Zero Gravity

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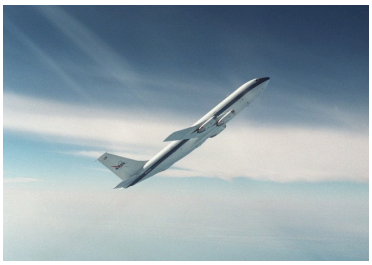
✓ **Question 1** 15/15 pts 99

Height of a Zero Gravity Parabolic Flight

Background Information:



Have you ever wondered what it might feel like to float weightlessly in space? One way to try it out is to fly on a special aircraft that astronauts use to train for their trips to space. Both NASA and the Russian Space Agency have been flying these for years. The way it is done is to fly to a high altitude, drop down to gain speed, then start a large parabolic path up in the sky. For a time ranging from 10 to 20 seconds, along the top part of the parabolic flight, an environment simulating zero gravity is created within the plane. This effect can cause some nausea in the participants, giving rise to the name "Vomit Comet", the plane used by NASA for zero-G parabolic training flights. Currently, there is also a private company that will sell you a zero-G ride, though it is a bit expensive.

This lab will have you develop a mathematical model for the parabolic path.

It is composed of three parts.

Part I

You will find the system of equations needed to find the values to create the model. Using three given data points that describe the altitude (the height in feet) of the plane at a given time (in seconds), you will determine a 3X3 system of linear equations. You will also write the system as an augmented matrix.

Part II

You will find the solution of the system of equations which gives you the coefficients, a, b, and c that you will use for the quadratic model of the flight: $h(t) = at^2 + bt + c$

You will also use your model to find the time that the maximum height of the plane is reached and the maximum height itself.

Part III

You will visualize the model by plotting the function on an appropriately scaled set of axes.

$Part I$

The Data: Here are three times and the measured height of the plane at those times.

Time (t) in seconds	Height (h) in feet
2	23926
20	32188
40	33768

To find the coefficients for your model, plug the data into the equation:

$$h = at^2 + bt + c$$

The data points are just like x and y values, where the x value is the time t in seconds and the y value is the altitude h in feet. Plug these into the model to get three linear equations with variables a , b ,and c .

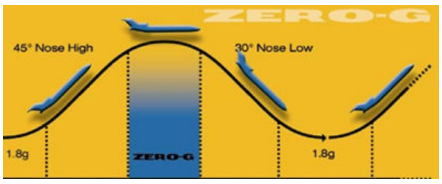
Data Values	Enter the resulting equation	
$(2, 23926)$	$23926 = 4a + 2b + c$	
$(20, 32188)$	$32188 = 400a + 20b + c$	
$(40, 33768)$	$33768 = 1600a + 40b + c$	

Now that you have your system of 3 equations with 3 unknowns, you will have to solve it. For this lab, you can solve the system using any method you prefer.

✓ **Question 2** 7/7 pts 98-99

Height of a Zero Gravity

Parabolic Flight, Part II



In $PartI$ you found a 3x3 system of equations using data from the flight. The solution to that system can now be used to create the quadratic model that gives the height of the plane as a function of time.

a) Enter the solutions to your system here:

$a =$ -10

$b =$ 679

$c =$ 22608

b) Use your solutions to form the quadratic model of the flight:

$h(t) =$ $-10t^2 + 679t + 22608$

c) Use $h(t)$ to find the time when the plane reaches its maximum height. Round your answer to one decimal place, if necessary:

$t_{\max} =$ 34 seconds

d) Use $h(t)$ and $t_{\max}$ to find the maximum height the plane reaches. Round your answer to the nearest foot.

$h_{\max} =$ 34134 feet

e) The time and the maximum height correspond to what point on the graph of $h(t)$? Fill in the answer below.

$(t_{\max}, h_{\max})$ is the vertex of the parabola.

Take note of your answers to parts c) and d) as you will need them in $PartIII$ to graph $h(t)$.

✓ **Question 3** 5/5 pts 97-99

Height of Zero Gravity

Parabolic Flight, Part III

In $PartII$ of this lab, you found the quadratic function, $h(t)$, that models the parabolic flight used to acheive "zero-G".

a) Let's confirm you have the correct function. Enter it below.

$h(t) =$ $-10t^2 + 679t + 22608$

b) Let's confirm you found the correct coordinates for the vertex. Enter them below.

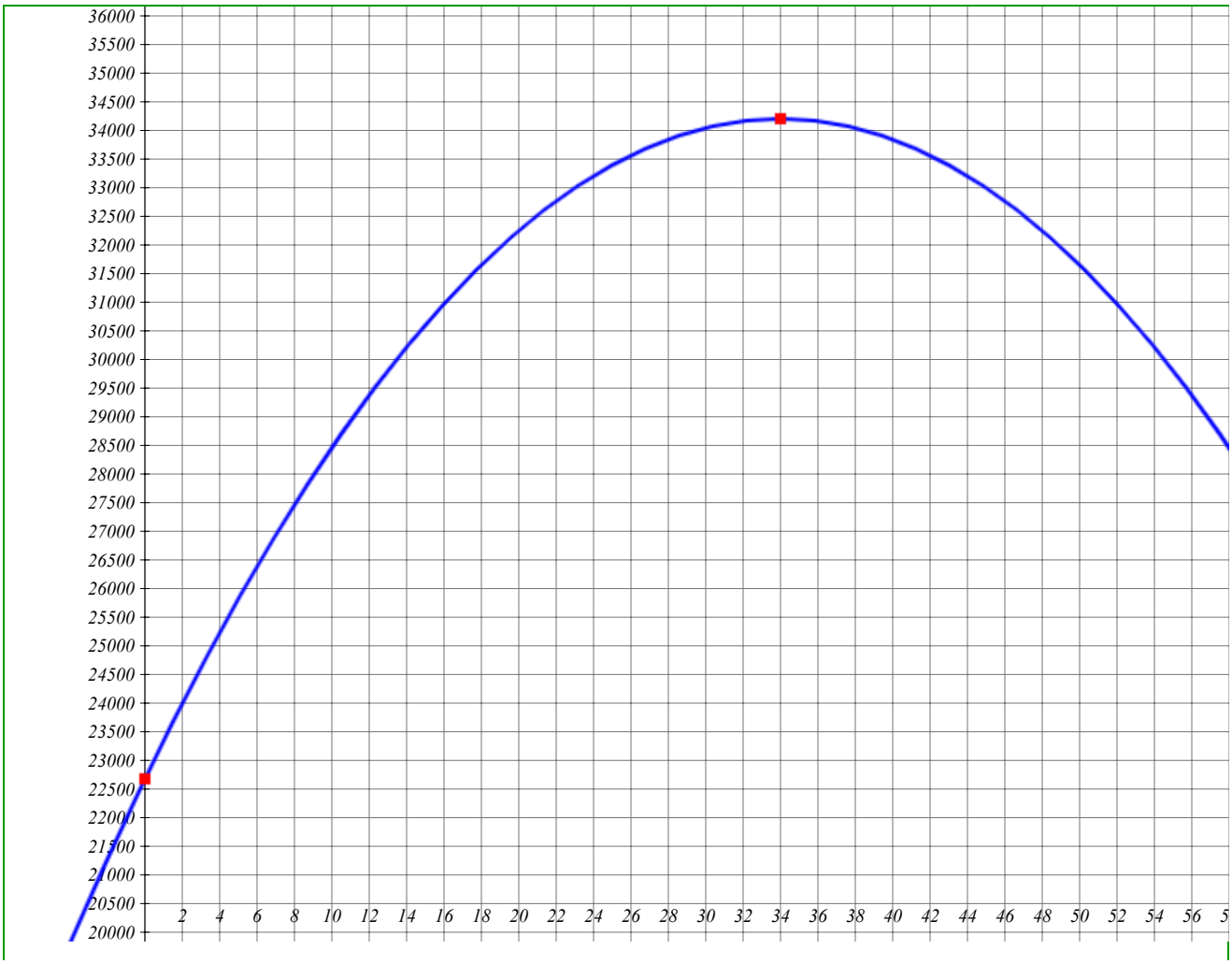
$\text{Vertex: } ($ 34 , 34134 $)$

You are almost ready to graph your quadratic model. To use the graphing feature, you will start by plotting the vertex and then one other point. The easiest other point to use is the h-intercept (this is just like a y-intercept but your vertical axis in this model is the height, thus it is an h-axis).

c) To find the h-intercept, you just need to evaluate your function at $t = 0$. Do that here:

$h(0) =$ 22608

d) You are ready to graph your quadratic model: $h(t) = at^2 + bt + c$. It would be tricky to get the vertex and h-intercept in exactly the right place. As long as you get it close, the program should accept your answer. Give it a try.



✓ **Question 4** ☑ 13/13 pts ↺ 99

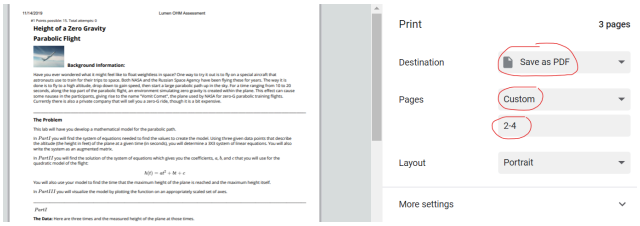
Zero Gravity

Parabolic Flight

Reflective Writing

Instructions:

After you have completed the Zero-G project **you have the option to post it and the following reflective writing in your General Education ePortfolio (or you can choose another project, as directed by your instructor)**. Your completed project can be printed to a pdf file and posted in that form. To print it to a pdf file, click on the "Print Version" link under the question links on the left hand side of the page. Click the "Print" button. Then select "Save as PDF" and do "Custom" and "2-4" (to get rid of a blank page at the start and this page too).



The reflective writing should be posted as a typed paper, proof-read for typos, spelling, and grammar. Use Times New Roman 12-point font and double space. Add a title (e.g. "Modeling Zero-G Parabolic Flight"). This must be saved as a pdf. Please note that posted files must be pdf files, not Word documents or other types of files. If you have a recent version of Word you can convert your file to a pdf format using that program. There are also several free pdf converters available. For example, Cute PDF (Links to an external site.) allows you to “print” files to a pdf format.

Please upload the documents to your ePortfolio so that it is visible to your instructor.

Provide a brief introduction explaining the lab in your own words. Also in the introduction, tell the audience which mathematical techniques you used in the lab (e.g. plotting graphs). Then, please respond to each of the questions below. Your writing should be in an essay form (written in paragraphs). The response should be at least one page in length.

Please Answer the Following Questions (in essay form):

1. Introduce the lab and which mathematical techniques were used.
2. Do you think this project shows how math can be applied to the real world?
    a. If “yes”, please elaborate why are the results important or beneficial?
    b. If “no”, how could the lab change to make it more applicable to the “real world”?

3. Can you think of or find an example of (Hint: see the exercises in your text) another application where quadratic functions could be used to model a situation? Be specific.

4. If you were the on the flight crew in this lab, or if your were the pilot, would it be important to be able to explain the results of the lab to potential passengers? What details would you need to share with them? Be specific.
5. Did this assignment change your opinion of the usefulness of math?
    a. Write at least one paragraph stating what ideas changed and why.
    b. If this project did not change the way you think, write how this project gave further evidence to support your existing opinion about applying math. Be specific.

ePortfolio: Post a copy of this lab, including the Reflective Writing, to your ePortfolio. For more information about ePortfolios, please see the syllabus or the SLCC webpage . Once you have posted it, complete the separate ePortfolio submission assignment through Canvas.

I have printed this assignment and will review the ePortfolio assignment and instructions provided by my instructor.

True ✓