

Team 42's report

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Executive Summary

When designing falls and rises of a roller coaster, what must be done to ensure safety of the passengers and still give the passengers pleasure? We asked ourselves this very question. We have constructed a program to go about solving this problem. Our program outputs points that can be plotted to form the shape of a safe drop, given the distance of the roller coaster from the center of the hill and the velocity of the car at the top of the hill. With the results of this program, you can plot the shape of a safe drop on a x/y axis. The formula that we used for this program $h = ax^2 / 2v^2$, where (h) equals the distance between the roller coaster and the top of the hill, (a) equals acceleration due to gravity,

(v) equals the velocity the car travels over the top of the hill, and (x) equals the horizontal distance away from the center of the hill.

Problem

The problem that we investigated was to find out what must be done to ensure

safety of passengers when designing falls and drops of a roller coaster. In our problem we

only included a few variables, and they are the following: H= Height from the top of the

hill, X= Distance away from the center of the hill, V= The velocity the roller coaster car

travels over the top of the hill, and the constant variable, A= Acceleration due to gravity 9.8 m/s/s.

The Method That We Used to Solve Our Problem

The way we solved our problem was we created a program that tells the user a

safe rate of vertical and horizontal motion for a drop on a roller coaster. The results of

our program can be used to show what speeds are too fast for a hill by giving output of

graphing points (to get the most accurate results, you would input a lot of information to

graph the roller coaster accurately). We decided to include the variable of acceleration

due to gravity only, we did not use any other variables except for the input variables. For

example, if the speed was 100 kph and the distance of the car from the top hill was 15m

the output would be .11025m away from the center of the hill.

Results and Conclusions

Through our research and program output we have found that by using the equation $H = ax^2 / 2v^2$ you can find the shape of a safe drop for any speed. We discovered that if a roller coaster enters a decline at too high of a speed the descent will be very slight. This will not give fun or the feeling of weightlessness.

We have found speeds of around 8 and 10 kph to be good speeds for the enter of a drop that will be steep but not too steep. High speeds such as 56 kph are not good entering speeds.

Team 42's C++ Program

```
#include <iostream.h>

int main ()
{
float h=0, x=0, v=0, a=0;
//explain function of program
cout << "This is Team 42's Roller Coaster Program." << endl;
cout << "This program determines the shape of a drop that will" << endl;
cout << "be safe and give the feeling of weightlessness." << endl;
//enter first variable(velocity)
cout << "Enter the velocity the roller coaster car travels " << endl;
cout << "over the top of the hill in km/h;" << endl;
cin >> v;
//enter second variable(Horizontal Distance)
cout << "Enter the distance away from the center of the hill in meters:" << endl;
cin >> x;
a=9.8; //acceleration due to gravity
h = ( a * (x*x) ) / ( 2 * (v*v) ); //equation to find Y(vertical distance)

//output of all variables
cout << "The velocity the roller coaster car travels" << endl;
cout << " over the top of the hill is: " << v << " km/h. " << endl;
```

```

cout << "You entered: " << x << " meters as the distance away" << endl;
cout << " from the center of the hill." << endl;
cout << "The height from the top of the is: " << h << " meters." << endl;
cout << "Next, plot the distance away from the center of the hill" << endl;
cout << " and the height from the hill, then run the program again." << endl;
cout << "Input other numbers for x to find any point on the drop." << endl;
cout << "Plot these points on a graph" << endl;
cout << "to see the shape of the hill." << endl;

return (0);
}

```

Program output

Roller coaster travels over top of hill at a speed of 8 kph

Distance from center of hill	Distance from top of hill
1	-0.07656
2	-0.30625
3	-0.68906
4	-1.225
5	-1.91406
6	-2.75625
7	-3.75156
8	-4.9
9	-6.20156
10	-7.65625
11	-9.26406
12	-11.025
13	-12.9391
14	-15.0063
15	-17.2266

Significant Original Achievement

The output of our program determined the shape of a safe drop on a roller coaster. By graphing the data that is produced on an x/y axis, the roller coaster drop that is formed will run smoothly without harming any of the passengers aboard.

Acknowledgments

We would like to thank Las Cruces High School

Computational Science Department for

its use of its computers and our sponsoring teacher,
Mr. McBride. We would also like to

thank our fellow classmates for the helpful critique
that further refined our project.

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CoasterForce

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Chilidog C++ Help

http://207.108.244.130/Classes/Assigncs/C++_AiS_Text/index_C++.html