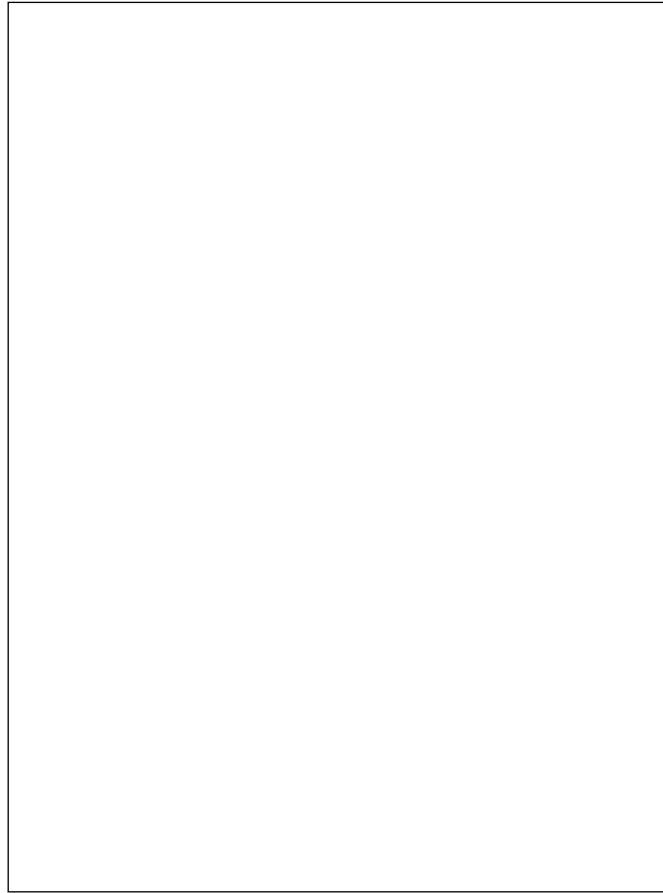


Why do We Call it Algebra?



Postage stamp issued by the Soviet Union in 1983, to mark the 1200th anniversary of the birth of Al-Khwarizmi

Abu Ja'far Mohammed ibn Musa Al-Khwarizmi
Father of Ja'far, Mohammed, son of Moses, native of the
town of Al-Khwarizmi

A Page from Al-Khwarizmi's book

*The Compendious Book on Calculation by Completion
and Balancing*

Al-Kitāb al-mukhtaṣar fī hīsāb al-ğabr wa'l-muqābala

(Arabic)

Why do We Call it Algebra?

algebra

Main Entry: **al·ge·bra**

Pronunciation: 'al-j&-br&

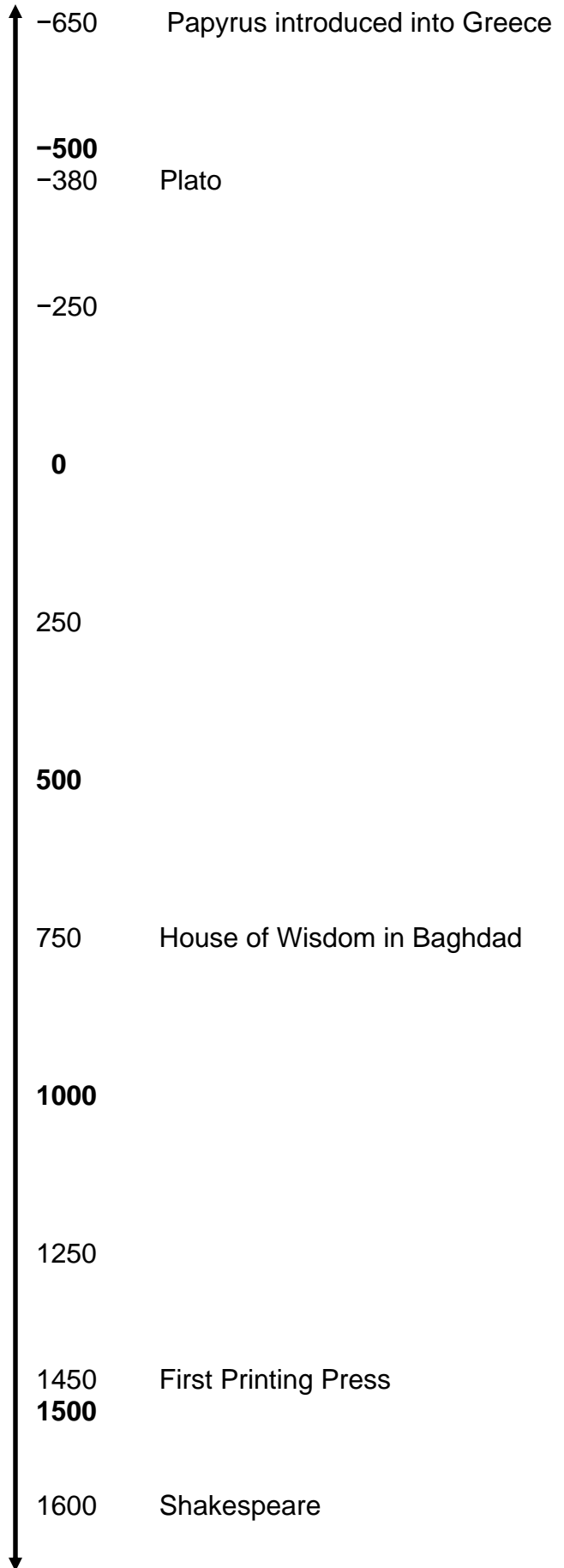
Function: *noun*

Etymology: Medieval Latin, from Arabic *al-jabr*, literally, the reduction

1 : a generalization of arithmetic in which letters representing numbers are combined according to the rules of arithmetic

2 : any of various systems or branches of mathematics or logic concerned with the properties and relationships of abstract entities (as complex numbers, matrices, sets, vectors, groups, rings, or fields) manipulated in symbolic form under operations often analogous to those of arithmetic

Time Line



*The ink of the scholar is more holy than
the blood of the martyr*

The Prophet Muhammad

algorithm

Main Entry: **al·go·rithm**

Pronunciation: 'al-g&-"ri-[th]&m

Function: *noun*

Etymology: alteration of Middle English *algorisme*, from Old French & Medieval Latin; Old French, from Medieval Latin *algorismus*, from Arabic *al-khuwArizmi*, from *al-KhwArizmI* fl A.D. 825 Islamic mathematician

: a procedure for solving a mathematical problem (as of finding the greatest common divisor) in a finite number of steps that frequently involves repetition of an operation; *broadly* : a step-by-step procedure for solving a problem or accomplishing some end especially by a computer

Amazon.com

First published in 1202

This translation: 2003

MAA Online, March 2003:

"The *Liber abaci* of Leonardo Pisano (today commonly called Fibonacci) is one of the fundamental works of European mathematics. No other book did more to establish the basic framework of arithmetic and algebra as they developed in the Western world."

Silk Route Odyssey: Caravan from Fergana to Khiva

The center of Central Asia, Uzbekistan is home to three of the most renowned of the Silk Road oases - Samarkand, Bukhara and Khiva. Built from baked desert earth and decorated to reflect the desert sky, these cities beckoned the ancient caravans like shimmering mirages.

Our trip begins in the modern Uzbek capital, Tashkent. From here we fly to the fertile Fergana Valley, heartland of Uzbekistan.

Bordered by the Tien Shan Mountains, the valley is an oasis of cotton fields and melon plantations, dotted with ancient villages distinguished for their silk production and their ceramic tiles.

We continue on to Samarkand, the grand capital of the Tatar conqueror Tamerlane. Here we admire the grace of the blue-tiled Registan, and visit Ulug Bek's Observatory. The grandson of Tamerlane, Ulug Bek was fascinated by the stars, and spent his life constructing the best-equipped observatory in the medieval world.

We brave the vast Kyzyl Kum Desert, whose red sands protect the remnants of Alexander the Great's ancient well

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"Very unusual and very well done tour - experiences from A to Z: gorgeous architecture, fascinating dress of the local people, the thrill of seeing Bukhara and Khiva - I loved it all! MIR is about the best company I've ever used! Thanks!"

Virginia Britton
East Boothbay, ME

Completing the Square

What is the square which combined with ten of its roots will give a sum total of 39?

Solve $x^2 + 10x = 39$

The manner of solving this type of equation is to take one-half of the roots just mentioned. Now the roots in the problem before us are 10. Therefore take 5, which multiplied by itself gives 25, an amount which you add to 39 giving 64. Having taken then the square root of this which is 8, subtract from it half the roots, 5 leaving 3. The number 3 therefore represents one root of this square



Postage stamp issued by the Soviet Union in 1983, to mark the 1200th anniversary of the birth of Al-Khwarizmi

$$x^2 + 10x = 39$$

$$x^2 + 10x + 25 = 39 + 25$$

$$(x + 5)^2 = 64$$

$$x + 5 = 8 \text{ or } x + 5 = -8$$

$$x = 3 \text{ or } x = -13$$

Al-Samawal

Born: about 1130 in Baghdad, Iraq

Died: about 1180 in Maragha, Iran

Describing how to construct the third row of Pascal's Triangle, on his way to finding coefficients for the expansion of $(a + b)^5$

If we transfer the 'one' in the second column into a third column, then add 'one' from the second column to 'two' below it, we obtain 'three' to be written under the 'one' in the third column. If we then add 'two' from the second column to 'one' below it we have 'three' which is written under the 'three', then we write 'one' under this 'three'; we thus obtain a third column whose numbers are 'one', 'three', 'three', and 'one'.

Col 1	Col 2	Col 3	Col 4	Col 5	...
1	1	1	1	1	...
1	2	3	4	5	...
	1	3	6	10	...
		1	4	10	...
			1	5	...
				1	...

Al-Samawal

Born: about 1130 in Baghdad, Iraq

Died: about 1180 in Maragha, Iran

The golden ratio is $\frac{\sqrt{125}-5}{15-\sqrt{125}}$

$$\begin{aligned}\frac{\sqrt{125}-5}{15-\sqrt{125}} &= \frac{5\sqrt{5}-5}{15-5\sqrt{5}} \\ &= \frac{5(\sqrt{5}-1)}{5(3-\sqrt{5})} \\ &= \frac{\sqrt{5}-1}{3-\sqrt{5}} \\ &= \frac{3\sqrt{5}+5-3-\sqrt{5}}{9-3\sqrt{5}+3\sqrt{5}-5} \\ &= \frac{2\sqrt{5}+2}{4} \\ &= \frac{2(\sqrt{5}+1)}{2 \cdot 2} \\ &= \frac{1+\sqrt{5}}{2}\end{aligned}$$

Al-Samawal

Father: Abul-Abbas Yahya al-Maghribi, Fez, Morocco

Mother: Anna Isaac Levi, Basra, Iraq

Al-Samawal converts to Islam in 1163

Toledo, Spain

School of Translation, 1150

View of Toledo by El Greco

Keith Devlin:

Latin was the language of the European scholars, and thus the target language for the translations. Since few European scholars knew Arabic, however, the translation was often done in two stages, with a Jewish scholar living in Spain translating from the Arabic to some common language and the visiting scholar then translating from that language into Latin. In the same way, many ancient Greek texts, from Aristotle to Euclid, were also translated into Latin, whereupon they began to make an impact in the West.

Greek to Arabic

The following mathematical Greek texts on Hellenistic mathematics were translated into Arabic, and subsequently into Latin:

- Euclid's *Data*, *Optics*, *Phaenomena* and *On Divisions*.
- Euclid's *Elements* by al-Hajjaj (c. 8th century).
- Revision of Euclid's *Elements* by Thabit ibn Qurra.
- Apollonius' *Conics* by Thabit ibn Qurra.
- Ptolemy's *Almagest* by Thabit ibn Qurra.
- Archimedes' *Sphere and Cylinder* and *Measurement of the Circle* by Thabit ibn Qurra.
- Archimedes' *On triangles* by Sinan ibn Thabit.
- Diophantas' *Arithmetica* by Abu'l-Wáfa.
- Menelaus of Alexandria's *Sphaerica*.
- Theodosius of Bithynia's *Spherics*.
- Diocles' treatise on mirrors.
- Pappus of Alexandria's work on mechanics.

Sanskrit to Arabic

The following mathematical Sanskrit texts on Indian mathematics were translated into Arabic, and subsequently into Latin:

- *The Sindhind* by Ibrahim al-Fazari, Muhammad al-Fazari and Yaqub ibn Tāriq (c. 8th century).
- *Surya Siddhanta* by al-Fazari.
- Brahmagupta's *Brahma Sphuta Siddhanta* by al-Fazari.
- Brahmagupta's *Khandakhayaka*.
- Aryabhata's *Aryabhatiya*.
- Aryabhata's *Arya Siddhanta*.
- Varahamihira's *Pancha Siddhanta*.
- Bhaskara I's *Lagu Bhaskariya*.
- Bhaskara II's *Lilavati* (to Persian rather than Arabic).

Arabic to Latin

The following mathematical Arabic texts on Islamic mathematics were translated into Latin:

- *Introduction to Astronomy* by Adelard of Bath (fl. 1116-1142).
- Al-Khwarizmi's arithmetical work *Liber ysagogarum Alchorismi* and *Astronomical Tables* by Adelard of Bath.
- Al-Khwarizmi's trigonometrical tables which deal with the sine and tangent by Adelard of Bath (1126).
- Al-Khwarizmi's *Zij al-Sindhind* in Spain (1126).
- *Liber alghoarismi de practica arismetrice*, an elaboration of al-Khwarizmi's *Arithmetic*, by John of Seville and Domingo Gundisalvo (fl. 1135-1153).
- *Secretum Secretorum* by John of Seville and Domingo Gundisalvo.
- Costa Ben Luca's *De differentia spiritus et animae* by John of Seville and Domingo Gundisalvo.
- al-Battani's *De motu stellarum*, which contains important material on trigonometry, by Plato of Tivoli (fl. 1134-1145).
- Abraham bar Hiyya's *Liber embadorum* by Plato of Tivoli.
- *Liber de compositione alchimiae (The Book of the Composition of Alchemy)* by Robert of Chester (f. 1141-1150).
- Al-Khwarizmi's *Kitab al-Jabr wa-l-Muqabala (Algebra)*, *Kitab al-Adad al-Hindi (Algoritmi de numero Indorum)*, and revised astronomical tables by Robert of Chester.
- Al-Khwarizmi's *Kitab-ul Jama wat Tafriq* by Bon Compagni (1157).
- Al-Khwarizmi's *Algebra* by Gerard of Cremona (fl. 1150-1185).
- Jabir ibn Aflah's *Elementa astronomica* by Gerard of Cremona.
- The Banu Musa's (Muhammad bin Musa, Ahmad bin Musa and Hasan bin Musa) works on geometry by Gerard of Cremona.
- Abdur Rahman's commentary on Euclid's *Elements* by Gerard of Cremona.
- Muhammad ibn Muhammad Baqi's commentary on Euclid's *Elements* by Gerard of Cremona.
- Abul Abbas Nairizi's commentaries on Euclid and Ptolemy by Gerard of Cremona.
- The works of Thabit ibn Qurra by Gerard of Cremona.
- Abu Kamil's *Algebra*.
- Al-Biruni's *Tariq Al Hind*.
- Al-Fazari's *The Sindhind*.
- The works of Omar Khayyam.
- The works of Nasir al-Din Tusi.
- The works of Mu'ayyad al-Din al-'Urdu (c. 1250).
- The works of Ibn al-Shatir (1304–1375).
- The works of Nasir al-Din Tusi (to Byzantine Greek rather than Latin).