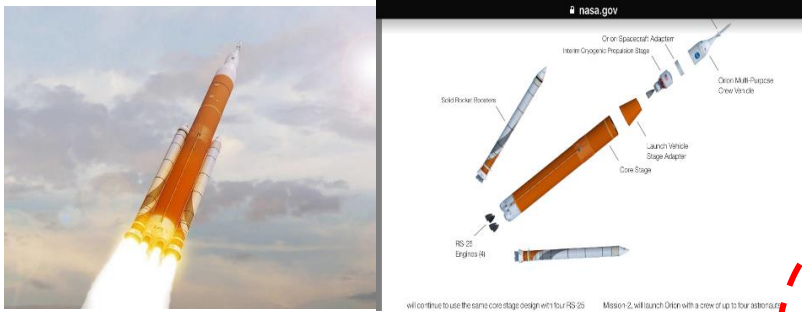


# NEWTON'S 2<sup>ND</sup>. LAW

Units 6 & 7 Dr. John P. Cise, Professor of Physics, Austin Com. College,  
1212 Rio Grande St., Austin Tx., 78701 [jpcise@Austincc.edu](mailto:jpcise@Austincc.edu) & New York Times, February 16, 2017, by Kenneth Chang

## NASA Looks to Speed Timetable for Putting Astronauts in Deep Space

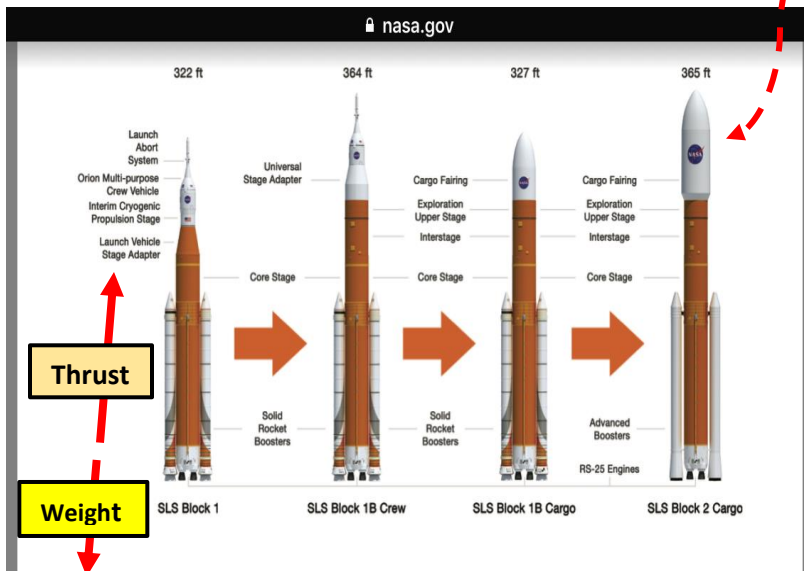


**INTRODUCTION:** The NASA site on the Space Launch System (SLS) states block 1 Rocket at lift off comprises 2 solid fuel booster rockets of 7,200,000 lb. thrust + central liquid fuel rocket with 1,670,000 lb. thrust (see graphic at left). **Thus at launch block 1 total thrust of  $\sim 8.8 \times 10^6$  lb. thrust. The weight at launch is  $5.75 \times 10^6$  lb.** The larger Block 2 rocket has a total thrust of  $9.2 \times 10^6$  lb. and weight at launch of  $6.5 \times 10^6$  lb. Assume mass is about same in first 10 seconds after launch.

**QUESTIONS:** (a) Find Net force on Block 1 rocket at launch?, (b) Find mass of Block 1 rocket?, (c) Find acceleration of Block 1 rocket at launch?, (d) Find speed (in ft./s. & mph) of Block 1 after 10 s. of launch?, (e) Find distance traveled in first 10 s.? (f) Same questions as above for Block 2 rocket.  $F_{\text{net}} = ?$ , (g)  $m = ?$ , (h)  $a = ?$ , (i)  $v = ?$ , (j)  $x = ?$ , (k) Find apparent wt. (each case) of 160 lb. astronaut at launch?

**HINTS:**  $F_{\text{NET}} = m a$ , Weight =  $m g$ ,  $g = 32 \text{ ft./s.}^2$ ,  
 $V = v_0 + at$ ,  $x = v_0 t + \frac{1}{2} a t^2$ ,

**ANSWERS:** (a)  $3.05 \times 10^6$  lb., (b)  $1.796 \times 10^5$  slugs  
(c)  $a \sim 16.97 \text{ ft./s.}^2$  (d)  $v \sim 170 \text{ ft./s.}$  or  $\sim 116 \text{ mph}$   
(e)  $x \sim 849 \text{ ft.}$ , (f)  $2.7 \times 10^6$  lb., (g)  $m \sim 2.031 \times 10^5$  Slugs,  
(h)  $a = 13.29 \text{ ft./s.}^2$ , (i)  $v = 133 \text{ ft./s.}$  or  $\sim 91 \text{ mph}$ ,  
(j)  $x \sim 665 \text{ ft.}$  (k)  $W_{\text{BLOCK 1}} \sim 245 \text{ LB.}$ ,  $W_{\text{B2}} \sim 226 \text{ lb.}$



An artist's rendition of NASA's Space Launch System. NASA announced on Wednesday that it wanted to consider taking astronauts on the rocket's first flight. In the first public inkling of the Trump administration's aspirations for space exploration, NASA announced on Wednesday that it wanted to consider taking astronauts on the first flight of its **new heavy-lift rocket**. That type of notable mission could speed up **a return to the moon**. Under current plans, the **first launch was scheduled for late 2018** and did not include a crew for testing the systems aboard the rocket and the capsule, named Orion. **Under the current plans for the first launch, a crewless Orion capsule would spend three weeks in space, flying to the moon and entering an orbit about 40,000 miles above the surface.** With astronauts on board, the mission would most likely be shorter, perhaps similar to the trajectory taken by Apollo 8 in December 1968, when three NASA astronauts made 10 orbits around the moon in 20 hours and then returned to Earth. The first Space Launch System rocket also uses an upper stage that is derived from the Delta 4 rocket that has not been rated for crewed missions. NASA is developing a more powerful upper stage for the second flight. The risks of flying people on the first launch of a rocket are much greater. In the **Apollo program**, NASA launched several crewless missions to gain confidence before adding astronauts on Apollo 7. Two commercial systems by Boeing and SpaceX to take astronauts to the International Space Station will also fly crewless test flights first. The first launch of the **space shuttle** in 1981 did carry astronauts. Boeing and Lockheed Martin put out statements that supported the effort. **"The possibility of NASA accelerating the timeline to put humans into the vicinity of the moon and onto Mars is exciting,"** Boeing said. The Lockheed Martin statement noted some of the challenges. "We'll look at accelerating remaining crew system designs, as well as potential technical and schedule challenges and how to mitigate them," the company said. Mr. Lightfoot wrote in his memo, "From my interactions with the transition team, NASA is clearly a priority for the president and his administration."