DOGBALL

A summary of the main aspects

This currently-brief summary assumes that you attended a workshop at which Dogball appeared. Either a 3-hour workshop, or a 50-minute workshop (in which everything happened very quickly). ☺
It may not follow, exactly how our workshop unfolded – it seemed to be a little different each time, depending on what you asked and said.

Introduction

Balls have both flight and bounce characteristics.
Vary some aspect of a ball and it will fly differently and bounce differently.
Who would have thought knowing something about this would matter. Have a read of
https://en.wikipedia.org/wiki/Deflategate

So how might be study the bounce characteristics of a ball.
What ball might be a good ball, educationally speaking.
It turns out that Dogball is the gun!

The problem

Describe how Dogball bounces.

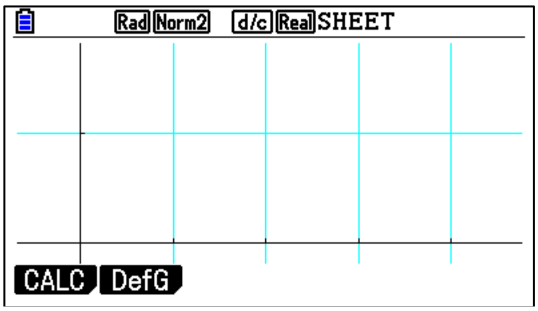
The beginning step

Let Dogball fall freely and bounce until he bounces no more. Use a motion sensor to record the distance (*d*) between the sensor and the top of dogball.

With the system we used, *d* was recorded every 0.02 of a second, for a little over

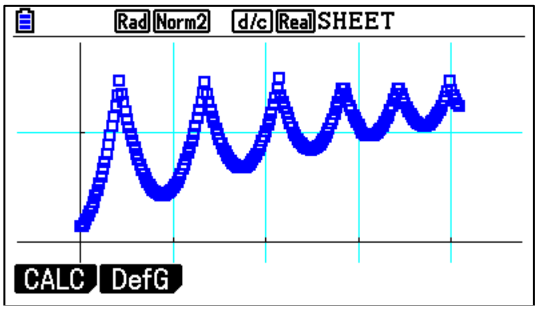
Your-task 1

Without seeing the data, draw what you think the graph of *d* vs *t* will look like.



Do you recall what you drew?

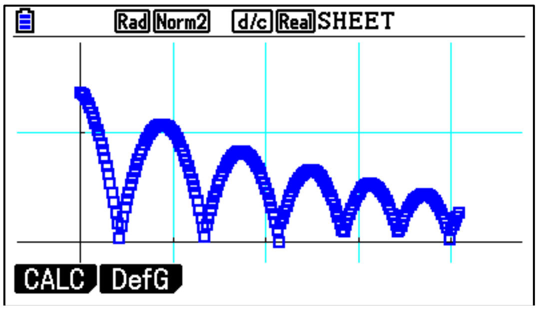
The next step
Graph the data.



Your-task 2
Make a list of things that come to mind as you look at the graph of the data.

- Is there something you want to do?
- Was there a realisation you came too – oh, yes, right!
- Did it make you wonder …

The next step
"Flip" the data. *d* is now a different quantity.



Your-task 3
When did the 10th peak occur and how high was Dogball at that time?
You might recall this being a less than straight forward task.

Use trace to pick out the time and distance of Dogball's top of flight positions.

Peak number *n*	1	2	3	4	5	6
t	0	0.88	1.72	2.48	3.12	3.72
d	1.36	1.07	0.83	0.66	0.53	0.44

Calculate some ratios or determine some models using regression.

$$d = 1.39(0.737)^t \qquad d = 1.68(0.796)^n$$

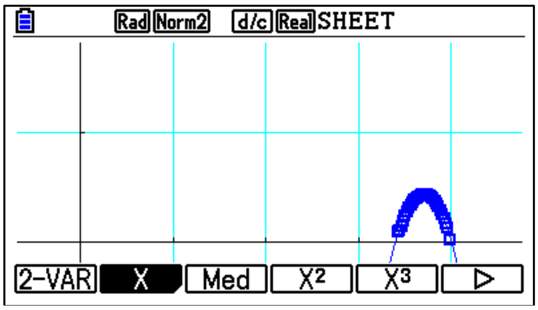
Over to you to recall the rest. How close was your prediction?

Recall we talked about https://en.wikipedia.org/wiki/Coefficient_of_restitution
As such, "*b*", is in fact not a constant.

Your-task 4
What Dogball's position at t = 6.7 seconds? (Perhaps not at a peak!)

Recall we isolated sections of the motion and developed a piece-wise model for d in terms of t.

Below you can see the last section.



The model we developed is given below:

$d = -5.18t^2 - 0.95t + 1.37$ for $0 \leq t < 0.42$

$d = -4.8t^2 + 8.49t - 2.66$ for $0.42 \leq t < 1.34$

$d = -4.87t^2 + 16.93t - 13.85$ for $1.34 \leq t < 2.14$

$d = -4.85t^2 + 24.11t - 29.3$ for $2.14 \leq t \leq 2.84$

$d = -5.17t^2 + 32.36t - 50$ for $2.84 \leq t \leq 3.42$

$d = -4.79t^2 + 35.5t - 65.2$ for $3.42 \leq t \leq 3.98$

We then stood back and observed the coefficients and …

We then considered writing this set as 'one', replacing the coefficients with functions.

And that was about it.