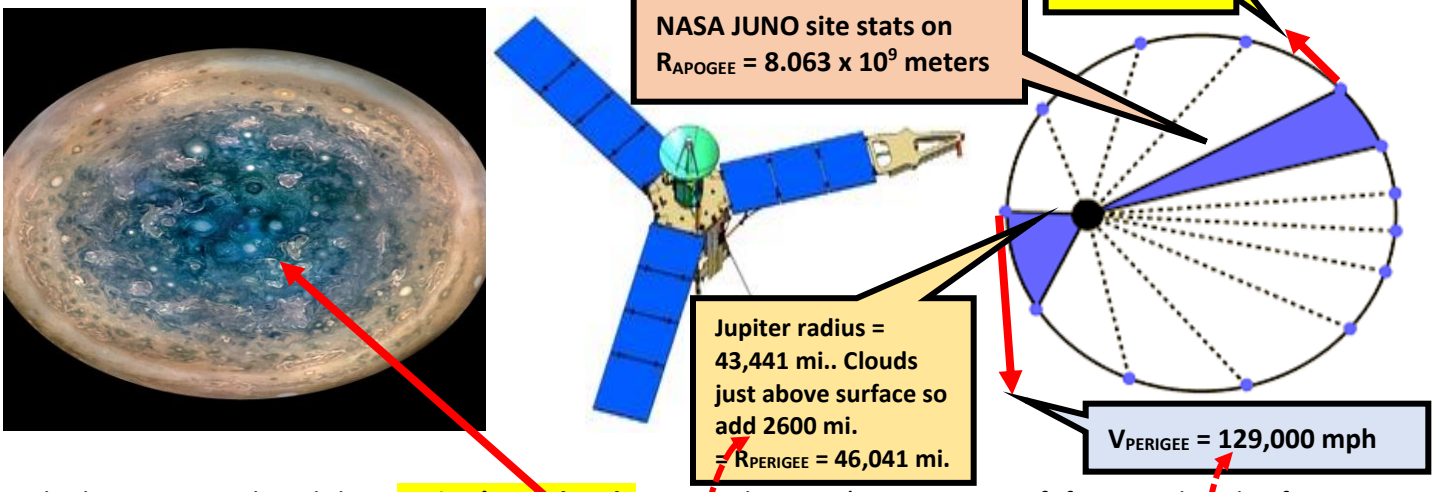
CENTRIPETAL FORCE CAUSING ROTATION & EQUAL AREAS IN EQUAL TIMES

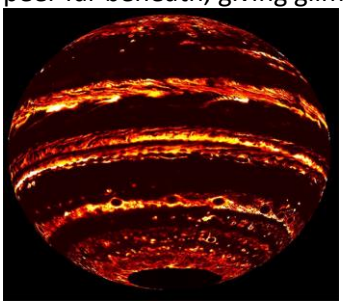
Units 13 &14 Dr. John P. Cise, Professor of Physics, Austin Com. College, Austin Tx. jpcise@austincc.edu , & NYTimes May 26. 2017 by Ken Chang

---

NASA's Jupiter Mission Reveals the 'Brand-New and Unexpected'



Multiple images combined show **Jupiter's south pole**, as seen by NASA's Juno spacecraft from an altitude of 32,000 miles. The oval features are cyclones. The top and bottom of Jupiter are pockmarked with a chaotic mélange of swirls that are immense storms hundreds of miles across. The planet's interior core appears bigger than expected, and swirling electric currents are generating surprisingly strong magnetic fields. Auroral lights shining in Jupiter's polar regions seem to operate in a reverse way to those on Earth. And a belt of ammonia may be rising around the planet's equator. Those are some early findings of scientists working on NASA's Juno mission, an orbiter that arrived at Jupiter last July. **Juno takes 53 days to loop around Jupiter in a highly elliptical orbit, but most of the data gathering occurs in two-hour bursts when it accelerates to 129,000 miles an hour and dives to within about 2,600 miles of the cloud tops.** The spacecraft's instruments peer far beneath, giving glimpses of the inside of the planet, the solar system's largest.



Infrared images and spectra of Jupiter's thermal emission based on readings from the Jovian Infrared Auroral Mapper aboard the Juno spacecraft.

INTRODUCTION: **Kepler's 2nd. Law states planets in elliptical orbits sweep out equal areas in equal amounts of time:** $A_{PERAGEE}/t = A_{APOGEE} / t$

$$\tfrac{1}{2} R_P V_P t / t = \tfrac{1}{2} R_A V_A t/t$$

$$R_P V_P = R_A V_A \qquad \text{eq. 1}$$

Goal here is to find velocity at apogee (far point).

QUESTIONS: **(a) Convert Apogee radius in meters to miles?, (b) Using eq. 1 (statement of sweeping out equal areas in equal amounts of time) find speed of Juno spacecraft at it's orbital apogee?**

HINTS: **1610 meters = 1 mile**

ANSWERS: **(a)** $R_{APOGEE} = 4.97 \times 10^6$ **miles , (b)** $V_{APOGEE} = 1195$ **mph**

COMMENT BY AUTHOR: **1195 mph is quite reasonable considering huge distance Juno is from Jupiter at apogee (far point in elliptical orbit).**