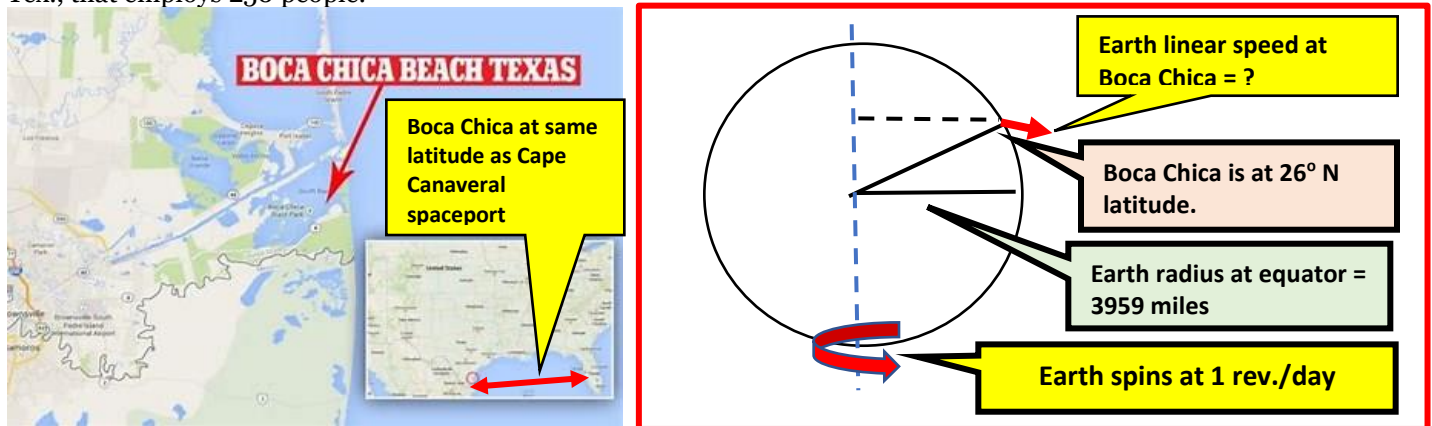ORBITAL VELOCITY & CENTRIPETAL FORCE FROM GRAVITY

Units 13 & 14, Dr. John P. Cise, Professor of Physics, Austin Com. College, Austin Tx , jpcise@austincc.edu, & New York Times , August 4, 2017

Elon Musk's SpaceX to Construct Spaceport in Texas

By THE ASSOCIATED PRESS AUG. 4, 2014

The State of Texas and SpaceX, the technology company led by Elon Musk, have announced that the company will **build the first commercial site for orbital launches on the state's southernmost tip. The $85 million site at Boca Chica Beach, east of Brownsville, will be used to launch commercial satellites**. The state said it would provide $2.3 million from the Texas Enterprise Fund, offering an additional $13 million from the Spaceport Trust Fund. SpaceX, which is based in California, is expected to create 300 jobs at the site. The company has a testing facility in McGregor, Tex., that employs 250 people.

BOCA CHICA BEACH TEXAS

Boca Chica at same latitude as Cape Canaveral spaceport

Earth linear speed at Boca Chica = ?

Boca Chica is at 26° N latitude.

Earth radius at equator = 3959 miles

Earth spins at 1 rev./day

INTRODUCTION: The advantage of launching satellites as far south on earth's surface is the rockets launching satellites have a initial tangential(tangent to earth)velocity due to the earth's rotation of one rotation per day. For a 150 mile high orbit a satellite needs to have a tangential speed of about 17,000 mph. The first purpose of this application is to show first the space X rocket has a tangential speed of about 932 mph just sitting on Boca Chica launch pad. Thus, less energy is needed to achieve the 17,000 mph for a 150 mile high orbit of earth.

QUESTIONS: (a) Find radius (in miles) to center of earth at Boca Chica, Texas? (see graphic above for important numbers)
(b) Find angular velocity ω (in radians/s.) of earth?, (c) Find tangential speed(in miles/s.) of earth at Boca Chica Texas?
(d) Convert answer (c) to mph at Boca Chica, Texas?, (e) What % of required 17,000 mph for a 150 mile high orbit
Is attained by launching at Boca Chica's latitude of 26° N latitude?

HINTS: 5280 ft. = 1 mile, $V = R \omega$ = tangential velocity, $\omega = 2\pi f = 2\pi/T$, f(earth) = 1 rev./day, day = 24 hrs,
3600 s./hr., T =period of rotation,

ANSWERS: (a) $R_{at\ Boca\ Chica}$ = 3558.32 miles, (b) ω = 7.27 X 10^{-5} radians/s.,(c) $V_{at\ Boca\ Chica}$ = 0.2587 mi./s.
(d) $V_{at\ Boca\ Chica}$ = 932 mph , (e) 932 mph/17,000 mph = ~ 5.5% of orbital speed is achieved due to launching
very far south as possible.