

Investigating the motion of a model dragster – Teachers' guide

Datalogging is very important in the motor vehicle industry and hence this context for the students' work. The activity has been designed around the use of a model dragster so that the context relates well.

The activity involves students in the analysis of Velocity-time graphs produced by running a bar tape or picket fence tape through a photogate. It provides opportunities to deal with the differences between 'distance travelled' and 'change of displacement' and between 'speed' and 'velocity'. Distinguishing between 'average' and 'near instantaneous' can also be broached. For all pupils there will be a need to explain what 'acceleration' means and how it is calculated from both raw data and from the gradient of a Velocity-time graph. For some it would be useful to draw attention to the fact that 'change of velocity' rather than 'change of speed' is involved. A comment that an object rotating in a circle at constant speed is accelerating may help too. Do not be tempted to get students to analyse Acceleration-time graphs produced by this method as the cumulative errors that occur in the multiple calculations made causes the graphs to be poor representations of reality. Alternative methods of obtaining the same data would be with the ultrasonic motion sensor or a photogate with the ultra pulley attachment.

Uncertainties (or errors) in results could be calculated and incorporated on graphs as error bars prior to trying various best-fit lines or curves. As you will note in the graph of Figure 2 I found, surprisingly, that there appeared to be direct proportionality between the Number of winds and the Highest average velocity attained.

For some it would be useful to go through the details of how the computer, with its associated datalogger and photogate, provides values for the times via the passing of the start of each opaque section of the tape. Speed/velocity and acceleration are in fact calculated through first and second derivative algorithms and is best left unsaid unless you are dealing with A-level students. For younger students you could of course deal with the more obvious means of making such calculations.

Answers to questions and typical results

Results will no doubt vary with the design of the model dragster and the rubber band being used on it.

- Q1** With a number of winds the dragster should be seen to increase in velocity initially and then slow down. With only two winds I found that its maximum velocity was reached almost immediately and so it appeared to just be slowing down. The graphs showed a rise and then a fall.
- Q2** Those with the largest number of windings tended to show uniform acceleration for a short time, straight line with unchanging gradient, but then gradient lessened and eventually went negative. Those with only two winds had an almost instantaneous negative gradient, with this being increasingly negative.

Below are details of my averaged results and overleaf the associated graph.

Number of winds of wheels and rubber band	Average highest velocity m/s
0	0
2	0.72
3	1.05
4	1.40
5	1.75
6	2.10

Figure 1 Data table for model dragster activity

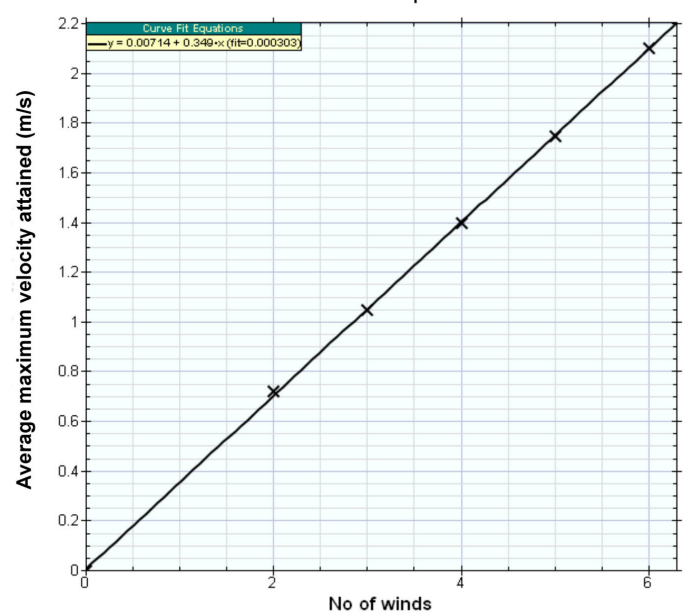


Figure 2 Graph of Average maximum velocity of model dragster against Number of winds of wheels/rubber band (produced with djb microtech's *Simple Data Handling*)

Useful weblinks

Datron Technology Limited

http://www.datrontechnology.co.uk/newsstory_ss.php?id=68

Here is a news story about the *Wildside Inc Top Fuel* dragster on which Datron Technology provides the datalogging system.

Santa Pod Raceway

<http://www.santapod.co.uk/>

This website provides details of the raceway, events, rides available, toys, videos/DVDs. If your school is close by then a visit might be good.

The Acceleration Archive – Peter Jones' Gallery

http://www.theaccelerationarchive.co.uk/peter/jones_06.html

Here are plenty of pictures of top dragsters in action.

Walt Disney World Test Track

<http://www.wdwmagic.com/test.htm>

With General Motors, Walt Disney World have developed a test track for the public to use. This site tells you a little about it.

York Raceway

<http://www.york-raceway.co.uk/aboutus.html>

Another location to watch dragsters, hot rods and the like. It's about fifteen miles east of York. Details here of events.