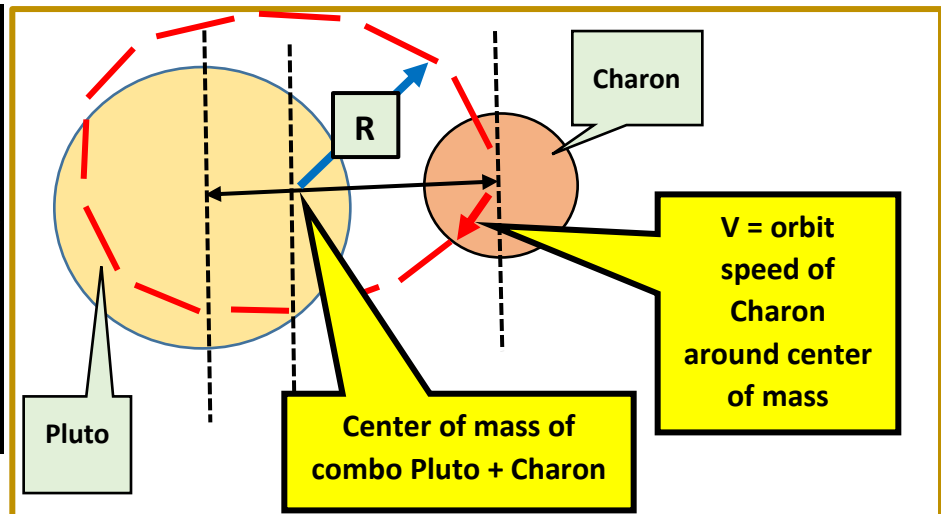
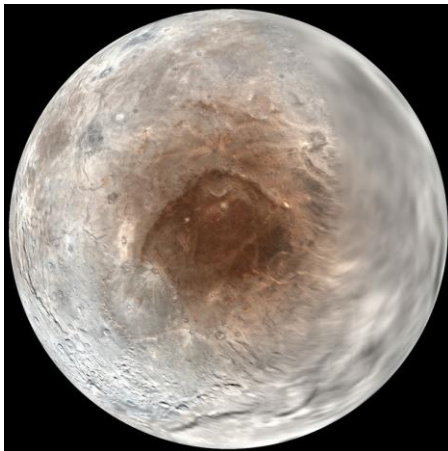


# CENTRIPETAL FORCE FROM GRAVITY

Unit 14 & some 8 Dr. John P. Cise, Professor of Physics, Austin Com. College, 1212 Rio Grande St., Austin Tx. 78701  
[jpcise@austincc.edu](mailto:jpcise@austincc.edu) & New York Times , September 15, 2016 by Jonah Engel Bromwich & Nicholas St. Fleur

## Why Pluto's Moon Charon Wears a Red Cap



The red cap on the north pole of Charon, the largest of Pluto's moons.

It turns out that [Pluto](#) may be responsible for maintaining the highlights on the red head of its biggest moon.

Scientists think Pluto, which was consigned to underdog status when it was **demoted to a dwarf planet a decade ago**, may actually be more of a bully. Data published in the journal Nature on Wednesday reinforced the theory that Pluto's atmosphere is releasing gas captured near **Charon's frigid northern pole, forcing the largest of its five moons to wear a blotchy, reddish-brown dunce cap**. He said the color would be familiar to those who used to travel to Los Angeles [when the city was more polluted](#). **"Back in the old days when you'd fly into Los Angeles, there'd be a sea of this orangey-brown muck,"** he said. **"That's basically light hydrocarbons that are the product of human activity — like the of people's gas tanks — being affected by ultraviolet light from the sun,"** a chemical process similar to the one occurring **on Charon**. Scientists theorize that Pluto and Charon were formed by the same collision some four and a half billion years ago. And **while Pluto's radius is nearly twice the size of Charon's, their centers are about 11,800 miles apart**, a distance so comparatively small that they move in a lock step rare for celestial bodies, each keeping the same face directed toward its mate at all times.

**INTRODUCTION:** Goal here is to find orbit speed of Charon around center of mass. The radius  $R$  of Charon's orbit is needed to solve for  $v$  by using gravity providing centripetal force:  $GmM/R^2 = mv^2/R$ . Thus,  **$[GM/R]^{1/2} = v$**   
 eq.1  $M =$  mass of Pluto + Charon combined =  $13 \times 10^{21}$  kg. +  $1.586 \times 10^{21}$  kg. =  $14.586 \times 10^{21}$  kg.  $R$  can be found as it is the distance from center of mass(cm). Let  $X =$  distance cm is from center of Pluto. The cm can be found using cm finding equation  **$X = \frac{\sum x m}{\sum m}$** . Take (0,0) to be at center of Pluto. Distance between Pluto and Charon is given in the article above as 11,800 miles.

**QUESTIONS:** (a) Convert 11,800 miles to meters?, (b) Find  $X$ ? Distance cm is from center of Pluto? (c) Find orbit  $R$  radius of Charon.  $R = 11,899$  miles(in meters) –  $X$ , (d) Find orbital speed  $v$  of Charon?

**HINTS:**  $G =$  gravitational constant =  $6.67 \times 10^{-11}$  N m<sup>2</sup>/kg<sup>2</sup>, mile = 1609 meters

**ANSWERS:** (a)  $18.986 \times 10^6$  m., (b)  $2.063 \times 10^6$  m., (c)  $R = 16.911 \times 10^6$  m, (d)  $v = \sim 2.4 \times 10^2$  m./s. or 0.24 km./s.

**NOTE:** Computed orbit speed  $v$  of Charon is just a little short reported by NASA and Wikipedia. Dr. Cise