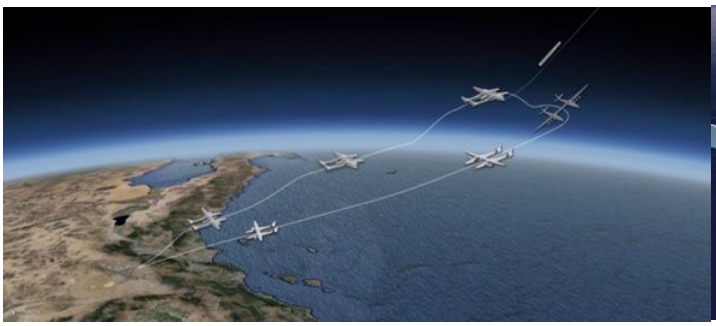
ENERGY-WORK **Units 10 & 11 Dr. John P. Cise, Professor of Physics, Austin Com. College, 1212 Rio Grande St., Austin Tx. 78701 jpcise@austincc.edu & New York Times, June 20, 2016 by Nick Wingfield & Kenneth Chang**

Stratolaunch's Gargantuan Flying Launchpad Edges Toward the Skies



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MOJAVE, Calif. — The world's largest airplane by wingspan sits in a cradle of scaffolding as workers fit the remaining parts that will turn it into a **flying launchpad for firing rockets into space.**

Everything about this project, called Stratolaunch, screams bigness. The slogan "Think Big" is plastered on workers' T-shirts and on posters around the hangar in the desert outside Los Angeles, where the plane is being assembled. The effort is being financed by the jumbo fortune of Paul G. Allen, the billionaire space enthusiast and a Microsoft founder.

"A really big plane means carrying anything from a really big rocket to a smaller rocket. That allows us to serve a broader set of customers." Stratolaunch bought two used Boeing 747s from United Airlines, removed most of their critical parts and is now reassembling them into one carrier plane with a new shell made of lightweight graphite composites. It is hoped that the plane will take off with a rocket slung underneath, which it would then **drop from an altitude of more than 30,000 feet, sending it on its way to space.** The wingspan of Stratolaunch's airplane stretches 385 feet. In an interview, Mr. Beames said that Stratolaunch, which will be able to **carry payloads of over 500,000 pounds,** was the right size. "It's definitely not overbuilt,"

INTRODUCTION: **Compared to classical rocket launches this addresses three fundamental problems: 1. The plane can fly around bad weather to hit moving "launch windows". (2) You can launch into different types of orbits from different points on earth, (3) Stratolaunch carries the rocket into thinner air. Which grants a 5 –10% improvement in performance.**

QUESTIONS: **(a) Find the gravitational potential energy(U) increase the rockets did not have to provide to a 500,000 lb. Payload since the plane carried the payload rocket to 30,000 ft. prior to firing the rockets? , b)A little over 17,000 mph is needed to place a satellite in earth orbit. At mid earth latitudes the earth is spinning at ~ 800 mph. The Stratolauncher can fly at 530 mph and thus get rockets a boost in initial speed to 1330 mph. Find % 800 mph kinetic energy(K) is compared to 17,000 mph K? (c) Same question as (b) except find % 1330 mph K is compared to 17,000 mph K? (d) Find % increase in K from 800 mph to 1330 mph compared to K at 17,000 mph? (e)Sea level air density (ρ)is 23.77 slugs/ft.^{3}. At 30,000 ft. ρ is 8.91 slugs/ft.^{3}. $f_{DRAG} = -1/2\ C\ \rho\ A\ v^2$. Consider all variable in f_{DRAG} constant except ρ. Find % decrease in f_{DRAG} from sea level to 30,000 ft.? HINTS: Kinetic energy $K = ½\ m\ v^2$, potential energy $U = m\ g\ h$, $g = 32$ ft./s.^{2}**

ANSWERS: ***(a) 15 X 10^9 ft. lb. or 15 Billion ft. lb., (b) 2.21 %, (c) 6.12 %, (d) ~ 4 %, (e) ~267% less drag force than sea level.***
COMMENT: ***Thus, Stratolaunch: Reduces U to get payload up, reduces friction drag work, increases initial kinetic E.***