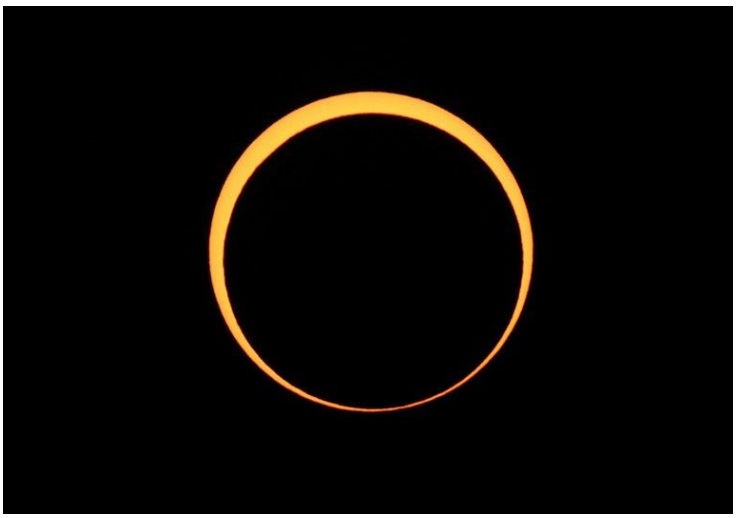
KINEMATICS + CENTRIPETAL FORCE

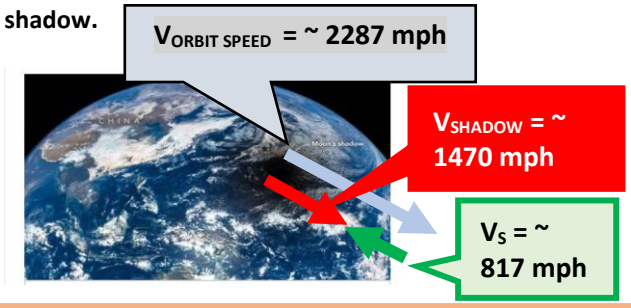
Units 4,5,8,14 Dr. John P. Cise, Professor of Physics, Austin Com. College, Austin Texas, jpcise@austincc.edu & New York Times , August 18, 2017 by Jonah Engel Bromwich , Dedicated to my Xavier Univ. professors 1958-1962: Hart, Marchacio,Poldosky.

The Demons of Darkness Will Eat Men, and Other Solar Eclipse Myths



INTRODUCTION: **First goal is to find speed of moon's shadow on earth. The shadow speed V(red below) is due to two motions. Orbit speed V_O(tan) of moon rotating about the earth + earth surface speed V_S (green) due to earth's rotation on axis.** $V = V_O - V_S$

V_S is negative since earth is moving in same direction as shadow.



An annular eclipse as seen from Arizona in 2012. Many ancient civilizations saw eclipses as bad omens.
We understand the cosmic calculus that leads to solar eclipses like the one that will enchant many Americans on Monday. But even for the most jaded skygazers, a solar eclipse can provoke a visceral sense of wonder that the phenomenon provoked long before it was understood. "If you were the Greeks, before they came to have an understanding of eclipses, you might think it was a bad omen, something the gods were telling you you had done wrong," he said. "If you were the Chinese, you thought dragons were eating the sun." "If you read the 'Anglo-Saxon Chronicle' — which is a really boring read — but if you scan through it, you'll find lots of instances of eclipses, all related to other bad things," he added.

INTRODUCTION (CONTINUED): **The moon orbital speed is due to gravity supplying the centripetal force:**
$m v_o^2/R = G m M/R^2$ **, thus,** $v_o = [G M/R]^{1/2}$ **where G = gravitational constant = 6.673 X 10^{-11} N $m^2/kg.^2$, M = earth mass = 6 X 10^{24} kg., R = ave. distance moon is from the earth = 3.8329 X 10^8 m.**
At 38° N latitude the earth radius is[radius at equator (3959 mi.) X cos. 38°] = 3120 mi., Thus, speed of earth due to axis rotation = $V_S = 2\Pi R/24$ **hrs.**

QUESTIONS: **(a) Find orbit speed V_O ? In units of m./s. & mph , (b) Find linear speed (in mph) of earth's surface V_S due to earth axis spin at 38° N Latitude?, (c) Find speed (in mph) of eclipse shadow on earth's surface V_{SHADOW} = ?, (d) Find speed of shadow knowing It is 68 mi. in diameter and it passes in 2 min. 40 seconds (2.66 min.)?**
HINTS: π **= 3.1416 , 60 min./hr. , [2.237 mph]/ m./s. , X = V t**
ANSWERS: **(a)** V_{ORBIT} **= 1022.57 m./s. or 2287 mph, (b)** V_S **= 817 mph , (c)** V_{SHADOW} **= ~ 1470 mph**
(d) V_{SHADOW} **= X/T = 68 MI./[2.66/60] = ~ 1530 mph** **COMMENT:** **Below are NASA estimates of shadow speed.**

google.com

City	Mid-totality	Totality Duration	Shadow Speed
Madras, OR	10:20 a.m.	2m 02s	2,203 mph (3,545 km/h)
Rexburg, ID	11:34 a.m.	2m 17s	1,879 mph (3,024 km/h)
Casper, WY	11:43 a.m.	2m 26s	1,720 mph (2,768 km/h)
Alliance, NE	12:50 p.m.	2m 30s	1,635 mph (2,631 km/h)
Grand Island, NE	12:59 p.m.	2m 34s	1,535 mph (2,470 km/h)
Columbia, MO	1:13 p.m.	2m 37s	1,488 mph (2,394 km/h)
Carbondale, IL	1:21 p.m.	2m 37m	1,458 mph (2,346 km/h)
Hopkinsville, KY*	2:26 p.m.	2m 40m	1,452 mph (2,337 km/h)
Greenville, SC	2:39 p.m.	2m 11m	1,472 mph (2,369 km/h)
Columbia, SC	2:43 p.m.	2m 30m	1,479 mph (2,380 km/h)