Introduction

Also see:

- businessinsider.com article about the book
- A summary of the equations
- https://en.wikipedia.org/wiki/In_Pursuit_of_the_Unknown
- https://en.wikipedia.org/wiki/Ian_Stewart_(mathematician)
- https://en.wikipedia.org/wiki/Euler_Book_Prize
- https://github.com/Jonathanseng/17-Equations-that-change-the-world
- https://github.com/peterlharding/17-equations-that-changed-the-world

1 The Square on the Hypotenuse

1.1 Pythagoras' Law

"The square of the hypotenuse is equal to the sum of the squares of the other two sides."

$$a^2 = b^2 + c^2$$

https://en.wikipedia.org/wiki/Pythagoras

2 Shortening the Proceedings

Logarithms - John Napier, 1610

$$\log xy = \log x + \log y$$

https://en.wikipedia.org/wiki/John_Napier

3 Ghosts of Departed Quantities

Calculus - Issac Newton, 1668

$$\frac{df}{dt} = \lim_{h \to 0} \frac{f(t+h) - f(t)}{h}$$

https://en.wikipedia.org/wiki/Isaac_Newton

4 The System of the World

Law of Gravity - Issac Newton, 1687

$$F = G\frac{m_1 m_2}{r^2}$$

https://en.wikipedia.org/wiki/Isaac_Newton

5 Portent of the Ideal World

The Square Root of minus One - Leonhard Euler, 1750

$$i^2 = -1$$

https://en.wikipedia.org/wiki/Leonhard_Euler

6 Much Ado about Knotting

Euyler's Formula for Polyhedra - Leonhard Euler, 1751

$$V - E + F = 2$$

https://en.wikipedia.org/wiki/Leonhard_Euler

7 Patterns of Chance

Normal Distribution - Carl Friedrich Gauss, 1810

$$\Phi(x) = \frac{1}{\sqrt{2\pi\sigma}} e^{\frac{(x-\mu)^2}{2\sigma^2}}$$

https://en.wikipedia.org/wiki/Carl_Friedrich_Gauss

8 Good Vibrations

Wave Equation - Jean le Rond d'Alembert. 1746

$$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$$

https://en.wikipedia.org/wiki/Jean_le_Rond_d%27Alembert

9 Ripples and Blips

Fourier Transforms - Joseph Fourier, 1822

$$\hat{f}(\xi) = \int_{-\infty}^{\infty} f(x)\, e^{-2\pi i x \xi} dx$$

https://en.wikipedia.org/wiki/Joseph_Fourier

10 The Ascent of Humanity

Navier-Stokes Equation - Claude-Louis Navier, George Stokes, 1845

$$\rho\left(\frac{\partial \mathbf{v}}{\partial t}+\mathbf{v}\cdot\boldsymbol{\nabla}\mathbf{v}\right)=-\boldsymbol{\nabla}p+\boldsymbol{\nabla}\cdot\mathbf{T}+\mathbf{f}$$

or using Einstein notation:

$$\frac{\partial(\rho\vec{u})}{\partial t}+\vec{\nabla}\cdot\rho\vec{u}\otimes\vec{u}=-\vec{\nabla}p+\vec{\nabla}\cdot\overline{\overline{\tau}}+\rho\vec{f}$$

- https://en.wikipedia.org/wiki/Claude-Louis_Navier
- https://en.wikipedia.org/wiki/Sir_George_Stokes,_1st_Baronet
- https://en.wikipedia.org/wiki/Navier%E2%80%93Stokes_equations

11 Waves in the Ether

Maxwell's Equations - James Clerk Maxwell, 1865

$$\frac{\partial \mathcal{D}}{\partial t} = \nabla \times \mathcal{H}, \qquad \text{(Faraday's Law)}$$

$$\frac{\partial \mathcal{B}}{\partial t} = -\nabla \times \mathcal{E}, \qquad \text{(Ampère's Law)}$$

$$\nabla \cdot \mathcal{B} = 0, \qquad \text{(Gauss's Law)}$$

$$\nabla \cdot \mathcal{D} = 0. \qquad \text{(Colomb's Law)}$$

or

$$\boldsymbol{\nabla} \cdot \mathbf{E} = 0$$
$$\boldsymbol{\nabla} \cdot \mathbf{H} = 0$$
$$\boldsymbol{\nabla} \times \mathbf{E} = -\frac{1}{c}\frac{\partial \mathbf{H}}{\partial t}$$
$$\boldsymbol{\nabla} \times \mathbf{H} = -\frac{1}{c}\frac{\partial \mathbf{E}}{\partial t}$$

where $\mathbf{E}$ is the Electric Field and $\mathbf{H}$ is the magnetic field.

https://en.wikipedia.org/wiki/James_Clerk_Maxwell

12 Law and Disorder

Second Law of Thermodynamics - Ludwig Boltzmann, 1874

$$d\mathbf{S} <= 0$$

https://en.wikipedia.org/wiki/Ludwig_Boltzmann

13 One Thing is Absolute

Relativity - Albert Einsten, 1905

$$E = mc^2$$

https://en.wikipedia.org/wiki/Albert_Einstein

14 Quantum Weirdness

Schrodinger's Equation - Edwin Schrodinger, 1927

$$i\hbar \frac{\partial}{\partial t} \Phi = \hat{H} \Phi$$

https://en.wikipedia.org/wiki/Erwin_Schr%C3%B6dinger

15 Codes, Communications and Computers

Information Theory - Claude Shannon, 1949

$$H = \sum_{x} p(x) log_2 \, p(x)$$

https://en.wikipedia.org/wiki/Claude_Shannon

16 The Imbalance of Nature

Chaos Throry Theory - Robert May, 1975

$$x_{t+1} = kx_t(1 - x_t)$$

17 The Midas Formula

The Black-Scoles Equation - F. Black & M. Scholes - 1990

$$\frac{1}{2}\sigma^2 S^2 \frac{\partial_2 V}{\partial S_2} + rS\frac{\partial V}{\partial S} + \frac{\partial V}{\partial t} - rV = 0$$

https://en.wikipedia.org/wiki/Black%E2%80%93Scholes_model

Extras

The binomial coefficient, $\binom{n}{k}$, is defined by the expression:

$$\binom{n}{k} = \frac{n!}{k!(n-k)!}$$