Voyages to the Terrestrial Planets Lab: *Rocketry, part 3*

Overview: For the next part of this lab, we are going to be launching our rockets. Launching should be a lot of fun, but it also going to be some work as you will need to collect data as you are launching your rocket. You will need to divide the work load up among your team members – one person will get to launch the rocket, one person will time the rocket's travel time, and another will track the rocket's altitude. You are going to then synthesize these collected data, perform some calculations with them and then compare them to real rockets – your results and findings will then be written up in a short (relatively short, at least) lab report and presentation to the class.

To do: There are several steps for today's lab and I outline them below:

Part 1: In class, before going out to the field

a) Attach your engine into your rocket and get it ready to go (if you have not done so already)
b) Put batteries into your ignition switch, if it has not already been done
c) Weigh your rocket on the scale and record the provided weight
d) Take a picture of your rocket
e) Pick up an altitude tracking kit (I only have six of these, so some groups will need to share)
f) Make sure your launch pad is assembled or that you can borrow someone else's for your launch
g) Read through the rest of the steps below

Part 2: Outside, prior to launch

a) Practice using the tracking device by having someone throw an object in the air and following it with the tracker
b) Place your launch pad on one of the tarps
c) Measure the distance from the launch pad to where you will be tracking the rocket; record this distance in your notebook – since we are on the football field, be at least 100 yards away
d) Have someone get a stop clock ready to be able to time the travel of your rocket – two people doing this would be better – one to time the rocket to its maximum height and the second to measure its travel time back to Earth. Make sure you end up recording these times as well.
e) Attach your rocket to the launch pad

Part 3: Outside, launch time

a) Take a picture of your rocket on the launch pad – we will launch one team's rocket at a time
b) Make sure everyone on your team knows their job – you will need to communicate with each other!
c) Make sure everyone is a safe distance away from the launch pad (I would recommend 20 to 30 feet away – also make sure your launch guide (the metal pole) is pointing straight up)
d) LAUNCH!!
e) Everyone collect the data that they are suppose to and RECORD that data

Part 4: Back in the lab

a) Start using your data to calculate the rocket's average velocity, height attained, force of your rocket, and its acceleration…I provide notes for solving these unknowns below
b) Go through the details in this packet regarding your write-up

Notes to solving for your unknowns:

Your rocket's attained height:

a) ASSSUME that your rocket traveled up in a straight line. This is obviously a very simplifying assumption, but it will make calculating your altitude easier
b) Sketch out your rocket traveling straight up, the distance between the altitude tracker and the launch pad, and the measured angle on the altitude tracker
c) Once you sketch this out, you should see a certain type of triangle emerge. From that triangle you can measure the height that your rocket attained. Hint: This involves trigonometry…

Your rocket's velocity:

a) Velocity is the distance something traveled divided by the time it took that something to travel that distance. However, your rocket's upward velocity will be different than its downward velocity. Subsequently, you need to measure the upward velocity and also the downward velocity – hence having the two stop watches
b) You will need to calculate the upward velocity and the downward velocity

Your rocket's acceleration:

a) Acceleration is the rate of change of your velocity. In simpler terms, it is the difference in your initial and final velocities divided by time; that difference in velocities should be your final velocity minus your initial velocity
b) You will need to calculate your velocity first. However, remember that when your rocket reaches its highest elevation, the velocity of that point is zero. Similarly, when your rocket begins its downward descent, its initial velocity will be zero…its maximum velocity will be when it hits the ground. Calculate the acceleration of your rocket going up and your rocket coming back down.

Your rocket's force on liftoff:

a) Remember Newton's second law that states that force is equal to mass multiplied by acceleration
b) Calculate the force of your rocket when it is lifting off – take this to be your rocket's thrust