Tecnológico de Monterrey

MOTION: Position, velocity and acceleration
Second Partial Project

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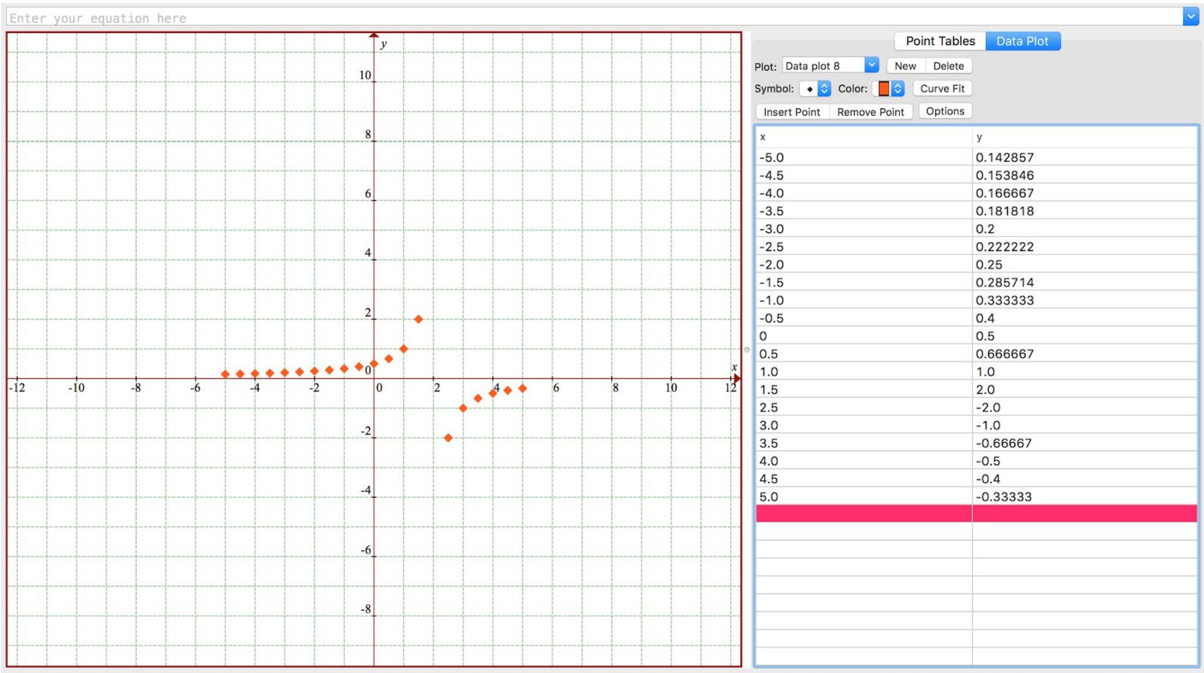
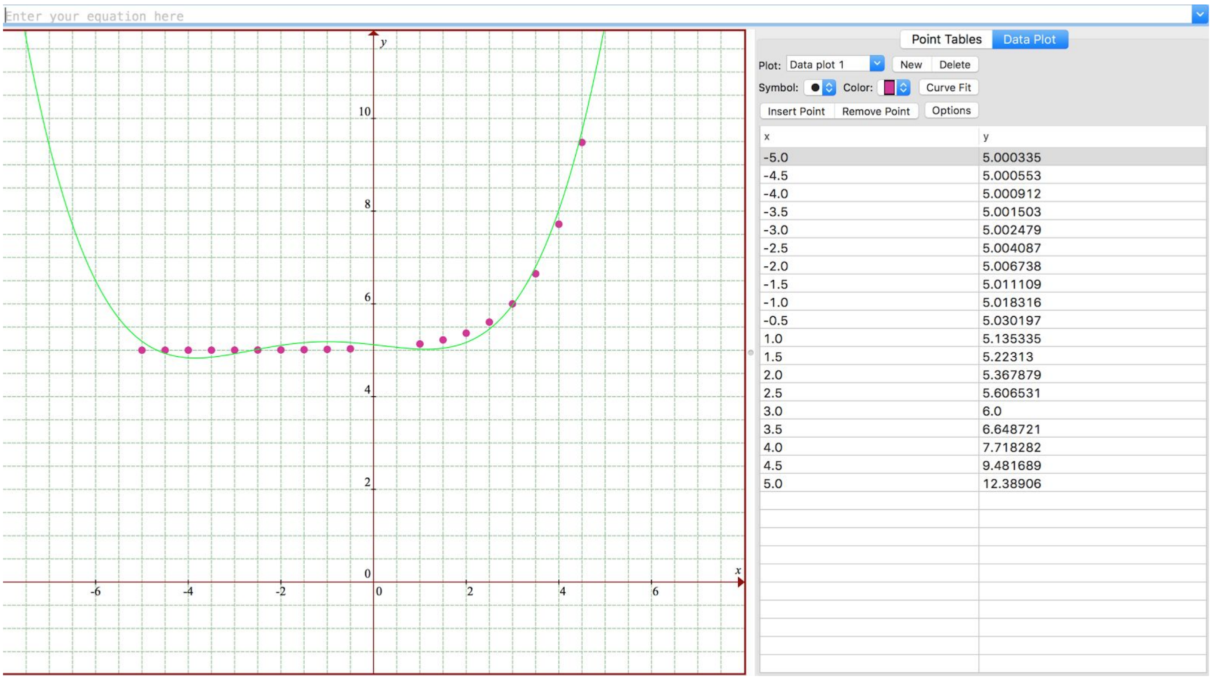
In this project we are going to be analyzing position, velocity and acceleration by using the derivatives of their equations to get those values. The main purpose of this project is for us to apply the concepts and knowledge we learned and acquired in class in order to understand them better and know how to use them in real life examples like this one. To solve this problems we'll make use of a software called "Graphmatica" in order to get the graphs and its equations in an easier and faster way. Also, we will apply several rules in order to derive the equations and get the new equations for both velocity and acceleration.

Table: f(t)



x	y
-5.0	0.142857
-4.5	0.153846
-4.0	0.166667
-3.5	0.181818
-3.0	0.2
-2.5	0.222222
-2.0	0.25
-1.5	0.285714
-1.0	0.333333
-0.5	0.4
0	0.5
0.5	0.666667
1.0	1.0
1.5	2.0
2.5	-2.0
3.0	-1.0
3.5	-0.66667
4.0	-0.5
4.5	-0.4
5.0	-0.33333

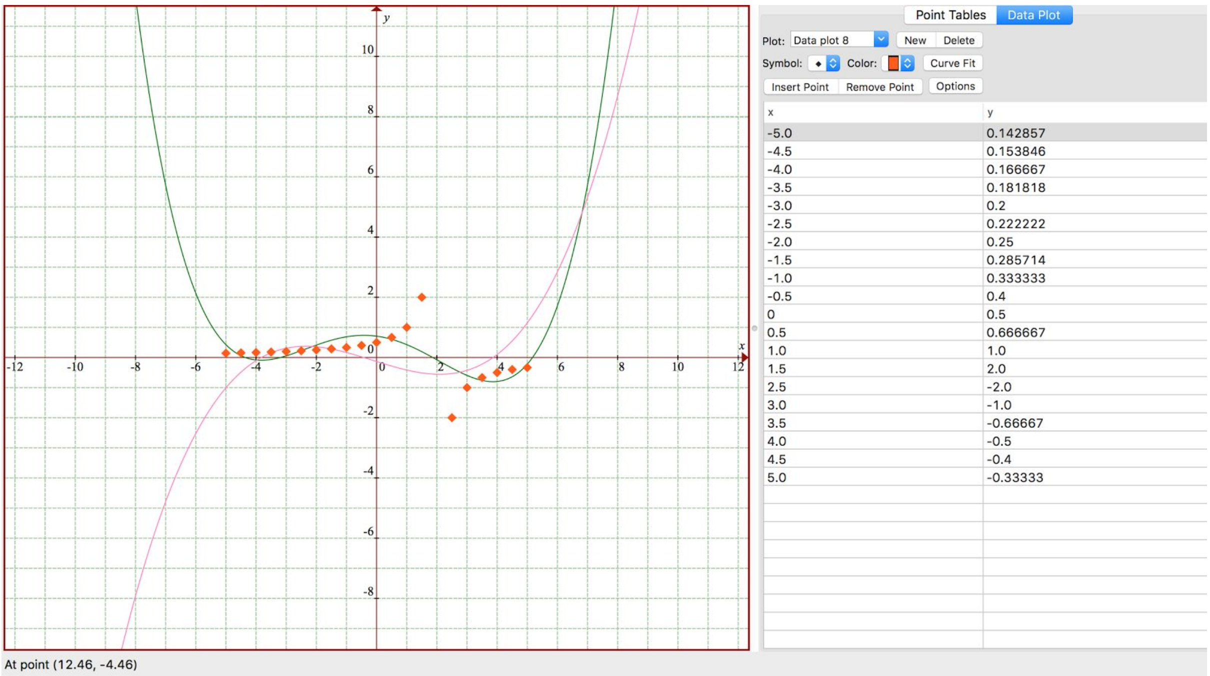
Scattered points



x	y
-5.0	5.000335
-4.5	5.000553
-4.0	5.000912
-3.5	5.001503
-3.0	5.002479
-2.5	5.004087
-2.0	5.006738
-1.5	5.011109
-1.0	5.018316
-0.5	5.030197
1.0	5.135335
1.5	5.22313
2.0	5.367879
2.5	5.606531
3.0	6.0
3.5	6.648721
4.0	7.718282
4.5	9.481689
5.0	12.38906

Original

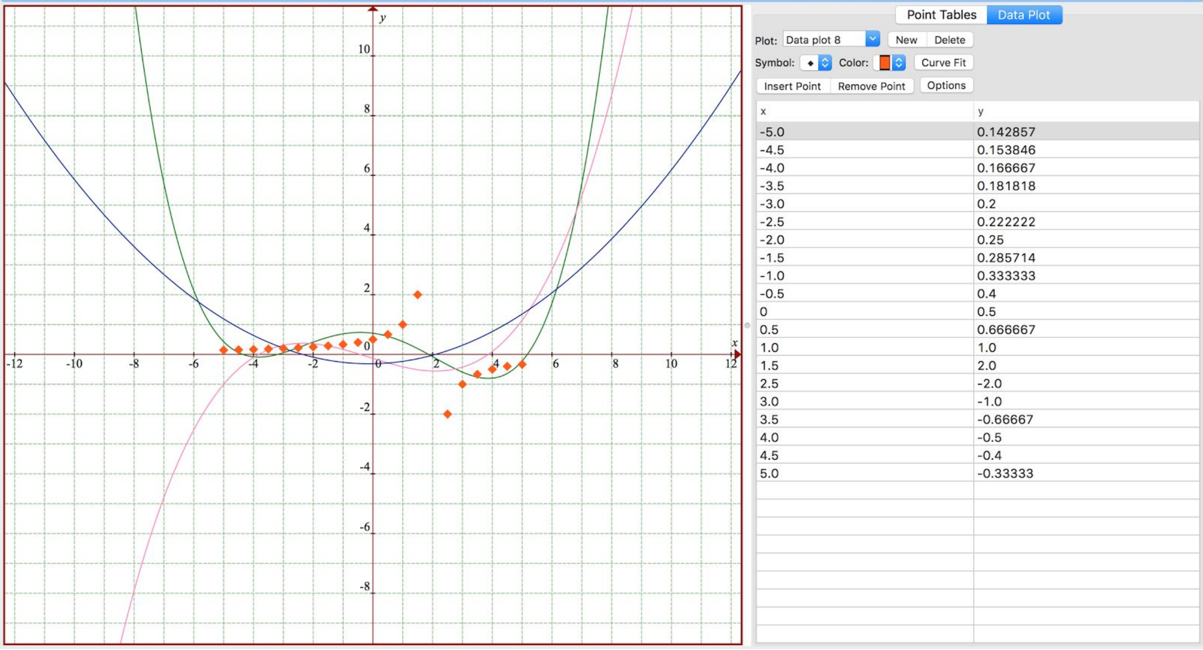
Equation for position: y = 0.005276x^4 + 0.002718x^3 - 0.156143x^2 - 0.132737x + 0.708588



x	y
-5.0	0.142857
-4.5	0.153846
-4.0	0.166667
-3.5	0.181818
-3.0	0.2
-2.5	0.222222
-2.0	0.25
-1.5	0.285714
-1.0	0.333333
-0.5	0.4
0	0.5
0.5	0.666667
1.0	1.0
1.5	2.0
2.5	-2.0
3.0	-1.0
3.5	-0.66667
4.0	-0.5
4.5	-0.4
5.0	-0.33333

Derivative

Equation for velocity: y=0.0211x^3 + 0.0082x^2 - 0.3123x - 0.1327 y=0.0211*x^3 + 0.0082*x^2 - 0.3123*x - 0.1327 ' deriv. of y = 0.005276x^4 + 0.002718x^3 - 0.156143x^2 - 0.132737x + 0.708588

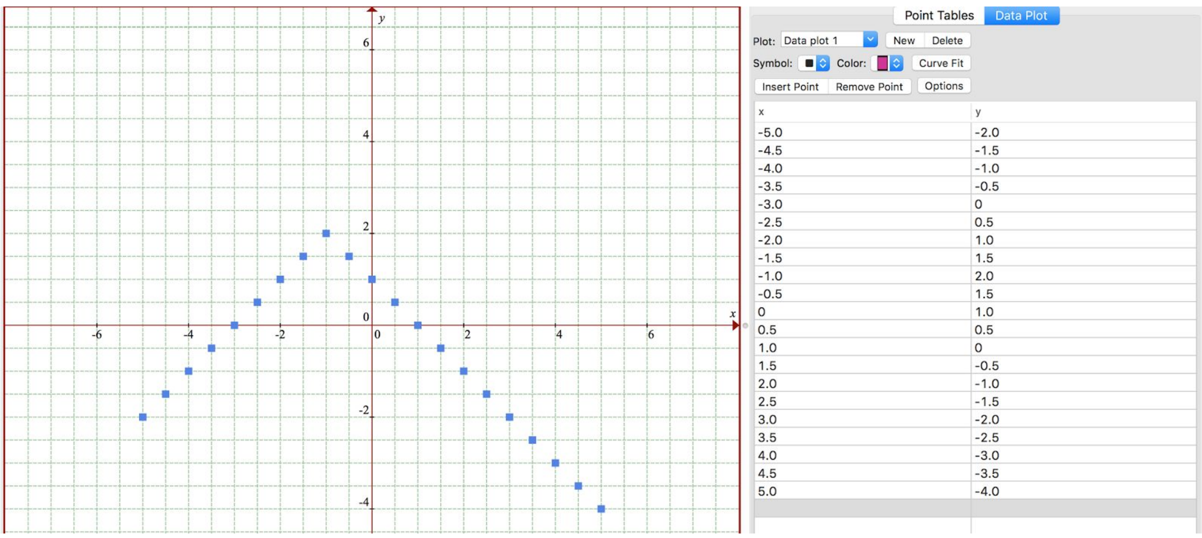


x	y
-5.0	0.142857
-4.5	0.153846
-4.0	0.166667
-3.5	0.181818
-3.0	0.2
-2.5	0.222222
-2.0	0.25
-1.5	0.285714
-1.0	0.333333
-0.5	0.4
0	0.5
0.5	0.666667
1.0	1.0
1.5	2.0
2.5	-2.0
3.0	-1.0
3.5	-0.66667
4.0	-0.5
4.5	-0.4
5.0	-0.33333

Second derivative

Equation for acceleration: y=0.0633x^2 + 0.0163x - 0.3123

Table g(t)



x	y
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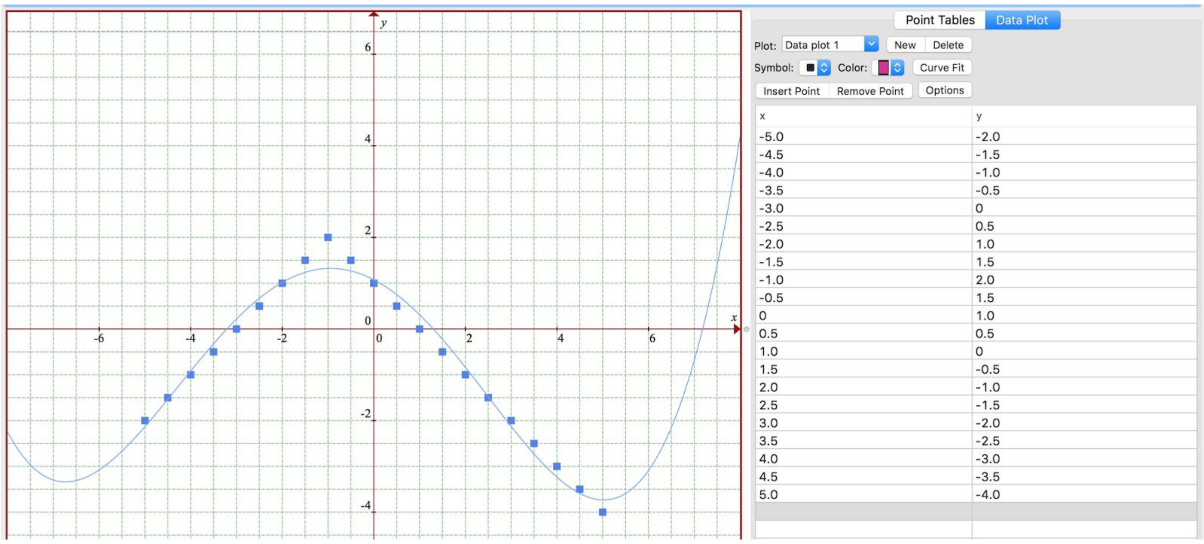
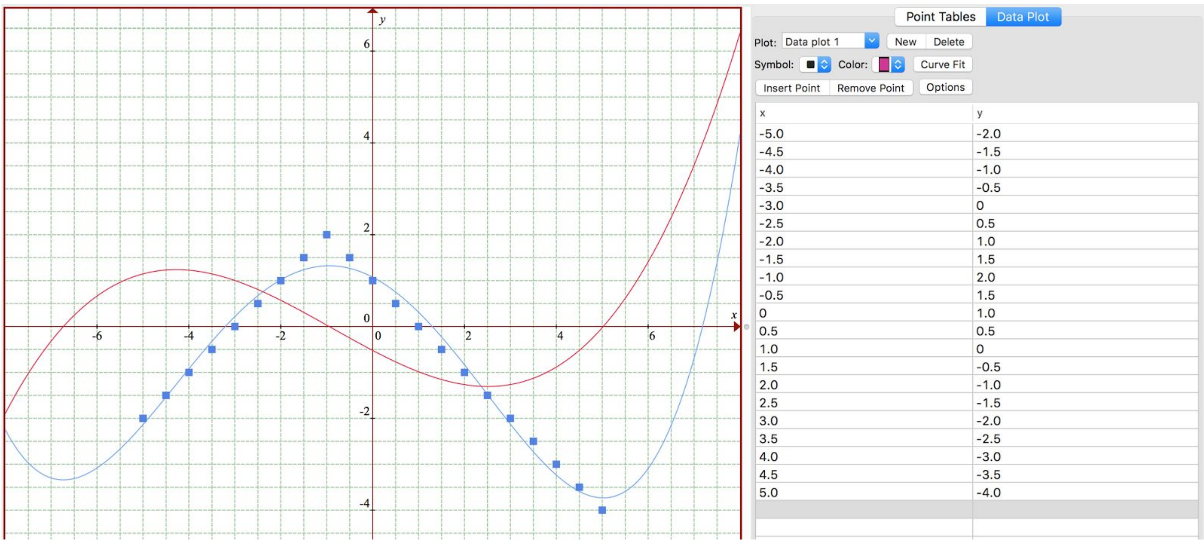
-4.5	-1.5
-4.0	-1.0
-3.5	-0.5
-3.0	0
-2.5	0.5
-2.0	1.0
-1.5	1.5
-1.0	2.0
-0.5	1.5
0	1.0
0.5	0.5
1.0	0
1.5	-0.5
2.0	-1.0
2.5	-1.5
3.0	-2.0
3.5	-2.5
4.0	-3.0
4.5	-3.5
5.0	-4.0



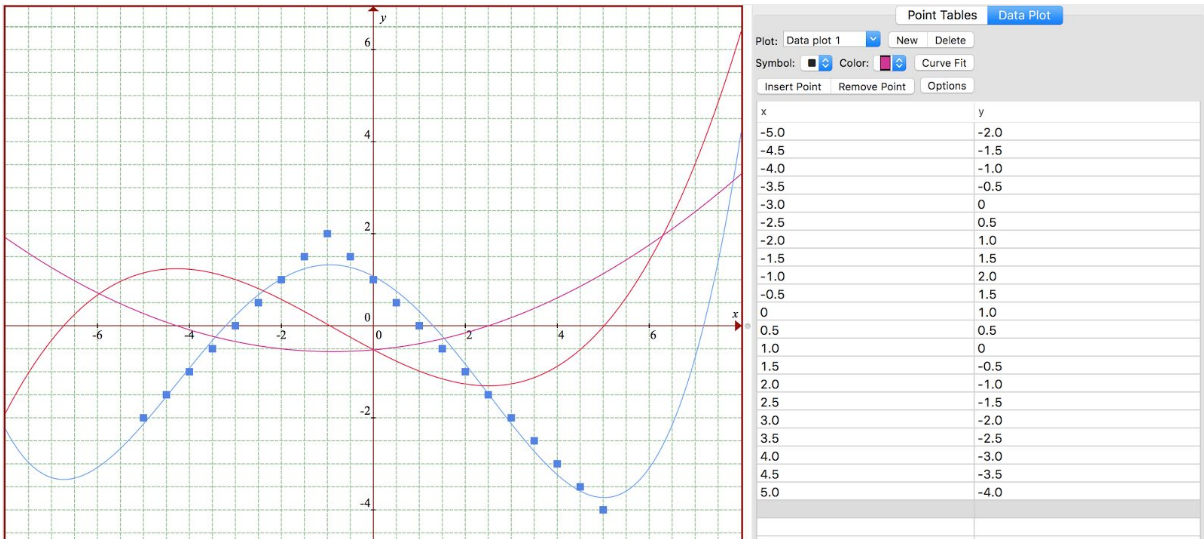
Original

Equation for position: y = 0.004071x^4 + 0.014423x^3 - 0.262116x^2 - 0.520382x + 1.074703



Derivative

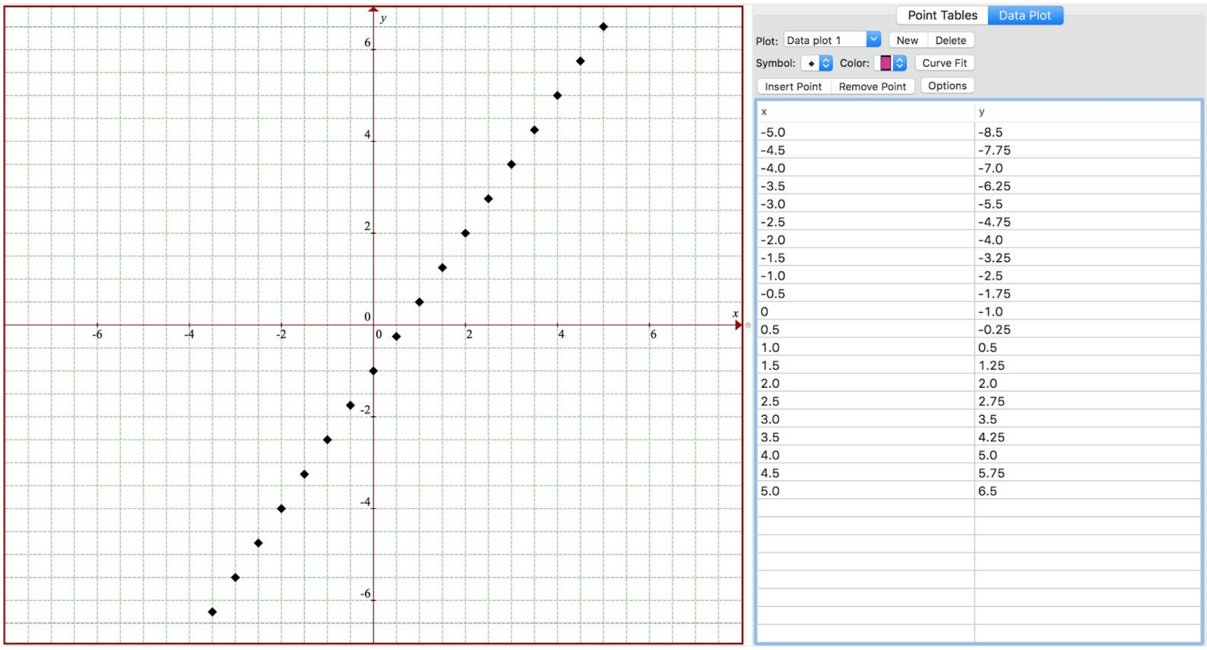
Equation for velocity: y=0.0163x^3 + 0.0433x^2 - 0.5242x - 0.5204



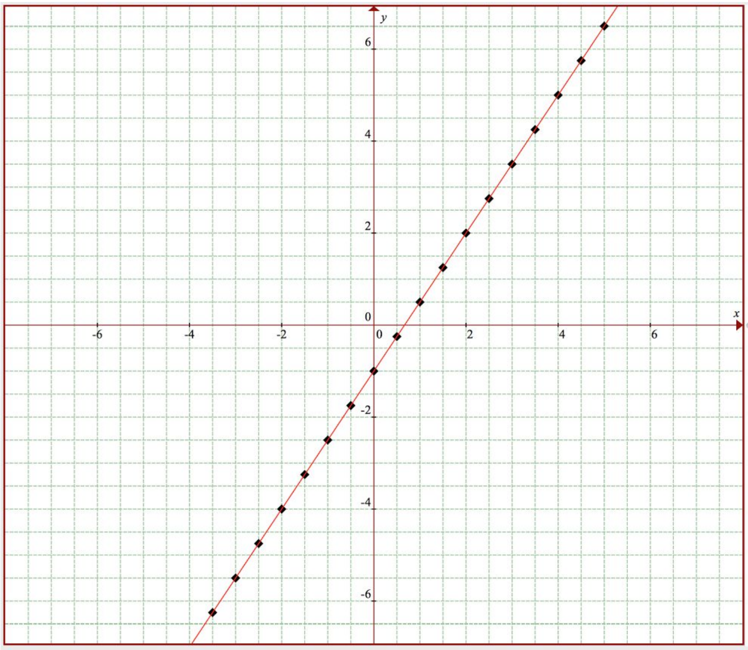
Second derivative

Equation for acceleration: y=0.0489x^2 + 0.0865x - 0.5242

Table h(t)



Scattered points

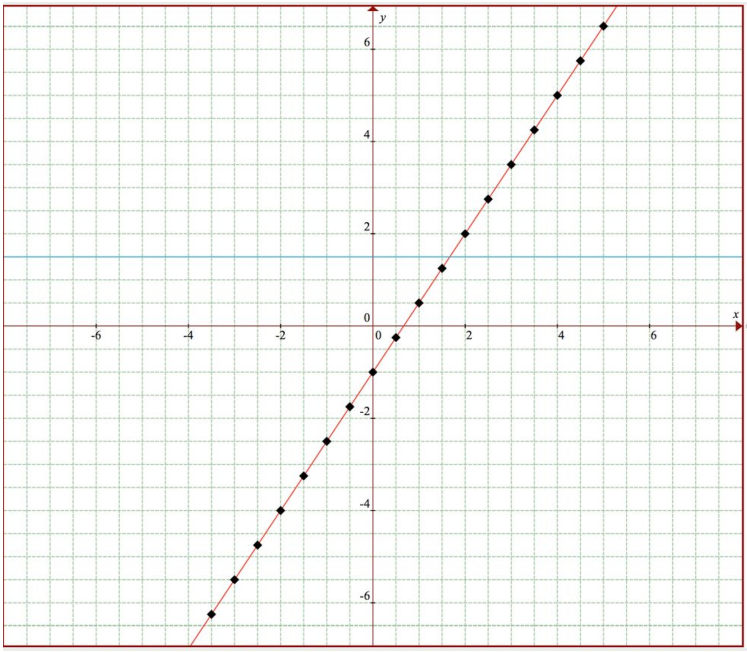


Point Tables | Data Plot
Plot: Data plot 1 | New | Delete
Symbol: | Color: | Curve Fit
Insert Point | Remove Point | Options

x	y
-5.0	-8.5
-4.5	-7.75
-4.0	-7.0
-3.5	-6.25
-3.0	-5.5
-2.5	-4.75
-2.0	-4.0
-1.5	-3.25
-1.0	-2.5
-0.5	-1.75
0	-1.0
0.5	-0.25
1.0	0.5
1.5	1.25
2.0	2.0
2.5	2.75
3.0	3.5
3.5	4.25
4.0	5.0
4.5	5.75
5.0	6.5

Original:

Equation for position: y = 1.5x - 1.0

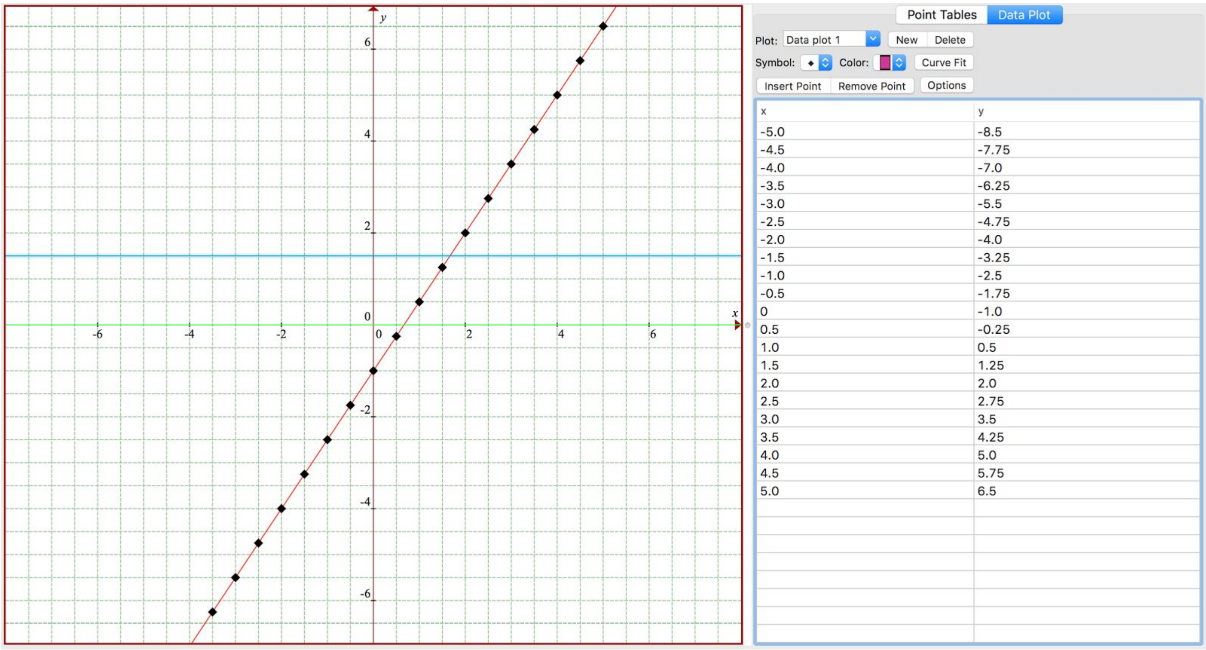


Point Tables | Data Plot
Plot: Data plot 1 | New | Delete
Symbol: | Color: | Curve Fit
Insert Point | Remove Point | Options

x	y
-5.0	-8.5
-4.5	-7.75
-4.0	-7.0
-3.5	-6.25
-3.0	-5.5
-2.5	-4.75
-2.0	-4.0
-1.5	-3.25
-1.0	-2.5
-0.5	-1.75
0	-1.0
0.5	-0.25
1.0	0.5
1.5	1.25
2.0	2.0
2.5	2.75
3.0	3.5
3.5	4.25
4.0	5.0
4.5	5.75
5.0	6.5

Derivative

Equation for velocity: y=1.5

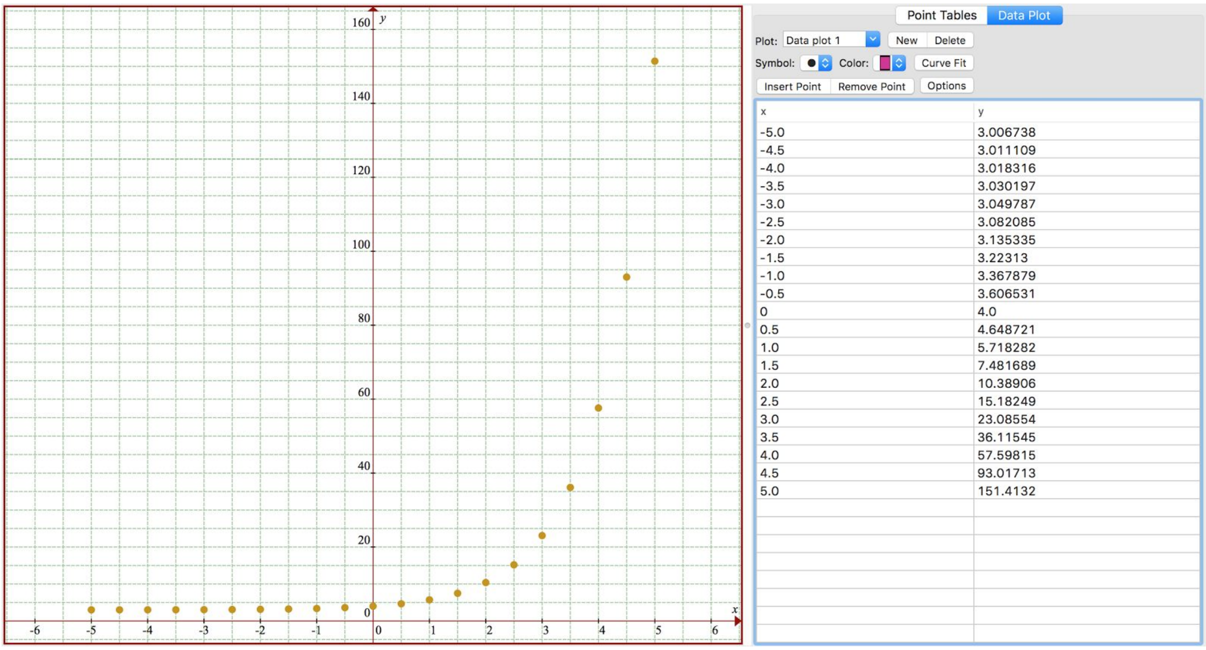


x	y
-5.0	-8.5
-4.5	-7.75
-4.0	-7.0
-3.5	-6.25
-3.0	-5.5
-2.5	-4.75
-2.0	-4.0
-1.5	-3.25
-1.0	-2.5
-0.5	-1.75
0	-1.0
0.5	-0.25
1.0	0.5
1.5	1.25
2.0	2.0
2.5	2.75
3.0	3.5
3.5	4.25
4.0	5.0
4.5	5.75
5.0	6.5

Second derivative

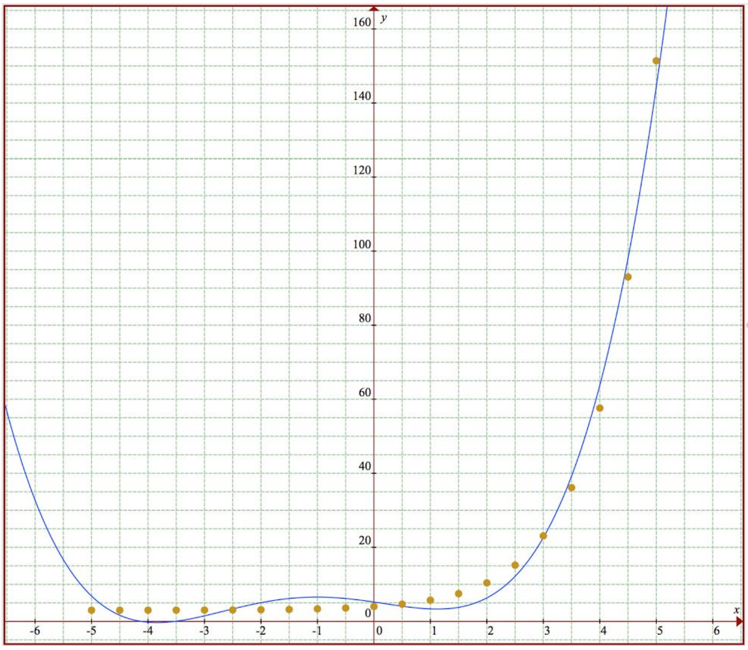
Equation for acceleration: y=0

Table F(t)



x	y
-5.0	3.006738
-4.5	3.011109
-4.0	3.018316
-3.5	3.030197
-3.0	3.049787
-2.5	3.082085
-2.0	3.135335
-1.5	3.22313
-1.0	3.367879
-0.5	3.606531
0	4.0
0.5	4.648721
1.0	5.718282
1.5	7.481689
2.0	10.38906
2.5	15.18249
3.0	23.08554
3.5	36.11545
4.0	57.59815
4.5	93.01713
5.0	151.4132

Scattered points

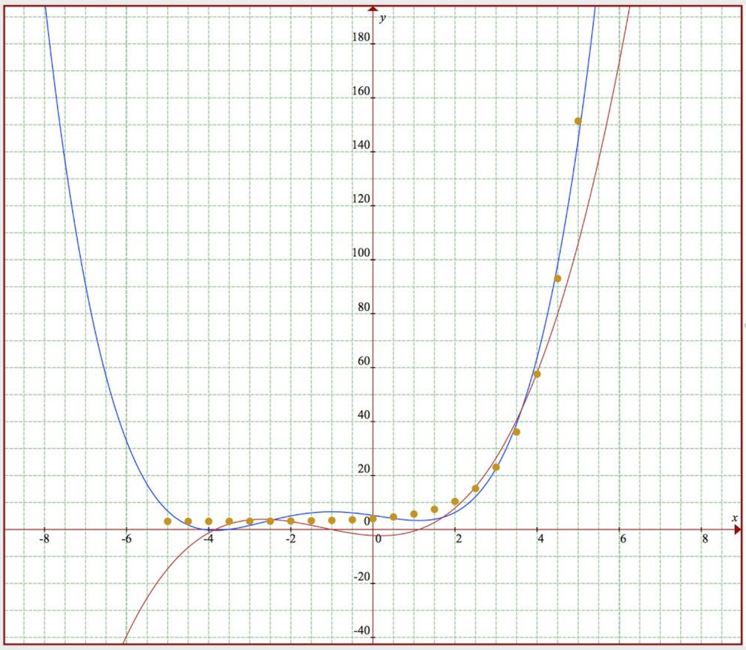


x	y
-5.0	3.006738
-4.5	3.011109
-4.0	3.018316
-3.5	3.030197
-3.0	3.049787
-2.5	3.082085
-2.0	3.135335
-1.5	3.22313
-1.0	3.367879
-0.5	3.606531
0	4.0
0.5	4.648721
1.0	5.718282
1.5	7.481689
2.0	10.38906
2.5	15.18249
3.0	23.08554
3.5	36.11545
4.0	57.59815
4.5	93.01713
5.0	151.4132

Original:

Equation for position: y = 0.128554x^4 + 0.639648x^3 - 0.398068x^2 - 2.23492x + 5.225019

y = 0.128554x^4 + 0.639648x^3 − 0.398068x^2 − 2.23492x + 5.225019 ' curve-fit of Data plot 1; R²=0.991547, chi²=237.272182 after 1463 iterations

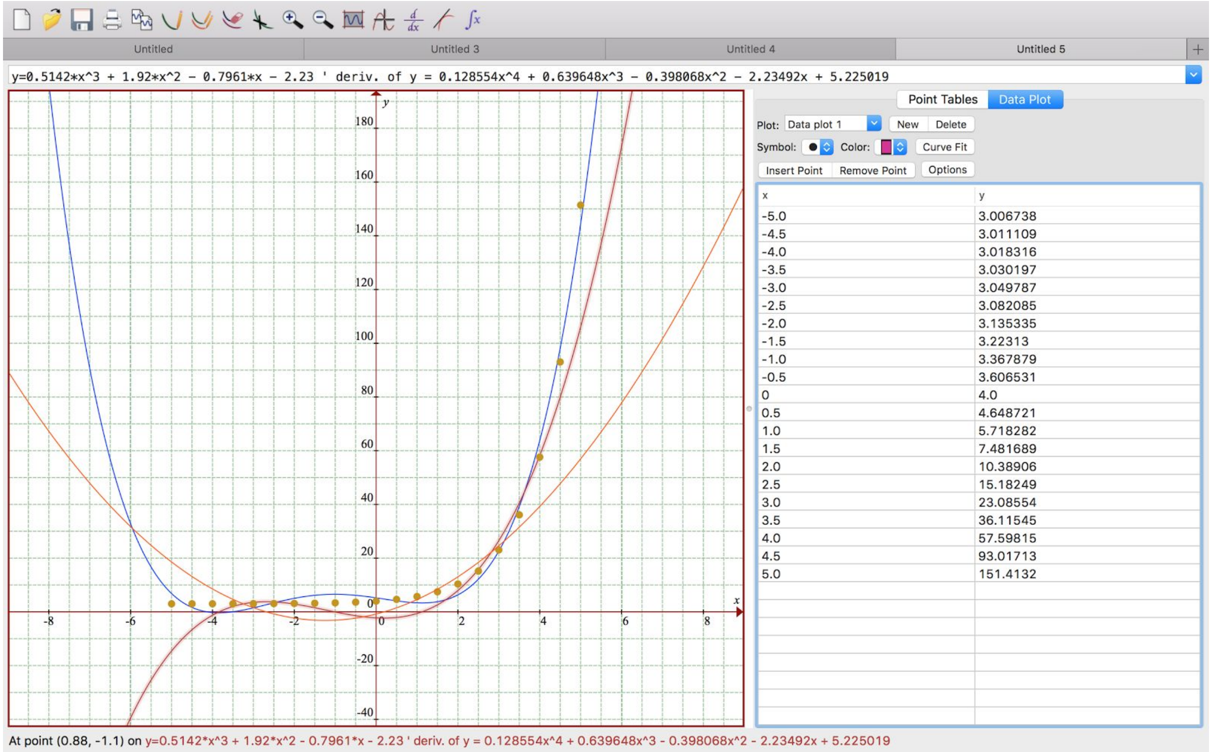


Point Tables
Data Plot
Plot: Data plot 1
New
Delete
Symbol:
Color:
Curve Fit
Insert Point
Remove Point
Options

x	y
-5.0	3.006738
-4.5	3.011109
-4.0	3.018316
-3.5	3.030197
-3.0	3.049787
-2.5	3.082085
-2.0	3.135335
-1.5	3.22313
-1.0	3.367879
-0.5	3.606531
0	4.0
0.5	4.648721
1.0	5.718282
1.5	7.481689
2.0	10.38906
2.5	15.18249
3.0	23.08554
3.5	36.11545
4.0	57.59815
4.5	93.01713
5.0	151.4132

Derivative:

Equation for velocity: y=0.5142*x^3 + 1.92*x^2 - 0.7961*x - 2.23

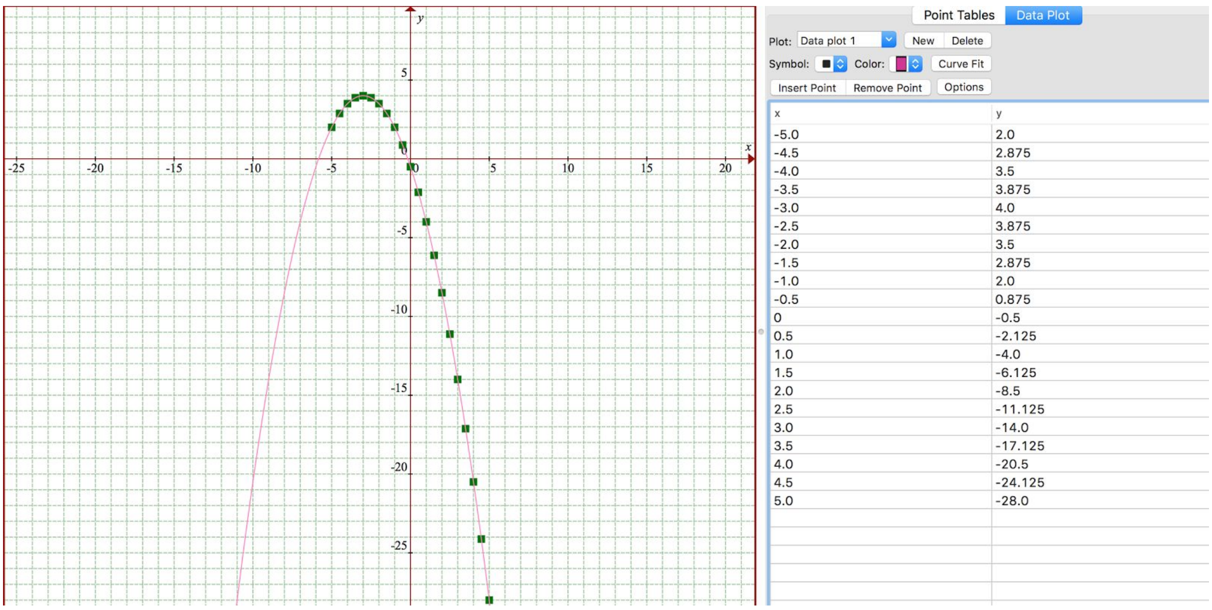


x	y
-5.0	3.006738
-4.5	3.011109
-4.0	3.018316
-3.5	3.030197
-3.0	3.049787
-2.5	3.082085
-2.0	3.135335
-1.5	3.22313
-1.0	3.367879
-0.5	3.606531
0	4.0
0.5	4.648721
1.0	5.718282
1.5	7.481689
2.0	10.38906
2.5	15.18249
3.0	23.08554
3.5	36.11545
4.0	57.59815
4.5	93.01713
5.0	151.4132

Second derivative:

Equation for acceleration: y=1.54x^2 + 3.84x - 0.7961

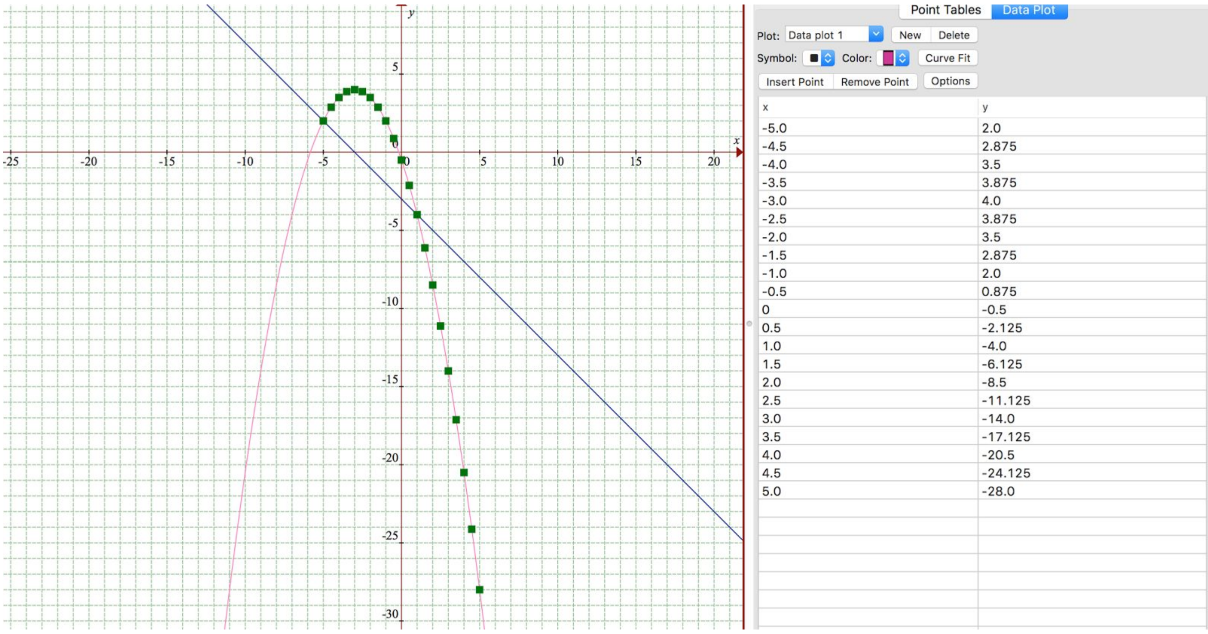
Table G(t)



x	y
-5.0	2.0
-4.5	2.875
-4.0	3.5
-3.5	3.875
-3.0	4.0
-2.5	3.875
-2.0	3.5
-1.5	2.875
-1.0	2.0
-0.5	0.875
0	-0.5
0.5	-2.125
1.0	-4.0
1.5	-6.125
2.0	-8.5
2.5	-11.125
3.0	-14.0
3.5	-17.125
4.0	-20.5
4.5	-24.125
5.0	-28.0

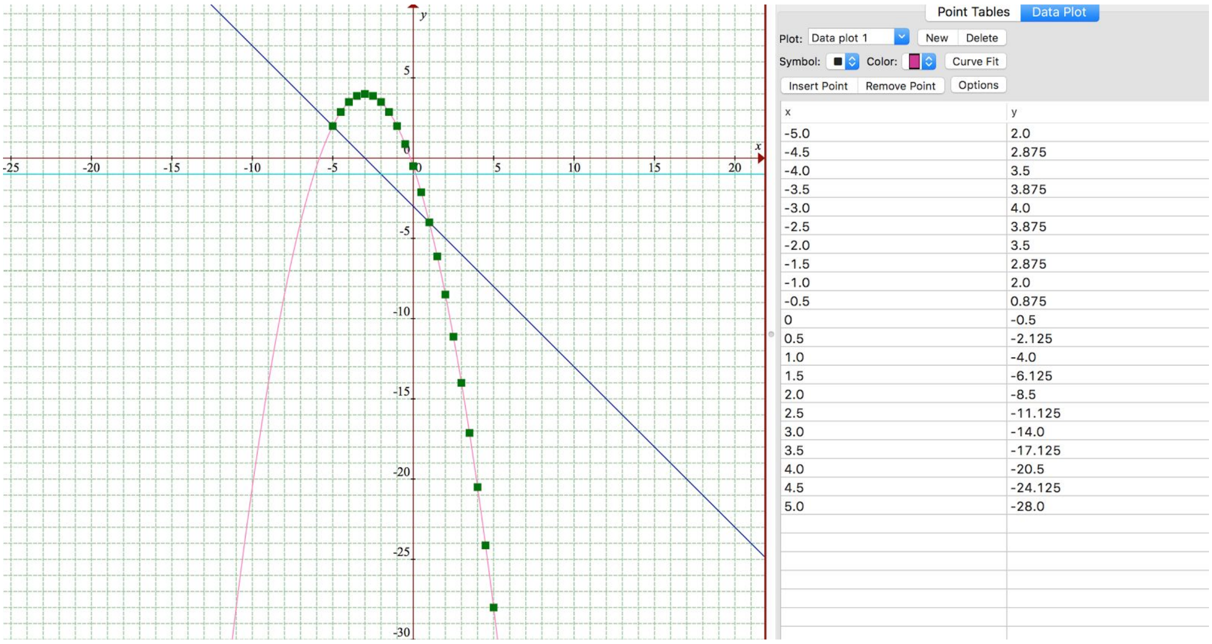
Original:

Equation for position: y = -0.5x^2 - 3.0x - 0.5



Derivative:

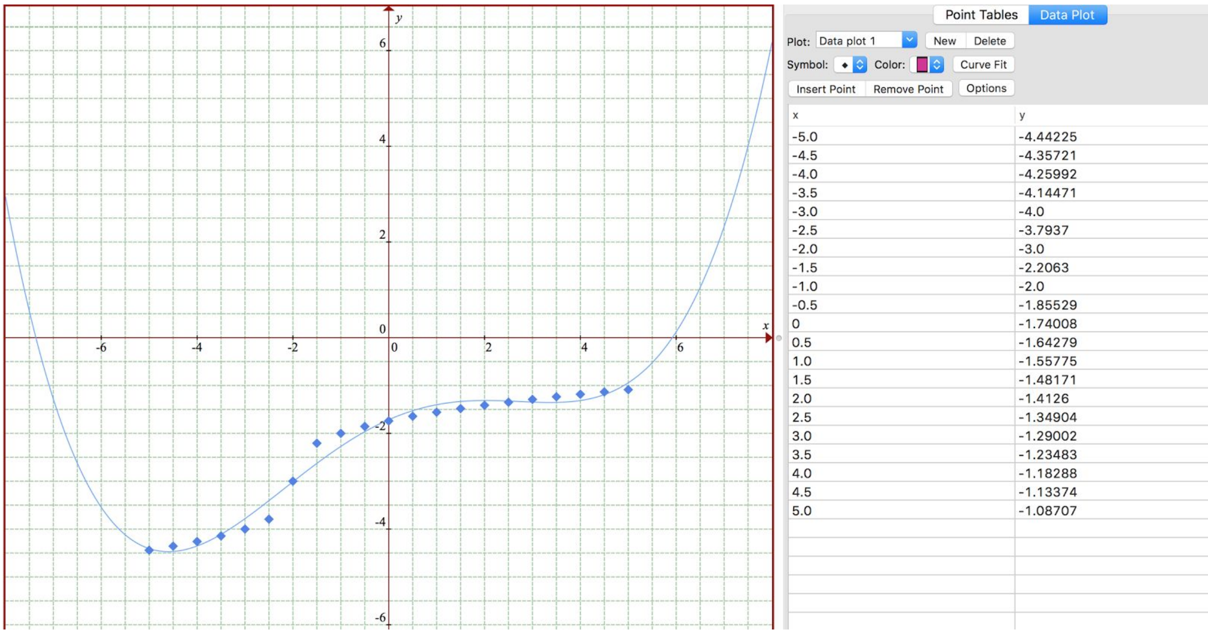
Equation for velocity: y=-x - 3



Second derivative:

Equation for acceleration: y=-1

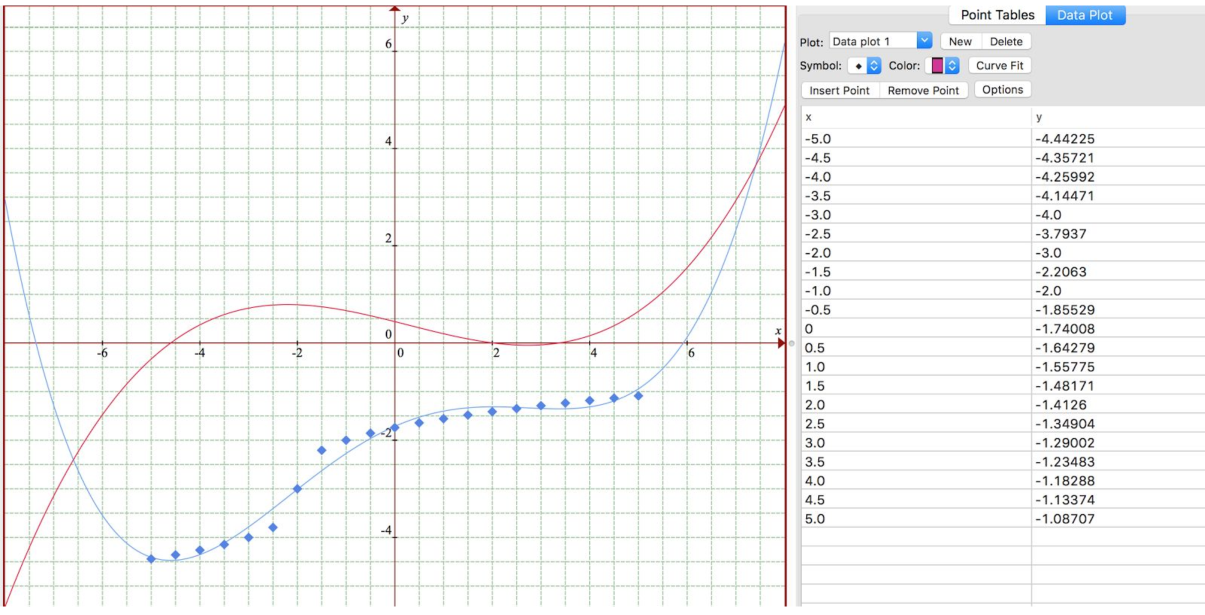
H(t)



x	y
-5.0	-4.44225
-4.5	-4.35721
-4.0	-4.25992
-3.5	-4.14471
-3.0	-4.0
-2.5	-3.7937
-2.0	-3.0
-1.5	-2.2063
-1.0	-2.0
-0.5	-1.85529
0	-1.74008
0.5	-1.64279
1.0	-1.55775
1.5	-1.48171
2.0	-1.4126
2.5	-1.34904
3.0	-1.29002
3.5	-1.23483
4.0	-1.18288
4.5	-1.13374
5.0	-1.08707

original:

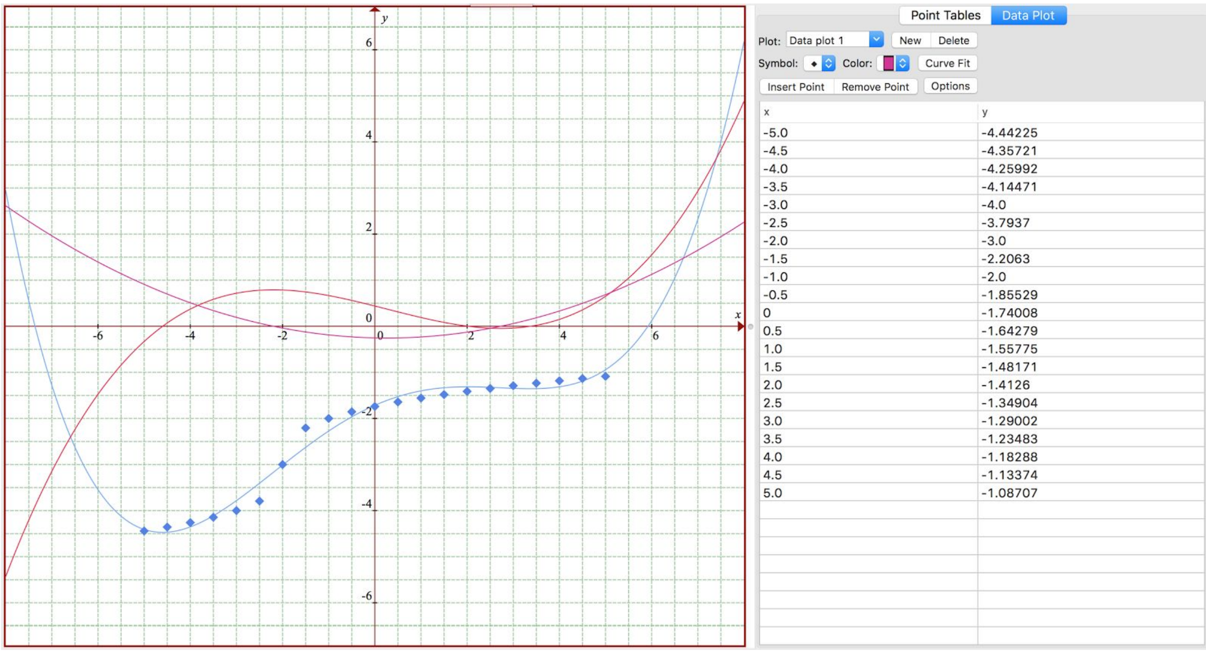
Equation for position: y = 0.0035x^4 - 0.003717x^3 - 0.125938x^2 + 0.439458x - 1.714742



x	y
-5.0	-4.44225
-4.5	-4.35721
-4.0	-4.25992
-3.5	-4.14471
-3.0	-4.0
-2.5	-3.7937
-2.0	-3.0
-1.5	-2.2063
-1.0	-2.0
-0.5	-1.85529
0	-1.74008
0.5	-1.64279
1.0	-1.55775
1.5	-1.48171
2.0	-1.4126
2.5	-1.34904
3.0	-1.29002
3.5	-1.23483
4.0	-1.18288
4.5	-1.13374
5.0	-1.08707

Derivative

Equation for velocity: y=0.014x^3 - 0.0112x^2 - 0.2519x + 0.4395



Second derivative

Equation for acceleration: y=0.042x^2 - 0.0223x - 0.2519

Conclusions:

Paola Salazar

As shown in the different graphs and functions in order for us to get the result of the derivative the main procedure used was power rule since not one of the functions include a parenthesis and all of the original functions had an x elevated to a certain power. Because of the great availability of the program used (graphmatica) and the fact that it is free is great for people to use it in order to visually see real life problems.

Ana Cris Lozano

As a conclusion, I think that this project was very helpful for us to understand better how to apply derivatives in order to find velocity and acceleration given the equation of position. This made us realize how there is math in an everyday situation and we didn't even know. Also, using Graphmatica was very useful because with this software we could accomplish the project in an easier and faster way.

Caro Salazar

To conclude with this project, it was interesting to apply the class material to it. We can observe that in all our resulting graphs we needed to use power rule to get the derivatives, thanks to graphmatica we were able to solve all of these equations to turn them into graphs and it was really simple and useful to use.

Bibliography

How to Analyze Position, Velocity, and Acceleration with Differentiation. (n.d.). Retrieved October 10, 2017, from http://www.dummies.com/education/math/calculus/how-to-analyze-position-velocity-and-acceleration-with-differentiation/

Distance, Velocity, and Acceleration. (n.d.). Retrieved October 10, 2017, from https://www.cliffsnotes.com/study-guides/calculus/calculus/integration/distance-velocity-and-acceleration

Prokup, N. (n.d.). Position, Velocity and Acceleration - Concept - Calculus Video by Brightstorm. Retrieved October 10, 2017, from https://www.brightstorm.com/math/calculus/antiderivatives-and-differential-equations/position-velocity-and-acceleration/