

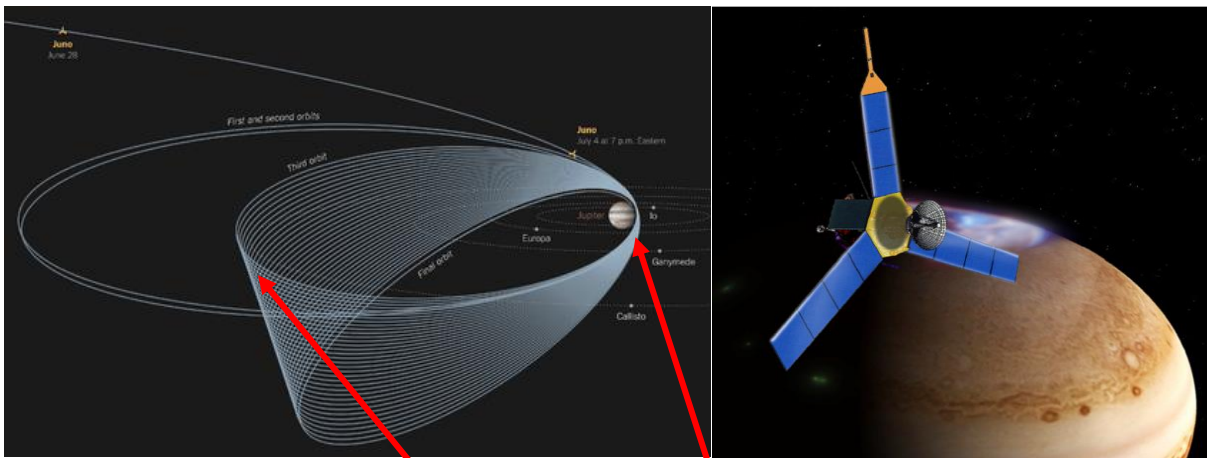
# CENTRIPETAL FORCE PROVIDED BY GRAVITY

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## NASA's Juno Spacecraft Will Soon Be in Jupiter's Grip

On July 4, 2016, NASA's Juno spacecraft will arrive to study Jupiter after a trip of nearly two billion miles. [Watch in Times Video](#) » **After traveling for five years and nearly 1.8 billion miles, NASA's Juno spacecraft will announce its arrival at Jupiter** with the simplest of radio signals: a three-second beep. NASA expects the beep, marking the end of a 35-minute engine burn to slow the spacecraft down and allow it to be captured by Jupiter's gravity, to arrive at [Earth](#) at 11:53 p.m. Eastern time next Monday. "I can tell you when that completes, you're going to see a lot of celebration," said Rick Nybakken, Juno's project manager, **"because that means we'll be in orbit around Jupiter"**, and that'll be really cool." Juno's mission is to explore the enigmas beneath the cloud tops of Jupiter. How far down does the Big Red Spot storm that has swirled for centuries extend? What is inside the solar system's largest planet?



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On July 4, as the main engine on the spacecraft fires, in the control room at [NASA's Jet Propulsion Laboratory](#) in Pasadena, Calif., there will be nothing to control, and all anyone there will be able to do is wait and watch. If anything goes wrong, there is no way for anyone to intercede. The radio signals take 48 minutes to travel from Jupiter. **Juno is to make a series of 37 highly elliptical orbits passing over Jupiter's north and south poles over 20 months. (((At its farthest, it will be about two million miles from Jupiter. For each orbit, it will accelerate inward, reaching 128,000 miles per hour, and pass within 3,100 miles of Jupiter's cloud tops.)))**

Juno Science orbits

<http://SpaceFlight101.com/Juno/Juno-mission-trajectory-design/>

Science Phase & Jupiter Orbit Design(see this section at above site)

After the Capture Orbits and the PRM, Juno is in its science orbit with a clean-up orbit (#3) starting on November 2 following the Period and Perijove Reduction Maneuvers in October. The first clean science orbit will start on November 16, 2016 and the last on February 6, 2018 (#36, Extra Orbit).

Note: Above are clearly 15 months of 33 orbits.

This is 15 mo./33 orbits = 0.454 mo./orbit = (.454)x(30.5 days/mo. = ~ 13.8 days/orbit = period ave.

Through Orbit 36, Juno performs science operations before the planned End Of Mission occurs on orbit 37.

**INTRODUCTION:** The goal here is to find the mass of Jupiter using Kepler's 3<sup>rd</sup> law:  $R^3/T^2 = G M/4\pi^2$   
R = ave. radius of elliptical orbit =  $[R_A + R_P]/2$   
 $R_{APOGEE} = \sim 2 \times 10^6$  miles,  $R_{PERIGEE} = 3,100$  mi.  
T = period of Juno (as seen at left) = 13.8 days.

**QUESTIONS:** (a) Find R in meters? (b) Find T in seconds?, (c) Find mass (M) of Jupiter ?

**HINTS:** 1609.344 m.= mile , 24 hrs./day, 3600 s./hr.

**ANSWERS:** (a)  $1.612 \times 10^9$  m., (b)  $1.192 \times 10^6$  s (c)  $\sim 1.744 \times 10^{27}$  kg. **NOTE:** Published NASA Jupiter mass is  $1.89 \times 10^{27}$  kg.. Thus, 8% close.