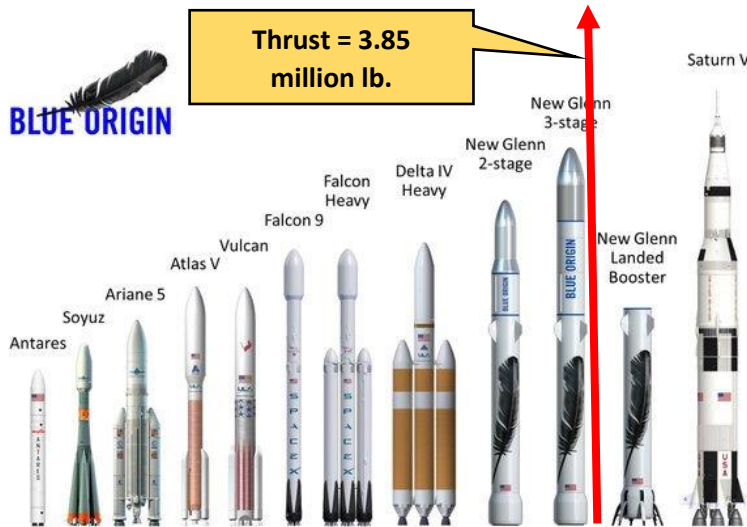


NEWTON'S 2ND LAW, $F_{NET} = M A$ Units 6 & 7

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& New York Times, September 13, 2016 by Daniel Victor

Meet New Glenn, the Blue Origin Rocket That May Someday Take You to Space



QUESTIONS: (a) Find net force on "New Glenn" at Launch? **NOTE:** Consider air friction negligible. (b) Find mass (in slugs) of "New Glenn"? (c) Find acceleration at launch? **NOTE:** Consider mass constant, (d) 20 seconds after launch blast off, find speed of "New Glenn"? (e) How far (x) has "New Glenn" gone in the first 20 seconds of flight?

HINTS: weight = $m g$, $g = 32 \text{ ft./s.}^2$, $x = v_{AVE} t$
 $v = v_0 + a t$, $x = v_0 t + \frac{1}{2} a t^2$,

ANSWERS: (a) $0.45 \times 10^6 \text{ lb.}$, (b) $1.0625 \times 10^5 \text{ slugs}$
(c) 4.235 ft./s.^2 , (d) 42.35 ft./s. , (e) 847 ft.

The rockets, named New Glenn after John Glenn, the first American to orbit the Earth, are almost as large as the Saturn V rocket that NASA used from 1966 to 1973. Blue Origin, the secretive space company created by Jeffrey P. Bezos, offered a look at its newest rocket design on Monday — and, by extension, its ambitions to make space travel more frequent and inexpensive.

Weight = $m g = 3.40 \text{ million}$

Both the rocket and the ambitions appear to be big.

The rockets, named New Glenn after John Glenn, the first American to orbit the Earth, are almost as large as the Saturn V rocket that NASA used from 1966 to 1973, before rockets started being built smaller. The two-stage version that could venture to low-Earth orbit will be 270 feet tall, and the three-stage version, which could fly outside Earth's orbit, will be 313 feet tall. Both will be 23 feet in diameter, **packing seven BE-4 engines, which are developed by Blue Origin, and lifting off with 3.85 million pounds of thrust.**

Blue Origin plans to first launch the rocket from Launch Complex 36 at Cape Canaveral, Fla., before the end of the decade. "Our vision is millions of people living and working in space, and New Glenn is a very important step," Mr. Bezos, the billionaire founder of Amazon, said in an email update. Perfecting the technology of reusable rockets — which the New Glenn rockets would be — could have profound implications on the cost and frequency of space travel. Imagine how much more expensive a flight from New York to London would be if airlines built a new 747 jet for each flight, throwing them away after one use. That is effectively the current model of the space industry; rockets typically crash back into Earth after exhausting their fuel, and the steep costs of travel depress how often it happens.

"Reusability is a total game-changer," said Charles Miller, the president of NexGen Space L.L.C., a space and public policy consultancy. "It's on the order of going from the sail to the steam engine, or going from the horse to the automobile." Blue Origin **first launched** its reusable New Shepard rocket from West Texas in November, sending a capsule that would eventually carry paying passengers to a height of 329,839 feet, just crossing the 100-kilometer line that is considered the beginning of outer space.