CENTRIPETAL FORCE & GRAVITY

Unit 14 & 8 Dr. John P. Cise , Professor of Physics, Austin Community College, 1212 Rio Grande St., Austin Tx. 78701 jpcise@austincc.edu & NYTimes 11/21/16 D. Overbye

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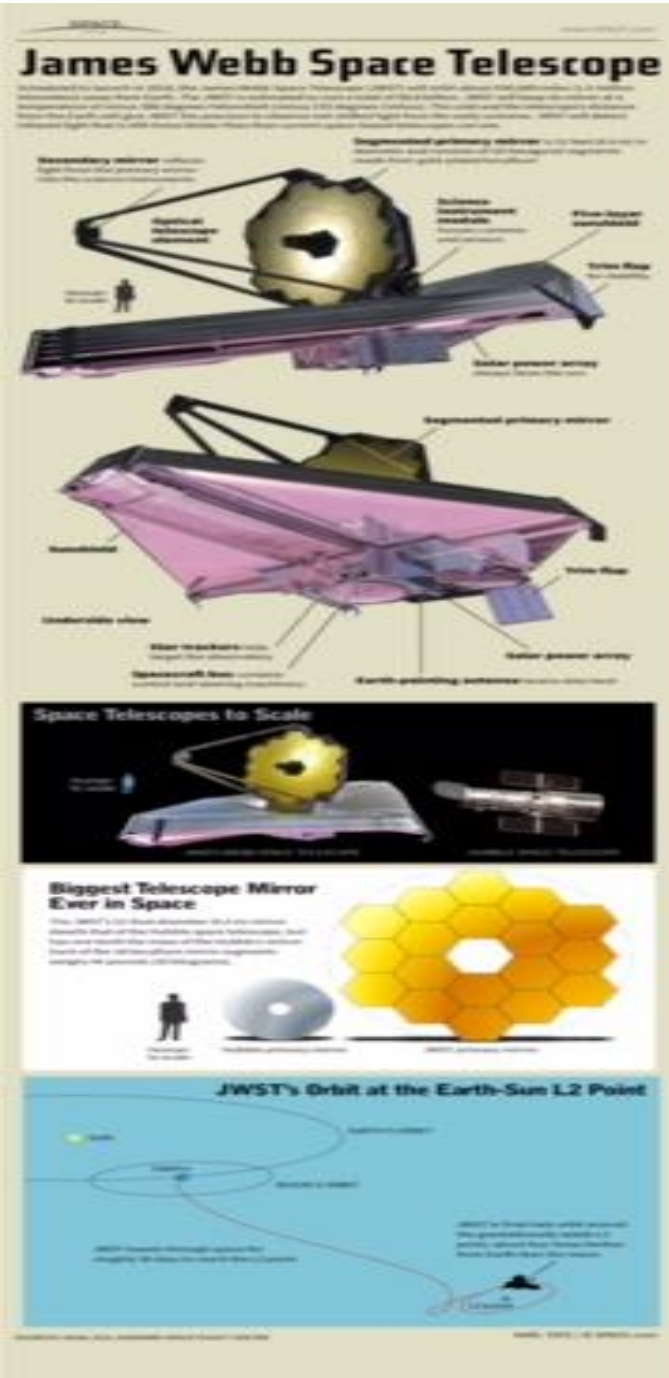
Telescope That 'Ate Astronomy' Is on Track to Surpass Hubble

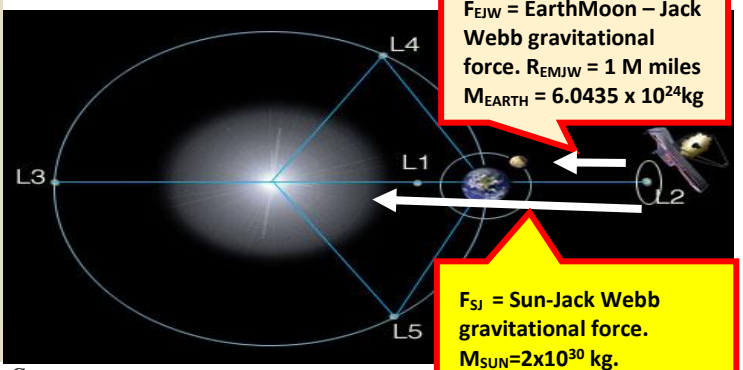


INTRODUCTION: The Jack Webb Space telescope will be 1 M miles further out from the earth-moon than the 92,960,000 miles the earth is from the sun now. See article below. This spot is called Lagrangian point 2. This the exact point in space where gravity from the sun and earth-moon system is the correct magnitude to provide the required gravitational centripetal force to keep Jack Webb in orbit about the sun with the same period as the earth (365 days). See graphic below. Mass of Jack Webb telescope = 6500 kg.

QUESTIONS: (a) Convert sun – jack webb distance to meters?, (b) Convert Earth – jack webb distance to meters? (c) Find gravitational force of sun on JackWebb(F_{SJ}) ?, (d) Find gravitational force earth-moon system on JackWebb (F_{EJW})?,(e) Find Total gravitational force on Jack Webb telescope due to sun and earth-moon system?, (f) Convert Period (T) of Jack Webb telescope about the sun (365 days) to seconds? , (g) Find centripetal force Jack Webb needs to stay in orbit about the sun, (h) Find (g) in lb.?, (i) Find speed of Jack Webb as it orbits sun in m/s & mph? $v = C/T = 2\pi R/T$

HINTS: $F_{GRAVITATION} = G\,m\,M/R^2$, G = grav. constant = 6.67×10^{-11} N $m^2/kg.^2$, $F_{CENT} = m\,v^2/R$, $v = R\,\omega = R\,2\pi f = R\,2\pi/T$, $F_{CENTRIPETAL} = m\,4\pi^2\,R_{SJW}/T^2$, 2.237 mph/(m/s.)

ANSWERS: (a) 1.512×10^{11} m., (b) 1.609×10^{9} m. (c) 37.92147 N , (d)1.01207 N, (e) 38.9335 N , (f) T = 3.1536×10^{7} s., (g) 39.016 N , (h) 8.72 lb.(i)30,100 m/s. (i) ~ 67,350 mph **Comment:** Amazing: 8.72 lb.to hold orbit.



F_{EJW} = EarthMoon – Jack Webb gravitational force. R_{EMJW} = 1 M miles $M_{EARTH} = 6.0435 \times 10^{24}$kg

F_{SJ} = Sun-Jack Webb gravitational force. $M_{SUN} = 2 \times 10^{30}$ kg. M_{JW} = 6,500 kg. $R_{SJW} = 9.396 \times 10^{7}$ miles

The 18 mirrors that make up the heart of NASA's James Webb Space Telescope, at the Goddard Space Flight Center.

GREENBELT, Md. — The next great space telescope spread its golden wings this month.

Once in space, the telescope will unfold a giant umbrella the size of a tennis court to keep the sun off it. The telescope, marooned in permanent shade a million miles beyond the moon, will experience an infinite cold soak.It will be launched on an Ariane 5 rocket supplied by the European Space Agency as part of Europe's contribution to the observatory, and go into orbit around the sun at a point called L2 about a million miles from Earth.