BACCALAURÉAT-Session 2016

Epreuve de Discipline Non Linguistique

Mathématiques/Anglais

Why quadratics can save your life ?

Most people have heard of Galileo, a colourful Professor of Mathematics at the University of Pisa. [...] At the heart of Galileo's work was an understanding of dynamics, which has huge relevance to such vital activities as knowing when (and how) to stop our car [...]

A very important application [of his work] is to find the stopping distance of a car travelling at a given velocity u. Suppose that a car is travelling at such a speed, and you apply the brakes, how long will it take to stop? Even journalists might be interested in this question, especially if it means avoiding an accident.

In particular, if a constant deceleration a is applied to slow a car down from speed u to speed 0, then the stopping distance s is given by $s = \frac{u^2}{2a}$. The reason that this result is so important for all of us is that it predicts that doubling your speed quadruples, rather than doubles, your stopping distance. In this quadratic expression we see stark evidence as to why we should slow down in urban areas, as a small reduction in speed leads to a much larger reduction in stopping distance. Solving the quadratic equation correctly here could, quite literally, save your, or someone else's life!

Adapted from http://plus.maths.org/content/os/issue30/features/quadratic/index

Questions

1. Make a short presentation of the text.

   Explain briefly what you know about quadratic equations.

2. a) Explain why the equation $s = \frac{u^2}{2a}$ "predicts that doubling your speed quadruples, rather than doubles, your stopping distance."

   b) Knowing that the road is damp and the deceleration of your car is approximately $a = 20\,000 mph/h$, what is the speed limit in order to stop in 40 meters ? (1 mile = 1609 meters)

3. Why is it important to solve the quadratic equation?

   What do you think of speed limits on motorways?