

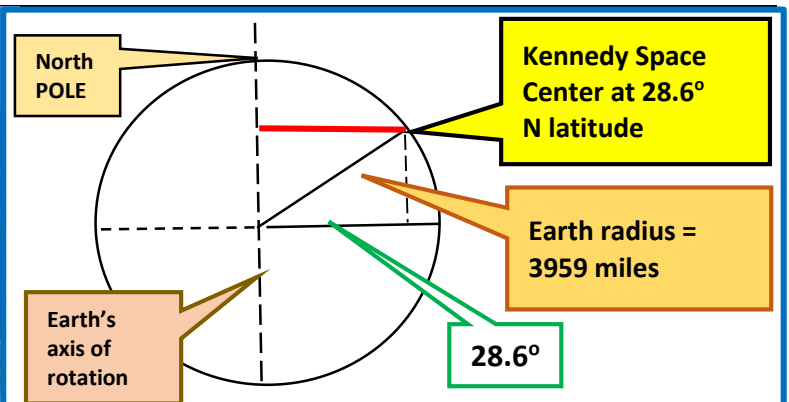
# KINEMATICS

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The refurbished Launch Complex 39B at Kennedy Space Center, which is on the ocean and surrounded by marshland, in 2013



**INTRODUCTION:** The linear speed of the earth's surface is greatest at the equator where the latitude is  $0^\circ$ . As the latitude becomes larger the distance to axis of rotation becomes shorter (see graphic above). The Red line in above graphic is distance to earth's axis of rotation for Kennedy Space Center. This higher linear speed helps launch rockets easier near the equator or lower latitudes.

**QUESTIONS:** (a) Find distance to earth's axis of rotation at Kennedy Space Center? (b) Find circumference of earth at Kennedy Space Center latitude? (c) Find linear speed of earth at Kennedy Space Center latitude? (d) Find earth circumference at equator? (e) Find linear speed of earth at Equator? The European Space center is located close to equator in French Guiana.

## NASA Is Facing a Climate Change Countdown

**HINTS:**  $\cos \theta = \text{adj./hyp.}$  ,  $C = 2\pi r$  ,  $v = x/t$  , 24 hrs./day

**ANSWERS:** (a) 3476.93 mi. (b) 21,846.17 mi.  
(c) 910.26 mph (d) 24,875.12 mph (e) 1036.5 mph  
**COMMENT:** With higher linear speed near equator or low latitudes it is easier to orbit rockets.

Kennedy Space Center and other NASA facilities near coastlines are facing the **prospect of continually rising waters**

A rising sea level will bring even greater risk over time — and perhaps sooner than most researchers expected. According to [a study published last week](#), warming pressure on the Antarctic ice sheet could help push sea levels higher by as much as five or six feet by the end of this century. Pondering the Problem NASA, which has at least \$32 billion worth of structures and facilities around the country, has been considering the possible effects of climate change for nearly a decade, said Kim W. Toufexis, a strategist who leads the master planning program for the space agency. NASA, after all, is in the business of risk management. By 2007, “we had to acknowledge that we should recognize climate change and extreme weather as a formal risk that we should be actually managing,” Mr. Toufexis said. In fact, NASA's climate risk extends far beyond Florida. About two-thirds of the land that NASA manages is within 16 feet of mean sea level, and much of it is near the coasts. “We are tremendously linked to the drink,” Mr. Toufexis said.

### Why the Coast?

Which leads to another obvious question: Why build billions of dollars worth of launch infrastructure on a risky coast in the first place? Safety and physics tell the tale. Launching over water is safer than over land and people. Also, **rockets are best launched from sites closer to the Earth's fat Equator, where the greater diameter of the planet provides a slingshot effect that gives each rocket more bang for the propulsion buck.** The Air Force was already firing missiles from Cape Canaveral when NASA showed up. The idea of firing from Florida preceded space travel by nearly 100 years. In 1865, Jules Verne foresaw launches from Tampa in “From the Earth to the Moon.” Verne, in fact, even [envisioned a competition](#) for the launch site between Florida and the Gulf Coast of Texas, with a pitched political battle for the plum program. In real life, Florida got the launches, and coastal Texas got the Johnson Space Center, home to mission control and astronaut training.