The 17 equations that changed the world

Pythagoras' theorem

\[ a^2 + b^2 = c^2 \]

Why is this important?
It provides a vital link between geometry and algebra, and was an essential tool for surveying, navigation, and the development of the slide rule.

What did it lead to?
It led to the creation of complex numbers, which in turn led to the development of quantum mechanics.

Chaos theory

\[ x_{n+1} = 4x_n(1-x_n) \]

Why is this important?
It models how a population of living creatures changes from one generation to the next, and has limitations on how much useful work can be extracted from heat.

What did it lead to?
Better steam engines, estimates of the efficiency of renewable energy, the 'heat death of the universe', and death rays as a weapon.

Euler's formula for polyhedra

\[ e^{i\theta} = \cos \theta + i\sin \theta \]

Why is this important?
It is the equation that ushered in the information age. It established the close relationship between trigonometry and complex numbers.

What did it lead to?
It is used in the definition of digital audio and video, and is a key feature of innumerable scientific and technological problems.

Wave equation

\[ \frac{\partial^2 u}{\partial t^2} - \nabla \cdot (c^2 \nabla u) = f \]

Why is this important?
It explains how radio waves and light propagate, and how sound waves travel in the air.

What did it lead to?
It was used to develop the theory of general relativity and quantum mechanics.

Maxwell's equation

\[ \nabla \times E = -\partial B/\partial t \]

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Relativity

\[ E = mc^2 \]

Why is this important?
It describes how the price of a financial derivative changes over time, based on the principle that when the price is not right, the derivative carries no risk and you can make a profit by exploiting the difference.

What did it lead to?
It makes it possible to trade a derivative before it matures and to avoid an 'upside' or 'downside' risk as a result.

Black-Scholes equation

\[ \frac{\partial V}{\partial t} + \frac{1}{2} \sigma^2 S^2 \frac{\partial^2 V}{\partial S^2} + rS \frac{\partial V}{\partial S} - rV = 0 \]

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