, $g = G M/R^2$,**

QUESTION: Confirm g (gravitational acceleration) on surface of Bennu is as stated below in article about ~ 10^{-4} $m./s.^2$?

ANSWER: g = ~ 0.86 X 10^{-4} $m./s.^2$, close to stated 10^{-4} $m./s.^2$

The Osiris-Rex robotic spacecraft is set to launch from Cape Canaveral, Fla. In July 2020, it is to slowly descend to the asteroid Bennu and then move like a pogo stick on its surface, grabbing a sample.

Osiris-Rex will survey Bennu for more than a year to select the site where it will grab the sample of rock. **In July 2020, the spacecraft, about the size of an sport utility vehicle, is to slowly descend and bounce off the surface like a pogo stick at a gentle pace of a quarter-mile per hour.** Its shape, like a top, fatter around the Equator as **(((it(Osiris-Rex Spacecraft) spins around(Asteroid Bennu) in 4.3 hours(Period T)))**.

Studying this asteroid could also come in handy if it is ever on a collision course with Earth. **((With about a 14-month orbit(about earth), Bennu))** passes fairly close once every six years. Bennu is not large enough to wreak planetwide extinctions — the asteroid that is thought to have killed off the dinosaurs 66 million years ago was about six miles wide — but a collision would be devastating. Impact would occur at more than 27,000 miles per hour, unleashing energy equivalent to 1,450 million tons of TNT. "**in almost no gravity(~ 10^{-4} m/s^2), you get to gently touch it, take your sample and then back away. On Bennu's surface, the pull of gravity may be somewhere from one-hundred-thousandth to one-millionth as that of Earth's, depending on the location. That means the spacecraft, about 3,000 pounds while awaiting launch, will probably weigh less than an ounce as it nudges Bennu to collect the rock.**

INTRODUCTION 4: **In the last article line above it is stated the earth weight (3000 lb.) robotic spacecraft would weigh less than one ounce on Bennu. Is this true? QUESTIONS: (a) Find mass of 3000 lb. robotic spacecraft? (b) Gravity on Bennu is 10^{-4} $m./s^2$, find weight(in lb.) of robotic spacecraft on Bennu?, (c) Find weight in ounces? HINTS: weight = m g , g_{EARTH} = 32 $ft./s.^2$, 16 oz./ lb.**
ANSWERS: (a) m = 93.75 slugs , (b) 93.75 X 10^{-4} lb., (c) ~ 0.15 ounce , certainly less than an ounce as stated in the article. Happyness!