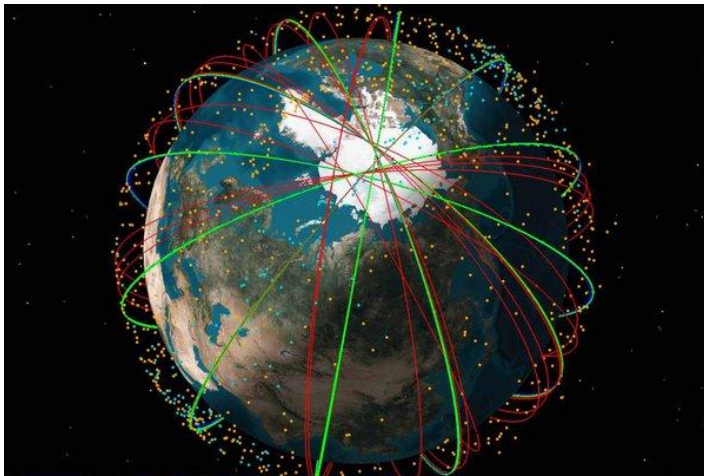


CENTRIPETAL FORCE & GRAVITATION Unit 14 & 8

Dr John Cise, Professor of Physics , Austin Community College, 1212 Rio Grande St., Austin Tx. 78746 jpcise@austincc.edu
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For Space Mess, Scientists Seek Celestial Broom



In 2009, a Russian satellite hit an Iridium communications satellite. Here, Iridium satellite orbits and collision debris clouds.

INTRODUCTION: Objects in orbit are held in orbit by Gravity. The force of gravity is: $F = G m M_{\text{earth}} / R^2$
 $R = R_{\text{earth}} + h$, where h = height above earth.
This gravitational force supplies the needed centripetal force mV^2/R . Thus, $GmM_{\text{earth}}/R^2 = mV^2/R$
And solving for R $R = GM_{\text{earth}}/V^2$

QUESTION: Find the average height h (in m and miles) of space junk traveling at 17,000 mph above the earth's surface? **HINT:** $G = \text{gravitational constant} = 6.673 \times 10^{-11} \text{ N m}^2/\text{kg}^2$ $M_{\text{earth}} = 5.9742 \times 10^{24} \text{ kg}$.
 $R_{\text{earth}} = 6.378 \times 10^6 \text{ meters}$, $1.6093 \text{ km} = 1 \text{ mile}$
 $0.447 \text{ m/s} = 1 \text{ mph}$

ANSWER: $h = 522,000 \text{ m}$, 522 km. , or 324 miles

The most obvious sign that there is a lot of junk in space is how much of it has been falling out of the sky lately: a defunct [NASA](#) satellite last year, a failed Russian space probe this year. While the odds are tiny that anyone on [Earth](#) will be hit, the chances that all this orbiting litter will interfere with working satellites or the International Space Station are getting higher, according to a recent [report](#) by the National Research Council. There is a straightforward solution: dispose of the space junk, especially big pieces, before they collide and break into smaller ones. Researchers are stepping in with a variety of creative **solutions, including nets that would round up wayward items and drag them into the Earth's atmosphere**, where they would harmlessly burn up, and balloons that would similarly direct the debris into the atmosphere. Also on the table: firing lasers from the ground. Not to blow things up, which would only make more of a mess, but to nudge them into safer orbits or into the atmosphere. In 1978, Donald J. Kessler, who led NASA's office of space debris, first predicted the cascade effect that would take place when leftover objects in space started colliding. Today, Dr. Kessler is retired in North Carolina but still contemplating the issue — and the need to clean up. “The sooner they do it, the cheaper it will be,” he said. “The more you wait to start, the more you'll have to do.” With so many **items whizzing around at more than 17,000 miles per hour** and shattering as they crash, the threat to working satellites, which are vital to hurricane tracking, GPS systems and military surveillance, has grown more immediate. Three years ago, a derelict Russian satellite slammed into an Iridium communications satellite, smashing both into tens of thousands of pieces. The Air Force currently tracks **20,000 pieces of orbiting space junk**, which includes old rocket parts and dead satellites. NASA just gave \$1.9 million to [Star Technology and Research](#), a small company in South Carolina, to develop and test technologies for a spacecraft it calls the **ElectroDynamic Debris Eliminator** — Edde, for short. **Powered by a 6-mile-long wire — make that “space tether” — that generates energy as it is pulled through the Earth's magnetic field, Edde would sidle up to a piece of junk, whip out a disposable net to catch it and then move to a lower orbit, where air friction would coax the item to re-enter the atmosphere.** Edde, staying in orbit, would then move on to its next target.