what's the point of...

PYTHAGORAS?

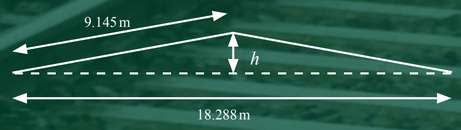
Stay on track with maths

Railway tracks can be made of connecting pieces of rail that are usually 60 feet (18.288 m) long. The pieces are either bolted or welded together at the ends.

When the rails are bolted together a small gap is left between them to allow for expansion in hot weather. The familiar 'clackety-clack' noise is the result of a train moving over the gaps between the rails.

If the gaps weren't left there could be a serious problem with the rails buckling when they expand on a hot day. You can model the effect of a piece of track expanding using Pythagoras' theorem.

If the track expanded by just 0.01% to 18.290 m (i.e. by about 2 mm) the height of the middle of the track would have risen by over 13 cm!



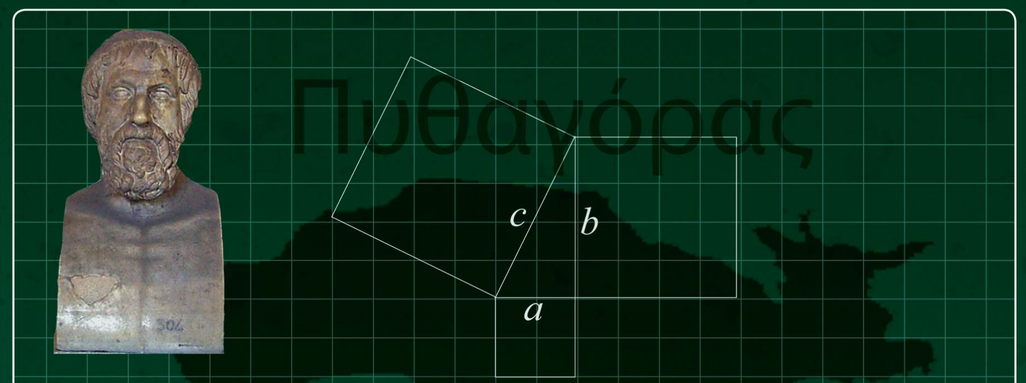
Welded rails are now more common. Welded tracks give a smoother ride, especially at higher speeds, but are more susceptible to buckling as there aren't any gaps. To avoid buckling rails are heated before laying them.

Want to be square ... use the 3-4-5 rule

You've probably met 3-4-5 triangles when studying Pythagoras' theorem: if a right angled triangle's base is 3 units and its height is 4 units then its hypotenuse is 5 units. This works because the angle between the base and the height is a right angle. Did you know that carpenters and joiners reverse this as an easy way to check if a corner is a right angle?

To check if an angle is a right angle carpenters measure 3 units (inches, metres, tens of centimetres, light years or whatever you want!) from the angle along one side and make a mark, then measure 4 units from the angle along the other side and make a second mark. The distance between the two marks should be exactly 5 units.

This easy check is used to see if edges are at right angles to each other and if walls are perpendicular.



It's not all Greek to me!

Pythagoras lived on the Greek island on Samos between 570 and 495 BC where he brought together one of the first schools of mathematics. He is widely credited with discovering the theorem that bears his name but there are other examples from the ancient world that demonstrate knowledge of the relationship between the length of the sides of right-angled triangles.

In India, where the result is often known as the Bhaskara theorem, there is evidence of knowledge of the relationship that predates Pythagoras. The ancient Indian mathematicians Baudhayana, who lived around 800 BC, and Apastamba, who lived around 600 BC, featured the relationship in their writings. Some people believe that both of these were based on earlier discoveries in Mesopotamia (which covered what is now Iraq, and parts of Iran, Syria and Turkey).

In China the relationship is known as the Gougu theorem. The *Chou Pei Suan Ching* contained a proof of the Gougu theorem and appeared between 500 BC and 200 BC.

Written by Tom Button, Peter McOwan, Matt Parker and Zia Rahman
Special thanks to Professor David Arrowsmith (QMUL), Makhan Singh, Melanie Ashfield and James Anthony, University of Birmingham

• For further information, articles and resources visit:
www.moremathsgrads.org.uk • www.mathscareers.org.uk
plus.maths.org • nrich.maths.org • www.cs4fn.org

Design: info@jamesanthonygraphics.com Reorder: info@pinstripegroup.co.uk - quote 41813