**Curiosity in Motion**

***Introduction***

*On November 26th, 2011, the Mars Science Laboratory (aka Curiosity) Rover was launched from Earth. In order to celebrate the 1-year launch anniversary of this marvelous and legendary icon of space exploration and scientific study, you will analyze some of the scientific aspects of Curiosity’s journey to Mars.*

*The goal of this assignment is to show you how the science of motion can be applied in the “real world.” In addition, hopefully, at the end of this assignment, you may also develop an appreciation for the spectacular feat of intricate, precise engineering and ingenuity that went into building Curiosity.*

***Directions and Questions***

*Go to* [*http://www.jpl.nasa.gov/video/index.cfm?id=1090*](http://www.jpl.nasa.gov/video/index.cfm?id=1090)

***OR*** *go to Ms. Tharayil’s website and under the “Updates” page, click watch the second video posted about Curiosity called “7 Minutes of Terror.”* [*http://mstharayil.weebly.com/updates.html*](http://mstharayil.weebly.com/updates.html)

*Watch the video, and based on the info provided in the video* ***answer the following questions****.*

*For all questions, you may round to the nearest tenth (one decimal place).*

*SHOW YOUR WORK. DO NOT FORGET TO INCLUDE THE CORRECT UNITS!!!*

1. What deceleration did Curiosity have to achieve from the time it touches the top of the Martian atmosphere to the time it took to land on Mars? *(Hint: Pay very close attention to what Tom Rivellini, EDL Engineer, says about a fifth of the way into the video)* 
   1. What is the formula for acceleration?
   2. According to the video, what was Curiosity’s initial velocity at the time it touched the Martian atmosphere? YOU WILL NEED TO CONVERT THIS VELOCITY FROM MPH to **Km/Seconds**. (You may use a digital/online units converter if you need to.)
   3. What final velocity did it need to reach when it landed on Mars? YOU WILL NEED TO CONVERT THIS VELOCITY FROM MPH to **Km/Seconds**. (You may use a digital/online units converter if you need to.)
   4. How long did it take Curiosity to go from the time it touched the Martian atmosphere to the surface of Mars (*hint: what is the title of the video?)*
   5. Calculate the deceleration Curiosity would have had without atmospheric resistance and its parachutes, from the time it touched the Martian atmosphere to time it touched down, using the information below. You may calculate the deceleration in km/s2.
   6. Explain what would have happened to the rover if Curiosity really did decelerate and descend at this rate, without the presence of its parachutes and the Martian atmosphere.
      1. What does this tell you about the importance of friction? What type of friction was important here?
      2. How else can you relate this your understanding of forces and motion? *(Hint: think about Newton’s Laws of Motion)*
2. *Go to* [*http://www.jpl.nasa.gov/msl/*](http://www.jpl.nasa.gov/msl/). *Under where it says “****Resources****” on the right side of the screen, click on the link that says “****Landing Press Kit****” (*[*http://www.jpl.nasa.gov/news/press\_kits/MSLLanding.pdf*](http://www.jpl.nasa.gov/news/press_kits/MSLLanding.pdf)*)*

*Scroll down to Pg. 6. Read the section titled “Mission.”*

* 1. What was the total distance Curiosity traveled from Earth to Mars in kilometers?

*Now, scroll down to Pg. 25, titled “Mission Overview” and read through it.*

* 1. How many days did it take for Curiosity to get from Earth to Mars?

CONVERT THE NUMBER OF DAYS TO HOURS.

* 1. What is the formula for average speed?
  2. Using the information listed in #2.a. and 2.b., calculate Curiosity’s average speed during its cruise phase.

1. *Go to pg. 26, and read through it. Answer the following questions.*
   1. Did Curiosity always stay on the path/trajectory that it was supposed to?
   2. Prior to the first trajectory corrections on Jan. 11th and March 26th 2012, Curiosity would’ve missed Mars (if it stayed on that trajectory) by about how many kilometers and by how many hours?
   3. What does this tell about the importance of having precise calculations?
2. *Go back to* [*www.jpl.nasa.gov/msl*](http://www.jpl.nasa.gov/msl) *(the homepage). On the middle, right side of the screen, below the “****Resources****” section, there should be a banner called* ***“7 Minutes of Terror,”*** *click on it and it should expand.*

*Read through that banner.*

*Curiosity has its own Twitter feed written in the perspective of the rover itself (i.e. as if Curiosity were a talking person).*

*Below you will write a series of Tweets for Curiosity (from the perspective of Curiosity i.e. as if you were Curiosity itself) for each of the following stages of the Entry, Descent and Landing Stage.*

*Your tweet MUST be FACTUAL in nature but MUST also EXPRESS EMOTION.*

*You may use hashtags if you’d like.*

*\*REMEMBER A TWEET MUST BE 140* ***CHARACTERS*** *OR LESS\**

*(2 points each)*

Entry

1. Approaching Mars
2. Guided entry

Descent

1. Parachute deploys
2. Heat shield separates
3. Powered descent
4. Skycrane lowers the rover

Landing

1. Touchdown