CENTRIPETAL FORCE & GRAVITY

Units 14 & 8

Dr. John P. Cise , Professor of Physics , Austin Com. College , 1212 Rio Grande St., Austin Tx. 78701 & New York Times , March 15,2016 by Nicholas St. Fleur in Trilobites section of Science section every Tuesday

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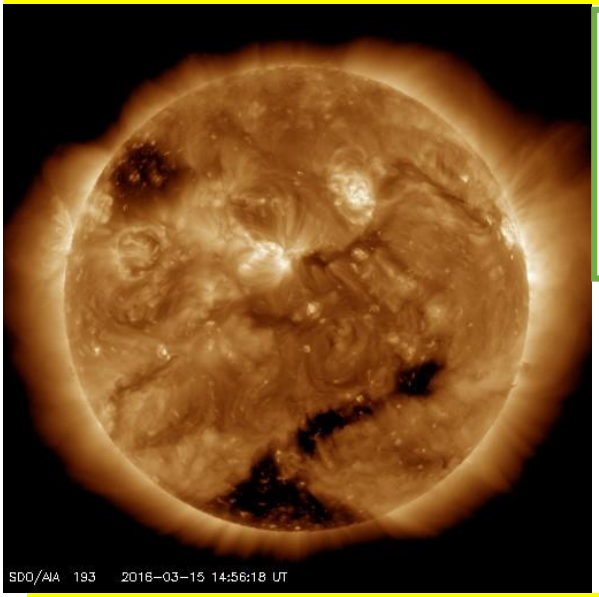
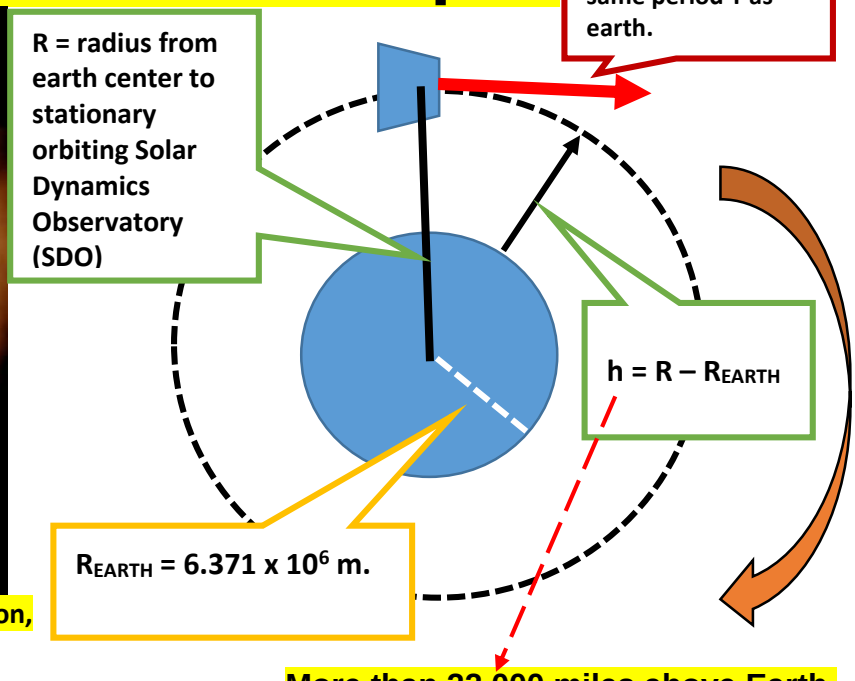
This Week's Other Solar Eclipse



A view of the sun during the spring eclipse season, from the Solar Dynamic Observatory. NASA



Wednesday's solar spectacle over the Pacific Ocean wasn't the only eclipse to happen this week. **More than 22,000 miles above Earth, NASA's Solar Dynamics Observatory, or SDO, watched the sun blackout every day for nearly a month.** The SDO is a 6,600-pound spacecraft that was designed to stare at the sun and investigate its magnetic fields and solar winds. Normally the ship's gaze goes completely undisturbed as it orbits the Earth. But twice a year, around the equinoxes, it enters what NASA calls "eclipse season." For three weeks, the Earth blocks the device's view of the sun once each day. This year starting on Feb. 19, the spacecraft began experiencing ephemeral blackouts that lasted only a few minutes. The obstructions gradually grew and by the beginning of March they peaked with a 72-minute eclipse. On Thursday it was back at around a few minutes, and by March 12 the SDO will return to its uninterrupted solar marathon.

INTRODUCTION: Gravity provides needed centripetal force to keep Solar Dynamics Observatory (SDO) satellite in a stationary orbit (same period as earth's rotation…$T = 24$ hrs. $= 8.64 \times 10^4$ s.) above the earth (see above graphic).

$G\,Mm/R^2 = m\,V^2 / R$ eq.1 but $V = R\,\omega = R\,2\pi f = R\,2\pi /T$ Thus eq. 1 becomes : $G\,M\,\cancel{m}/R^2 = \cancel{m}\,R^2\,4\,\pi^2/\,R\,T^2$

$$G\,M_{EARTH}\,T^2 / 4\,\pi^2 = R^3$$

HINTS & Given: $M_{EARTH} = 5.972 \times 10^{24}$ kg. , $G = 6.674 \times 10^{-11}$ m^2 N/kg.^{2} , 1 mile = 1609.3 meters

QUESTIONS: (a) Find distance from earth center (radius R in meters) SDO satellite must be placed to appear in stationary orbit above the same place on surface of earth? (b) Find height h above earth's surface SDO satellite must be placed to appear stationary? (c) Convert h in meters to miles? (d) Compare computed value for h in (c) with stated height in article?

ANSWERS: (a) $R = 42.31 \times 10^6$ m. , (b) $h = 35.935 \times 10^3$ m , (c) h = 22,330 miles , (d) Close! Article > 22,000