

Mind, Matter and Mathematics

Pope Benedict XVI on God and mathematics

at an interview with young people in 2005

THE POPE told his young questioners that: "The great Galileo said that **God wrote the book of nature in the form of the language of mathematics.** He was convinced that God has given us two books: the book of Sacred Scripture and the book of nature. And the language of nature -- it was his conviction -- is mathematics, so it is a language of God, a language of the Creator.

"The surprising thing is that this invention of our human intellect [i.e. mathematics] is truly the key to understanding nature, that nature is truly structured in a mathematical way, and that our mathematics, invented by our human mind, is truly the instrument for working with nature, to put it at our service, to use it through technology.

"It seems to me almost incredible that an invention of the human mind and the structure of the universe coincide. Mathematics, which we invented, really gives us access to the nature of the universe and makes it possible for us to use it. Therefore, the intellectual structure of the human subject and the objective structure of reality coincide: the subjective reason and the objective reason of nature are identical. I think that this coincidence between what we thought up and how nature is fulfilled and behaves is a great enigma and a great challenge, for we see that, in the end, **it is 'one' reason that links them both.**

"One reason could not discover this other reason were there not an identical antecedent reason for both. In this sense it really seems to me that **mathematics** -- in which as such God cannot appear -- **shows us the intelligent structure of the universe.** Now there are also theories of chaos, but they are limited because if chaos had the upper hand, all technology would become impossible. Only because our mathematics is reliable, it technology reliable"...

Conics and Physics and Co-ordinate Geometry

The mathematics of the three conic sections are absolutely vital for explaining:

ballistics from the **PARABOLA**;
planetary orbits from the **ELLIPSE**.
thermodynamics from the **HYPERBOLA**.

"e" the Exponential Number

This transcendental number "e" can be calculated to any number of required decimal places with a pencil and paper using Primary School arithmetic of the multiplication table and simple addition.

What is so special about "e" is that it is linked to sine, cosine and tangent which are usually explained in geometric terms of the three sides of the right-angled triangle, namely opposite, adjacent & hypotenuse. See *Handouts* n. 114.

π is a ratio of circumference to diameter

It's also another transcendental number and can be calculated to any required number of decimal places with much laborious arithmetic (even without a calculator which would already have π on it) from the complicated infinite series for the inverse tangent of 30° , i.e. $\arctan \pi/6$.

See *Mathematics for Millions* by Lancelot Hogben p. 486. Hogben is very good as a quick reference for quite advanced maths, with good diagrams and setting out. However, be warned. His helpful historical details are marred by sniping at Christianity for some absurdities uttered by churchmen.

Earlier *Handouts* on maths and science:

18: Pythagoras (and see p. 2 of this *Handouts*)

19. Trigonometry

23. Electricity; Logarithms

38. Paper called A4

41. Early Easter & algorithms for finding its date

67. Hidden Beauty of Quadrilaterals

80. Fun with Figures

92. Rhythms in Reciprocals

106. Pulleys and Square Roots

110. Seven! Snippets; Equations of Motion

114. God and Science; Maths in the Bible

127. Maths for Muddlers

139. Tricksy Numbers & Fantasy Numbers

161. Quadratic Equations

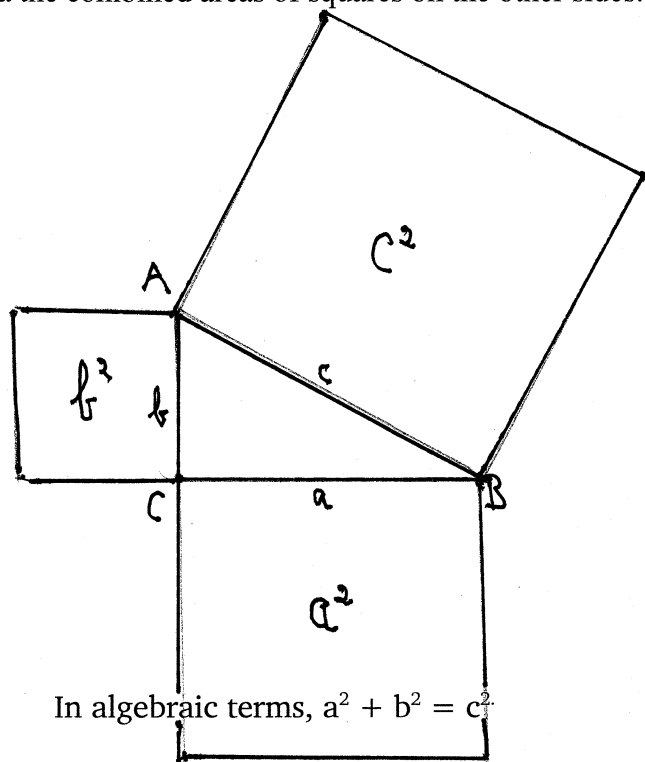
178. 97% of Scientists Agree on Nothing.

(incomplete n. 185 Maths Science Religion

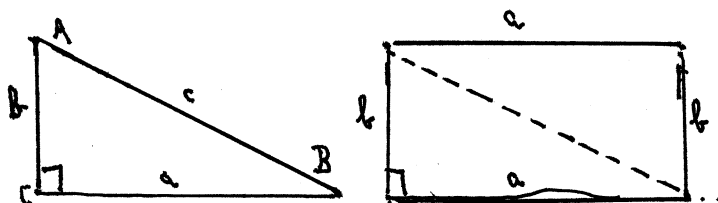
Pythagoras and his famous Theorem revisited

after earlier treatment in *Handouts* n. 18

PYTHAGORAS' THEOREM for any triangle $\triangle ABC$, sides a, b, c and C a right angle (90°) is that the geometric square on the big side equals in area the combined areas of squares on the other sides.

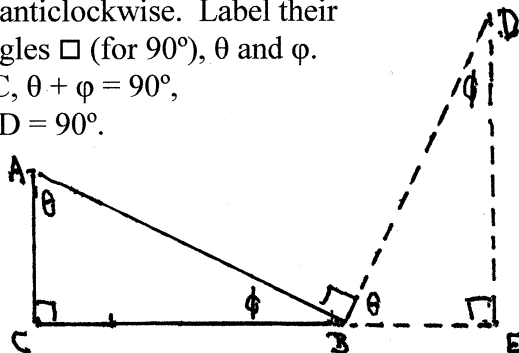


Assumption, from earlier theorems, the area of any 90° triangle is $\frac{1}{2} ab$, being half of a rectangle whose area is its length by its breadth, $a \times b = ab$.



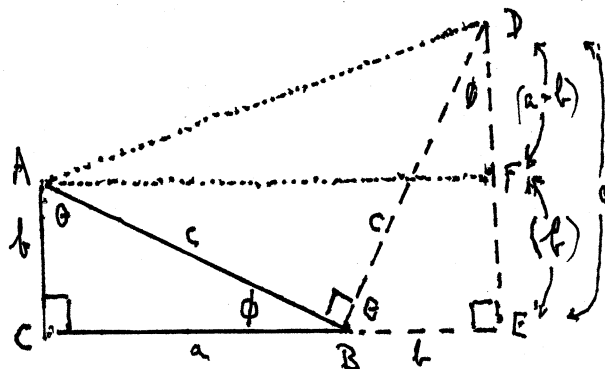
Construction 1 with new lines shown as hyphens

Alongside $\triangle ABC$, construct a $\triangle BDE$ of the same size and shape (i.e. congruent) but rotated through 90° anticlockwise. Label their matching angles \square (for 90°), θ and ϕ . From $\triangle ABC$, $\theta + \phi = 90^\circ$, so angle $ABD = 90^\circ$.



Construction 2 with new lines dotted

Draw dotted lines for (1) a rectangle ACEF, (2) a third $\triangle ADB$ and (3) a fourth $\triangle ADF$ (neither is congruent with $\triangle ABC$ or $\triangle BDE$ or with each other).



There are four 90° \triangle s, ABC, BDE, ADB, ADF . In $\triangle ADF$, the sides adjacent to 90° are $a+b$ and $a-b$. (because opposite sides of a rectangle are equal) and in $\triangle ADB$, both sides adjacent to 90° sides are c .

THE PROOF

(1). Area of trapezium ACED is sum of areas of 3 \triangle s:
 $\triangle ABC + \triangle BDE + \triangle ADB$
 $= \frac{1}{2} ab + \frac{1}{2} ab + \frac{1}{2} c^2$
 $= ab + \frac{1}{2} c^2$

(2). Area of trapezium ACED also equals sum of the areas of rectangle ACEF and the triangle $\triangle ADF$
 $= b(a+b) + \frac{1}{2}(a+b)(a-b)$
 $= ab + b^2 + \frac{1}{2}(a^2 - b^2)$ proved below \downarrow
 $= ab + b^2 + \frac{1}{2} a^2 - \frac{1}{2} b^2$
 $= ab + \frac{1}{2} b^2 + \frac{1}{2} a^2$

From (1) and (2), $ab + \frac{1}{2} c^2 = ab + \frac{1}{2} b^2 + \frac{1}{2} a^2$
 $\frac{1}{2} c^2 = \frac{1}{2} b^2 + \frac{1}{2} a^2$
 $a^2 + b^2 = c^2$ **Q.E.D.**

DIFFERENCE of TWO SQUARES:

Proof that $(a+b)(a-b) = a^2 - b^2$

Let $a+b = k$, so that LHS becomes $k(a-b) = ka - kb$

Substitute $(a+b)$ for k :

LHS $= (a+b)a - (a+b)b$

$= a(a+b) - b(a+b) = a^2 + ab - ab - b^2$

$= a^2 - b^2 =$ RHS..... **Q.E.D.**

(for those who don't know) \downarrow

Father James Tierney