NASA launched its Lunar Atmosphere and Dust Environment Explorer (LADEE) at 11:27 p.m. EDT Friday, September 6, 2013 from the agency's Wallops Flight Facility in Virginia. LADEE is scheduled to arrive at the moon in 30 days, then enter lunar orbit.

NASA's LADEE mission caused a sensation in the Eastern United States. Friday's launch was visible from Virginia to Massachusetts. The fireball was captured by photographers and videographers in many locations. Crowds gathered in Times Square in New York and on the steps of the Lincoln Memorial in Washington to watch.

The table below gives the flight data during the Stage 3 ignition period beginning 190 seconds after launch and just before Stage 3 burnout at 210 seconds.

Time (seconds)	Altitude (kilometers)	Range (kilometers)	Speed (meters/sec)
190	150	446	5339
192	151	456	5344
194	153	467	5535
196	154	478	5629
198	156	489	5744
200	158	500	5853
202	159	511	5962
204	161	522	5991
206	163	533	5993
208	164	546	5990

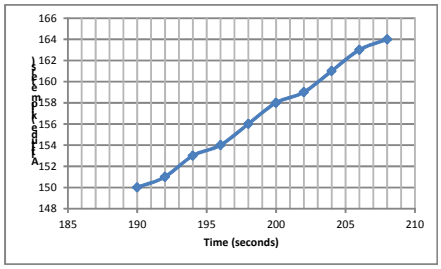
Problem 1 – Create a graph of the altitude in kilometers versus the time after launch in seconds. Over the plotted interval, what is the average slope of the line, and what does it represent? (Use proper units for the slope based on the graph)

Problem 2 – The distance between the launch gantry and the point directly under the current position of the rocket is called the range. Create a graph of the range of the rocket over this time interval. What is the average slope of the plotted line, and what does it represent? (Use proper units for the slope based on the graph)

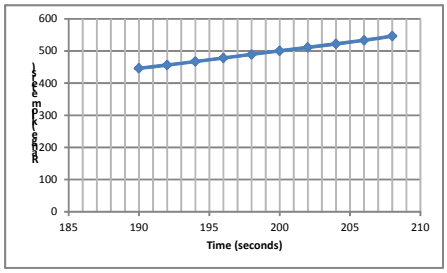
Problem 3 – Graph the speed of the rocket over the interval between 192 and 202 seconds. What is the average slope of the line, and what does this represent?
(Use proper units for the slope based on the graph)

LADEE Lights Up the East Coast
http://www.nasa.gov/content/ladee-lights-up-the-east-coast/index.html#.Uiq1e3eO6So
September 7, 2013

Problem 1 – Create a graph of the altitude in kilometers versus the time after launch in seconds. Over the plotted interval, what is the average slope of the line, and what does it represent? (Use proper units for the slope based on the graph). Answer: Average slope = (164-150)/(208-190) = +14 km/18 sec = **+0.78 km/sec. This represents the vertical speed of the rocket**.



Problem 2 – The distance between the launch gantry and the point directly under the current position of the rocket is called the range. Create a graph of the range of the rocket over this time interval. What is the average slope of the plotted line, and what does it represent? (Use proper units for the slope based on the graph). Answer: Slope = (546-446)/(208-190) = + 100km/18sec = **+5.56 km/sec. This represents the horizontal speed of the rocket.**



Note to Teacher: The vertical speed and horizontal speed are the legs of a right-triangle. The hypothenuse is the total speed of the rocket. Using the Pythagorean Theorem we can find $S^2 = (0.78^2 + 5.56^2)$ so S = 5600 meters/sec, which is close to the average rocket speed in the time interval, which is graphed in Problem 3.

Problem 3 – Graph the speed of the rocket over the interval between 192 and 202 seconds. What is the average slope of the line, and what does this represent? (Use proper units for the slope based on the graph). Answer: slope = (5962-5344)/(202-192) = (+618 meters/sec)/10sec = **+61.8 meters/sec^2. This represents the average acceleration of the rocket.** Note 1 Earth gravity = +9.8 meters/sec^2, so the average acceleration of the rocket is about '6 Gs' which would be very unpleasant for humans if this were a manned flight!