Activity description

In this activity students use acceleration and braking data from a car road test to draw graphs. They then interpret the graphs and make predictions about values that have not been plotted.

Suitability

Level 2 (Intermediate/Higher)

Time

2–3 hours depending on whether the graphs are drawn on a graphic calculator, spreadsheet or by hand.

Resources

Student information sheet and worksheet
Optional: slideshow
spreadsheet

Equipment

Optional: graphic calculators
spreadsheet or graph paper
activeboard or other equipment to run the slideshow

Key mathematical language

Data, speed, acceleration, origin, curve, graph, curve

Notes on the activity

This activity can be used at the start of the course to give students practice in drawing graphs (by hand or using a computer or graphical calculator) and interpreting them. The slideshow can be used to introduce the activity and to aid class discussion about the data before students draw the graphs.

The information sheet also contains the data; the worksheet requires students to draw four graphs and answer questions about them. Graphs showing the data points are given on slides 6–9.

You may wish to use one of the questions (and the corresponding slide) as an example before students try the others. Initial points you need to discuss with the class include choice of variables and axes, sensible scaling, labelling, and accurate plotting of points.

Questions on the worksheet requiring students to interpret the graphs could be used (with the corresponding slides) for class discussion.

During the activity

The activity can be carried out using graph paper, a graphical calculator or a spreadsheet.

If your students have already had plenty of practice and are confident drawing graphs by hand, then perhaps one of the other methods would be of more interest to them. You may decide to ask students to use different methods and then compare their results.

Points for discussion

Slides 4 and 5 contain the data that students will use to draw graphs. These slides also pose some questions about the data.

The main reason why the real and indicated speeds are different (slide 4) is that the law allows them to be up to 10% different and most manufacturers aim to make the speedometers read higher than the real speed. (They do not want their drivers being stopped for speeding when the speedometer says otherwise!)

There are also other reasons for variations: the speedometer is set up at the manufacturing stage and independent from the specific vehicle. So many assumptions are made, such as wheel size, tyre depth and air pressure, for example, and none of these may be identical to those on the real vehicle.

If you have time you could take this discussion further by asking students to suggest how speedometers work out the speed of a car (by multiplying the rate at which the drive shaft turns by the distance the wheel travels along the road in one turn).

Slides 6–9 contain the graphs for questions 1–4 on the worksheet. These can be used to discuss students' answers to the other parts of the worksheet.

The question given on the final slide is the same as that given in the 'Reflect on your work' section on the worksheet. You may decide to use this for class discussion at the end of the session, rather than asking students to write a report.

Extensions

The data can be used in a variety of other ways including

- fitting functions to data
- finding and interpreting gradients
- finding the area under a curve

Answers

1a See Slide 6.

b Yes, since points on a line between data points would have meaning and predict intervening values.

c Yes – the position of the data points indicate that a linear model is appropriate.

d Not necessarily.

e Indicated speed was zero when car was at rest.

f There is an error on the meter when the car is at rest.

h The meter shows speeds higher than the true speeds.

There is a percentage error of approximately 10% throughout the speed range tested.

Think about: you are able to travel at indicated speeds slightly above the speed limit without actually breaking the speed limit.

2a See Slide 7

b The true speed was zero when the test began.

d The graph is steepest at the origin and least steep at the other end. The acceleration of the car decreases as the test proceeds.

e The gradient of the graph would continue to approach zero ('flatten out') and the speed would reach a maximum value. This agrees with the fact that the car will have a maximum speed that it is not able to exceed.

3a See Slide 8

b Not necessarily. Indicated speed was not zero when the road test began.

d(i) 80 – 81 mph **(ii)** 92 – 93 mph

e(i) 2.7 – 2.9 s **(ii)** 11.4 – 11.6 s

f Similar shape but higher speeds than for question 2.

4a See Slide 9

b Yes – the distance taken to stop would be zero if the initial car speed was zero.

d(i) approx 5 m **(ii)** approx 80 m.

Think about: It is reasonable to extend the graph but only as far as the maximum speed achievable by the particular car used.