CENTRIPETAL FORCE & GRAVITY

Unit 14 & 8

Dr. John P. Cise, Professor of Physics, Austin Com. College, 1212 Rio Grande St., Austin Tx., 78701
jpcise@austincc.edu & New York Times , January 25, 2017 by Nicholas St. Fleur

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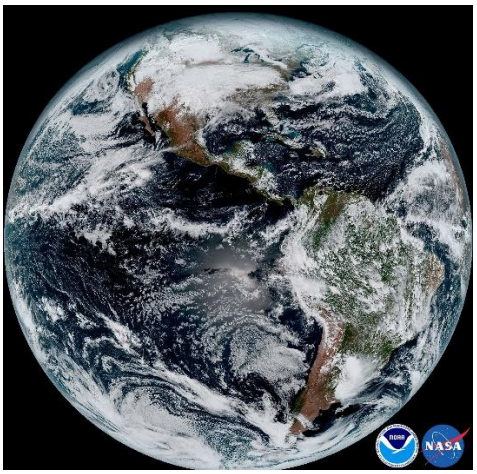
Better Weather Forecasts, and These Pretty Pictures, Too. January 2017.



Earth as seen by NOAA's newest satellite, the GOES-16, in an image released on Monday.

INTRODUCTION: This satellite appears stationary 22,300 miles above Equator(see article below). The satellite actually rotates in harmony with earth at 1 rev./day. Purpose of this application is to confirm the GOES satellite must be placed at 22,300 miles above equator. H = 22,300 miles

QUESTIONS: (a) Find radius (R) from center of earth GOES satellite must be placed (in meters & miles) to appear stationary above earth ?, (b) Find height (H) GOES satellite must be placed(in meters & miles) above earth surface ?, (c) Find tangential linear speed(m./s. & mph) of GOES satellite at 22,300 miles?

HINTS: Satellite stays in orbit since gravitational centripetal force is provided by gravity: $G\,m\,M/R^2 = m\,V^2/R$, where $V = R\,\omega = 2\,\pi\,f\,R = 2\,\pi\,R/T$, T = period Thus, $G\,M\,/\,R^2 = 4\,\pi^2\,R\,/T^2$, solving for $R = [\,G\,M\,T^2/\,4\,\pi^2]^{1/3}$, T = 1 day. 24 hrs./day , 3600 s./1 hr. , $G = 6.67 \times 10^{-11}$ N m.^{2}/kg.^{2} , $M_{EARTH} = 5.97 \times 10^{24}$ kg. R_{EARTH} = 3,959 miles, 1609 m./miles , $R = R_{EARTH} + H$,

Here's a reminder of how beautiful our planet is. The National Oceanic and Atmospheric Administration released the first batch of images taken by its **recently launched GOES-16 satellite on Monday.** With its high-definition camera, the satellite shows our blue marble with its wisps of white clouds and splotches of green and brown in vivid detail better than NOAA has seen with its weather satellites before.

Launched in November, GOES-16 is the first in a series of next-generation geostationary weather satellites from NOAA designed to observe Earth and provide **better weather forecasts**. It ***(((orbits the planet at approximately 22,300 miles above Earth,)))*** and according to NOAA can provide images of the full Western Hemisphere every 15 minutes, as well as images of the entire continental United States every five minutes. "It's more spectacular than we even envisioned," said Steven Goodman, NOAA's senior scientist for the GOES-R series. "The **higher spatial resolution makes my jaw drop."**

The composite image of the Western Hemisphere was captured at 1:07 p.m. Eastern time on Jan. 15, 2017. Compared to previous GOES satellites observing Earth, the tools on board GOES-16 can scan the planet five times faster, with four times the image resolution. Those improved capabilities allow GOES-16 to contribute more to NOAA's hurricane tracking efforts as well as to its severe-weather forecasting and monitoring. The satellite is also designed to observe fog, fires, dust storms, tornadoes, volcanic eruptions and lightning. "It's more than a pretty picture," Dr. Goodman said. "It gives us quantitative information and insight into the properties of the atmosphere and the land surface."

ANSWERS: (a) R = ~ 4.222 X 10^7 m. , R = ~ 26,240 miles , (b) H = 22,281 miles, H = 3.585 X 10^7 m. ,

(c) $V = R\,\omega = 2\,\pi\,f\,R = 2\,\pi\,R/T$ = ~ 7.37 X 10^4 m./s. or ~ 6870 mph

COMMENT: Stated height above earth of GOES satellite (22,300 miles approximately …..see above) and computed needed value of R are "close". Thanks to Newton's fourth law & Kepler's third law.