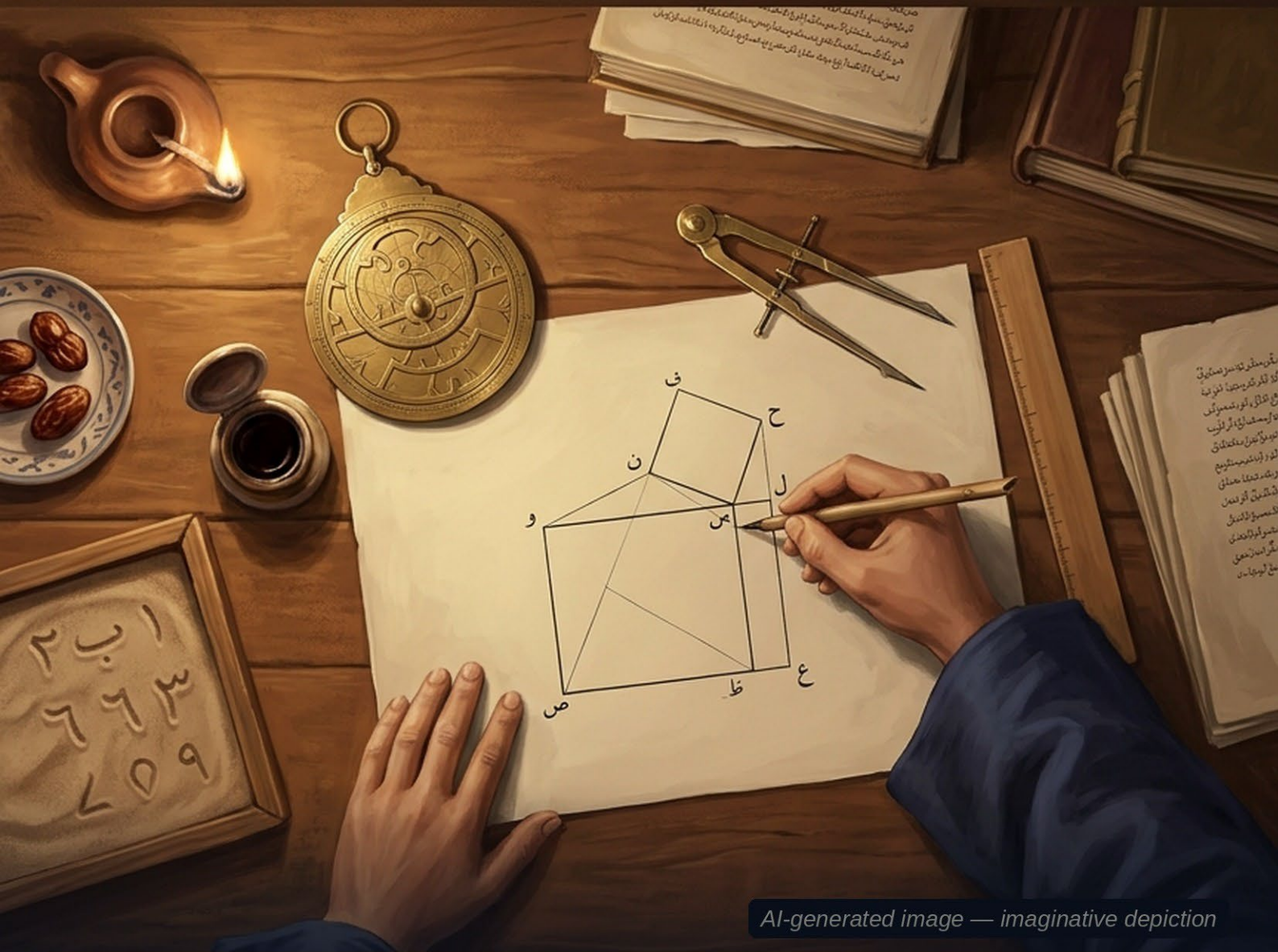
TRACING THE SCHOLARS OF ISLAM

SERIES 18

MUHAMMAD IBN MUSA AL-KHWARIZMI

Mathematician of the House of Wisdom, Author of al-Jabr Which Gave Algebra Its Name



AI-generated image — imaginative depiction

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

TRACING THE SCHOLARS OF ISLAM

SERIES 18

AL-KHWARIZMI

Mathematician of the House of Wisdom, Author of al-Jabr Which Gave Algebra Its Name

هُوَ ٱلَّذِي جَعَلَ ٱلشَّمۡسَ ضِيَآءٗ وَٱلۡقَمَرَ نُورٗا وَقَدَّرَهُۥ مَنَازِلَ لِتَعۡلَمُواْ عَدَدَ ٱلسِّنِينَ وَٱلۡحِسَابَۚ مَا خَلَقَ ٱللَّهُ ذَٰلِكَ إِلَّا بِٱلۡحَقِّۚ يُفَصِّلُ ٱلۡأٓيَٰتِ لِقَوۡمٖ يَعۡلَمُونَ

"It is He who made the sun a shining light and the moon a derived light and determined for it phases - that you may know the number of years and account [of time]. Allah has not created this except in truth. He details the signs for a people who know."

SURAH YUNUS 10:5

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ACKNOWLEDGEMENT

All praise is due to Allah, who made the sun and the moon so that mankind may know the number of years and the account of time. Blessings and peace be upon the Messenger of Allah ﷺ, and upon his family and his Companions.

This eBook is specially dedicated to my beloved wife,

ZAHARAH MOHD LATIF;

my dear children,

MUHAMMAD HAFIZ, NOOR HAZWANI, ABDUL HAKIM, NOOR HIDAYAH, NOR AQILA and **NOR ATIQAH**;

and my sons- and daughters-in-law,

FAZILAH, MALEK, HANIN, FAIRIZAL and **FIRWAN**.

This eighteenth book of Tracing the Scholars of Islam tells the story of the mathematician whose name we say every time we say “algorithm”, and whose book gave “algebra” its name. May his story remind us that mathematics, too, can be a way of serving the religion.

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ABOUT THE COVER OF THIS EBOOK

The cover of this eBook is an **image generated by artificial intelligence (AI)** — an ***imaginative depiction***. This time we look **straight down onto the desk**, and all that is visible are al-Khwarizmi's **two hands** — no face at all.

His right hand holds a **reed pen** and is drawing a **geometric diagram** on paper, a symbol of the geometric methods used in the book of ***al-Jabr*** to prove the solutions of equations. Around it are a **brass astrolabe**, **brass dividers**, a **ruler**, **ink**, an **oil lamp**, **dates** and manuscripts.

In the left corner is a **sand board** with numerals traced on it — a symbol of the ***Indian numerals*** that al-Khwarizmi introduced to the Muslim world and later to Europe. The **wooden bands** above and below hold the title and the author's name.

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Colour guide: green box = verses of the Qur'an; gold box = Hadith; brown box = history note (reports from the books of history and biography); blue table = comparison. Underlined blue narrator names can be clicked to open the narrator's page on sunnah.com.

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AL-KHWARIZMI

The eighteenth book of **Tracing the Scholars of Islam** tells the story of ***Muhammad ibn Musa al-Khwarizmi***, mathematician, astronomer and geographer at the ***House of Wisdom*** in Baghdad. His book, ***al-Kitab al-Mukhtasar fi Hisab al-Jabr wa al-Muqabalah***, gave its name to ***algebra***, while his own name became the origin of the word ***algorithm***.

What is remarkable: the book of al-Jabr was written for the ***everyday needs of Muslims*** — dividing inheritances, wills, trade and measuring land.

This eBook explores ***the age of Baghdad*** and the House of Wisdom, the contents of the book of al-Jabr with ***worked examples***, the link between mathematics and ***inheritance and wills***, the journey of ***numerals and zero*** around the world, his contributions to ***astronomy and geography***, and his legacy in the ***computer age***.

Note: The translation of Qur'anic verses in this eBook is that of Sahih International. The grading of each Hadith is stated in the Hadith box. Information from books of history and modern research is **biographical report (not Hadith)** *and is placed in the brown "History Note" boxes. The cover image is an AI-generated image. Al-Khwarizmi's dates are estimates. The inheritance calculations in this eBook are* **teaching examples** *only.*

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THE SUN, THE MOON AND THE RECKONING OF TIME

SURAH YUNUS 10:5

هُوَ ٱلَّذِى جَعَلَ ٱلشَّمْسَ ضِيَآءً وَٱلْقَمَرَ نُورًا وَقَدَّرَهُۥ مَنَازِلَ لِتَعْلَمُوا۟ عَدَدَ ٱلسِّنِينَ وَٱلْحِسَابَ ۚ مَا خَلَقَ ٱللَّهُ ذَٰلِكَ إِلَّا بِٱلْحَقِّ ۚ يُفَصِّلُ ٱلْـَٔايَٰتِ لِقَوْمٍ يَعْلَمُونَ ۝٥

It is He who made the sun a shining light and the moon a derived light and determined for it phases - that you may know the number of years and account [of time]. Allah has not created this except in truth. He details the signs for a people who know.

Translation: Sahih International — quran.com/10:5

EXPLANATION OF VERSE 10:5

Allah made the sun and the moon move by His decree ***"that you may know the number of years and account [of time]"***. The Qur'an itself invites people to ***count and measure***. Tafsir Ibn Kathir 10:5.

SURAH AR-RAHMAN 55:5

ٱلشَّمْسُ وَٱلْقَمَرُ بِحُسْبَانٍ ۝٥

The sun and the moon [move] by precise calculation.

Translation: Sahih International — quran.com/55:5

Al-Khwarizmi compiled ***Zij al-Sindhind***, astronomical tables for calculating the positions of the sun, moon and planets. This knowledge helped Muslims determine ***prayer times, the direction of the qiblah and the start of the month***.

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DAY, NIGHT AND RECKONING

SURAH AL-ISRA' 17:12

وَجَعَلْنَا ٱلَّيْلَ وَٱلنَّهَارَ ءَايَتَيْنِ ۖ فَمَحَوْنَآ ءَايَةَ ٱلَّيْلِ وَجَعَلْنَآ ءَايَةَ ٱلنَّهَارِ مُبْصِرَةً
لِّتَبْتَغُوا۟ فَضْلًا مِّن رَّبِّكُمْ وَلِتَعْلَمُوا۟ عَدَدَ ٱلسِّنِينَ وَٱلْحِسَابَ ۚ وَكُلَّ شَىْءٍ
فَصَّلْنَٰهُ تَفْصِيلًا ﴿١٢﴾

And We have made the night and day two signs, and We erased the sign of the night and made the sign of the day visible that you may seek bounty from your Lord and may know the number of years and the account [of time]. And everything We have set out in detail.

Translation: Sahih International — quran.com/17:12

This verse again states the purpose of the alternation of day and night: ***"may know the number of years and the account [of time]"***. The Arabic word ***hisab*** means "calculation", and from it comes the term ***'ilm al-hisab*** (arithmetic). These verses encouraged Muslim scholars to master ***mathematics and astronomy***. Tafsir Ibn Kathir 17:12.

Allah also describes Himself as the One who made ***"the sun and moon for calculation"*** (6:96). For scholars like al-Khwarizmi, calculating the motions of the heavens was a way of ***appreciating the precision of Allah's creation***.

ALLAH HAS ENUMERATED ALL THINGS

SURAH AL-JINN 72:28

لِّيَعْلَمَ أَن قَدْ أَبْلَغُوا۟ رِسَٰلَٰتِ رَبِّهِمْ وَأَحَاطَ بِمَا لَدَيْهِمْ وَأَحْصَىٰ كُلَّ شَىْءٍ
عَدَدًا ﴿٢٨﴾

That he may know that they have conveyed the messages of their Lord; and He has encompassed whatever is with them and has enumerated all things in number.

Translation: Sahih International — quran.com/72:28

This verse ends by saying that Allah ***"has enumerated all things in number"***. Allah's knowledge encompasses ***the number of every particle*** in the universe. Humans can count only a tiny part of it, and mathematics is a humble effort to understand the ***order*** that Allah has set. Tafsir Ibn Kathir 72:28.

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THE AGE: BAGHDAD AND THE HOUSE OF WISDOM

Al-Khwarizmi lived in ***the golden age of Baghdad***. The city was built by Caliph al-Mansur in 145 AH (762 CE) in a ***round*** shape, with the palace and mosque at its centre. Within a few decades Baghdad became ***the largest city in the world*** of its time, a hub of trade between China, India, Persia and the Mediterranean.

> **HISTORY NOTE: CALIPH AL-MA'MUN AND THE MEASUREMENT OF THE EARTH**
>
> Caliph ***al-Ma'mun*** (reigned 198–218 AH / 813–833 CE) is famous for supporting learning. The historical works mention that he ordered a group of astronomers to ***measure the length of one degree of meridian*** in the plain of ***Sinjar*** and near ***Kufa***, in order to estimate ***the circumference of the earth***.
>
> He also built ***observatories*** in Baghdad (ash-Shammasiyyah) and in Damascus (Mount Qasiyun) to improve astronomical tables. Al-Khwarizmi is associated with the scholarly work of this period.

THE HOUSE OF WISDOM: MORE THAN A LIBRARY

The ***House of Wisdom*** (Bayt al-Hikmah) brought together ***translators, mathematicians, astronomers and physicians***. There, Greek, Persian and Indian books — including the ***Sindhind*** (an Indian astronomical work) — were translated and studied. Modern historians disagree about the actual size of the institution, but all agree that Baghdad was then ***the centre of world learning***.

The lesson: knowledge flourishes when ***leaders value scholars***, and scholars ***cooperate*** across disciplines.

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WHO WAS AL-KHWARIZMI?

His full name was ***Abu Ja'far Muhammad ibn Musa al-Khwarizmi***. He is estimated to have been ***born around 780 CE*** and to have ***died around 850 CE***. The name "al-Khwarizmi" refers to ***Khwarazm***, a region in Central Asia (today part of Uzbekistan and Turkmenistan), as mentioned by Ibn al-Nadim.

HISTORY NOTE: AT THE HOUSE OF WISDOM, BAGHDAD

Al-Khwarizmi worked at the ***House of Wisdom*** (Bayt al-Hikmah) in Baghdad in the time of ***Caliph al-Ma'mun*** (813–833 CE). There, scholars translated, studied and developed knowledge from many civilisations.

Around ***820 CE*** he wrote the book of al-Jabr ***with the encouragement of Caliph al-Ma'mun***. In ***833 CE*** he completed ***Kitab Surat al-Ard***, a geography listing ***more than 2,400 coordinates*** of places and improving many values in Ptolemy's Geography.

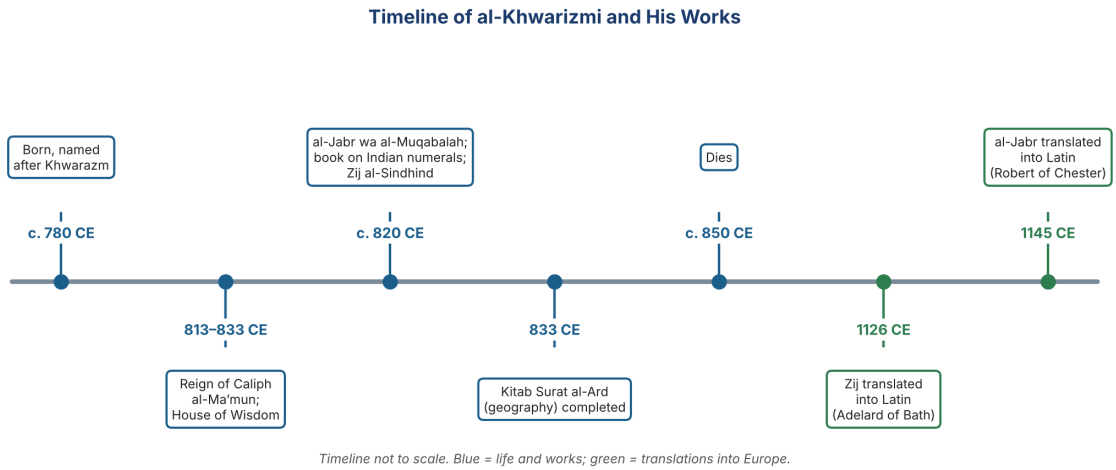


Figure 1: Timeline of al-Khwarizmi and his works.

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KHWARAZM AND QUESTIONS ABOUT THE MAN

Khwarazm is a fertile region around ***the delta of the Amu Darya river***, south of the Aral Sea. Cities such as ***Khiva*** and ***Kath*** were trading centres on the Silk Road. The region later produced another great scholar, ***al-Biruni*** (d. c. 1048 CE).

> **HISTORY NOTE: WHAT IS KNOWN AND WHAT IS NOT**
>
> Information about al-Khwarizmi's personal life is ***very scarce***. The historian ***at-Tabari*** mentions a "Muhammad ibn Musa al-Khwarizmi al-Majusi al-Qutrubbulli" in one event. Some scholars take this as evidence of a ***Zoroastrian family background***, while others think it is ***a copyist's error*** in the manuscript.
>
> What is clear is that ***the introduction to the book of al-Jabr*** opens with the ***basmalah***, praise of Allah and blessings upon the Prophet Muhammad ﷺ, and praises Caliph al-Ma'mun as ***Amir al-Mu'minin***. This shows that he wrote ***as a Muslim***.

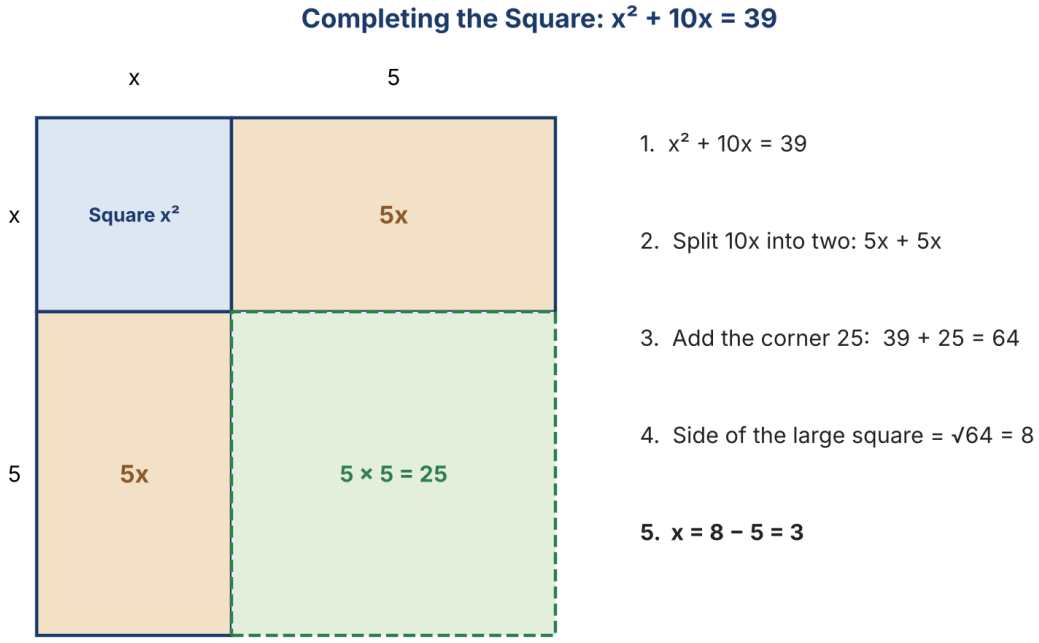
LESSON

When information about a figure is limited, we ***do not fill the gaps with invented stories***. We hold to ***the evidence we have*** — in this case, al-Khwarizmi's own words in his book.

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THE BOOK OF AL-JABR: MATHEMATICS FOR LIFE

The word ***al-jabr*** means “completion” or “restoration” — moving a negative term to the other side of an equation. ***Al-muqabalah*** means “balancing”. He classified equations into ***six types*** and solved them step by step, with ***geometric proofs***.



A famous example in the book of al-Jabr: “A square and ten roots are equal to thirty-nine.”

Figure 2: The method of completing the square in the book of al-Jabr.

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A large part of the book of al-Jabr deals with ***dividing inheritances (fara'id) and wills***. The science of inheritance requires precise calculation, as the Messenger of Allah ﷺ said:

HADITH — SAHIH AL-BUKHARI, NO. 6732

حَدَّثَنَا مُوسَى بْنُ إِسْمَاعِيلَ، حَدَّثَنَا وُهَيْبٌ، حَدَّثَنَا ابْنُ طَاوُسٍ، عَنْ أَبِيهِ، عَنِ ابْنِ عَبَّاسٍ ـ رضى الله عنهما ـ عَنِ النَّبِيِّ صلى الله عليه وسلم قَالَ «أَلْحِقُوا الْفَرَائِضَ بِأَهْلِهَا، فَمَا بَقِيَ فَهُوَ لأَوْلَى رَجُلٍ ذَكَرٍ».

TRANSLATION:

Ibn 'Abbas رضى الله عنهما narrated that the Prophet ﷺ said: **"Give the fixed shares (of inheritance) to those entitled to them. Whatever remains is for the nearest male relative."**

CHAIN OF NARRATION: Narrated by Imam al-Bukhari: from Musa ibn Isma'il, from Wuhayb ibn Khalid, from 'Abdullah ibn Tawus, from his father Tawus ibn Kaysan, from 'Abdullah ibn 'Abbas رضى الله عنهما.

REFERENCE: Narrated by Imam al-Bukhari in Sahih al-Bukhari, Book of the Laws of Inheritance (Kitab al-Fara'id), Hadith No. 6732; also narrated by Muslim (No. 1615).

GRADE: SAHIH — contained in Sahih al-Bukhari, the most authentic book of Hadith after the Qur'an by consensus of the Hadith scholars.

Source: https://sunnah.com/bukhari:6732

LESSONS FROM THIS HADITH

The laws of inheritance are ***Allah's decree***, and mathematics is ***a tool for carrying them out justly***. Al-Khwarizmi showed that arithmetic can be ***a service to the Shari'ah***.

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SIX TYPES OF EQUATION AND A WORKED EXAMPLE

Al-Khwarizmi did not use symbols such as x or ². All equations were written in ***ordinary words***: "wealth" (*mal*) for x², "root" (*jidhr*) for x, and "dirhams" for numbers. The table below shows his six types in modern notation.

TYPE (IN AL-KHWARIZMI'S WORDS)	MODERN NOTATION AND EXAMPLE
1. Squares equal roots	$ax^2 = bx$; e.g. $x^2 = 5x$, so $x = 5$.
2. Squares equal numbers	$ax^2 = c$; e.g. $x^2 = 9$, so $x = 3$.
3. Roots equal numbers	$bx = c$; e.g. $4x = 20$, so $x = 5$.
4. Squares and roots equal numbers	$x^2 + bx = c$; e.g. $x^2 + 10x = 39$, so $x = 3$.
5. Squares and numbers equal roots	$x^2 + c = bx$; e.g. $x^2 + 21 = 10x$, so $x = 3$ or $x = 7$.
6. Roots and numbers equal squares	$bx + c = x^2$; e.g. $3x + 4 = x^2$, so $x = 4$.

A FAMOUS EXAMPLE: $x^2 + 10x = 39$

Al-Khwarizmi solved it like this: ***(1)*** take half the number of roots, 10 ÷ 2 = 5; ***(2)*** square it, 5 × 5 = 25; ***(3)*** add it to 39, giving 64; ***(4)*** take the square root, 8; ***(5)*** subtract 5, so ***x = 3***. This method is known today as ***completing the square*** (Figure 2), and it is still taught in secondary schools (MacTutor: al-Khwarizmi).

LESSON

Al-Khwarizmi wrote every step ***clearly and in order*** — that is what "algorithm" means: an ordered set of steps for solving a problem. He taught that a complex problem can be solved if it is ***broken down into small steps***.

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QUADRATIC EQUATIONS IN MODERN LIFE

Al-Khwarizmi's fourth type of equation, $x^2 + bx = c$, belongs to the family of ***quadratic equations***. Today quadratic equations are used in many fields (Britannica: quadratic equation).

FIELD	EXAMPLE OF USE
Physics	Calculating the height of a ball thrown upwards over time: $h = ut - \frac{1}{2}gt^2$.
Engineering	Designing the curves of bridges and parabolic antennas.
Farming and land	Finding the length and width of a plot when its area and perimeter are known.
Finance	Calculating growth rates in investment and business planning.
Computer graphics	Drawing smooth curves in video games and digital design.

THE GENERAL FORMULA

The method of completing the square used by al-Khwarizmi eventually led to the ***quadratic formula*** that schoolchildren memorise: $x = [-b \pm \sqrt{(b^2 - 4ac)}] \div 2a$. Every time a student uses it, they continue work that began in Baghdad.

LESSON

Knowledge written more than a thousand years ago is still ***relevant and useful***. True and beneficial knowledge ***does not fade*** with time.

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THE CHAPTER ON MEASUREMENT: AREA AND VOLUME

The book of al-Jabr also contains a chapter on ***al-misahah*** (measurement), useful for ***surveying land, building houses and digging canals***. Al-Khwarizmi explains how to calculate the area and volume of various shapes.

SHAPE	METHOD IN THE BOOK OF AL-JABR (MODERN NOTATION)
Rectangle	Area = length × width.
Triangle	Area = ½ × base × height; the height is found using Pythagoras' theorem.
Circle	Circumference ≈ 3 × diameter; he also mentions other values of π such as √10 and 62832/20000.
Area of a circle	Area ≈ half the circumference × half the diameter.
Prism and cylinder	Volume = base area × height.
Pyramid and cone	Volume = ⅓ × base area × height.

A REMARKABLE VALUE OF Π

The value ***62832/20000 = 3.1416*** mentioned by al-Khwarizmi (taken from Indian mathematicians) is ***accurate to four decimal places***. The modern value of π is 3.14159… (Britannica: pi). He honestly noted that these values were ***approximations***, not exact values.

LESSON

Mathematics is not just theory in the classroom. Al-Khwarizmi showed that it is a tool to ***build, measure and act justly*** in matters of land and property.

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THE MATHEMATICS OF INHERITANCE AND WILLS

The Qur'an sets the share of each heir with ***exact fractions***:

SURAH AN-NISA' 4:11

يُوصِيكُمُ ٱللَّهُ فِيٓ أَوۡلَٰدِكُمۡۖ لِلذَّكَرِ مِثۡلُ حَظِّ ٱلۡأُنثَيَيۡنِۚ فَإِن كُنَّ نِسَآءٗ فَوۡقَ ٱثۡنَتَيۡنِ فَلَهُنَّ ثُلُثَا مَا تَرَكَۖ وَإِن كَانَتۡ وَٰحِدَةٗ فَلَهَا ٱلنِّصۡفُۚ وَلِأَبَوَيۡهِ لِكُلِّ وَٰحِدٖ مِّنۡهُمَا ٱلسُّدُسُ مِمَّا تَرَكَ إِن كَانَ لَهُۥ وَلَدٞۚ فَإِن لَّمۡ يَكُن لَّهُۥ وَلَدٞ وَوَرِثَهُۥٓ أَبَوَاهُ فَلِأُمِّهِ ٱلثُّلُثُۚ فَإِن كَانَ لَهُۥٓ إِخۡوَةٞ فَلِأُمِّهِ ٱلسُّدُسُۚ مِنۢ بَعۡدِ وَصِيَّةٖ يُوصِي بِهَآ أَوۡ دَيۡنٍۗ ءَابَآؤُكُمۡ وَأَبۡنَآؤُكُمۡ لَا تَدۡرُونَ أَيُّهُمۡ أَقۡرَبُ لَكُمۡ نَفۡعٗاۚ فَرِيضَةٗ مِّنَ ٱللَّهِۗ إِنَّ ٱللَّهَ كَانَ عَلِيمًا حَكِيمٗا ١١

Allah instructs you concerning your children: for the male, what is equal to the share of two females. But if there are [only] daughters, two or more, for them is two thirds of one's estate. And if there is only one, for her is half. And for one's parents, to each one of them is a sixth of his estate if he left children. But if he had no children and the parents [alone] inherit from him, then for his mother is one third. And if he had brothers [or sisters], for his mother is a sixth, after any bequest he [may have] made or debt. Your parents or your children - you know not which of them are nearest to you in benefit. [These shares are] an obligation [imposed] by Allah. Indeed, Allah is ever Knowing and Wise.

Translation: Sahih International — quran.com/4:11

This verse mentions fractions such as ***"two thirds"***, ***"half"*** and ***"a sixth"***. To divide an estate justly one must master ***fractions, common multiples and ratios***. Tafsir Ibn Kathir 4:11.

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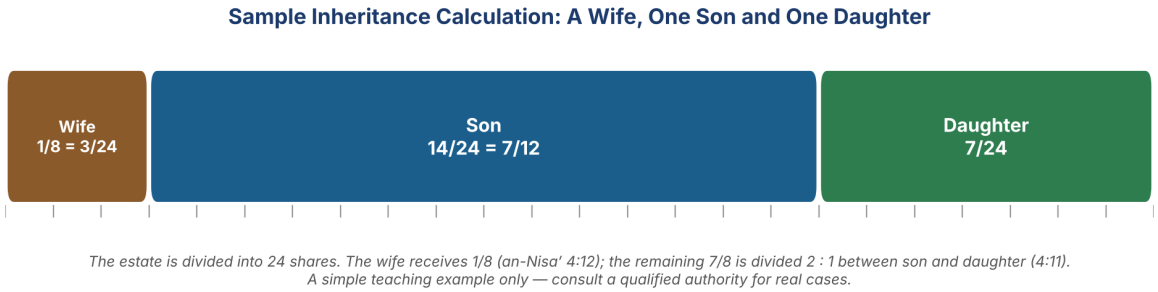


Figure 3: A sample inheritance calculation — a wife, one son and one daughter.

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THE LIMIT OF A BEQUEST: ONE THIRD

The second part of the book of al-Jabr also deals with ***bequests (wasiyyah)***. The Messenger of Allah ﷺ set the limit of a bequest in the following Hadith:

HADITH — SAHIH AL-BUKHARI, NO. 2742 (MUTTAFAQ 'ALAYH)

حَدَّثَنَا أَبُو نُعَيْمٍ، حَدَّثَنَا سُفْيَانُ، عَنْ سَعْدِ بْنِ إِبْرَاهِيمَ، عَنْ عَامِرِ بْنِ سَعْدٍ، عَنْ سَعْدِ بْنِ أَبِي وَقَّاصٍ ـ رضى الله عنه ـ قَالَ جَاءَ النَّبِيُّ صلى الله عليه وسلم يَعُودُنِي وَأَنَا بِمَكَّةَ، وَهْوَ يَكْرَهُ أَنْ يَمُوتَ بِالأَرْضِ الَّتِي هَاجَرَ مِنْهَا قَالَ «يَرْحَمُ اللَّهُ ابْنَ عَفْرَاءَ». قُلْتُ يَا رَسُولَ اللَّهِ، أُوصِي بِمَالِي كُلِّهِ قَالَ «لاَ». قُلْتُ فَالشَّطْرُ قَالَ «لاَ». قُلْتُ الثُّلُثُ. قَالَ «فَالثُّلُثُ، وَالثُّلُثُ كَثِيرٌ، إِنَّكَ أَنْ تَدَعَ وَرَثَتَكَ أَغْنِيَاءَ خَيْرٌ مِنْ أَنْ تَدَعَهُمْ عَالَةً يَتَكَفَّفُونَ النَّاسَ فِي أَيْدِيهِمْ، وَإِنَّكَ مَهْمَا أَنْفَقْتَ مِنْ نَفَقَةٍ فَإِنَّهَا صَدَقَةٌ، حَتَّى اللُّقْمَةُ الَّتِي تَرْفَعُهَا إِلَى فِي امْرَأَتِكَ، وَعَسَى اللَّهُ أَنْ يَرْفَعَكَ فَيَنْتَفِعَ بِكَ نَاسٌ وَيُضَرَّ بِكَ آخَرُونَ». وَلَمْ يَكُنْ لَهُ يَوْمَئِذٍ إِلاَّ ابْنَةٌ.

TRANSLATION:

Sa'd ibn Abi Waqqas رضى الله عنه said: The Prophet ﷺ came to visit me when I was (ill) in Makkah — and he disliked that a person should die in the land from which he had emigrated. He said, "May Allah have mercy on Ibn 'Afra'." I said, "O Messenger of Allah, may I bequeath all my wealth?" He said, "No." I said, "Half?" He said, "No." I said, "One third?" He said: **"One third — and one third is a lot. To leave your heirs rich is better than to leave them poor, begging from people.** Whatever you spend is charity, even the morsel you lift to your wife's mouth. Perhaps Allah will prolong your life, so that some people benefit from you and others are harmed by you." At that time he had no heir except one daughter.

CHAIN OF NARRATION: Narrated by Imam al-Bukhari: from Abu Nu'aym, from Sufyan, from Sa'd ibn Ibrahim, from 'Amir ibn Sa'd, from Sa'd ibn Abi Waqqas رضى الله عنه.

REFERENCE: Narrated by Imam al-Bukhari in Sahih al-Bukhari, Book of Wills, Hadith No. 2742. Also narrated by Muslim (No. 1628).

GRADE: SAHIH — contained in Sahih al-Bukhari, the most authentic book of Hadith after the Qur'an by consensus of the Hadith scholars.

Source: https://sunnah.com/bukhari:2742

LESSONS FROM THIS HADITH

A bequest ***may not exceed one third*** of the estate, so that heirs are not left in poverty. When bequests and inheritance shares are combined, the calculation becomes an ***algebraic equation***.

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THE MATHEMATICS OF TRADE: THE CHAPTER ON TRANSACTIONS

The chapter on ***al-mu'amalat*** in the book of al-Jabr discusses ***buying, selling, hiring and exchange***. The Qur'an gives a stern warning to those who cheat in measurement:

SURAH AL-MUTAFFIFIN 83:1–3

وَيْلٌ لِّلْمُطَفِّفِينَ ﴿١﴾

Woe to those who give less [than due].

ٱلَّذِينَ إِذَا ٱكْتَالُوا۟ عَلَى ٱلنَّاسِ يَسْتَوْفُونَ ﴿٢﴾

Who, when they take a measure from people, take in full?

وَإِذَا كَالُوهُمْ أَو وَّزَنُوهُمْ يُخْسِرُونَ ﴿٣﴾

But if they give by measure or by weight to them, they cause loss.

Translation: Sahih International — quran.com/83:1-3

These verses condemn ***"those who give less [than due]"***. Accurate calculation is the foundation of ***justice in trade***. Tafsir Ibn Kathir 83:1.

THE RULE OF FOUR NUMBERS

Al-Khwarizmi explains that every sale involves ***four numbers***: a quantity, a price, a second quantity and a second price. If three are known, the fourth can be calculated. Example: if ***10 measures*** of rice cost ***6 dirhams***, what do ***4 measures*** cost? Answer: 4 × 6 ÷ 10 = ***2.4 dirhams***. This is known today as ***ratio and proportion***.

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The Messenger of Allah ﷺ promised blessing to honest traders:

HADITH — SAHIH AL-BUKHARI, NO. 2079

حَدَّثَنَا سُلَيْمَانُ بْنُ حَرْبٍ، حَدَّثَنَا شُعْبَةُ، عَنْ قَتَادَةَ، عَنْ صَالِحٍ أَبِي الْخَلِيلِ، عَنْ عَبْدِ اللَّهِ بْنِ الْحَارِثِ، رَفَعَهُ إِلَى حَكِيمِ بْنِ حِزَامٍ ـ رضى الله عنه ـ قَالَ قَالَ رَسُولُ اللَّهِ صلى الله عليه وسلم « الْبَيِّعَانِ بِالْخِيَارِ مَا لَمْ يَتَفَرَّقَا ـ أَوْ قَالَ حَتَّى يَتَفَرَّقَا ـ فَإِنْ صَدَقَا وَبَيَّنَا بُورِكَ لَهُمَا فِي بَيْعِهِمَا، وَإِنْ كَتَمَا وَكَذَبَا مُحِقَتْ بَرَكَةُ بَيْعِهِمَا ».

TRANSLATION:

Hakim ibn Hizam رضى الله عنه said: The Messenger of Allah ﷺ said: **"The seller and the buyer have the option (to continue or cancel the sale) as long as they have not parted. If both of them speak the truth and make things clear (about the goods), their sale is blessed; and if they conceal and lie, the blessing of their sale is wiped out."**

CHAIN OF NARRATION: Narrated by Imam al-Bukhari: from Sulaiman ibn Harb, from Shu'bah ibn al-Hajjaj, from Qatadah ibn Di'amah, from Salih Abu al-Khalil, from 'Abdullah ibn al-Harith, from Hakim ibn Hizam رضى الله عنه.

REFERENCE: Narrated by Imam al-Bukhari in Sahih al-Bukhari, Book of Sales, chapter on when the seller and buyer make things clear and do not conceal, Hadith No. 2079. Also narrated by Muslim (No. 1532).

GRADE: SAHIH — contained in Sahih al-Bukhari, the most authentic book of Hadith after the Qur'an by consensus of the Hadith scholars.

Source: https://sunnah.com/bukhari:2079

LESSONS FROM THIS HADITH

Honesty and openness in trade bring ***blessing***, while deception destroys it. Correct calculation, clear prices and accurate weights are ***righteous deeds*** for a Muslim trader.

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INDIAN NUMERALS AND THE BIRTH OF "ALGORITHM"

HISTORY NOTE: FROM BAGHDAD TO THE WHOLE WORLD

Around 820 CE, al-Khwarizmi wrote a book on ***calculation with Indian numerals***, including the ***place-value system and zero***. The Arabic text is lost; what survives is a Latin translation entitled ***Algoritmi de numero Indorum***.

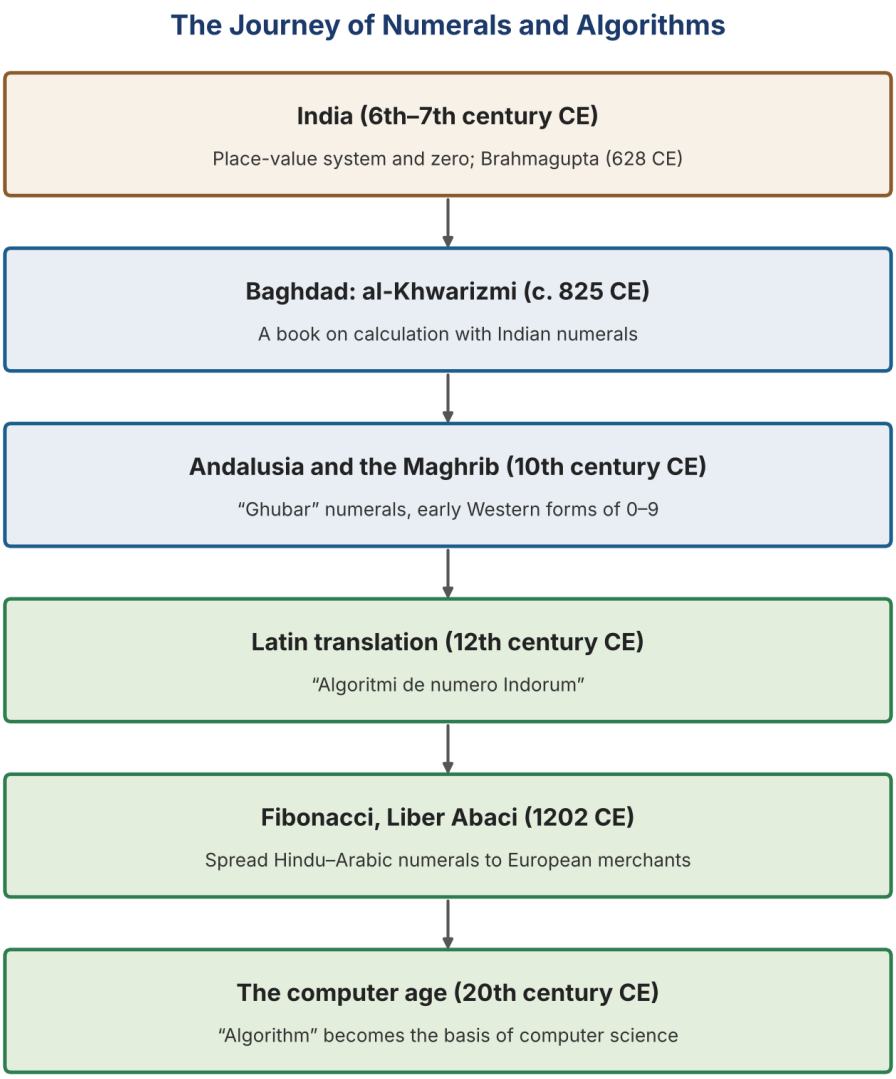
From the name ***"Algoritmi"*** came the words ***algorism*** and ***algorithm*** — today the foundation of computer science. The book of al-Jabr was translated into Latin by ***Robert of Chester (1145 CE)*** and ***Gerard of Cremona***, and became a mathematics textbook in European universities until the ***16th century***.

The numerals we use today — 0 to 9 — are known in the West as ***Hindu–Arabic numerals***, and they reached Europe partly through al-Khwarizmi's book.

REFLECTION

Every time we use a smartphone, we use ***algorithms*** — a word born from the name of a Muslim scholar in Baghdad.

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Simplified diagram. Brown = India; blue = Muslim world; green = Europe and the modern era.

Figure 4: The journey of numerals and algorithms, from India to the computer age.

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ZERO AND THE PLACE-VALUE SYSTEM

Why were Hindu–Arabic numerals so important? Compare them with the ***Roman numerals*** used in Europe before them.

FEATURE	ROMAN NUMERALS COMPARED WITH HINDU–ARABIC NUMERALS
Example: the number 2026	Roman: MMXXVI. Hindu–Arabic: 2026.
Place value	Roman has no place value; in Hindu–Arabic, the "2" in 2026 is worth 2,000 because of its position.
Zero	Roman has no symbol for zero; Hindu–Arabic uses 0 to mark an empty place.
Written calculation	Multiplying and dividing with Roman numerals is very hard; with Hindu–Arabic it can be done on paper step by step.
Modern use	The place-value system is the basis of the binary system in computers.

ZERO IN ARABIC

The Arabic word for zero is ***sifr*** (empty). From it came the words ***cipher*** and ***zero*** in European languages (Britannica: zero). One small numeral — a sign for nothing — lets people write ***any number, however large***, with only ten symbols.

LESSON

Muslim scholars ***took good knowledge*** from India, ***organised it*** more clearly, and then ***spread it***. Acknowledging the origin of knowledge is part of ***scholarly trust (amanah)***.

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ASTRONOMY: ZIJ AL-SINDHIND

Besides algebra, al-Khwarizmi compiled ***Zij al-Sindhind***, a ***zij*** (astronomical table) based on Indian and Persian methods. It contains tables for calculating the positions of ***the sun, moon and five planets***, times of ***eclipses***, and ***sine tables***.

> **HISTORY NOTE: TABLES THAT CROSSED CONTINENTS**
>
> The original Arabic text of Zij al-Sindhind is also lost. It reached us through ***the revision of Maslamah al-Majriti*** in Andalusia (10th century CE) and ***the Latin translation of Adelard of Bath*** (12th century CE).
>
> Tables like these were used to determine ***prayer times***, ***the qiblah*** and ***the calendar***. Al-Khwarizmi also wrote treatises on the ***astrolabe***, ***sundials*** and ***the Jewish calendar***.

TRIGONOMETRY IN WORSHIP

To calculate the qiblah from a given place, Muslim astronomers developed ***spherical trigonometry*** (Britannica: trigonometry). Today's qiblah apps on smartphones use formulas that descend from this tradition, combined with ***GPS***.

THE ASTROLABE AND THE SUNDIAL

Al-Khwarizmi also wrote on the ***astrolabe*** and the ***sundial***. The astrolabe is a brass instrument that lets its user find ***the time, the positions of stars and the latitude*** of a place by observing the sun or stars (Britannica: astrolabe).

> **HISTORY NOTE: AN INSTRUMENT THAT UNITED SCIENCE AND WORSHIP**
>
> In the Abbasid era, the astrolabe was used by the ***muwaqqit*** (timekeeper) of the mosque to determine ***prayer times***. Sundials were mounted on mosque walls to show the times of Zuhr and 'Asr.
>
> Muslim astronomers later created many more sophisticated astrolabes, and the instrument reached Europe through ***Andalusia***.

THE SCIENCE BEHIND IT

A sundial works because ***shadows*** change with the position of the sun. The time of ***'Asr***, for example, begins when an object's shadow has ***grown*** beyond its length at Zuhr. ***Geometry and trigonometry*** allow this time to be calculated for every day and every place.

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GEOGRAPHY: KITAB SURAT AL-ARD

The Qur'an invites people to ***travel the earth***:

SURAH AL-MULK 67:15

هُوَ ٱلَّذِى جَعَلَ لَكُمُ ٱلْأَرْضَ ذَلُولًا فَٱمْشُوا۟ فِى مَنَاكِبِهَا وَكُلُوا۟ مِن رِّزْقِهِۦ ۖ وَإِلَيْهِ ٱلنُّشُورُ ﴿١٥﴾

It is He who made the earth tame for you - so walk among its slopes and eat of His provision - and to Him is the resurrection.

Translation: Sahih International — quran.com/67:15

Allah ***"made the earth tame for you"*** and tells us to ***"walk among its slopes"***. To travel, people need ***maps and coordinates***. Tafsir Ibn Kathir 67:15.

HISTORY NOTE: KITAB SURAT AL-ARD (THE IMAGE OF THE EARTH)

Completed around ***833 CE***, the book lists ***more than 2,400 places*** — cities, mountains, seas, islands and rivers — with their ***latitude and longitude***, arranged by the seven ***climes*** (latitude zones).

Al-Khwarizmi ***corrected*** many values in Ptolemy's Geography, including ***the length of the Mediterranean***, which was far too great in Ptolemy's work. The only surviving Arabic manuscript is kept in ***Strasbourg***, France.

FROM PAPER MAPS TO GPS

The system of latitude and longitude used by al-Khwarizmi is still the basis of ***coordinate systems*** in digital maps and ***GPS*** today (NOAA: latitude and longitude). Geography helped trade, Hajj and the spread of Islam across continents.

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CALCULATION, THE MOON AND WORSHIP

Islam bases acts of worship on ***things that everyone can easily observe***, such as the new moon:

HADITH — SAHIH AL-BUKHARI, NO. 1913

حَدَّثَنَا آدَمُ، حَدَّثَنَا شُعْبَةُ، حَدَّثَنَا الأَسْوَدُ بْنُ قَيْسٍ، حَدَّثَنَا سَعِيدُ بْنُ عَمْرٍو، أَنَّهُ سَمِعَ ابْنَ عُمَرَ ـ رضى الله عنهما ـ عَنِ النَّبِيِّ صلى الله عليه وسلم أَنَّهُ قَالَ «إِنَّا أُمَّةٌ أُمِّيَّةٌ، لاَ نَكْتُبُ وَلاَ نَحْسُبُ الشَّهْرُ هَكَذَا وَهَكَذَا». يَعْنِي مَرَّةً تِسْعَةً وَعِشْرِينَ، وَمَرَّةً ثَلاَثِينَ.

TRANSLATION:

Ibn ‘Umar رضى الله عنهما narrated that the Prophet ﷺ said: **“We are an unlettered nation; we neither write nor calculate. The month is like this and like this”** — meaning sometimes twenty-nine days and sometimes thirty.

CHAIN OF NARRATION: Narrated by Imam al-Bukhari: from Adam ibn Abi Iyas, from Shu‘bah, from al-Aswad ibn Qays, from Sa‘id ibn ‘Amr, from ‘Abdullah ibn ‘Umar رضى الله عنهما.

REFERENCE: Narrated by Imam al-Bukhari in Sahih al-Bukhari, Book of Fasting (Kitab as-Sawm), Hadith No. 1913; also narrated by Muslim (No. 1080).

GRADE: SAHIH — contained in Sahih al-Bukhari, the most authentic book of Hadith after the Qur'an by consensus of the Hadith scholars.

Source: https://sunnah.com/bukhari:1913

LESSONS FROM THIS HADITH

This Hadith shows ***the ease of the Shari‘ah***: a Hijri month is 29 or 30 days, and its start can be known by anyone by sighting the new moon. It is ***not a prohibition on learning to write or calculate*** — the Companions themselves wrote down the Qur’an and calculated inheritances. Astronomy and mathematics later helped Muslims ***predict*** the appearance of the new moon more accurately.

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PRAYER AT SPECIFIED TIMES

SURAH AN-NISA' 4:103

فَإِذَا قَضَيْتُمُ ٱلصَّلَوٰةَ فَٱذْكُرُوا۟ ٱللَّهَ قِيَـٰمًا وَقُعُودًا وَعَلَىٰ جُنُوبِكُمْ ۚ فَإِذَا
ٱطْمَأْنَنتُمْ فَأَقِيمُوا۟ ٱلصَّلَوٰةَ ۚ إِنَّ ٱلصَّلَوٰةَ كَانَتْ عَلَى ٱلْمُؤْمِنِينَ كِتَـٰبًا مَّوْقُوتًا ﴿١٠٣﴾

And when you have completed the prayer, remember Allah standing, sitting, or [lying] on your sides. But when you become secure, re-establish [regular] prayer. Indeed, prayer has been decreed upon the believers a decree of specified times.

Translation: Sahih International — quran.com/4:103

Prayer is ***"a decree of specified times"*** for the believers. The prayer timetables we see in mosques today are calculated from ***the position of the sun*** — a continuation of the knowledge developed by Muslim astronomers such as al-Khwarizmi. Tafsir Ibn Kathir 4:103.

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THE HIJRI CALENDAR AND LUNAR RECKONING

The Islamic calendar is based on ***the motion of the moon***. Allah says:

SURAH AT-TAWBAH 9:36

إِنَّ عِدَّةَ ٱلشُّهُورِ عِندَ ٱللَّهِ ٱثْنَا عَشَرَ شَهْرًا فِى كِتَٰبِ ٱللَّهِ يَوْمَ خَلَقَ ٱلسَّمَٰوَٰتِ وَٱلْأَرْضَ مِنْهَآ أَرْبَعَةٌ حُرُمٌ ۚ ذَٰلِكَ ٱلدِّينُ ٱلْقَيِّمُ ۚ فَلَا تَظْلِمُوا۟ فِيهِنَّ أَنفُسَكُمْ ۚ وَقَٰتِلُوا۟ ٱلْمُشْرِكِينَ كَآفَّةً كَمَا يُقَٰتِلُونَكُمْ كَآفَّةً ۚ وَٱعْلَمُوٓا۟ أَنَّ ٱللَّهَ مَعَ ٱلْمُتَّقِينَ ﴿٣٦﴾

Indeed, the number of months with Allah is twelve [lunar] months in the register of Allah [from] the day He created the heavens and the earth; of these, four are sacred. That is the correct religion, so do not wrong yourselves during them. And fight against the disbelievers collectively as they fight against you collectively. And know that Allah is with the righteous [who fear Him].

Translation: Sahih International — quran.com/9:36

Allah has decreed that ***"the number of months with Allah is twelve [lunar] months"***. A Hijri year has about ***354 or 355 days***, about 11 days shorter than the solar year. Tafsir Ibn Kathir 9:36.

CALENDAR FACT	DESCRIPTION
Average lunar month	About 29.53 days (the synodic month), which is why a Hijri month has 29 or 30 days.
Hijri year	About 354.37 days; Ramadan moves through all the seasons in about 33 years.
Start of the calendar	Fixed in the time of Caliph 'Umar رضى الله عنه, beginning with the year of the Prophet's ﷺ Hijrah.
Calculation (hisab)	Astronomers calculate the conjunction (ijtima') and the visibility of the new crescent.

LESSON

The Hijri calendar teaches us that ***time is a trust***. With astronomy, Muslims can ***plan*** fasting, Hajj and zakat better, while still holding to ***sighting (ru'yah)*** as taught by the Sunnah (Britannica: lunar month).

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MATHEMATICS IN EVERYDAY WORSHIP

Besides inheritance, many acts of worship and daily affairs of Muslims require ***calculation***. The table below gives some examples.

WORSHIP / AFFAIR	CALCULATION INVOLVED (GENERAL SUMMARY)
Zakat on savings	2.5% of savings that reach the nisab and complete the hawl (one year).
Zakat on crops	10% if watered by rain or rivers; 5% if irrigated at cost and effort.
Gold nisab	About 85 grams of gold according to the well-known view; its value changes with the current gold price.
Fidyah and kaffarah	Counting the number of days and the measure of food for each day.
Prayer and imsak times	Calculating the position of the sun for every day and every place.
Qiblah direction	Calculating the angle from the latitude and longitude of the place and of the Ka'bah.

Exact rates and nisab should be checked with ***the zakat authority*** in one's own state or country.

LESSON

Mathematics is ***a tool of worship***. A Muslim who understands calculation can pay zakat, divide inheritance and perform other acts of worship ***accurately and confidently***. This is the spirit of the book of al-Jabr: arithmetic for ***life and religion***.

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KNOWLEDGE THAT IS TAUGHT

Al-Khwarizmi wrote the book of al-Jabr as a ***concise book*** so that it could be easily understood and taught. The Messenger of Allah ﷺ praised those who teach knowledge:

HADITH — SAHIH AL-BUKHARI, NO. 73

حَدَّثَنَا الْحُمَيْدِيُّ، قَالَ حَدَّثَنَا سُفْيَانُ، قَالَ حَدَّثَنِي إِسْمَاعِيلُ بْنُ أَبِي خَالِدٍ، عَلَى غَيْرِ مَا حَدَّثَنَاهُ الزُّهْرِيُّ، قَالَ سَمِعْتُ قَيْسَ بْنَ أَبِي حَازِمٍ، قَالَ سَمِعْتُ عَبْدَ اللَّهِ بْنَ مَسْعُودٍ، قَالَ قَالَ النَّبِيُّ صلى الله عليه وسلم « لاَ حَسَدَ إِلاَّ فِي اثْنَتَيْنِ رَجُلٌ آتَاهُ اللَّهُ مَالاً فَسُلِّطَ عَلَى هَلَكَتِهِ فِي الْحَقِّ، وَرَجُلٌ آتَاهُ اللَّهُ الْحِكْمَةَ، فَهْوَ يَقْضِي بِهَا وَيُعَلِّمُهَا ».

TRANSLATION:

‘Abdullah ibn Mas‘ud رضى الله عنه said: The Prophet ﷺ said: **“There is no envy except in two cases: a man whom Allah has given wealth and he spends it in the way of truth, and a man whom Allah has given wisdom (knowledge) and he judges by it and teaches it.”**

CHAIN OF NARRATION: Narrated by Imam al-Bukhari: from al-Humaidi, from Sufyan ibn ‘Uyainah, from Isma‘il ibn Abi Khalid, from Qais ibn Abi Hazim, from ‘Abdullah ibn Mas‘ud رضى الله عنه.

REFERENCE: Narrated by Imam al-Bukhari in Sahih al-Bukhari, Book of Knowledge, chapter on envying in knowledge and wisdom, Hadith No. 73. Also narrated by Muslim (No. 816).

GRADE: SAHIH — contained in Sahih al-Bukhari, the most authentic book of Hadith after the Qur'an by consensus of the Hadith scholars.

Source: https://sunnah.com/bukhari:73

LESSONS FROM THIS HADITH

A clearly written book went on to be ***taught*** for more than a thousand years. Knowledge made easy for others is ***knowledge whose benefit keeps flowing***.

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KNOWLEDGE WHOSE REWARD KEEPS FLOWING

The Messenger of Allah ﷺ mentioned three things whose reward continues after death:

HADITH — SAHIH MUSLIM, NO. 1631

حَدَّثَنَا يَحْيَى بْنُ أَيُّوبَ، وَقُتَيْبَةُ، - يَعْنِي ابْنَ سَعِيد - وَابْنُ حُجْرٍ قَالُوا حَدَّثَنَا إِسْمَاعِيلُ، - هُوَ ابْنُ جَعْفَرٍ - عَنِ الْعَلاَءِ، عَنْ أَبِيهِ، عَنْ أَبِي هُرَيْرَةَ، أَنَّ رَسُولَ اللَّهِ صلى الله عليه وسلم قَالَ « إِذَا مَاتَ الإِنْسَانُ انْقَطَعَ عَنْهُ عَمَلُهُ إِلاَّ مِنْ ثَلاَثَةٍ إِلاَّ مِنْ صَدَقَةٍ جَارِيَةٍ أَوْ عِلْمٍ يُنْتَفَعُ بِهِ أَوْ وَلَدٍ صَالِحٍ يَدْعُو لَهُ ».

TRANSLATION:

Abu Hurayrah رضى الله عنه narrated that the Messenger of Allah ﷺ said: **"When a person dies, his deeds come to an end except for three: ongoing charity, knowledge that is benefited from, or a righteous child who prays for him."**

CHAIN OF NARRATION: Narrated by Imam Muslim: from Yahya ibn Ayyub, Qutaybah ibn Sa'id and 'Ali ibn Hujr, from Isma'il ibn Ja'far, from al-'Ala' ibn 'Abd al-Rahman, from his father, 'Abd al-Rahman ibn Ya'qub, from Abu Hurayrah رضى الله عنه.

REFERENCE: Narrated by Imam Muslim in Sahih Muslim, Book of Wills (Kitab al-Wasiyyah), chapter on the reward that reaches a person after death, Hadith No. 1631.

GRADE: SAHIH — contained in Sahih Muslim, the second most authentic book of Hadith after Sahih al-Bukhari.

Source: https://sunnah.com/muslim:1631

LESSONS FROM THIS HADITH

Al-Khwarizmi died more than eleven hundred years ago, yet his methods are still taught every day in schools around the world. Beneficial knowledge is ***an investment for the Hereafter***. Every teacher, writer and student who shares knowledge can hope for a reward that ***keeps flowing***.

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THE HEIRS OF ALGEBRA

After al-Khwarizmi, many Muslim mathematicians ***developed*** algebra further.

HISTORY NOTE: THE SUCCESSORS

Abu Kamil of Egypt (d. c. 930 CE) extended al-Khwarizmi's methods to more complex equations and irrational numbers. His work later influenced ***Fibonacci***.

Al-Karaji (d. c. 1029 CE) in Baghdad freed algebra from geometry and introduced a method close to ***mathematical induction***. ***As-Samaw'al*** (d. c. 1175 CE) continued this work with decimal fractions.

'Umar al-Khayyam (d. 1131 CE), the poet and mathematician of Nishapur, classified and solved ***cubic equations*** geometrically, and helped compile the remarkably accurate ***Jalali calendar***.

LESSON: CONNECTED KNOWLEDGE

No scholar starts from nothing. Every generation ***stands on the shoulders*** of the one before. Al-Khwarizmi opened the path, and his heirs widened it. This is the spirit of ***the chain of knowledge (sanad)*** in the Islamic tradition.

MANUSCRIPTS AND TRANSLATIONS OF THE BOOK OF AL-JABR

HISTORY NOTE: HOW THE BOOK REACHED US

Among ***the oldest surviving Arabic manuscripts*** of the book of al-Jabr is one copied in ***743 AH (1342 CE)***, now kept at the ***Bodleian Library, Oxford***.

The Latin translation by ***Robert of Chester*** (1145 CE) begins with the words "Dixit Algorismi" — "al-Khwarizmi said". The first English translation was published by ***Frederic Rosen*** in ***1831***, and a modern critical edition was published by the scholar ***Roshdi Rashed*** (2007).

WHY DO MANUSCRIPTS MATTER?

Without ***copyists, libraries and translators***, al-Khwarizmi's knowledge might have been lost like his book on Indian numerals and his original Zij. Preserving manuscripts and books is ***preserving the knowledge of the Ummah***.

LESSON

We too can contribute by ***digitising, translating and sharing*** beneficial knowledge. Every free eBook, translation and recorded lecture continues the tradition of ***copying and spreading knowledge***.

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ARITHMETIC AND ASTRONOMY IN THE MALAY WORLD

The knowledge developed by al-Khwarizmi and his heirs reached the Malay world through ***scholars who studied in Makkah and Cairo***. ***Astronomy (falak)*** and ***arithmetic (hisab)*** were taught in pondok schools to determine prayer times, the qiblah and the start of the month.

> **HISTORY NOTE: ASTRONOMERS OF THE MALAY WORLD**
>
> ***Shaykh Tahir Jalaluddin*** (1869–1956), a scholar born in Minangkabau who settled in the Malay Peninsula, was renowned as ***an expert in astronomy***. He wrote books on calculating prayer times and the qiblah using ***logarithms***, and corrected the qiblah of several mosques.
>
> Earlier, scholars such as ***Shaykh Ahmad al-Fatani*** (1856–1908) also wrote on arithmetic and astronomy in Malay Jawi script.

THE LEGACY TODAY

Today, ***prayer timetables*** in Malaysia are prepared by the religious authorities using modern astronomical calculation, and ***observatories*** are used to sight the new moon. All of this continues a tradition of knowledge that began in Baghdad.

LESSON

Mathematics and astronomy are ***not foreign sciences*** to the Malay Muslim community. They are part of ***the heritage of our scholars***, and the younger generation should carry them on.

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FROM ALGORITHM TO COMPUTER

Today, an ***algorithm*** means an ordered series of steps for solving a problem — from a cooking recipe to a computer program (Britannica: algorithm). Search engines, map apps, banking systems and artificial intelligence all depend on algorithms.

A SIMPLE ALGORITHM

An algorithm for calculating ***zakat on savings*** (simplified): ***(1)*** check whether the savings reach the ***nisab*** and have completed the ***hawl*** (one year); ***(2)*** if so, multiply the savings by ***2.5%***; ***(3)*** if not, no zakat is due. Clear steps like these are the soul of every computer program.

> **HISTORY NOTE: MODERN TRIBUTES**
>
> A statue of al-Khwarizmi stands in ***Khiva***, Uzbekistan, and several universities and institutions are named after him. The Soviet Union and other countries issued ***postage stamps*** commemorating his anniversary.

REFLECTION

Muslim students who study ***computer science*** today are continuing the legacy of Muslim scholars. Use technology for ***good***, and make algorithms a tool for ***easing the affairs of the Ummah***.

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ESTABLISHED REPORTS AND POPULAR STORIES

Many claims about al-Khwarizmi circulate on social media and in popular books. The table below separates what is established from what needs checking.

STORIES AND THEIR STATUS

POPULAR STATEMENT	STATUS
The book of al-Jabr gave algebra its name.	Established. “Algebra” comes from the word al-jabr.
The word “algorithm” comes from al-Khwarizmi’s name.	Established, through the Latin translation “Algoritmi”.
Al-Khwarizmi invented the zero.	Incorrect. Zero and the place-value system came from India; he spread them.
Al-Khwarizmi was the first person to solve equations.	Incorrect. The Babylonians, Greeks (Diophantus) and Indians came earlier; he made algebra an independent, organised discipline.
The book of al-Jabr was written for inheritance, wills and trade.	Established. A large part of the book deals with them.
His dates of birth and death are known precisely.	No. Both are only estimates (c. 780 and c. 850 CE).
Al-Khwarizmi used the symbols x and y in equations.	Incorrect. He wrote equations in words; modern symbols appeared centuries later.
Al-Khwarizmi was the head of the House of Wisdom.	Uncertain. Sources say he worked there, but his exact position is unclear.

REFLECTION — HONOUR WITHOUT EXAGGERATION

Al-Khwarizmi ***does not need*** to be called the inventor of zero to be honoured. His real contribution — organising algebra as a ***systematic discipline*** and spreading place-value numerals — was enough to change the world.

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LESSONS AND CONCLUSION

LESSONS FROM THIS EBOOK

First: The Qur'an invites people to count and measure (10:5; 55:5; 17:12).

Second: Mathematics can serve the Shari'ah, as in the laws of inheritance (Sahih al-Bukhari 6732; 4:11).

Third: A bequest is limited to one third so that heirs are not neglected (Sahih al-Bukhari 2742).

Fourth: The Shari'ah is easy, and calculation helps rather than burdens (Sahih al-Bukhari 1913).

Fifth: Prayer has specified times, and astronomy helps us keep them (4:103).

Sixth: Make knowledge easy and teach it (Sahih al-Bukhari 73).

Seventh: Beneficial knowledge keeps earning reward after death (Sahih Muslim 1631).

Eighth: Travel the earth and make use of geography (67:15).

Ninth: Break big problems into small steps — that is the spirit of the algorithm.

Tenth: Acknowledge the origin of knowledge and honour the contributions of other civilisations.

Eleventh: Honour real contributions without adding inaccurate claims.

Twelfth: Be honest in weights and in trade (83:1–3; Sahih al-Bukhari 2079).

Thirteenth: Time is a trust — the calendar and prayer times are kept through knowledge (9:36).

CONCLUSION

Al-Khwarizmi died around 850 CE, but his name lives on in the words ***algebra*** and ***algorithm***. The next book of **Tracing the Scholars of Islam**, in sha Allah, will tell the story of the ***Banu Musa***, the three engineer brothers of the House of Wisdom. Wallahu a'lam.

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GLOSSARY AND REFLECTION QUESTIONS

GLOSSARY

TERM	MEANING
Al-jabr	"Completion" — moving a negative term to the other side of an equation; origin of the word "algebra".
Al-muqabalah	"Balancing" — removing equal terms from both sides of an equation.
Mal, jidhr	"Wealth" (x^2) and "root" (x) in al-Khwarizmi's language.
Algorithm	An ordered series of steps for solving a problem; named after al-Khwarizmi.
Place value	A system in which the value of a digit depends on its position.
Sifr	The Arabic word for "empty"; origin of the words "cipher" and "zero".
Zij	A book of astronomical tables for calculating the positions of the sun, moon and planets.
Fara'id	The science of dividing an estate according to the Qur'an and Sunnah.
Wasiyyah (bequest)	A gift of property after death to non-heirs; limited to one third.

REFLECTION QUESTIONS

1. Why did al-Khwarizmi write a mathematics book for the needs of inheritance and wills? What does this mean for us today?

2. Try solving $x^2 + 6x = 16$ with al-Khwarizmi's method. What is the value of x?

3. Why are the place-value system and zero so important compared with Roman numerals?

4. How does astronomy help Muslims keep prayer times and the direction of the qiblah?

5. Al-Khwarizmi acknowledged that the numerals came from India. What does this teach about scholarly trust?

6. How can Muslim students use algorithms and computing for the good of the Ummah?

SUGGESTED ACTIVITIES

Activity 1: Write an "algorithm" step by step for a daily task, such as performing ablution or preparing breakfast. Is every step clear and in order?

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Activity 2: Draw a square with side x and add two rectangles of 5 × x as in Figure 2. Use the drawing to solve $x^2 + 10x = 39$ by hand, as al-Khwarizmi did.

Activity 3: Check the prayer timetable for your area for a week. Notice how Fajr and Maghrib change slightly every day, and discuss why.

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SURAH AL-BAQARAH 2:261

مَّثَلُ ٱلَّذِينَ يُنفِقُونَ أَمۡوَٰلَهُمۡ فِي سَبِيلِ ٱللَّهِ كَمَثَلِ حَبَّةٍ أَنۢبَتَتۡ سَبۡعَ سَنَابِلَ فِي كُلِّ سُنۢبُلَةٖ مِّاْئَةُ حَبَّةٖۗ وَٱللَّهُ يُضَٰعِفُ لِمَن يَشَآءُۚ وَٱللَّهُ وَٰسِعٌ عَلِيمٌ ٢٦١

The example of those who spend their wealth in the way of Allah is like a seed [of grain] which grows seven spikes; in each spike is a hundred grains. And Allah multiplies [His reward] for whom He wills. And Allah is all-Encompassing and Knowing.

Translation: Sahih International — quran.com/2:261

SURAH SABA' 34:39

قُلۡ إِنَّ رَبِّي يَبۡسُطُ ٱلرِّزۡقَ لِمَن يَشَآءُ مِنۡ عِبَادِهِۦ وَيَقۡدِرُ لَهُۥۚ وَمَآ أَنفَقۡتُم مِّن شَيۡءٖ فَهُوَ يُخۡلِفُهُۥۖ وَهُوَ خَيۡرُ ٱلرَّٰزِقِينَ ٣٩

Say, "Indeed, my Lord extends provision for whom He wills of His servants and restricts [it] for him. But whatever thing you spend [in His cause] - He will compensate it; and He is the best of providers."

Translation: Sahih International — quran.com/34:39

HADITH — SAHIH MUSLIM, NO. 2588

حَدَّثَنَا يَحْيَى بْنُ أَيُّوبَ، وَقُتَيْبَةُ، وَابْنُ، حُجْرٍ قَالُوا حَدَّثَنَا إِسْمَاعِيلُ، - وَهُوَ ابْنُ جَعْفَرٍ - عَنِ الْعَلاَءِ، عَنْ أَبِيهِ، عَنْ أَبِي هُرَيْرَةَ، عَنْ رَسُولِ اللَّهِ صلى الله عليه وسلم قَالَ « مَا نَقَصَتْ صَدَقَةٌ مِنْ مَالٍ وَمَا زَادَ اللَّهُ عَبْدًا بِعَفْوٍ إِلاَّ عِزًّا وَمَا تَوَاضَعَ أَحَدٌ لِلَّهِ إِلاَّ رَفَعَهُ اللَّهُ ».

TRANSLATION:

Abu Hurayrah رضى الله عنه narrated that the Messenger of Allah ﷺ said: "Charity does not decrease wealth.

Allah does not increase a servant who forgives except in honour. And no one humbles himself for the sake of Allah except that Allah raises him in rank."

CHAIN OF NARRATION: Narrated by Imam Muslim: from Yahya bin Ayyub, Qutaibah bin Sa'id and 'Ali bin Hujr, from Isma'il bin Ja'far, from al-'Ala' bin 'Abd al-Rahman, from his father 'Abd al-Rahman bin Ya'qub, from Abu Hurayrah رضى الله عنه .

REFERENCE: Narrated by Imam Muslim in Sahih Muslim, Book of Virtue, Good Manners and Joining the Ties of Kinship (Kitab al-Birr wa al-Silah wa al-Adab), chapter on the encouragement of forgiveness and humility, Hadith No. 2588.

GRADE: SAHIH — contained in Sahih Muslim.

Source: https://sunnah.com/muslim:2588

HADITH — SAHIH MUSLIM, NO. 1631

حَدَّثَنَا يَحْيَى بْنُ أَيُّوبَ، وَقُتَيْبَةُ - يَعْنِي ابْنَ سَعِيدٍ - وَابْنُ حُجْرٍ قَالُوا حَدَّثَنَا إِسْمَاعِيلُ، - هُوَ ابْنُ جَعْفَرٍ - عَنِ الْعَلاَءِ، عَنْ أَبِيهِ، عَنْ أَبِي هُرَيْرَةَ، أَنَّ رَسُولَ اللَّهِ صلى الله عليه وسلم قَالَ « إِذَا مَاتَ الإِنْسَانُ انْقَطَعَ عَنْهُ عَمَلُهُ إِلاَّ مِنْ ثَلاَثَةٍ إِلاَّ مِنْ صَدَقَةٍ جَارِيَةٍ أَوْ عِلْمٍ يُنْتَفَعُ بِهِ أَوْ وَلَدٍ صَالِحٍ يَدْعُو لَهُ ».

TRANSLATION:

Abu Hurayrah رضى الله عنه narrated that the Messenger of Allah ﷺ said: "When a person dies, his deeds come to an end except for three: an ongoing charity, knowledge that is benefited from, or a righteous child who prays for him."

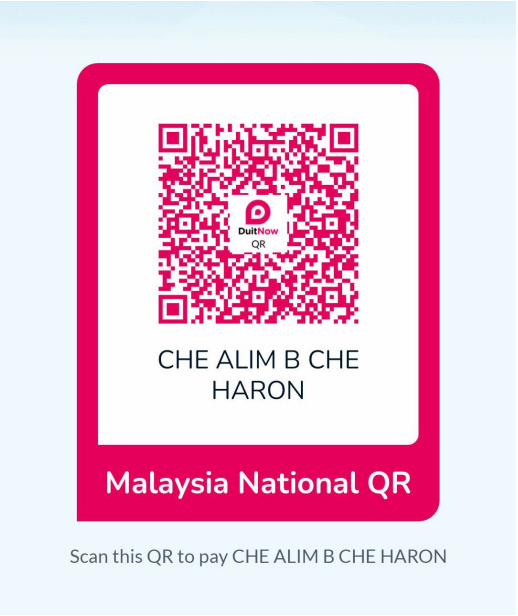
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REFERENCE: Narrated by Imam Muslim in Sahih Muslim, Book of Wills (Kitab al-Wasiyyah), chapter on the reward that reaches a person after his death, Hadith No. 1631.

GRADE: SAHIH — contained in Sahih Muslim.

Source: https://sunnah.com/muslim:1631

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