# Islamic Contributions to Human Civilisation

## AUSTRALIAN INTERNATIONAL ISLAMIC COLLEGE

*"The primary objective of this subject and the accompanying resource is to expose our students to the celebrated achievements and noble contributions of their ancestors.*
*The aim is to inspire them to expand their curiosity and further their knowledge, through inquiry learning and evidence-based research, with the goal of making significant contributions to humanity".*

**Imam Abdul Quddoos Azhar**

Founder of
Australian International Islamic College

# CONTENTS

# FOREWARD

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

اَلْحَمْدُ لِلَّهِ رَبِّ الْعَلَمِينَ

*"Among the Servants, only those who are possessed of Knowledge truly fear God"* (Al-Quran 35-28)

*This inscription was found above the entrances to Universities in Spain during the Muslim era.*

*The world is held up by four pillars:*

| The Wisdom of the Learned | The Justice of the Great | The Prayers of the Righteous | The Valour of the Brave |
| --- | --- | --- | --- |

It is important to note that wisdom heads the list of virtues in the inscription. This is not surprising as Islam highly recommends learning, initiating, contemplating, inventing and discovering. The Prophet (May Peace and Blessings be Upon Him) stated that the "Ink of a scholar is more precious than the martyr's blood". This statement highlights the status of learning as a means to identify virtue.

For several centuries, Muslims remained faithful to the tenets of their religion. As per Philips K. Hitti, "During the first part of the middle ages, no other people made as important a contribution to human progress as did the Arabs".

In this brief outline of, "Muslim Contribution towards Humanity through Science, Technology and Civilisation", only a few of the most important discoveries, which we owe to the genius of Muslim research, are mentioned. A few scholars, philosophers and writers who added lustre to science and literature and exerted a notable influence on western thought, are highlighted.

## ASTRONOMY

Astronomy was the first of the sciences to attract the curiosity of the Muslim scholars. Observatories were built in every important centre in the Islamic Empire. Those in Baghdad, Cairo, Cordova, Toledo and Samarkand were renowned. The second Abbasi Calipha, Al-Mansur (754-775) was an astronomer. Under his successors, Haroon Rasheed and Al-Mamoon's -'Bayt al Hikma, The House of Wisdom', was established in Baghdad. The 'School of Wisdom' produced many important work. Errors were rectified and Greek tablets were corrected. It is also credited with the discovery of the movement of the suns apogee, the evolution of the obliquity of the elliptical and its progressive diminution.

## MATHEMATICS

The Arabs favoured the science of Mathematics. Muslim scholars discovered many basic principles of Arithmetic, Geometry and Algebra. The invention of Algebra is attributed to the Muslims. The invention of the sign Zero (0) in 978, revolutionised mathematics. Al Khwarizmi who is one of the best scientific minds of the Muslim world, was the most influential personality in mathematical thought during the Middle Ages. Philip Hitti and Thabit bin Jarrah, who developed algebra

and first realised its application to geometry, praised him and continued his work. Arab knowledge of mechanics was equally advanced for that era.

## PHYSICS

Humboid cited the following, "It is the Arabs who should be regarded as the real founders of Physics". M. Charles (Professor of Optical Sciences, University of Arizona), mentioned that the treatise in optics by Muslims, was an event of primary importance in science. He asserted that it was the beginning of the modern science of optics. E. Bernard of Oxford believed that the Arabs discovered the use of the pendulums for clocks and even though the invention of the compass was credited to the Chinese, he maintains that it was the Muslims who perfected it and made practical use of it by applying the magnetic needle to solve problems of navigation.

## CHEMISTRY

The Arabs discovered the chemical elements alcohol, sulphuric acid, aqua, and nitric acid among others. Many terms in chemistry such as alcohol, alembic, alkali and elixir are of Arabic origin. Countless products in daily use today, such as camphor, distilled water, plasters, syrups and ointments are also a legacy of the Arabs.

The art of dyeing, the curing of leather and the tempering of steel have Arab roots too.

The invention of gunpowder linked with the names of Roger Bacon, Albertus and Berthold, is often attributed to the Chinese. Research, however, indicates that the Arabs invented gunpowder as an explosive substance capable of firing projectiles. These were used primarily in the Siege of Algeciras (1342–44) when Alfonso XI tried to take the Muslim city of Al-Jazeera Al-Khadra (called Algeciras by the Christians) in the Reconquest of Spain.

The Arabs invented paper which opened a new era of civilisation. The diffusion of cheap books and popularisation of learning had become possible since the Arabs replaced the parchment, made by processed skins of animals of the ancient world and silk paper of the Chinese, by the ordinary paper that we know today.

## NATURAL SCIENCES

The Arabs devoted themselves to studying nature and making their own observations. They introduced perfumes and spices, incense, attar of roses, various vegetables, Yamani coffee and domestic animals, which included horses, goats from Minor Asia and Moroccan sheep. They developed a high standard in agricultural practices and geology.

## MEDICINE

The science of Medicine attracted the Muslims right from the first century of Hijra, the migration of Muslims from Makkah to Medina. For centuries, Muslim textbooks formed the basis of medical studies in all the European universities. The Arab physicians/surgeons carried out the first cataract operation in 1256. The circulatory system of the blood was demonstrated in Damascus in 1280, which was 300 years before William Harvey described the present description of the circulatory system to whom this important discovery is usually attributed. Al-Razi introduced into pharmacy the use of mild purgatives such as cupping for cases of apoplexy and the use of cold water for persistent fever. Al-Razi's work was translated into Latin and printed on several occasions in 1509 in Venice and 1528 and 1578 in Paris. His book, "Mansouri" was highly regarded and referenced as a medical manual.

The Muslims have contributed very important progress in the field of surgery. They knew about anaesthetic, which is considered a modern discovery. Often before a painful operation, Muslim doctors would administer a drug made from a plant named Danile until the patient became unconscious.

In the third century of Hijra, under Al-Kindi, the Muslim school of scholasticism was formed. Many writers including Al-Farabi and Ibn Sina undertook the task of reconciling Plato and Aristotle and bringing them in line with the revealed religion. Islam succeeded in reconciling monotheism. Ibn Rushd's commentaries on Aristotle brought him unequalled fame, so much so that his commentaries were used as set texts in preference to the treatise of Aristotle in universities in the west.

## LITERATURE

One of the most remarkable achievements of the Muslims was their contribution to philosophical thought and literature. Ibn Hazm, one of the most brilliant minds of Muslim Spain, exercised a lasting influence on the literature of the west. As a prolific writer, he wrote many fables, tables and apologues, which from the tenth century spread throughout Europe. His work has been translated into Spanish, Latin, Hebrew, Persian and French.

Dante's, 'The Divine Comedy', demonstrated the huge influence of Muhuddin Ibn Arabi. The 1001 Nights had a large following around the world.

Muslim Spain produced many doctors. Ibn Zuhr was the first to combine the study of medicine with that of surgery and pharmacy. His writing on surgery contained the first mention of bronchotomy and detailed instructions for the treatment of dislocation and fractures.

Averroes (Ibn Rushd) whose reputation as an Aristotelian commentator eclipsed his merit as a doctor, wrote a commentary on Ibn Sina's, "Cannon" and works of Galen. He is famous for the treatise on theriac and a book on poisons and fevers. His principal medical work, "Kulliyat", which was first printed in 1490 in Venice, was later reprinted several times in different countries.

## PHILOSOPHY

In Science and Philosophy, Muslim thinkers showed an all-encompassing intellectual curiosity. Arab philosophical speculation dates from the first century of the Muslim era about the existence of God, His unity, His power, His justice and other divine attributes. These resulted in opposing schools of thought being formed, which merged around the questions of predestination, moral freedom, salvation, succession to the Prophet and other matters.

Rumi, Sadi, Shirazi, Hafiz and Omar Khayyam have all contributed to the treasure of literature of the world. Hafiz's book "Dewan" was translated into all European languages. He is one of the most widely read poets in the world.

## GEOGRAPHY & HISTORY

Ibn Haykal, Al-Biruni, Idrisi and Ibn Battuta's contributions to this field have been invaluable. Idrisi wrote a treatise on geography for Roger II of Sicily. For 350 years, his treatise was used and referred to. European cartographers copied this treatise with negligible variations.

The general map of the world is attributed to Ulugh Beg, the author of the famous astrological tables bearing his name. When developing it, he referred to the writing of Nasrudeen Tusi and the observations of Al-Koshadja. He later undertook a voyage to China and verified the measurement of one degree of the meridian of the world.

When Vasco da Gama saw the Sea-Chart belonging to Maylem Cana, a Muslim from Gujarat in 1497, he took it as a guide to Malinda.

He also had a Sea-Chart drawn by an Arab who helped when he was navigating the sea of Oman and the Persian Gulf. In this way, Muslim scholars contributed to the discovery of America.

Written in Haiti and dated October 1498, Christopher Columbus names Averroes as one of the authors who led him to determine the existence of the new world.

## POLITICAL SCIENCE & SOCIOLOGY

Al-Farabi, Ibn Zaher, Al-Mawardi, Ibn Khaldun and Abul Faiz, were the authorities and the pioneers in this field of study. In accordance with Al-Farabi's philosophy, high moral aims are assigned to the universal state and its governors. He believed that the duty of the state was to assure its citizens perfect government on earth and happiness after death.

Abul Fazl's work, 'Akbar Nameh', is the most important work on Muslim history in India. In the last part of the book, Ain Akbari gives invaluable information about the workings of the legal and administrative mission of the state and the social conditions of the Indians. In addition, information on religion, philosophy and law is provided. Arts and crafts, public finance, administrative reports, statistics and weaponry are also highlighted.

## ARCHITECTURE

The heritage and monuments of Cairo, Cordova, Samarkand, Delhi, Agra and Istanbul together with scores of Islamic monuments, mosques, heritage buildings and universities, comprehensively demonstrate the great skill and vast talent of Muslim architects.
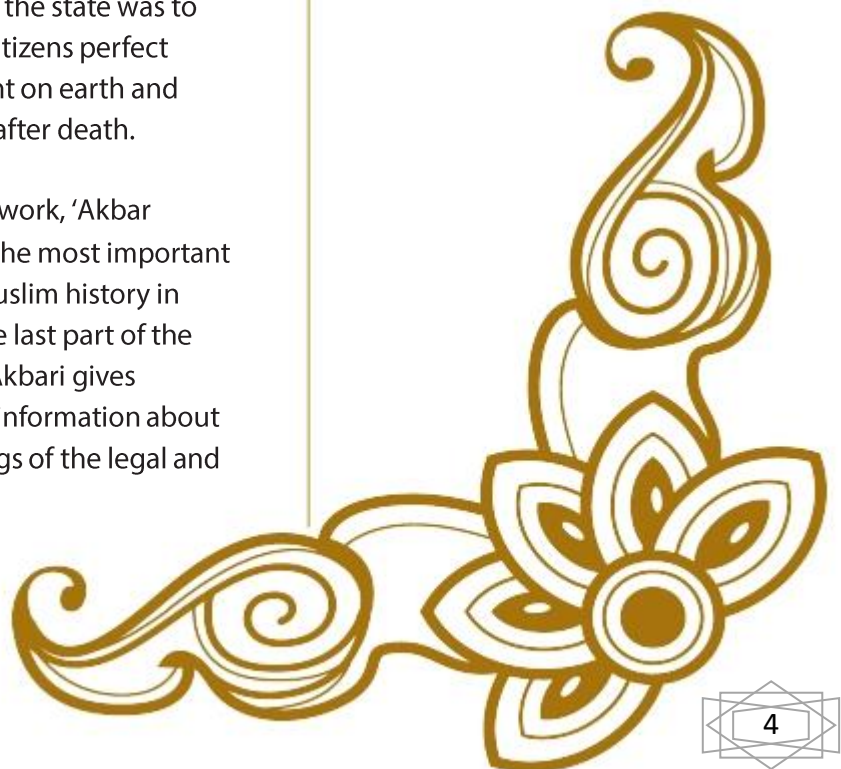
# Muhammad Ibn Musa Al-Khwarizmi
**Mathmatician, Astonomer, Geographer**

# Who was Muhammad Ibn Musa Al-Khwarizmi?

Born in 770 in Khiva, Uzbekistan.

Died in 840 in Baghdad, Iraq.

- Muhammad Ibn Musa Al-Khwarizmi, known in the West as Algorizm, was a renowned Persian Mathematician, Astronomer and Geographer.
- He was considered the inventor of Algebra.
- His pioneering work on the system of numerals is better known as 'Algorithm', which was named after his last name.

# CONTRIBUTIONS

## 1. Mathematics

- He was the first mathematician to distinguish between algebra and geometry and gave geometrical solutions to linear and quadratic equations.

- Al-Khwarizmi was responsible for introducing the Arabic numeral system to the western world. His numeral system which is identical to the one used today, was based on ten Indian symbols (0,1,2,3,4,5,6,7,8,9) as opposed to the cumbersome Roman numeral system which used I, V, L and C to describe numbers up to one hundred. The Arabic system developed by Al-Khwarizmi also had zero, negative numbers, the decimal system and operations of fractions.

- He developed detailed trigonometric tables containing the sine functions.

- Al-Khwarizmi developed the calculus of two errors, which led him to the concept of differentiation.

- He refined the geometric representation of conic sections.

- Al-Khwarizmi 's famous book Al-Jabr wa al-Muqabilah was named after him and was used in European universities until the 16th century.

## 2. Astronomy

He wrote 116 tables cataloguing the movements of the sun, the moon and the five planets at that time.
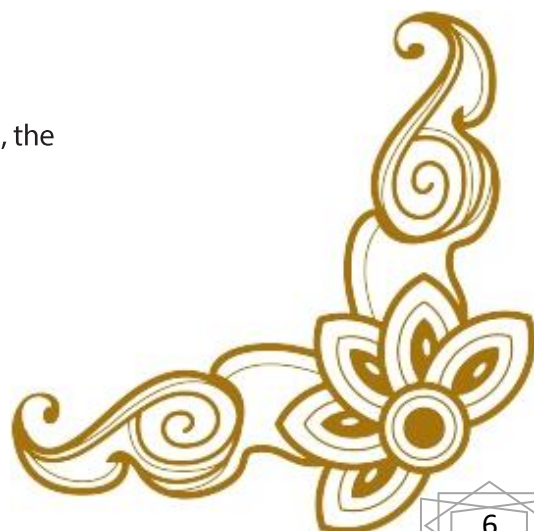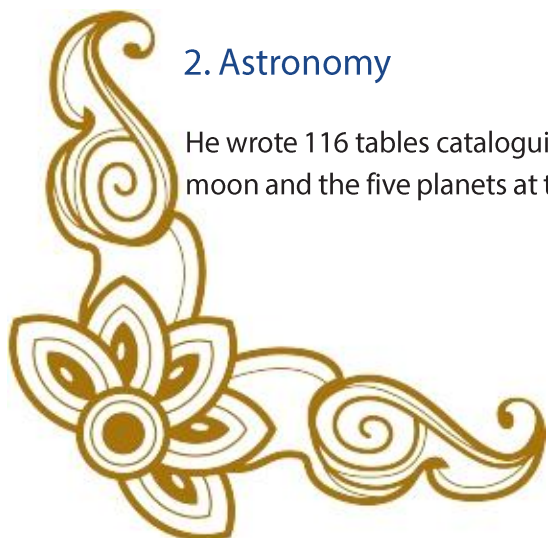
## 3. Geography

- He produced the first map of the globe in 830 and measured the volume and circumference of the earth.

- Al-Khwarizmi supervised the team of 70 geographers to create a map of the then, "Known World".

- His sundial was universal and could be used to observe the sun, the moon and the other stars from anywhere on the earth.

- His sundials were frequently used in mosques to determine prayer times.



*Portrait of Al-Khwarizmi on a postage stamp*

*Al-Khwarizmi map of the world at that time*
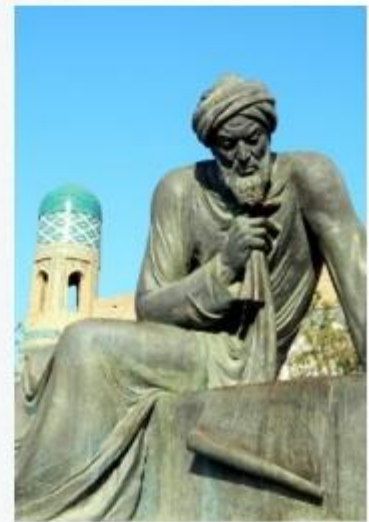
*Monument to Al-Khwarizmi in Khiva in Uzbekistan*

## LEGACY

1  A Stamp was issued in honour of Al-Khwarizmi by the former USSR in 1983.

2  A Modern Statue of Al-Khwarizmi is on display in Khiva, Uzbekistan.

3  The front cover of 'Al-Khwarizmi, The inventor of Algebra', book published in 2006, written by Corona Brezina, shows his picture on the front page.

# STUDY QUESTIONS

1. Summarise the life of Muhammad Ibn Musa Al-Khawrizmi.

_____

2. List his contributions.

_____

3. Evaluate the impact of his work on contemporary society.

_____

4. Explain why learning about Al-Khawrizmi is important for understanding mathematics, astronomy and geometry?

_____

5. Explain what has inspired you about his life, work and legacy?

_____

6. Explain what surprised you about his life?

_____

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

_____

8. Construct a diagram, and/or map/timeline/model of his work.

_____

9. Draw a map of where he used to live and compare it to a map used today.

_____

10. Research the Islamic World during his time and present your findings.

_____

# Abu Uthman Amr Ibn Bakr Al-Basri Al-Jahiz

**Zoology, Scientist**

## Who was Abu Uthman Amr Ibn Bakr Al-Basri Al-Jahiz?

- Born in 776 in Basra, Iraq.

- Died in 868 in Basra, Iraq.

- Abu Uthman Amr Ibn Bakr Al-Basri Al-Jahiz was a prolific writer who wrote more than 230 books. During his lifetime, he made contributions in the following subjects

  **1**  Arabic Grammar
  **2**  Zoology – Kitab al Hayawan (Book of Animals)
  **3**  Poetry
  **4**  Lexicography (The art of effective speaking)
  **5**  Rhetoric (compilation of dictionary)

- He  wrote on scientific and complex subjects for non-specialists and common people.
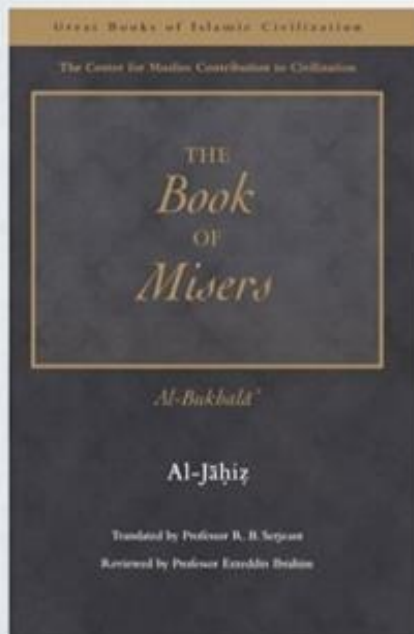
## CONTRIBUTIONS

### 1. Books

- Al-Jahiz's earliest writing on the 'Institution of the Caliphate' was well received at the court of Baghdad.

- Some of Al-Jahiz's famous books are: The Book of Animals, The Art of Keeping One's Mouth Shut, Against Civil Servants, Arab Food, In Praise of Merchants, Levity and Seriousness, Misers, and Eloquence & Demonstration.



*From the book "Al Kitab al Hayawan"*
*(The Book of Animals)*

## 1. Books continued

**a**  *His Book of Animals "The al-Hayawan"* is an encyclopaedia of seven volumes describing 350 species of animals.

- He described how ants store and preserve grain in their nests during the rainy season.

- He observed that certain parasites adapt the colour of their hosts.

- He approached this book by saying, 'The only way I can hope to win your interest is to present my book to you in the most attractive form. Leading you from an argument based on the wise Qur'an, to memorable traditions, to genuine poetry.'

**b**  His Book of Misers: is a collection of stories about the greedy, humorous and satirical - ridiculing beggars, singers and scribes for their greedy behaviour. These stories are considered one of the best literary works of Al-Jahiz. Many of the stories continue to be reprinted in magazines throughout the Arabic speaking world.

**c**  The Book of Eloquence and Demonstration. This book is considered to have started Arabic literacy theory in a formal systematic fashion. Al-Jahiz defines eloquence as the ability of the speaker to deliver an effective message while keeping it as brief as possible.

*"Book of Misers" written by Al-Jahiz*
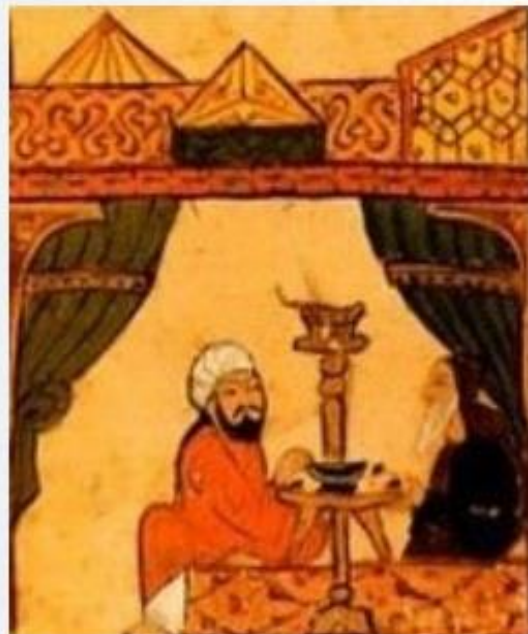
*An image from the "Book of Misers" a ninth century work of satire by Al-Jahiz*

# STUDY QUESTIONS

1. Summarise the life of Abu Uthman Amr Ibn Bakr Al-Basri Al-Jahiz.
   _____

2. List his contributions.
   _____

3. Evaluate the impact of his work on contemporary society.
   _____

4. Explain why learning about Al-Jahiz is important for understanding Zoology and Science?
   _____

5. Explain what has inspired you about his life, work and legacy?
   _____

6. Explain what surprised you about his life?
   _____

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.
   _____

8. Construct a diagram, and/or map/timeline/model of his work.
   _____

9. Draw a map of where he used to live and compare it to a map used today.
   _____

10. Research the Islamic World during his time and present your findings.
    _____

# Jabir Ibn Hayyan

## Chemistry and Medicine

# Who was Jabir Ibn Hayyan?

- Born in 721 in Tus, Iran.

- Died in 815 in Kufa, Iraq.

- Jabir Ibn Hayyan, known in the west as Geber was the ninth century Persian Alchemist who **contributed to** Chemistry, Astronomy, Astrology Medicine Pharmacy, Philosophy and Physics.

- He is known as the Father of Chemistry and his contributions include, perfection of scientific techniques such as crystallisation, distillation, calcination, sublimation and evaporation.    He also developed several instruments for conducting these experiments.

## CONTRIBUTIONS

1. Ibn Hayyan introduced experimental investigation into alchemy (derived from the Arabic word al-Kimiya). This did much to free alchemy from superstition, and turn it into a science.

2. He emphasised that definite quantities of various substances are involved in a chemical reaction.

3. Ibn Hayyan introduced several technical terms such as 'alkali'

4. He invented laboratory equipment such as ALEMBIC and RETORT.

5. In the Middle Ages, Ibn Hayyan's treatises on alchemy were translated into Latin and became the standard text of alchemy in Europe.

6. He is credited with discovering several chemical processes including:
   Crystallisation
   Distillation

7. Ibn Hayyan discovered substances which include:

   - Citric acid
   - Acetic acid (from vinegar)
   - Tartaric acid
   - Arsenic
   - Antimony
   - Bismuth
   - Sulphur
   - Mercury

8. He also invented a kind of paper that resisted fire and ink that could be read at night.

9. Ibn Hayyan invented an additive, which when applied to an iron surface inhibited rust and when applied to textile would make it water repellent.
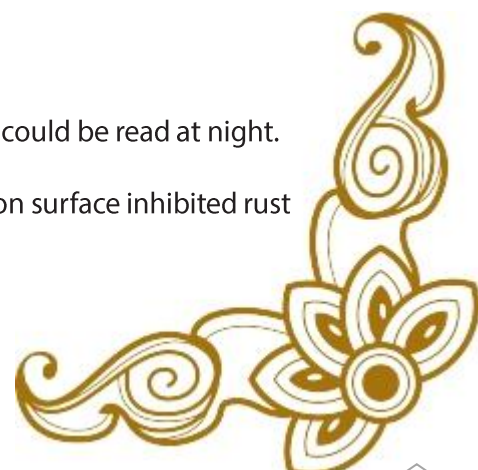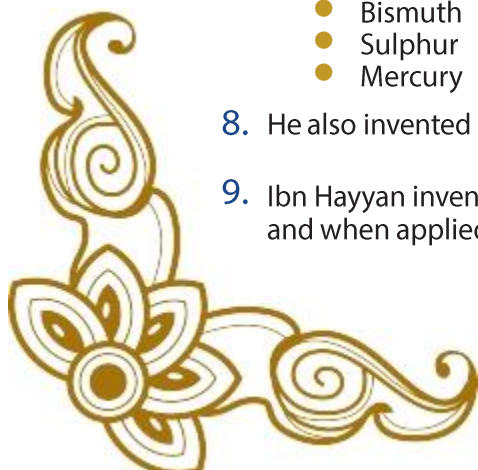
**10** Some of his contributions include prevention of rusting technique, lettering in gold, and developed aqua regia to dissolve gold, to name a few.

**11** Many of Ibn Hayyan's works were translated with no acknowledgement of his authorship. However, he was finally described, "as the most famous Arabian prince and philosopher", in later years.
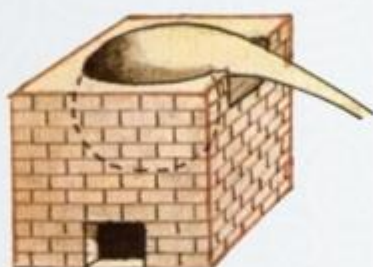


## LEGACY

**1** Ibn Hayyan is mentioned in "Paulo Coelho's" best seller, "The Alchemist"

**2** He is mentioned in the American sitcom, "The Big Bang Theory", in the episode, "The Guitarist Amplification".

**3** Ibn Hayyan is mentioned in the graphic novel, "Habibi" by Craig Thompson p.253-254

**4** In the DC Comic book titled 'Demon Knights', the 11th Century engineer Al-Jabir appears to be based on Jabir Ibn Hayyan.



*Jabir Ibn Hayyan exhibition in the University of Delaware Library in the USA*
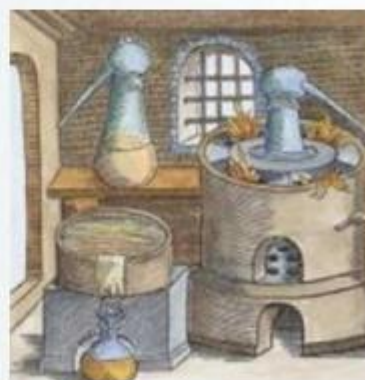
*Distillation process by Jabir Ibn Hayyan*

# STUDY QUESTIONS

1. Summarise the life of Jabir Ibn Hayyan.

   _____

2. List his contributions.

   _____

3. Evaluate the impact of his work on contemporary society.

   _____

4. Explain why learning about Jabir Ibn Hayyan is important for understanding chemistry and medicine?

   _____

5. Explain what has inspired you about his life, work and legacy?

   _____

6. Explain what surprised you about his life?

   _____

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

   _____

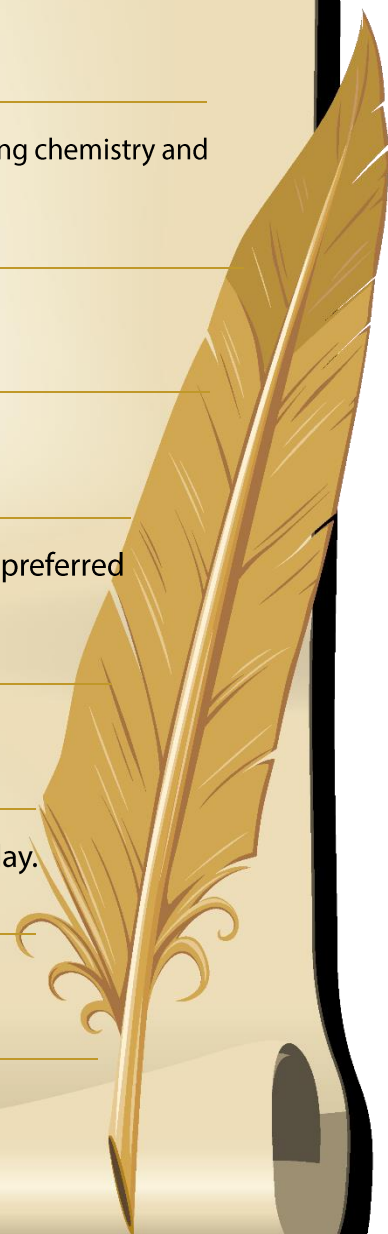8. Construct a diagram, and/or map/timeline/model of his work.

   _____

9. Draw a map of where he used to live and compare it to a map used today.

   _____

10. Research the Islamic World during his time and present your findings.

# Abu Abbas Ibn Kathir Al-Farghani

**Astronomer**

# Who was Abu Abbas Ibn Kathir Al-Farghani?

- Born in 790 in Farghana, Northern Iran.

- Died in 860.

- Abu Abbas Ibn Kathir Al-Farghani was one of the most famous Astronomers in the 9th Century, in the service of Al-Mamun and his successors.

- He made contributions to:
  1. Philosophy.
  2. Astronomy.
  3. Theoretical Physics.
  4. Engineering.

## CONTRIBUTIONS

1. Al-Farghani wrote, "Kitab fi al Harakat Samawiya wa Jawami Ilm al-Nujum", which is *"Elements of Astronomy"*, in English. It is a book on the celestial motion and the science of the stars. This book was translated into Latin and was used in Europe in 1590. Jacob Golius published a new Latin text together with the Arabic original in 1669. It was from the *"Elements of Astronomy"* (in Gherd's translation) that Dante derived the astronomical knowledge displayed in the 'Vita Nuova' and 'Convivio'.

2. Al-Farghani accepted Ptolemy's theory and the value of the precession, but thought that it affected not only the stars but also the planets.

3. He determined the diameter of the earth to be 6,500 miles and found the greatest distances and the diameters of the planets.

4. He supervised the construction of the Great Nilometer which is a structure for measuring the Nile River's clarity and water level during the flood, at Al Fusat (Old Cairo).

5. Al-Farghani created the treatise for the famous Astolat.

The cover page of the Latin translation of Al-Farghani's book of astronomy.

A shape from Latin translation of Al-Farghani's book of astronomy.

*This column in the middle was a marker to show the levels of water and it is connected to the Nile by three tunnels*

## LEGACY

1. The lunar crater on the moon Al-Farghani's named after him in recognition of his pioneering work in the field of Astronomy.

2. The Egyptian Government has erected a magnificent statue of Al-Farghani.



*Lunar crater named Algraganus after Al-Farghani*



*Statue of Al-Farghani in Farfona*

# STUDY QUESTIONS

1.  Summarise the life of Abu Abbas Ibn Kathir Al-Farghani.

2.  List his contributions.

3.  Evaluate the impact of his work on contemporary society.

4.  Explain why learning about Al-Farghani is important for understanding astronomy?

5.  Explain what has inspired you about his life, work and legacy?

6.  Explain what surprised you about his life?

7.  Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

8.  Construct a diagram, and/or map/timeline/model of his work.

9.  Draw a map of where he used to live and compare it to a map used today.

10. Research the Islamic World during his time and present your findings.
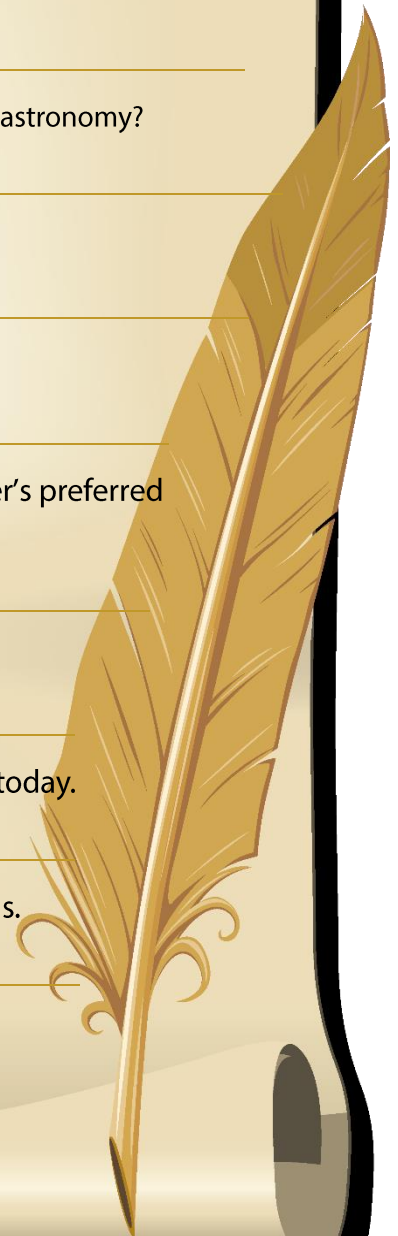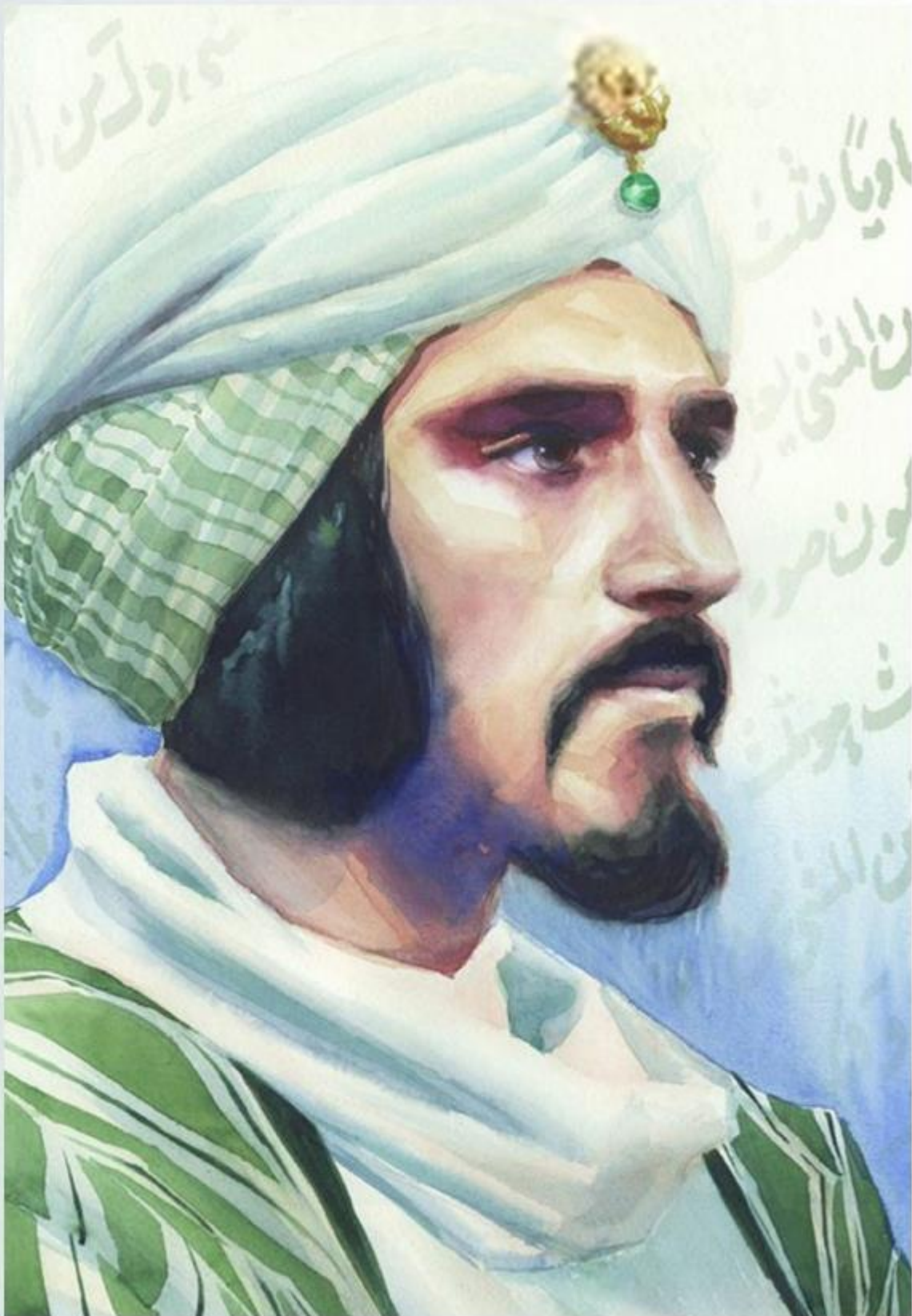
**Yaqub Ibn Ishaq Al-Kindi**

**Philosopher, Astronomer, Physician, Mathematician, Geographer**

# *Who was Yaqub Ibn Ishaq Al-Kindi?*

- Born in 800 in Basra, Iraq.

- Died in 873 in Baghdad, Iraq.

- Yaqub Ibn Ishaq Al-Kindi, known in the west as Alkindu, was known as the Philosopher of the Arabs, a mathematician, physician and a musician.

- He was an Islamic mathematician who wrote about the Indian number system as well as geometry and optics.

- He introduced the concept of Arithmetic.

- Al-Kindi's work inspired Roger Bacon.

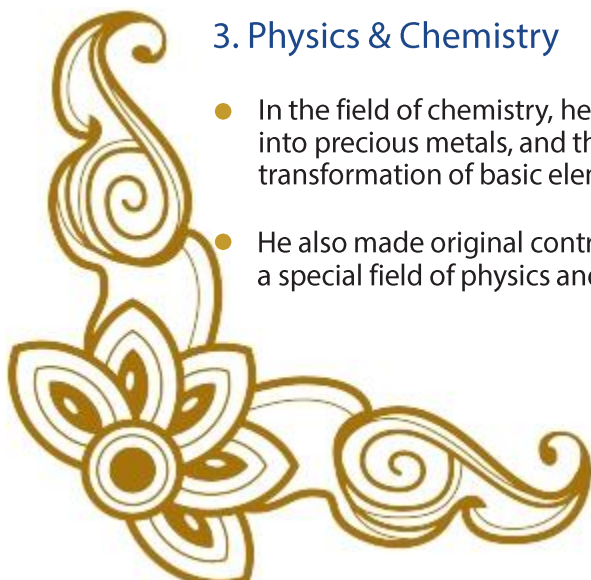## CONTRIBUTIONS

### 1. Books

- Al-Kindi wrote more than 240 books.

- He wrote hundreds of original treatises on many subjects ranging from Metaphysics, Logic, Psychology, Pharmacology, Astronomy, Astrology, Optics, Mathematics and Music theory.

- He also wrote several books on practical topics like, perfumes, swords, jewels, glass, dyes, zoology, tides, mirrors, meteorology and earthquakes.

### 2. Medicine

Al-Kindi was the first physician who systemically determined the dosage for most drugs.

### 3. Physics & Chemistry

- In the field of chemistry, he argued that base metals cannot be converted into precious metals, and that chemical reactions cannot produce a transformation of basic elements.

- He also made original contributions to geometrical optics, a special field of physics and wrote a book on it.

## 4. Mathematics

Al-Kindi contributed to spherical geometry and his work provided the foundation for modern arithmetic.

## 5. Music

Al-Kindi researched the scientific aspects of music and provided a method for the determination of pitch. He states that when a sound is produced, it generates waves in the air, which strike the eardrum.

## 6. Calligraphy

Al-Kindi was an expert calligrapher. At one point, he was employed as a calligrapher by Al-Mutawakkil (tenth Caliph of the Abbasid Caliphate).



*The first page of al-Kindi's manuscript "On Deciphering Cryptographic Messages", containing the oldest known description of cryptanalysis by frequency.*



*Al Kindi as depicted on the Syrian postage stamp*

# STUDY QUESTIONS

1. Summarise the life of Yaqub Ibn Ishaq Al-Kindi.

   _____

2. List his contributions.

   _____

3. Evaluate the impact of his work on contemporary society.

   _____

4. Explain why learning about Al-Kindi is important for understanding philosophy, astronomy, medicine, mathematics and geography.

   _____

5. Explain what has inspired you about his life, work and legacy?

   _____

6. Explain what surprised you about his life?

   _____

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

   _____

8. Construct a diagram, and/or map/timeline/model of his work.

   _____

9. Draw a map of where he used to live and compare it to a map used today.

   _____

10. Research the Islamic World during his time and present your findings.

   _____

## Thabit Ibn Qurrah

**Mechanics, Astronomer, Pure Mathematics and Geometry**

# Who was Thabit Ibn Qurrah?

- Born in 836 in Haran, Turkey.

- Died in 901 in Baghdad, Iraq.

- Thabit Ibn Qurrah, known in the West as Thebit, was a mathematician, physician, astronomer and translator who lived in Baghdad.

- He was the founder of calculus and statistics.

# CONTRIBUTIONS

## 1. Mathematics

- He wrote the theory of numbers and extended their use to describe the ratio between geometrical quantities.

- Ibn Qurrah was a pioneer in extending the concept of traditional geometry to geometrical algebra, spherical trigonometry, integral calculus and real numbers.

- He was the founder of statistics.

- He used arithmetic terminology to study several aspects of conic sections (parabola and ellipse).

- Ibn Qurrah's algorithm for computing the surface area and volume of solids is now known as integral calculus.

## 2. Astronomy

- Ibn Qurrah determined the length of the sidereal year as 365 days 6 hours and 12 seconds.

- He added the ninth sphere to Ptolemaic astronomy.

- Ibn Qurrah analysed several problems on the movements of sun and moon and wrote a treatise on sundials.

## 3. Mechanics

His original work on mechanics and physics involves examining the conditions of equilibrium of bodies, beams and levers.
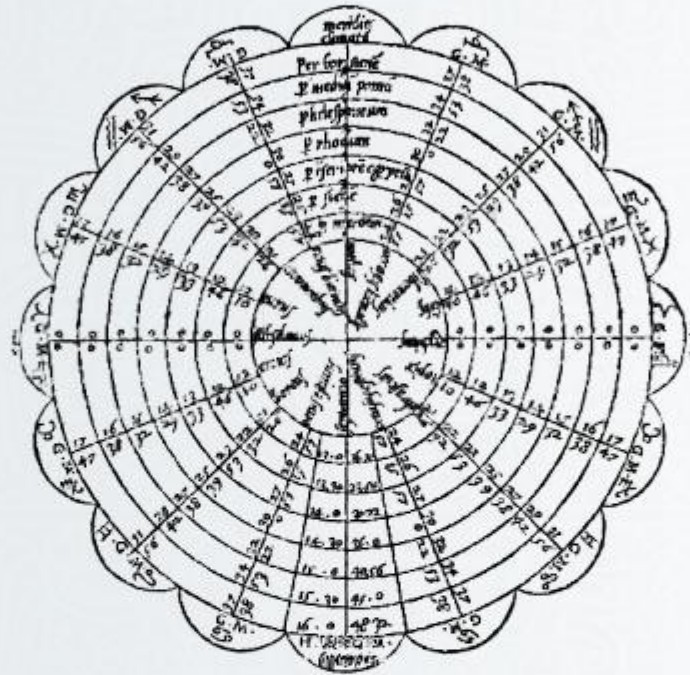
## 4. Translations

Ibn Qurrah translated many works into Arabic including, Ptolemy's Almagest, Euclid's Elements of Geometry, Apollonius's book on conic sections, and some of Archimedes' work.
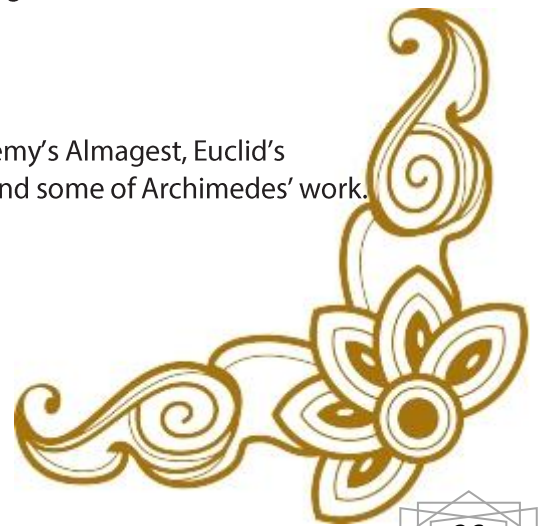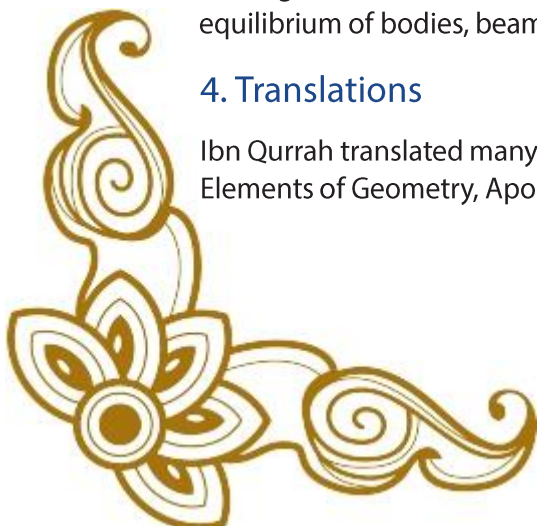
# LEGACY

1  In recent centuries, many of his books have been translated into European languages.

2  Thabit Ibn Qurrah was appointed as the court astronomer for the Abbasid Caliphate, Mu'tadid who reigned from 892 to 902.



*Thabit Ibn Qurrah translated and analysed numerous works by Ptolemy, which were written into Latin. A zodiacal diagram from a Latin edition of Almagest.*
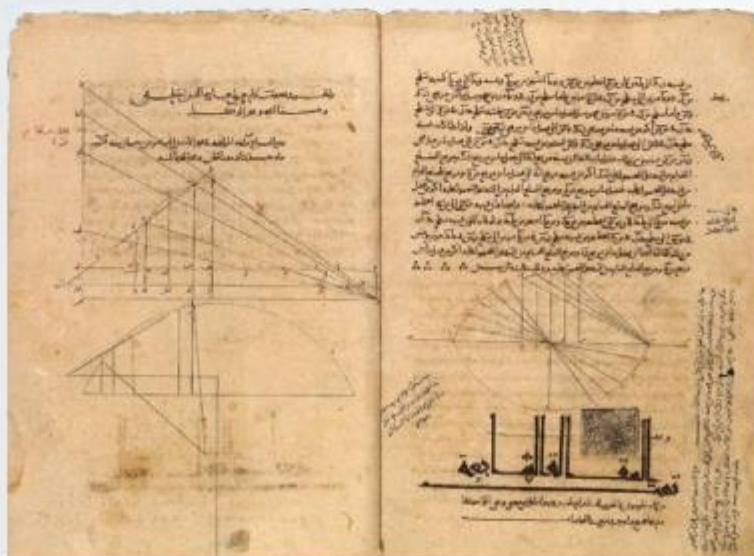


*Pages from Ibn Qurrah's Arabic translation of Apollonius' Conics*

# STUDY QUESTIONS

1. Summarise the life of Thabit Ibn Qurrah.

2. List his contributions.

3. Evaluate the impact of his work on contemporary society.

4. Explain why learning about Thabit Ibn Qurrah is important for understanding mechanics, astronomy, mathematics and geometry?

5. Explain what has inspired you about his life, work and legacy?

6. Explain what surprised you about his life?

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

8. Construct a diagram, and/or map/timeline/model of his work.

9. Draw a map of where he used to live and compare it to a map used today.

10. Research the Islamic World during his time and present your findings.
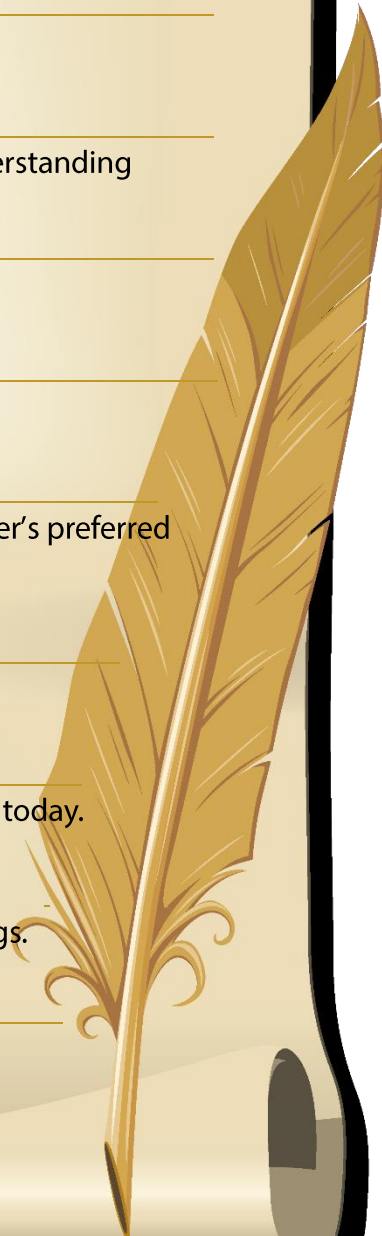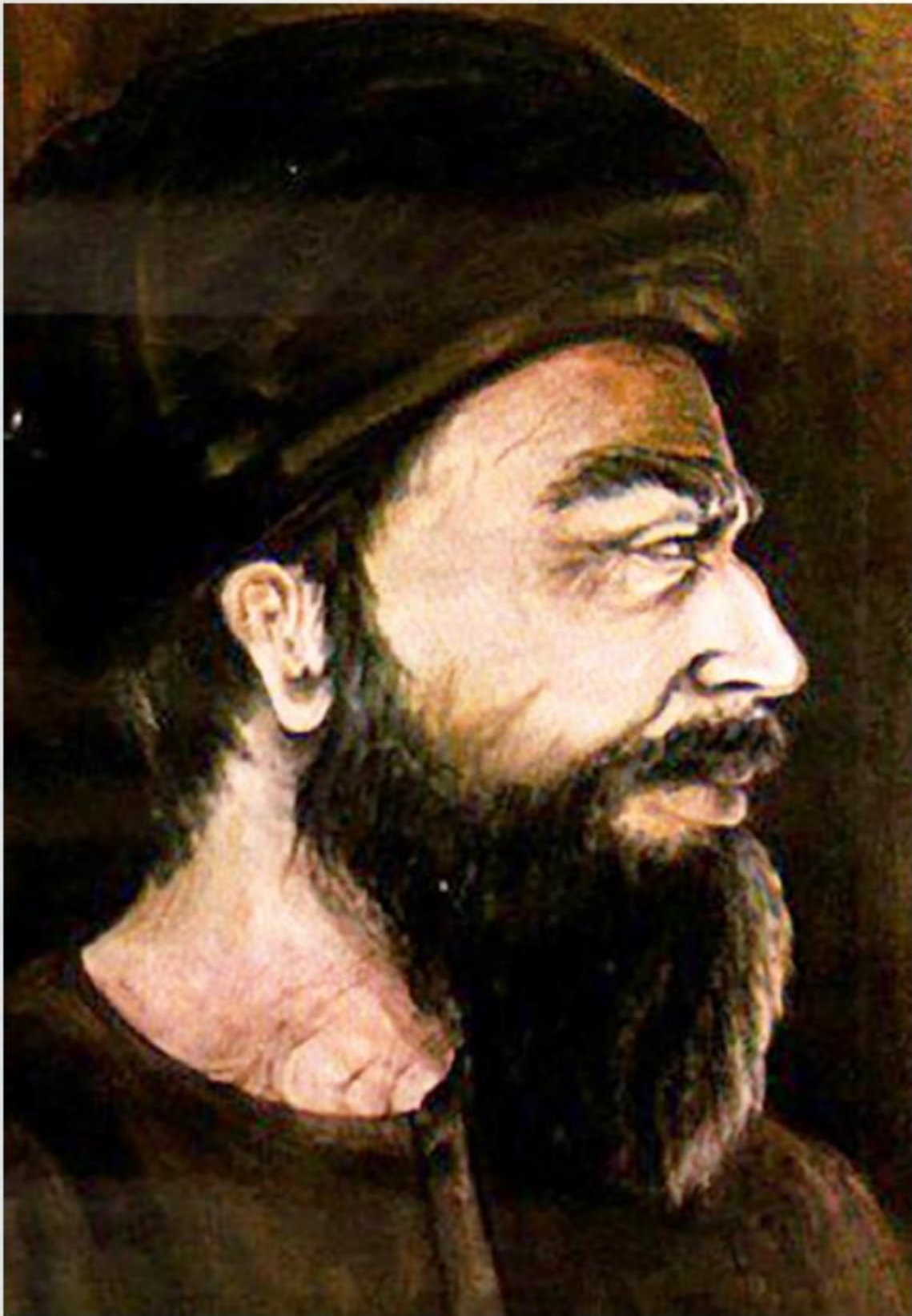
## Ali Ibn Rabban Al-Tabari

**Physician, Philosopher, Mathematician and Astronomer**

# Who was Ali Ibn Rabban Al-Tabari?

- Born in 838 in Merv, Turkmenistan

- Died in 870 in Baghdad, Iraq

- Ali Ibn Rabban Al-Tabari who was educated by his father Sahl, a well renowned scholar was a Hakim, scholar, physician and psychologist

- He produced the first encyclopaedia of medicine

## CONTRIBUTIONS

1. Al-Tabari produced many works. Among them are:
   a The King's Present.
   b A book on the proper care of health.
   c A work on the proper use of food, drink and medicine.
   d A book of Magic and Amulets.
   e A Treatise on Cupping.
   f A Treatise on the preparation of food.

2. He is well known for his seven-volume treatise Firdous al-Hikmat (Paradise of Wisdom), which is the first medical encyclopaedia that incorporates several branches of medical science. It was first published in the 20$^{th}$ century.

   The seven volumes contain:

   Vol 1: Discussions on the contemporary knowledge of medical science.
   Vol 2: Elucidation of the organs of the human body, rules for maintaining good health and comprehensive accounts of certain muscular diseases.
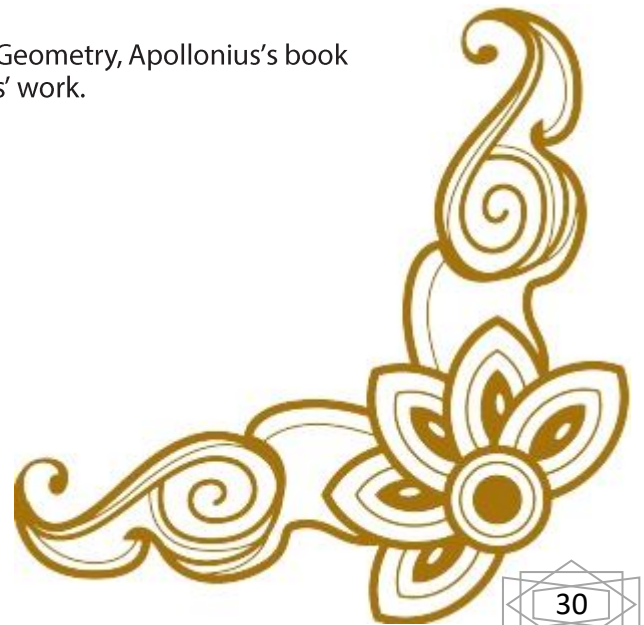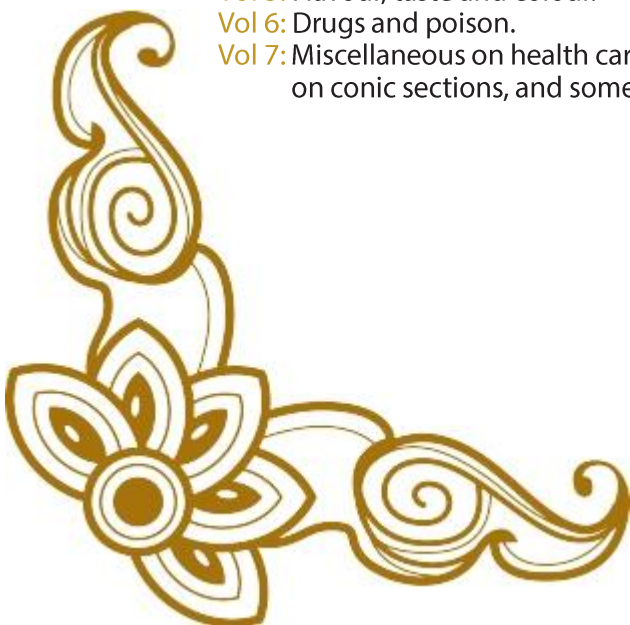   Vol 3: Discussions and prescriptions of diet for good health and the prevention of diseases.
   Vol 4: Discussions on all diseases from head to toe.
   Vol 5: Flavour, taste and colour.
   Vol 6: Drugs and poison.
   Vol 7: Miscellaneous on health care. Elements of Geometry, Apollonius's book on conic sections, and some of Archimedes' work.

**3.** Al-Tabari described the Quran as follows:

*"The Quran contains praises of God, belief in the Prophets and apostles, exhortations to good, everlasting deeds, command to do good and prohibition against doing evil, inspiration to the desire of paradise and avoidance of hell-fire.*

*The Quran inspired such reverence and sweetness in the hearts and which has achieved everlasting success."*

## LEGACY

**1**    Ali ibn Al-Tabari was given the title, 'Rabban', which signifies "Our Teacher" and "Our Master".

**2**    The University of Chicago Press has published (on behalf of History of Science in Society) Ali Al-Tabaris, "Paradise of Wisdom", which is one of the oldest Arabic compendiums of Medicine.
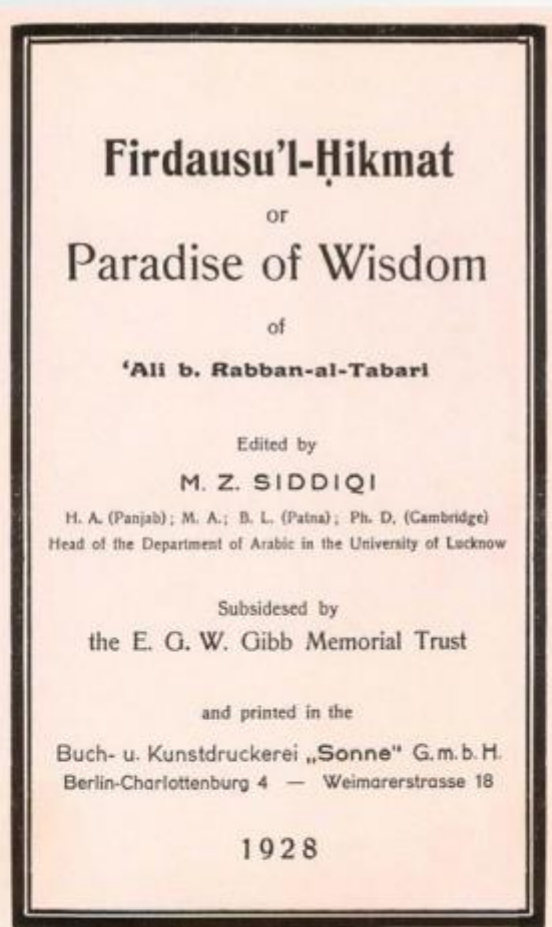


*English translation of the book "Paradise of Wisdom' by Al-Tabari*

## STUDY QUESTIONS

1. Summarise the life of Ali Ibn Rabban Al-Tabari.

2. List his contributions.

3. Evaluate the impact of his work on contemporary society.

4. Explain why learning about Al-Tabari is important for understanding philosophy, mathematics, astronomy and medicine.

5. Explain what has inspired you about his life, work and legacy?

6. Explain what surprised you about his life?

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

8. Construct a diagram, and/or map/timeline/model of his work.

9. Draw a map of where he used to live and compare it to a map used today.

10. Research the Islamic World during his time and present your findings.
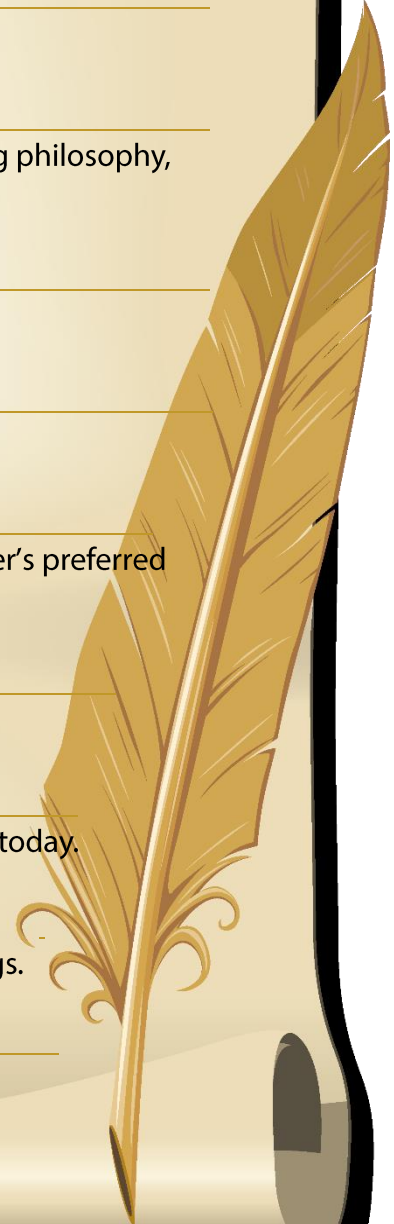
# Abu Abdullah Al-Battani

**Astronomer and Mathematician**

# Who was Abu Abdullah Al-Battani?

- Born in 850 in Harran, Turkey.

- Died in 929 in Samarra, Iraq.

- Abu Abdullah Al-Battani, known in the west as Albategnius, was a renowned Astronomer, Astrologer and Mathematician who accurately determined the length of the solar year.

- He contributed to numeric tables such as the Table of Toledo, used by astronomers to predict the movement of the sun, moon and planets across the sky.

## CONTRIBUTIONS

### 1. Astronomy

- Al-Battani made many important discoveries in astronomy, made several recommendations to Ptolemy, and rectified the calculations for the orbits of the moon and certain planets.

- He showed that the farthest distance between the sun and the earth varies and thus, annular eclipses of the sun are possible as well as total eclipses.

- Al-Battani determined with greatest accuracy, the obliquity of the seasons and the true and mean orbit of the ecliptic.

- He worked out the length of the tropical year and the season.

- He founded the true and mean orbit of the sun.

- Al-Battani revised orbits of the moon and the planets and proposed a new and very ingenious theory to determine the conditions of visibility of the new moon.

- He contributed to numeric tables such as Table of Toledo, used by astronomers to predict the movement of the sun, moon and planets across the sky.

- He catalogued 489 stars.

## 2. Mathematics

- Al-Battani's greatest fame came in mathematics with the use of trigonometric ratios that we use today.

- He developed the concept of cotangent and furnished their tables in degrees.

- He also discovered the reciprocal functions of secant and cosecant and produced the first table of cosecants which he referred to as a "table of shadows", for each degree from 1° to 90°.

- Al-Battani's trigonometric ratios shown, are cited in his book, 'Kitab al Zij' (Book of Astronomical Tables):

$$\tan a = \frac{\sin a}{\cos a}$$

$$\sec a = \sqrt{1 + \tan^2 a}$$

- He solved the equation sin x = a cos x discovering the formula:

$$\sin x = \frac{a}{\sqrt{1 + a^2}}$$

- Al Battani gives other trigonometric formulae for right-angled triangles such as:

$$b\sin(A) = a\sin(90° - A)$$

## LEGACY

1. The lunar crater Albalegnius on the moon is named after him.

2. The 'Doctor Who' novel, "Night of the Human", features a solar system called Battani 045.



Pages from Al-Battani's 'Kitab Az-Zij

# STUDY QUESTIONS

1. Summarise the life of Abu Abdullah Al-Battani

2. List his contributions.

3. Evaluate the impact of his work on contemporary society.

4. Explain why learning about Al-Battani is important for understanding astronomy and mathematics.

5. Explain what has inspired you about his life, work and legacy?

6. Explain what surprised you about his life?

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

8. Construct a diagram, and/or map/timeline/model of his work.

9. Draw a map of where he used to live and compare it to a map used today.

10. Research the Islamic World during his time and present your findings.
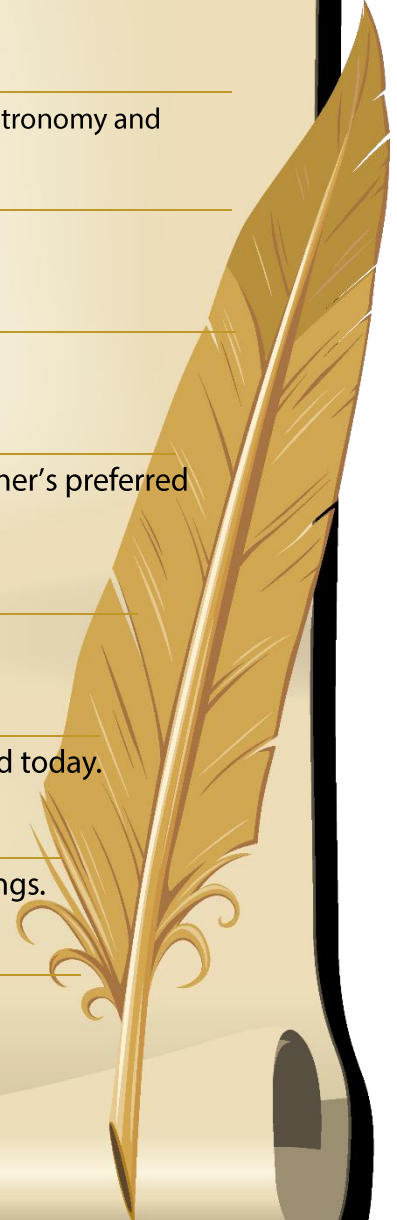
# Abu Bakr Muhammad Ibn Zakariya Ar-Razi

**Physician**

# *Who was Abu Bakr Muhammad Ibn Zakariya Ar-Razi?*

- Born in 865 in Ray (near Tehran), Iran.

- Died 925 in Ray, Iran.

- Abu Bakr Muhammad Ibn Zakariya Ar Razi, known in the West as Rhazes, was a renowned mathematician, physician, alchemist, chemist, philosopher and an important figure in the history of medicine.

- Early in his life, he was appointed the head of the physicians of the Ray Hospital and later head of the Baghdad hospital.

## CONTRIBUTIONS

1. Ar-Razi was a pioneer in the fields of paediatrics, obstetrics and ophthalmology. He greatly favoured cures through correct and regulated food and combined this with emphasis on the influence of psychological factors on health.

## 2. Books

- He was the first to draw a clear comparison between smallpox and chickenpox and Provided a clinical characterisation of the diseases.

- His greatest work al-Hawi 'Comprehensive Book' or 'Continens' in its Latin translation was used intensely throughout Europe for centuries.

- Ar-Razi wrote – Al Mansuri (on Surgery) and a general book on Therapy, which became part of the medical curriculum in Western universities.

## 3. Chemist

- Ar-Razi described for the very first time a systematic classification of carefully observed and verified facts regarding chemical substances, reactions and apparatus.

- He was the first to produce acids such as sulphuric acid.

- Ar-Razi developed several chemical instruments that remain in use to this day.

- He perfected the methods of distillation to gain alcohol.

- He was the first to introduce alcohol for medical purposes.

- Ar-Razi was also the first to use opium for anaesthesia.
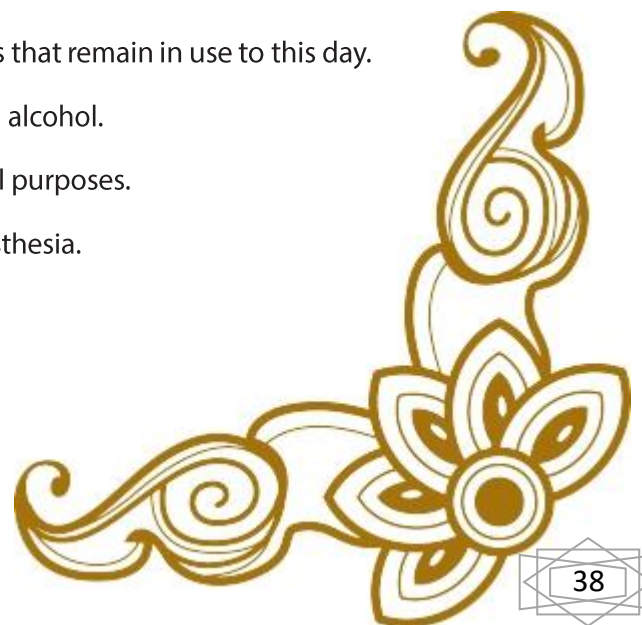
## 4. Ophthalmology

- Ar-Razi was the first physician to give an account of the operation for the extraction of a cataract.

- He discussed the pupillary reaction of the pupil of the eye and explained it was due to the presence of small muscles, which act per the intensity of light.

- He was the first to draw a clear comparison between smallpox and chickenpox

## LEGACY

1   The modern-day Ar-Razi Institute in Tehran and Ar-Razi University of Medical Sciences in Kermanshah, were named after him.

2   In June 2009, Iran donated a "Scholars Pavilion" to the United Nations office in Vienna. The Pavilion features statues of Ar-Razi, Avicenna, Birun and Omar Khayyam.

*Colophon of Ar-Razi's Book of Medicine*

*The statue of Ar-Razi in United Nations Office in Vienna is part of the "Scholars Pavilion" donated by Iran*

# STUDY QUESTIONS

1.  Summarise the life of Abu Bakr Muhammad Ibn Zakariya Ar-Razi.

    _____

2.  List his contributions.

    _____

3.  Evaluate the impact of his work on contemporary society.

    _____

4.  Explain why learning about Ar-Razi is important for understanding Medicine?

    _____

5.  Explain what has inspired you about his life, work and legacy?

    _____

6.  Explain what surprised you about his life?

    _____

7.  Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

    _____

8.  Construct a diagram, and/or map/timeline/model of his work.

    _____

9.  Draw a map of where he used to live and compare it to a map used today.

    _____

10. Research the Islamic World during his time and present your findings.

    _____
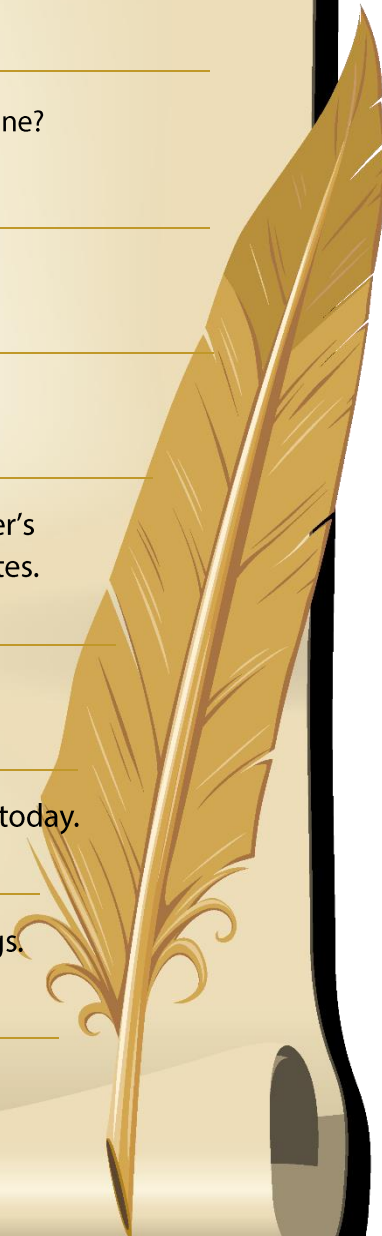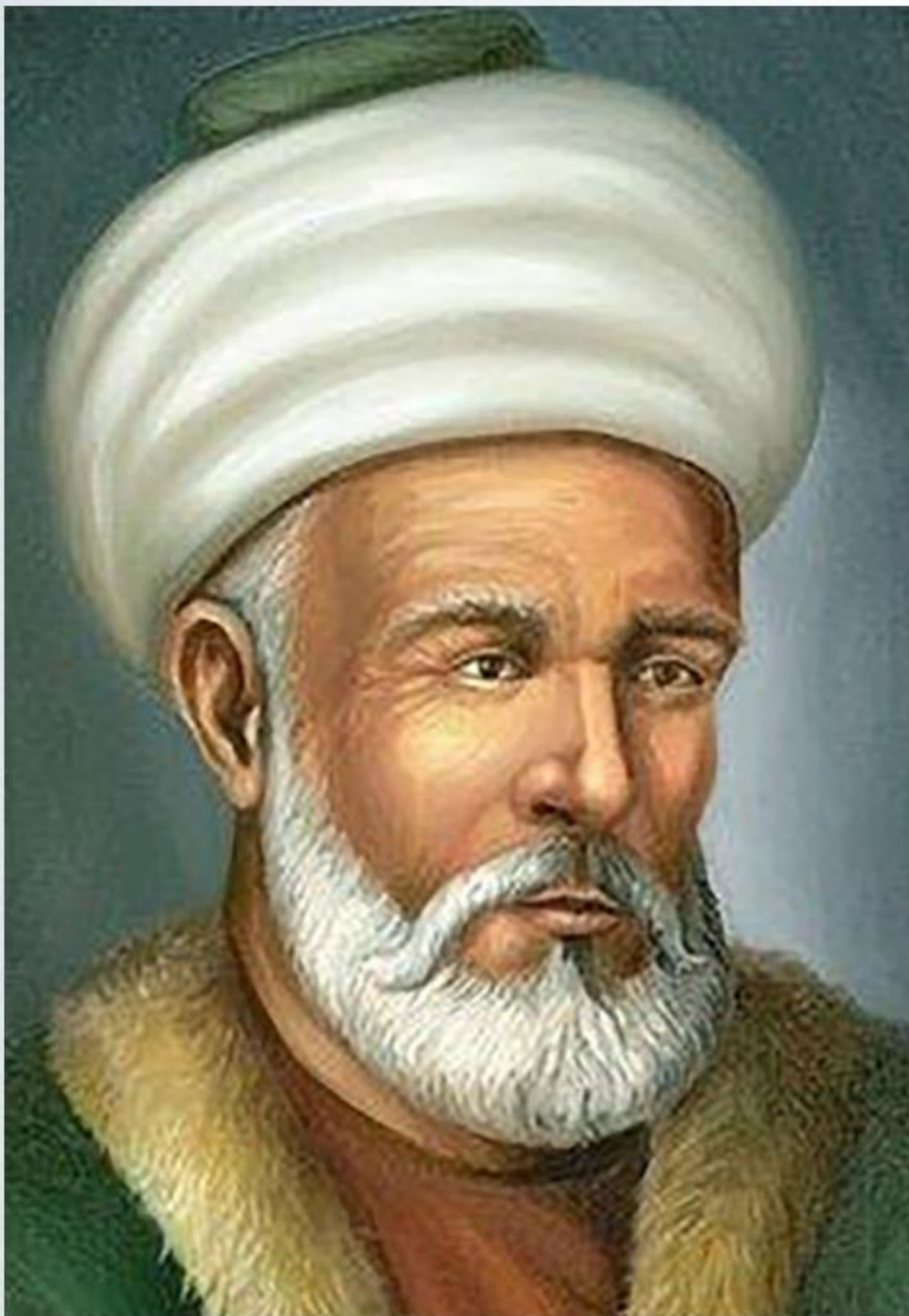
## Abu Al-Nasr Al-Farabi

**Philosophy, Logic, Sociology and Scientist**

# Who was Abu Al-Nasr Al-Farabi?

- Born in 872 in Farab, Kazakhstan.

- Died in 950 in Damascus, Syria.

- Abu Al-Nasr Al-Farabi, known in the West as *Al-Harabiu*, was educated in Farab and Bukhara and later in Baghdad.

- He was a renowned philosopher and jurist who wrote in the fields of:
  1 Political philosophy
  2 Metaphysics
  3 Ethics and Logic.

- Al Farabi was also a scientist, cosmologist, mathematician and music scholar.

# CONTRIBUTIONS

## 1. Science

Al-Farabi published a short treatise on "vacuum". He carried out the first series of experiments concerning the existence of a vacuum by using a plunger in water. He concluded that air's volume could expand to fill the available space and suggested the concept of a perfect vacuum was incoherent.

## 2. Books

Al-Farabi wrote several books on sociology, the most famous 'The Model City'.
He also wrote books on metaphysics and psychology that included his original work.

## 3. Sociology

He states that an isolated individual cannot achieve all the perfection by himself and without the aid of many other individuals. It is the innate disposition of every man to join another human being or other men in the labour he ought to perform.
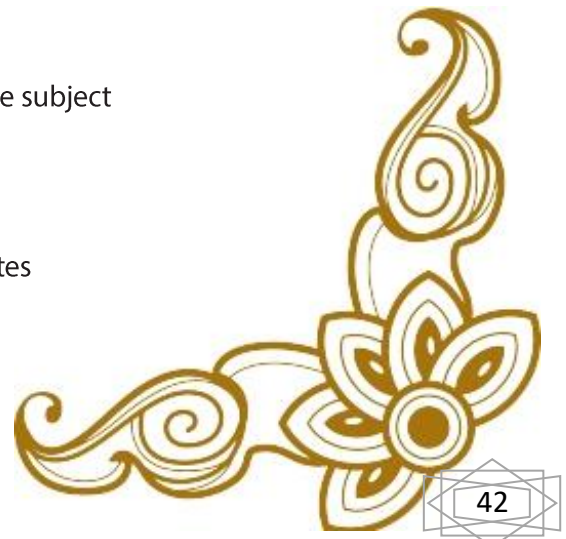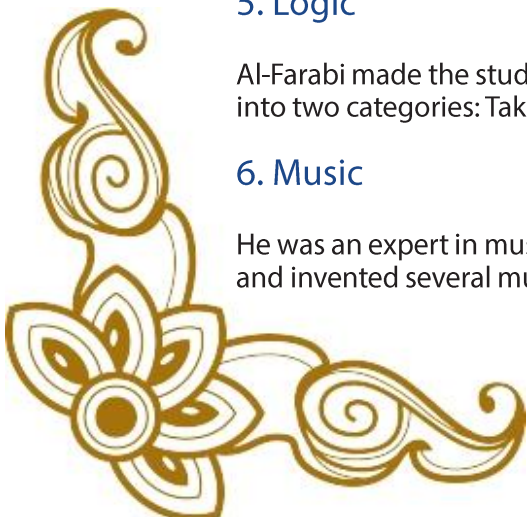
## 4. Philosophy

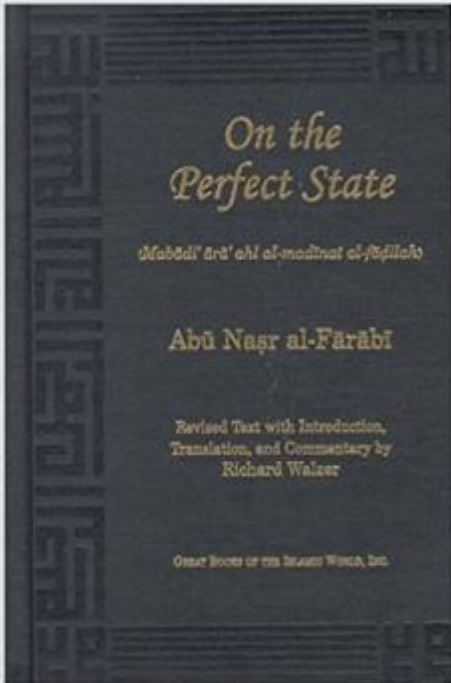He held the belief that philosophy and Islam are in harmony.

## 5. Logic

Al-Farabi made the study of logic systematic by dividing the subject into two categories: Takhayyul (idea) and Thubut (proof ).

## 6. Music

He was an expert in music. He contributed to musical notes and invented several musical instruments

Translation of Al-Farabi's book
"The Perfect State"

Pages from a 17th century manuscript of Al-Farabi's
commentary on Aristotle's metaphysics

## LEGACY

Al-Farabi regarded the ideal state to be ruled by the Prophet (Imam), instead of the philosopher (King), which was envisaged by Plato. Al-Farabi agreed that the ideal state was the city of Madina, when it was governed by the Prophet Muhammad as its Head of State, as he was in direct communication with Allah, whose laws were revealed to him.



An Iranian stamp bearing
an illustration of
Al-Farabi's imagined face

Al-Farabi on the currency
of the Republic of Kazakhstan

# STUDY QUESTIONS

1. Summarise the life of Abu Al-Nasr Al-Farabi.

   _____

2. List his contributions.

   _____

3. Evaluate the impact of his work on contemporary society.

   _____

4. Explain why learning about Al-Farabi is important for understanding philosophy, logic, sociology and science?

   _____

5. Explain what has inspired you about his life, work and legacy?

   _____

6. Explain what surprised you about his life?

   _____

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

   _____

8. Construct a diagram, and/or map/timeline/model of his work.

   _____

9. Draw a map of where he used to live and compare it to a map used today.

   _____

10. Research the Islamic World during his time and present your findings.

   _____
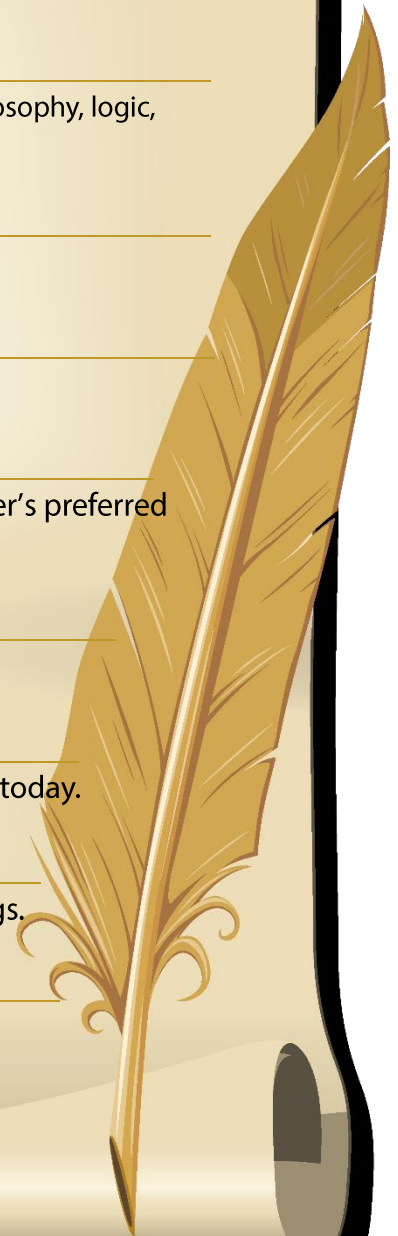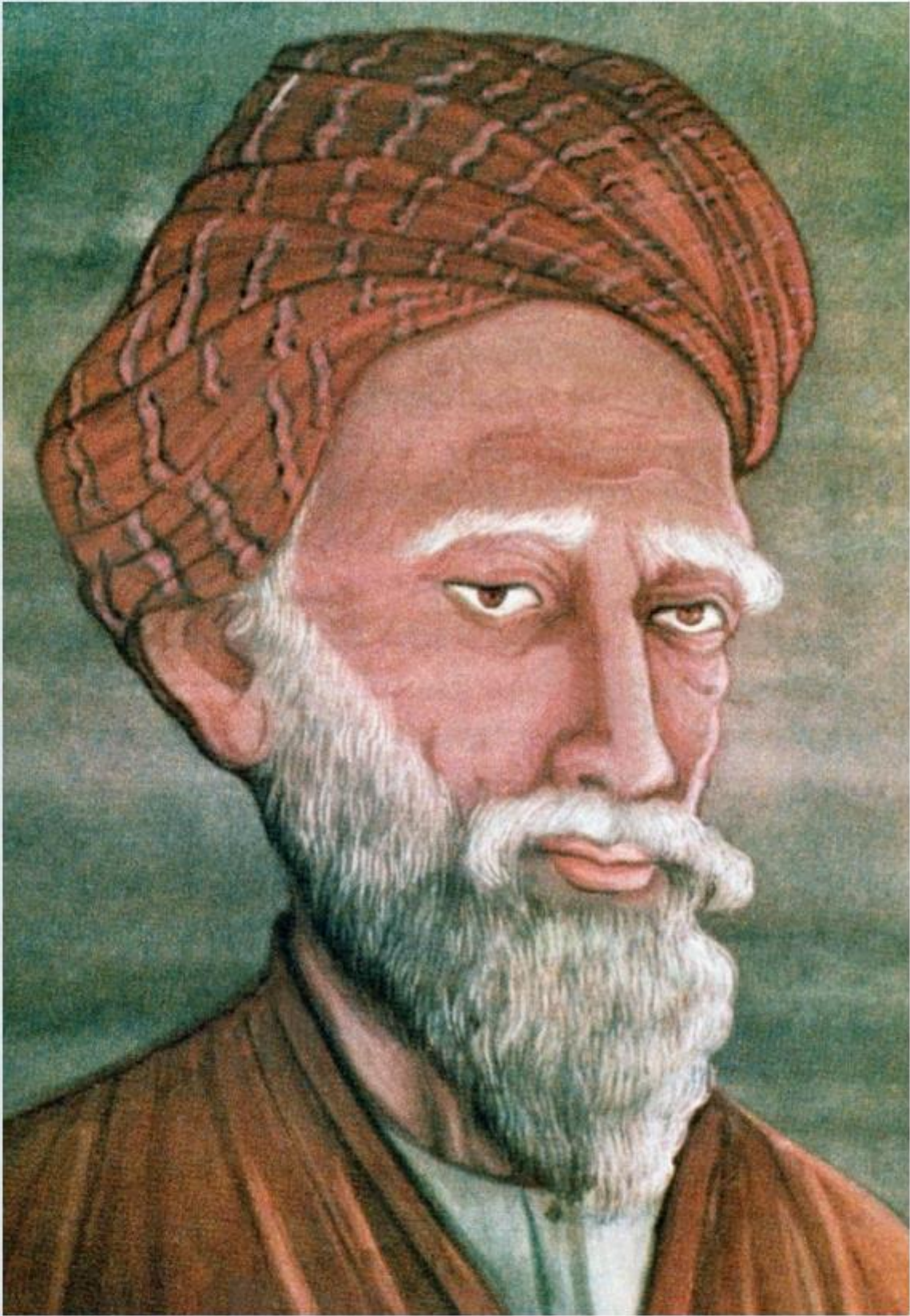
**Abul-Hasan Ali Al-Masu'di**
Geographer, Physicist and Historian

# Who was Abul-Hasan Ali Al-Masu'di?

- Born in 871 in Baghdad, Iraq.

- Died in 957 in Cairo, Egypt.

- Abul-Hasan Ali Al-Masu'di was a descendant of Abdallah Ibn Masu'd, a companion of the Holy Prophet (PBUH).

- He was a prominent Muslim historian and traveller.

- He was the first scholar who combined history and scientific geography.

- In 915, he travelled via Baghdad to India, where he visited Multan and Manoora, the capital of the Muslim State of Sindh.

  Al-Masu'di travelled to Gujrat, Deccan, Ceylon, Indo-China and China and proceeded via Madagascar, Zanzibar and Oman to Basra.

## CONTRIBUTIONS

1. In Basra, Abul Hasa Ali Al-Masu'di wrote, "Muruj-al-Dhahab" describing his experiences of various countries, people and climates.

2. He gives accounts of his contact with the Jews, Iranians, Indians and Christians.

3. He wrote his second book "Muruj-al-Zaman" in 30 volumes, chronologically describing in detail the geography and history of the countries that he had visited.

4. Al-Masu'di initiated the elements of analysis, reflection and criticism, which was later improved by Ibn Khaldun.

5. In his book "Al-Taribih", Al-Masu'di conducted a systematic study of history from the a perspectives of geography, sociology, anthropology and ecology.



*Al-Mas'udi's atlas of the world (reversed on the N-S axis to compare with modern geographical maps).*
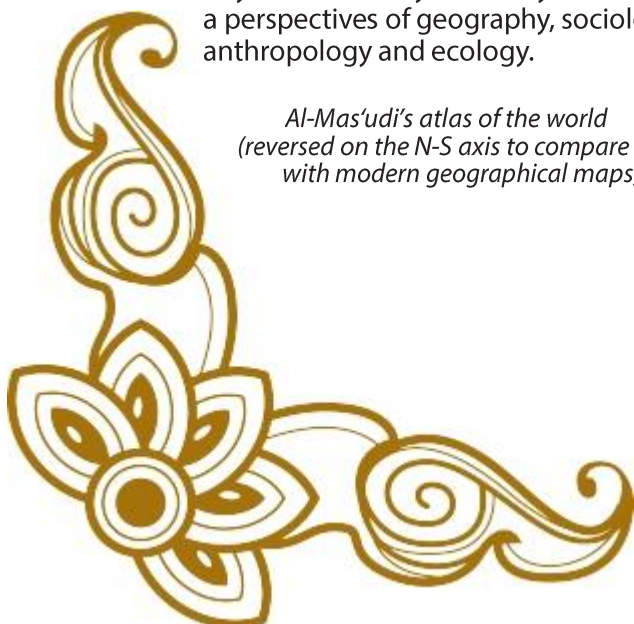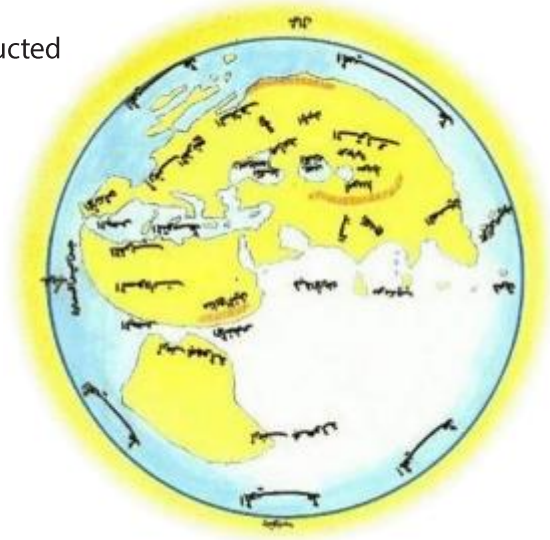
1. He had a deep insight into the causes of the rise and fall of nations.

2. He used his scientific and analytical approach to explain the causes of the eathquake of 955.

3. Al-Masu'di  discussed on the water of the Red Sea and other related earth sciences.

4. Abul-Hasan Ali Al-Masu'di was the first author to make mention of windmills, which were invented by the Muslims of Sijistan.

5. He made important contributions to Arabic music and other fields of science

## LEGACY

1  He named Iran as the land of wind and sand. There are wind-driven mills, that raise the water from the streams, whereby gardens are irrigated. Iran has been described as the country where frequent use of wind is made.

2  Barbier de Maynard and Pavet de Courteille translated the book by Al-Masu'di titled "The Meadows of Gold".  It has been compared with European and Greek historians who often referred to him as the Father of History.
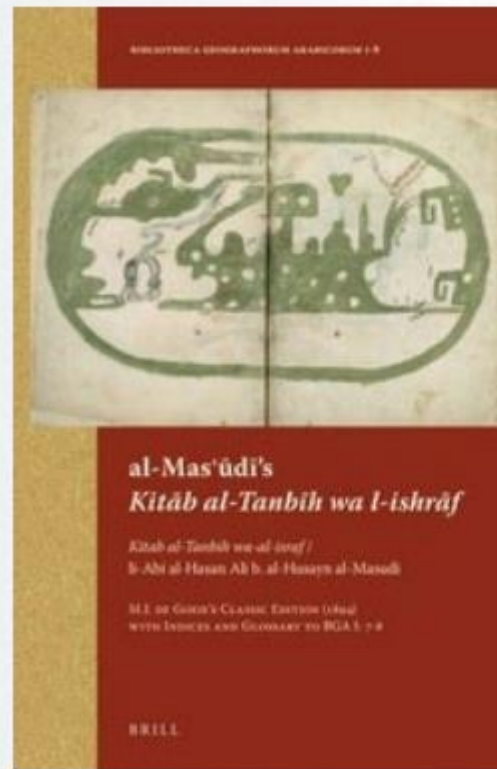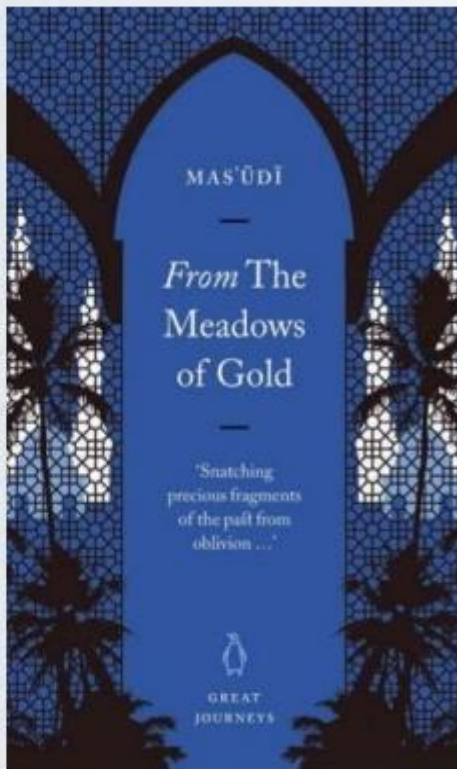
*Two  of Al-Masu'di's books translated into English*

# STUDY QUESTIONS

1. Summarise the life of Abdul-Hasan Ali Al-Masu'di.

2. List his contributions.

3. Evaluate the impact of his work on contemporary society.

4. Explain why learning about Al-Masu'di is important for understanding geography and history?

5. Explain what has inspired you about his life, work and legacy?

6. Explain what surprised you about his life?

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

8. Construct a diagram, and/or map/timeline/model of his work.

9. Draw a map of where he used to live and compare it to a map used today.

10. Research the Islamic World during his time and present your findings.
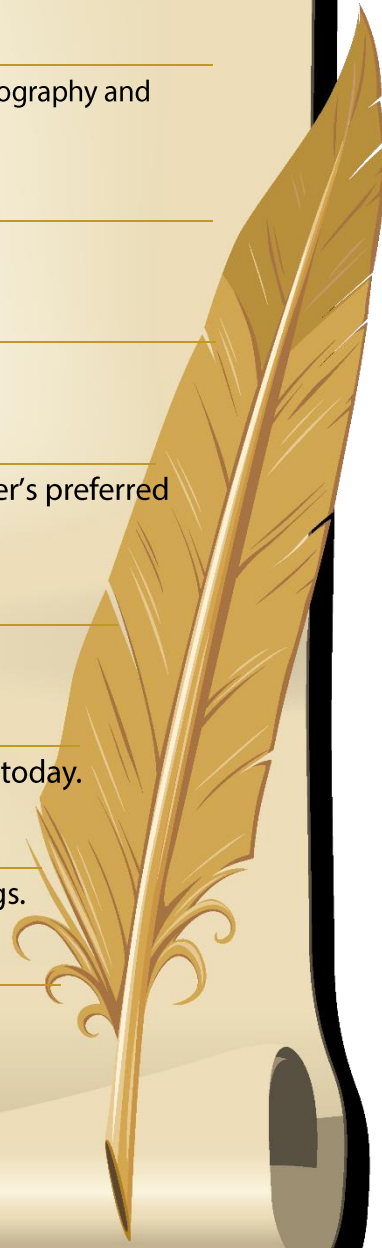
# Abdul Rahman Al-Sufi

**Astronomer**

# Who was Abdul Rahman Al-Sufi?

- Born in 903 in Ray, (Ancient city of Iran).

- Died in 986 in Shiraz, Iran.

- Abdul Rahman Al-Sufi was a prominent Persian astronomer.

- His famous "Book of Fixed Stars" (Kitab al Kawatib al Thabit al Musawwar), is a revision of Ptolemy's Almagest based on his own observations. Al-Sufi describes the position, colour and brightness of 1,018 objects. Many of the names of the stars are the Latin versions of the Arabic names mentioned by Al-Sufi in this book.

## CONTRIBUTIONS

1. The "Book of Fixed Stars" (Kitab al Kawatib al Thabit al Musawwar), was published in the year 964. It includes a catalogue of 1018 stars, giving their positions, magnitude and colours. He set out his results, constellation by constellation. For each constellation, he provided two drawings, one from the outside of cilestial globe and one from the inside ( as seen from the earth). In doing so, Al-Sufi identified more than 100 new stars.
In the 'Fixed Stars', he catalogued the Omicron Velorum Cluster IC2391 as a nebulous star.
2. Al-Sufi was the first astronomer to describe the 'nebulosity' of the nebula in Andromedia in his book of constellation ( Atlas of Heavens).
3. He made the earliest recorded observation of the Andromeda Galaxy in the year 964 AD describing it as a small cloud. These were the first galaxies. Other than the Milky Way to be observed from earth.
4. Al-Sufi contributed to the building of an important observatory in the city of Shiraz as well as constructing many astronomical instruments such as astrolabes and celestial globes.
5. Al-Sufi also wrote about the astrolabe – an instrument used to measure the altitude of stars and planets and used for navitional aid. It is described to have over 1000 uses in the areas of astronomy, astrology, horoscope, navigation, surveying, time keeping, Qiblah and Salaah prayer.
6. He named the southern group of stars al-Baqar al-Abyad or the 'White Bull' after receiving reports from Arab navigators in the Malay Archipelago. We now know this group of starts a Nubecula mayor ( the greater Magellanic Cloud).
.

# LEGACY

The lunar crater Azophu and the minor planet 12621 were named after Al-Sufi.
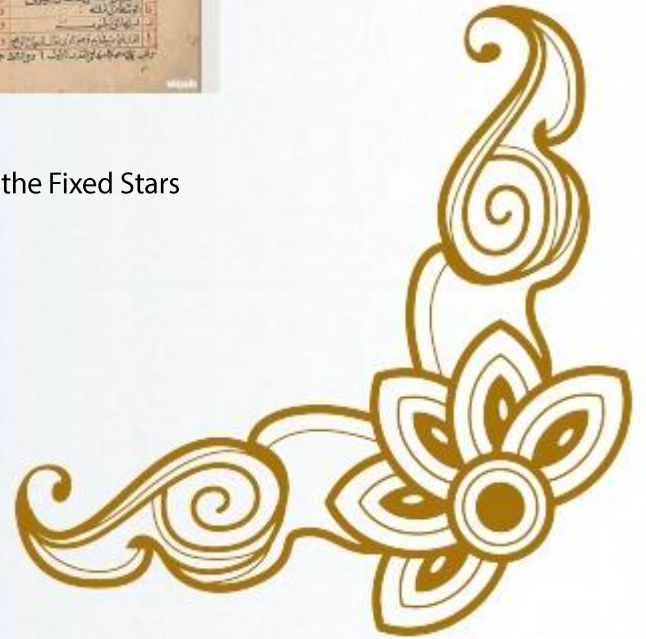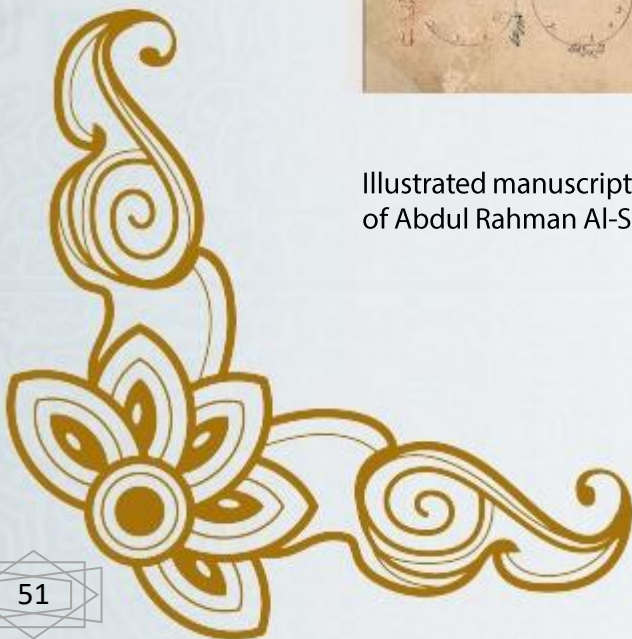


Left: The Creator Azophu named after Abdul Rahman Al-Sufi.

Above: The minor planet 12621 Azophu named after Abdul Rahman Al-Sufi.



Illustrated manuscript of the book of the Fixed Stars of Abdul Rahman Al-Sufi.

# STUDY QUESTIONS

1. Summarise the life of Abdul Rahman Al-Sufi.

2. List his contributions.

3. Evaluate the impact of his work on contemporary society.

4. Explain why learning about Al-Sufi is important for understanding astronomy?

5. Explain what has inspired you about his life, work and legacy?

6. Explain what surprised you about his life?

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

8. Construct a diagram, and/or map/timeline/model of his work.

9. Draw a map of where he used to live and compare it to a map used today.

10. Research the Islamic World during his time and present your findings.
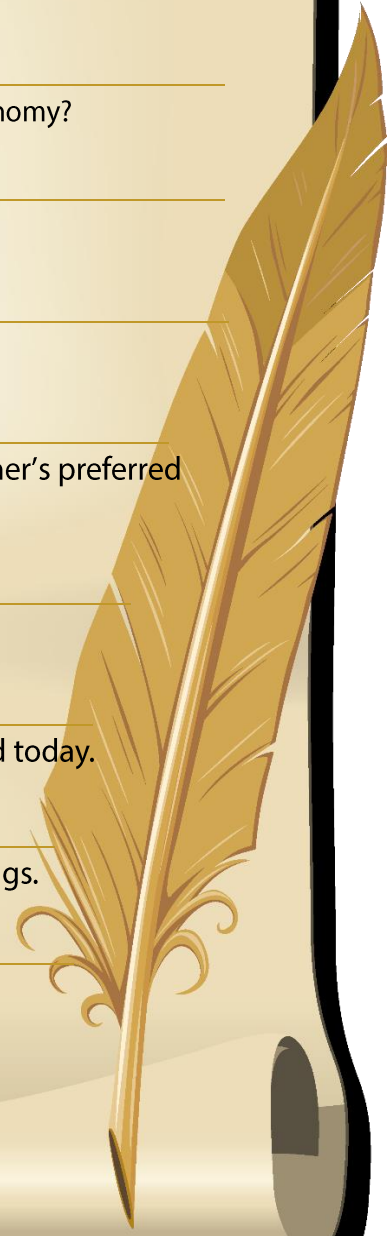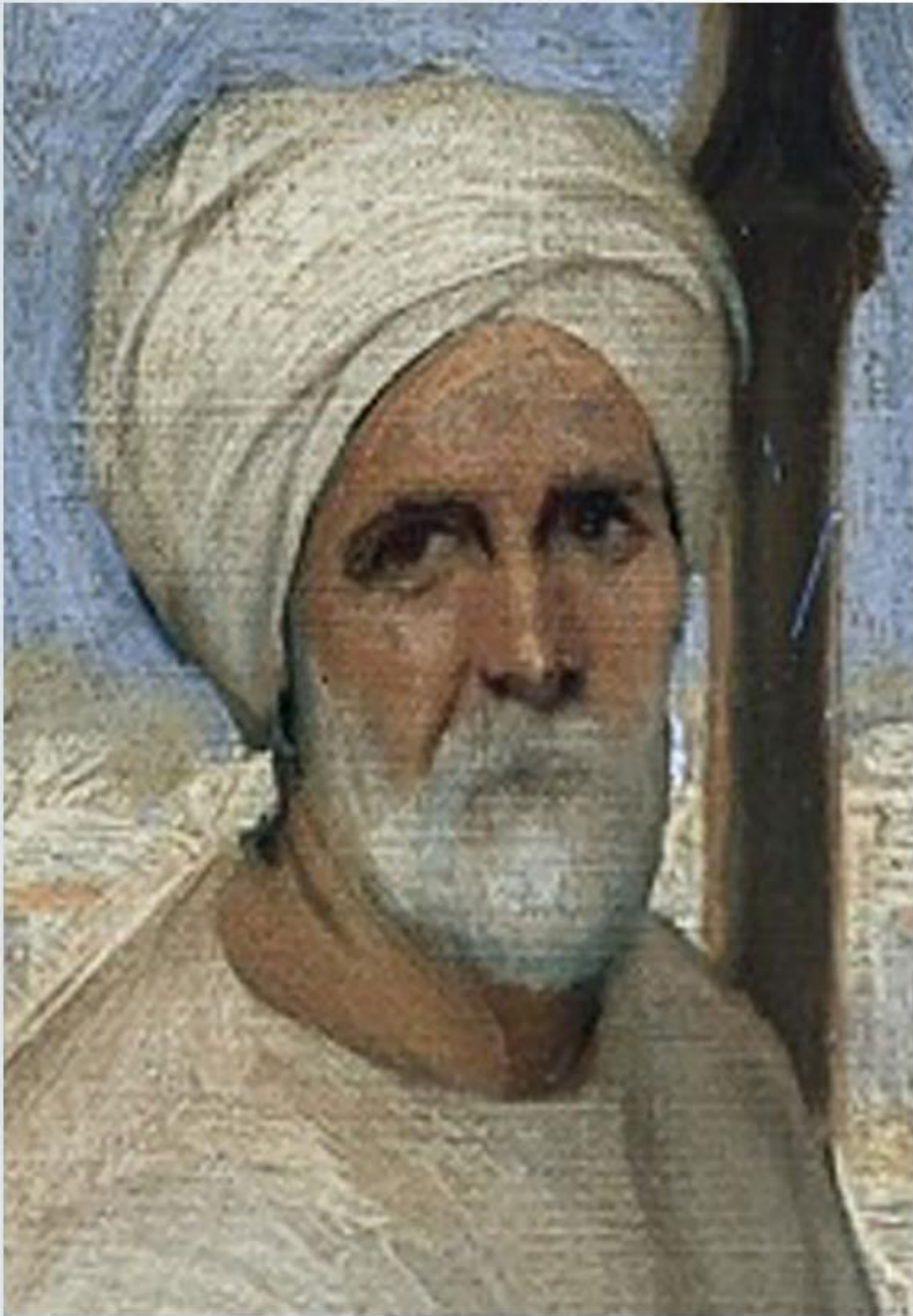
## Abul Qasim Al-Zahrawi

**Physician**

# *Who was Abul Qasim Al-Zahrawi?*

- Born in 936 in Medina Azahara, Cordoba, Spain.

- Died in 1013 in Cordoba, Spain.

- Qasim Al-Zahrawi, known as Albucasis in the west, was the greatest medieval surgeon and has been described as the father of surgery.

- His surgical procedures and surgical instruments had an enormous impact where some of his discoveries are still applied in medicine to this day.

- Al-Zahwari was the first surgeon to describe an ectopic pregnancy (where the foetus is outside the womb).

- He was also the first physician to identify the hereditary nature of haemophilia.

## CONTRIBUTIONS

### 1. Surgery

- Al-Zahrawi's 30-chapter medical treatise "Kitab al Tasrif li man Ajaz anltalif (An Aid for Those Who Lack the Capacity to Read Big Books)'- was published in year 1000.    The book covers a broad range of medical topics including dentistry and childbirth.
  In addition, it deals with surgical knowledge including diagrams and illustrations of more than 200 surgical instruments, most of which he introduced and developed.
  Al-Zahrawi gave detailed description of many surgical operations and their treatment, including cauterisation, removal of stone from the bladder. surgery of the eye, ear and throat, midwifery, removal of the dead foetus, amputation, dissection of animals styptics.

- In one chapter the importance of a positive doctor – patient relations is detailed.

- For five centuries during the middle ages, this book was the primary source and standard text for European medical knowledge and served as a reference for doctors and surgions.

- He was the first to use silk thread for stitching wounds and his use of catgul suture (made from sheep intestine) is still used in surgical procedures today.

### 2. Pharmacology

- Al-Zahrawi pioneered the preparation of medicines by sublimation and distillation and prescribed the use of diuretics, sudorifics, purgatives and hot baths.

- His publication titled "Liber Servitoris" provides recipes and explains how to prepare the "sample" from which complex drugs were compounded for general use.
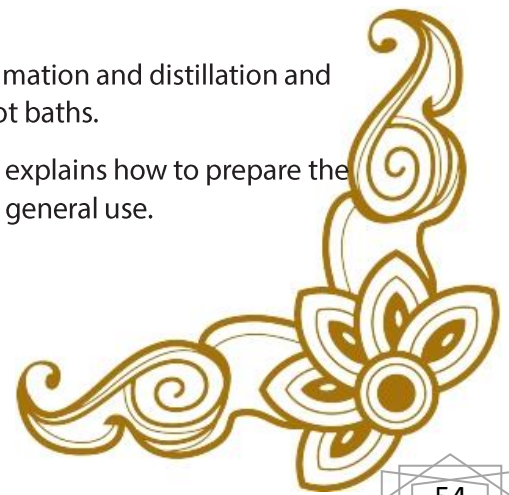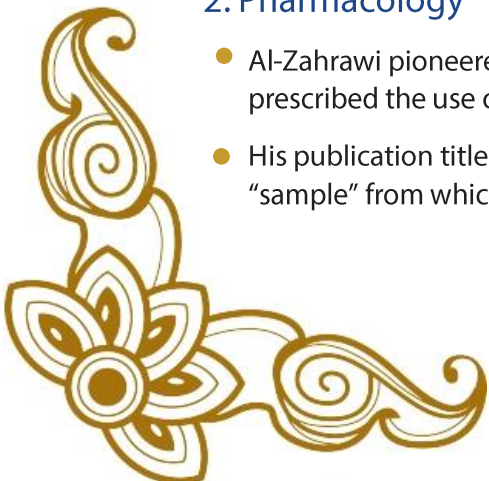
# LEGACY

The street of Cordoba where he lived is named in his honour as "Calle Albucasis".
On this street, he lived in House No 6, which is preserved until today by the Spanish Tourist Board with a bronze plaque, which reads, "This was the house where Al-Zahrawi lived".



*Drawing of dental instruments including a tongue depressor and tooth extractor from a surgical treatise by Al-Zahrawi.*

# STUDY QUESTIONS

1.  Summarise the life of Abul Qasim Al-Zahrawi.

    _____

2.  List his contributions.

    _____

3.  Evaluate the impact of his work on contemporary society.

    _____

4.  Explain why learning about Al-Zahrawi is important for understanding medicine?

    _____

5.  Explain what has inspired you about his life, work and legacy?

    _____

6.  Explain what surprised you about his life?

    _____

7.  Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

    _____

8.  Construct a diagram, and/or map/timeline/model of his work.

    _____

9.  Draw a map of where he used to live and compare it to a map used today.

    _____

10. Research the Islamic World during his time and present your findings.

    _____
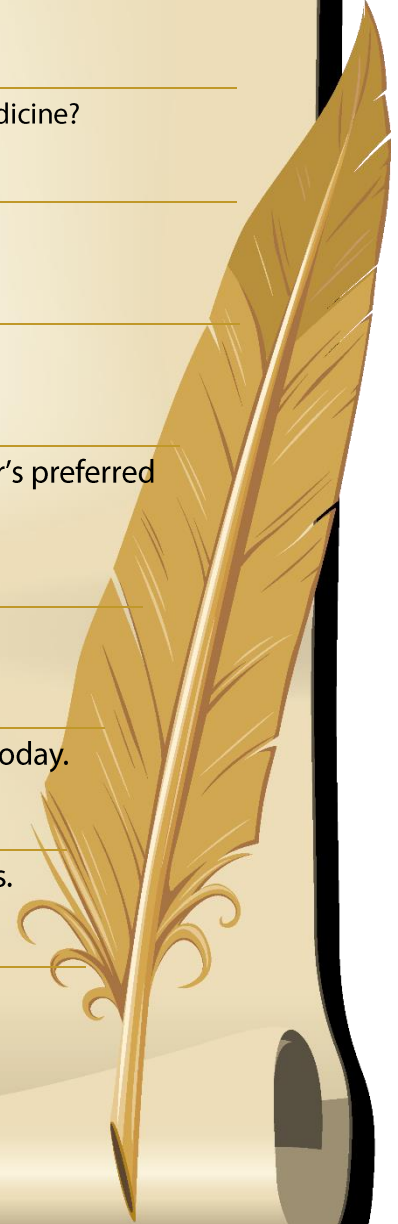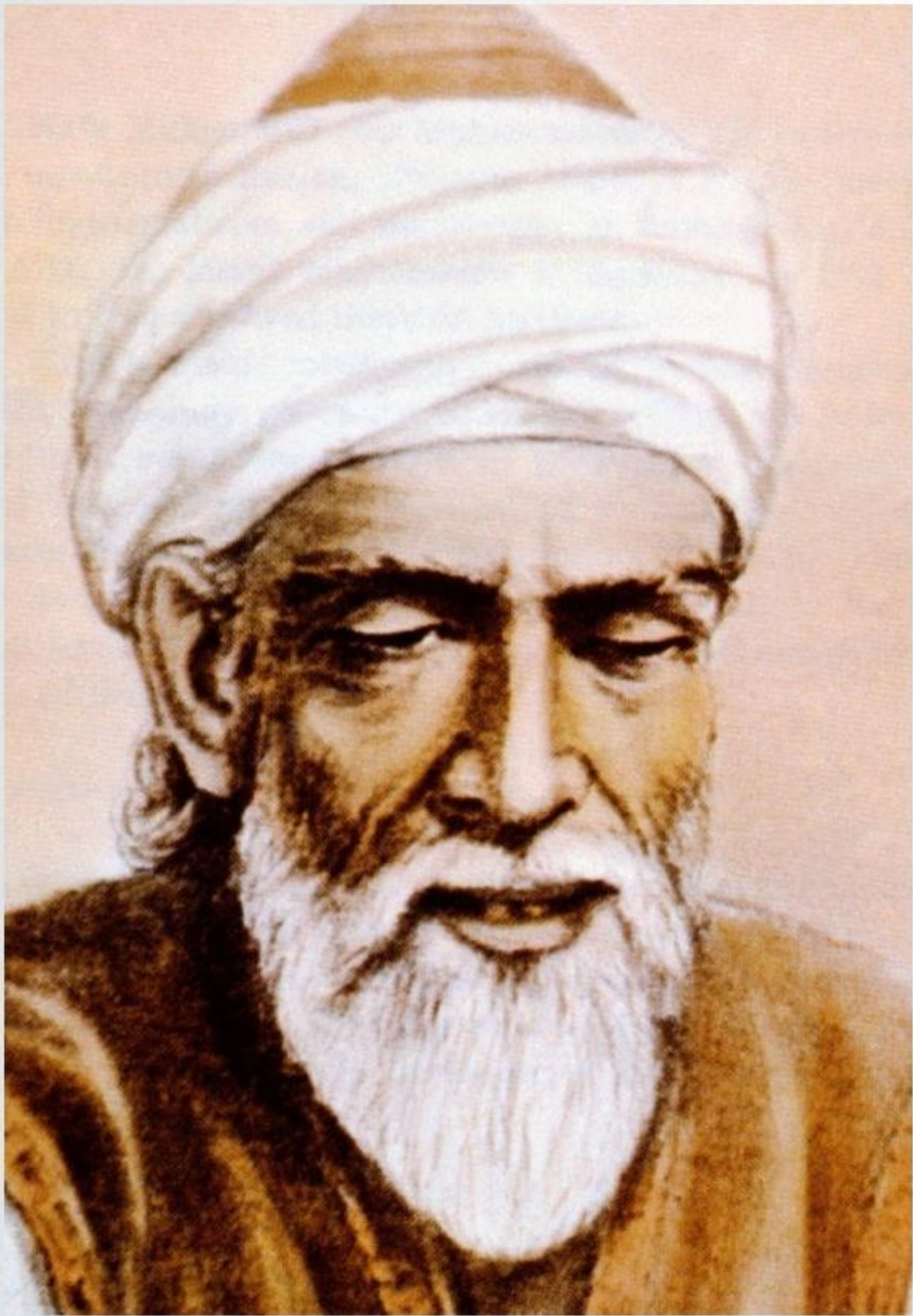
# Abul-Wafa Muhammad Al-Buzjani

## Mathematician and Astronomer

# Who was Abul-Wafa Muhammad Al-Buzjani?

- Born in 940 in Buzghan, Iran.

- In the year 959, he migrated to Baghdad and lived there until his death.

- Died in 997 in Baghdad, Iraq.

- Abul-Wafa Muhammad Al-Buzjani was a Persian mathematician and astronomer who worked in Baghdad.

- He made important innovations in spherical trigonometry.

- He is a credited with the use of negative numbers and compiling the tables of sine and tangent.

- Al-Buzjani introduced the secant and cosecant functions.

- His pioneering work in spherical trigonometry was hugely influential in both mathematics and astronomy.

## CONTRIBUTIONS

### 1. Astronomy:

Al-Buzjani was the first to build a wall quadrant to observe the sky.

### 2. Mathematics:

- In geometry, he wrote about the construction of a square equivalent to other squares; the construction of a regular polyhedral; the construction of a regular heptagon, construction of a parabola by points and geometrical solution of the equations:

$$x^4 = a \quad \text{and} \quad ax^3 = b$$

- In trigonometry, he was the first to show the generality of the sine theorem relative to spherical triangles. He developed a new method of constructing sine tables, the value of sin30' being correct to the right decimal place.

- He developed relations for sine (a+b) and the formula:

$$2 \sin^2 (a/2) = 1 - \cos a \quad \text{and} \quad \sin a = 2 \sin (a/2) \cos (a/2)$$

- He introduced the secant and cosecant   and knew the relations
- between the trigonometric lines, which are used to define them.

- He wrote many books on these subjects.

- He developed planetary theory and solutions to determine the direction of Qiblah.

## LEGACY

The lunar crater Abul-Wafa   is named after him.



**Page of the manuscript of Kitab al-majisti byAbul-Wafa Al-Buzjani**
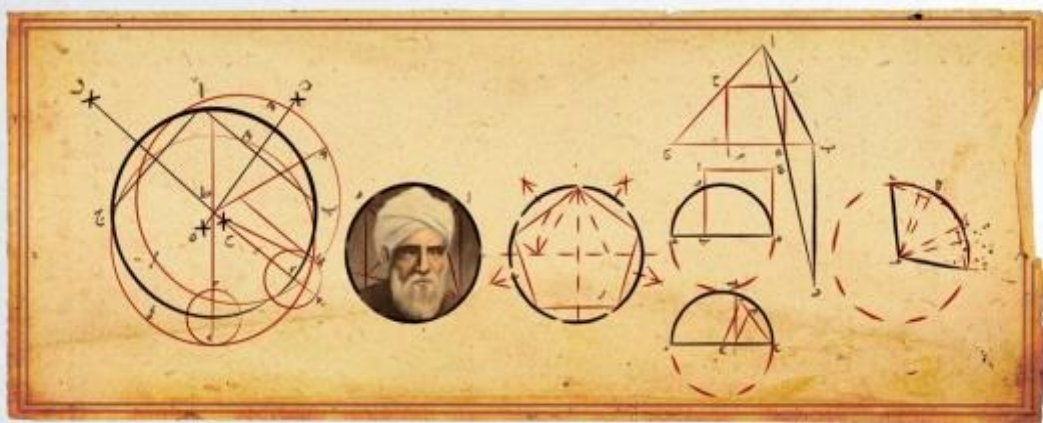


*An innovator whose contributions to science include one of the first known introductions to negative numbers, and the development of the first quadrant, a tool used by astronomers to examine the sky. His pioneering work in spherical trigonometry was hugely influential for both mathematics and astronomy.*

# STUDY QUESTIONS

1. Summarise the life of Abul Wafa Muhammad Al-Buzjani.

   _____

2. List his contributions.

   _____

3. Evaluate the impact of his work on contemporary society.

   _____

4. Explain why learning about Al-Buzjani is important for understanding mathematics and astronomy?

   _____

5. Explain what has inspired you about his life, work and legacy?

   _____

6. Explain what surprised you about his life?

   _____

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

   _____

8. Construct a diagram, and/or map/timeline/model of his work.

   _____

9. Draw a map of where he used to live and compare it to a map used today.

   _____

10. Research the Islamic World during his time and present your findings.

   _____
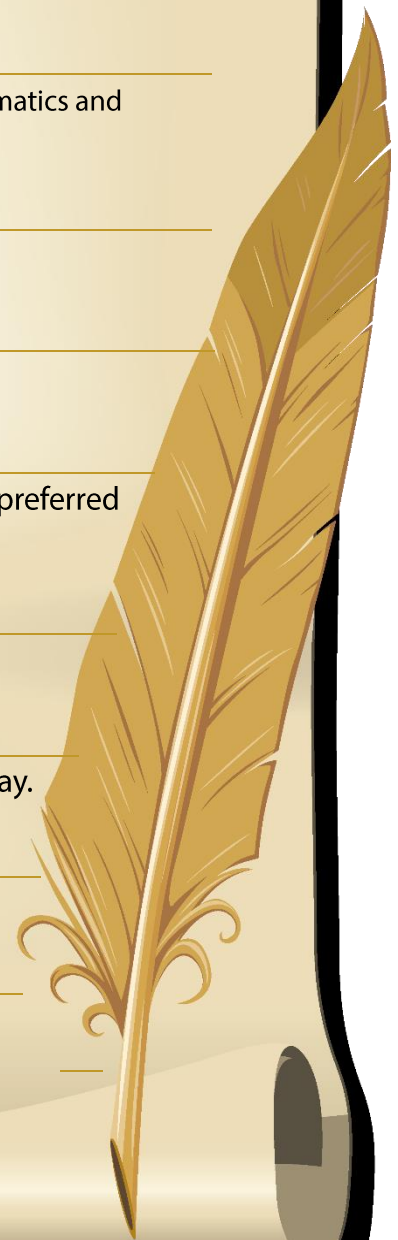
# Abu Ali Hasan Ibn Al-Haytham

**Scientist, Mathmetician, Astronomer and Philosopher**

# Who was Abu Ali Hasan Ibn Al-Haytham?

- Born in 965 in Basra, Iraq.

- Died in 1040 in Cairo, Egypt.

- Al-Haytham, known in the West as Alhazen, was an Arab scientist, mathematician, astronomer and philosopher.

- He is considered the father of modern optics due to his significant contribution to optics

- Abu Ali Hassan Ibn Al-Haytham, is widely regarded as the first theoretical physicist to discover that a hypothesis must be proven by experiments based on confirmable procedures or mathematical evidence. He thus developed an understanding of the scientific method 200 years before Renaissance scientists.

# CONTRIBUTIONS

## 1. Optics:

- Al-Haytham's (otherwise known as Alhazen), most famous work is his seven (7) volume treatise on optics – Kitab al Manazir (Book of Optics).

- Al-Haytham was the first to describe the various parts of the eye accurately and gave a scientific explanation of the process of vision.

- He stated that sight worked by the eye emitting rays of light.

- He conducted experiments on the propagation of light and colours, optical illusions and reflections.

- He examined light rays through air and water and discovered the laws of refraction by experiments with glass vessels filled with water.

- Roger Bacon based his work on Al-Haytham's work and his work influenced da Vinci and Kepler.

## 2. Scientific method of hypothesis

He developed the systematic observation of physical phenomena and their relationship to scientific theory of the systematic relationship between observations, hypothesis and verification.

## 3. Mathematics

In mathematics, Al-Haytham developed analytical geometry by establishing linkages between algebra and geometry.
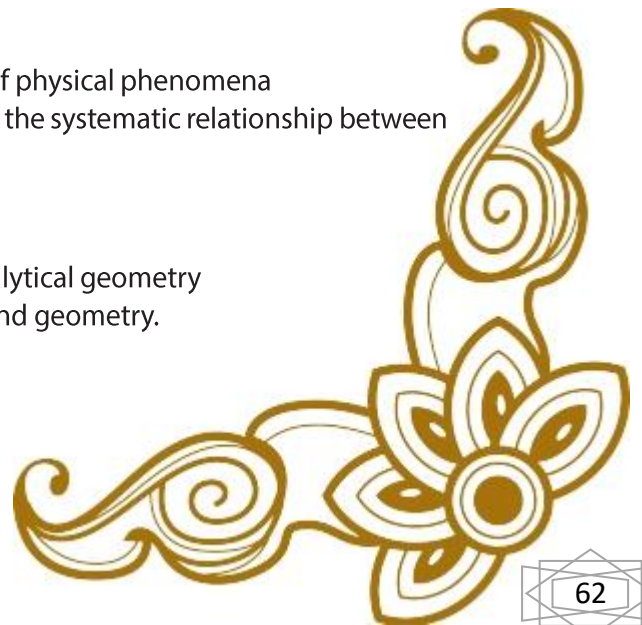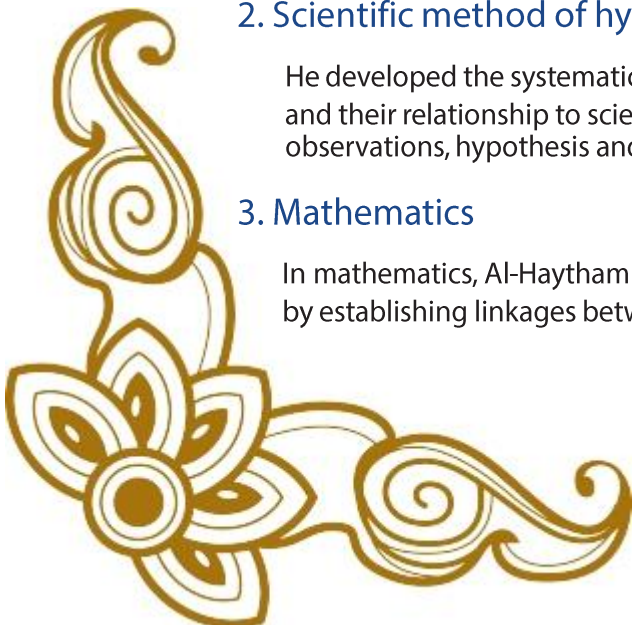
## 4. Physics

In physics, he was the first to propose that a body moves perpetually unless an external force stops or changes its direction of motion.



*Diagram of the eyes and related nerves*
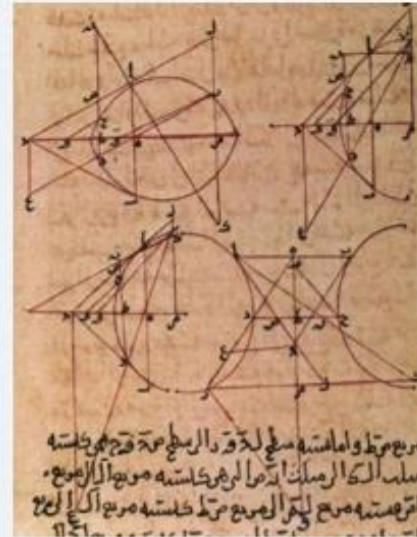


*Illustration from a copy of a mathematical treatise by Ibn Al-Haytham*

## LEGACY

**1** Al-Haytham's photo is printed on the Iraqi 10,000-dinar bank note which was issued in 2003, and on the 10-dinar note issued in 1982.

**2** The lunar Crater Al Hazen is named in his honour as was the asteroid 59239 Al Hasan.

**3** The Aga Khan University in Pakistan, named its ophthalmology endorsed chair, 'The Ibn Al-Haytham Associate Professor and Chief Ophthalmologist'.

**4** The 2015 International Year of Light celebrated the 1000th anniversary of the work on optics by Abu Ali Hasan Ibn Al-Haytham.



*Al-Haytham depicted on the10,000 Iraqi D*

## STUDY QUESTIONS

1.  Summarise the life of Abu Ali Hasan Ibn Al-Haytham.

_____

2. List his contributions.

_____

3. Evaluate the impact of his work on contemporary society.

_____

4.  Explain why learning about Al-Haytham is important for understanding mathematics, astronomy, science and philosophy?

_____

5. Explain what has inspired you about his life, work and legacy?

_____

6. Explain what surprised you about his life?

_____

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

_____

8. Construct a diagram, and/or map/timeline/model of his work.

_____

9. Draw a map of where he used to live and compare it to a map used today.

_____

10. Research the Islamic World during his time and present your findings.

_____
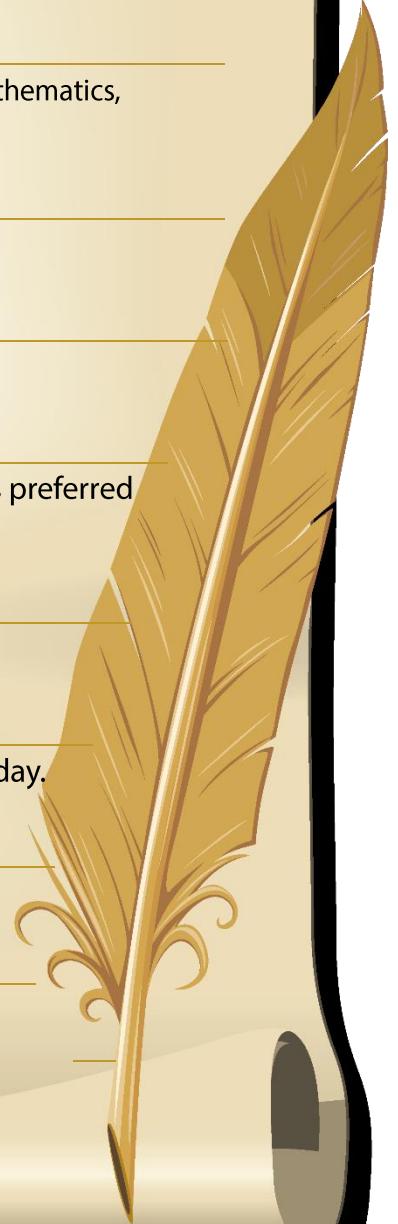
# Abu Al-Hasan Al-Mawardi

**Jurist, Sociologist, Political**

# Who was Abu Al-Hasan Al-Mawardi?

- Born in 972 in Basra, Iraq.

- He travelled to Baghdad for advanced studies.

- Died in 1058 in Baghdad, Iraq.

- Abu Al-Hasan Al-Mawardi was a Kurdish Islamic Jurist of the Shafi-school, most remembered for his work on religion, government, the caliphate as well as public and constitutional law.

- He was appointed as a chief "judge" in Baghdad.

- He is well remembered for his treatises on "The Ordinances of Government" which defines the functions of Caliphate Government.

## CONTRIBUTIONS

1. Abu Al-Hasan Al-Mawardi wrote 'Al-Hawi' which details the principles of jurisprudence. It is still held in high repute.

2. He wrote many books of political science with special reference to the functions and duties of the caliphs, the chief minister, other ministers, relationships between various elements of public and government and measures to strengthen the government and ensure victory in war.

3. In his book 'Doctrine of Necessity', he was in favour of a strong caliphate and discouraged unlimited powers delegated to governors, which tended to create chaos.

4. Al-Mawardi laid down clear principles for the caliph and qualities of voters, chief among which are the attainment of a degree of intellectually and purity of character.

5. He is credited with the following four (4) government treatises on rules and regulations.

    i.   The Ordinances of Government
    ii.  Laws regarding the Ministers
    iii. The Book of Sincere Advice to Rulers
    iv.  The Ethics of Religion and  this World

6. The ordinances of government Al-Mawadi developed  was followed by the Abbasid Caliphate and later by the Seljuqs (Empire Rulers) where the military held actual power while recognising the Caliph as the Supreme Head of Government.

## LEGACY

1  Al-Mawardi's Ordinances of Government was translated by Wafaa H. Wahaba of Lebanon and: Garnet Publishing in1996

2  On four occasions, he served as a diplomat on behalf of the Caliph Al- Qaim.
His successor Al-Qadr also entrusted Al-Mawardi as a diplomat
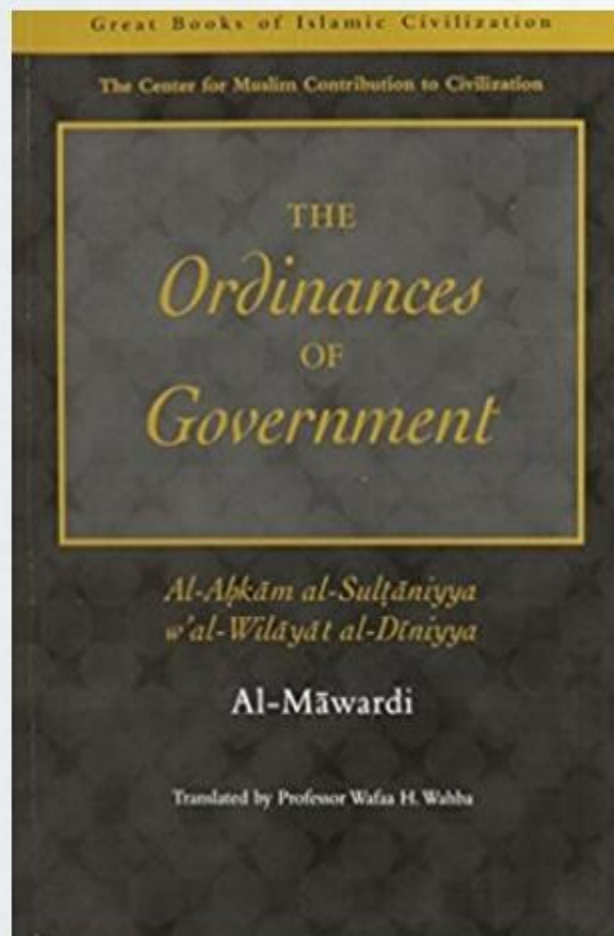


*"The Ordinance of Government"*
*written by Al-Mawardi and translated into English*

# STUDY QUESTIONS

1. Summarise the life of Abu Al-Hasan Al-Mawardi.

   _____

2. List his contributions.

   _____

3. Evaluate the impact of his work on contemporary society.

   _____

4. Explain why learning about Al-Mawardi is important for understanding sociology, politics and jusrisprudence?

   _____

5. Explain what has inspired you about his life, work and legacy?

   _____

6. Explain what surprised you about his life?

   _____

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

   _____

8. Construct a diagram, and/or map/timeline/model of his work.

   _____

9. Draw a map of where he used to live and compare it to a map used today.

   _____

10. Research the Islamic World during his time and present your findings.

   _____
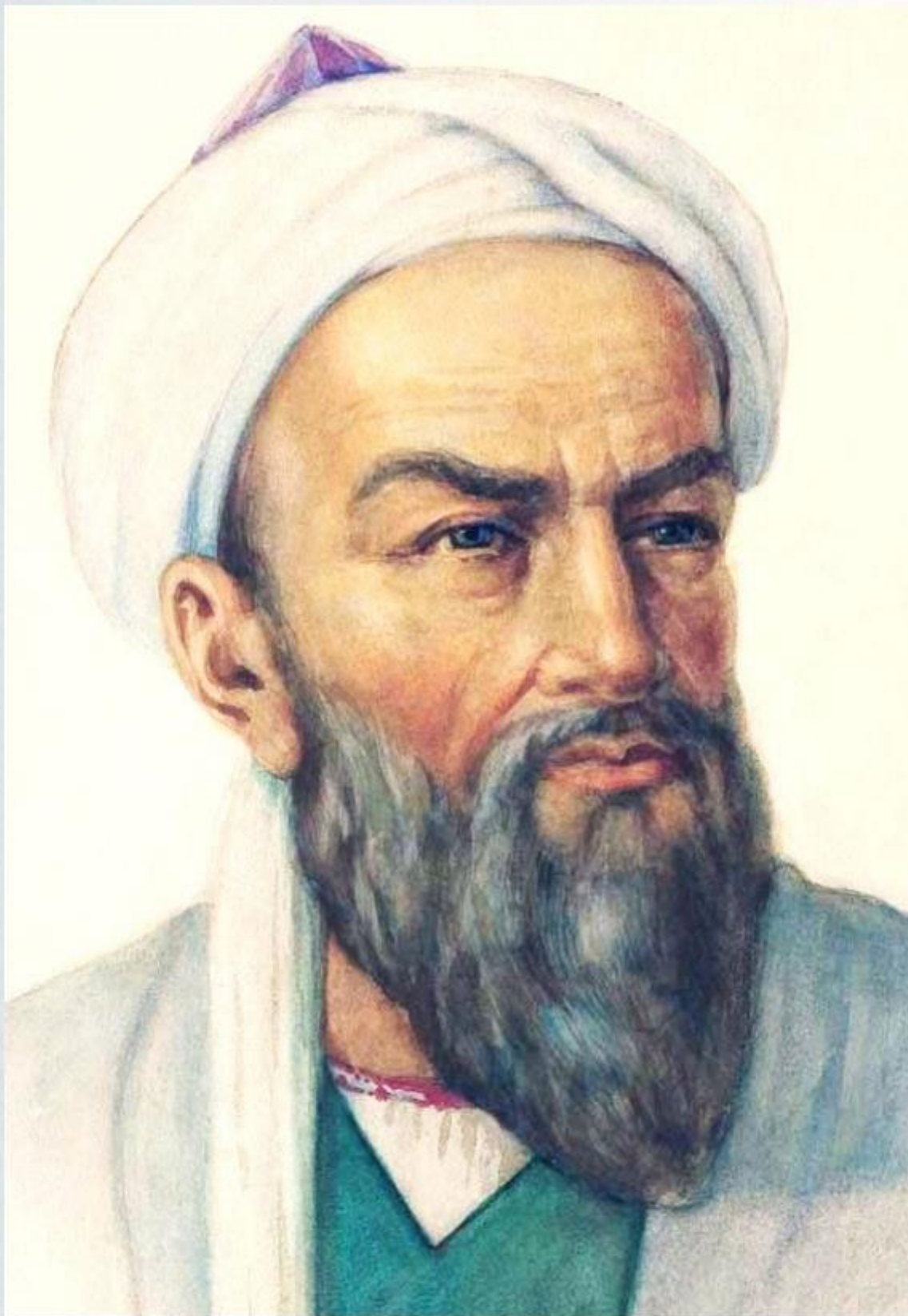
## Abu Rayhan Muhammad Al-Biruni

**Astronomer, Mathematician, Physicist, Physician, Geographer and Historian**

# *Who was Abu Rayhan Muhammad Al-Biruni?*

- Born in 973 in Khwarezm, Uzbekistan.

- Died in 1048 in Ghazni, Afghanistan.

- Abu Rayhan Muhammad Al-Biruni is regarded as one of the greatest scholars of the Medieval Islamic Era and was well versed in Physics, Mathematics, Astronomy, Natural sciences, Historian, Chronology and Surgery.

- He was a linguist and was conversant in Persian, Arabic, Sanskrit, Greek, and Hebrew.

- He travelled to India and authored "History of India" after exploring the Hindu faith.

- Al-Biruni contributed to Earth Sciences and Geography.

## CONTRIBUTIONS

### 1. Books

Ninety-five of 146 books written by Abu Rayhan Muhammad Al-Biruni were devoted to astronomy and mathematics.

### 2. Astronomy

Al-Biruni described the Milky Way as a collection of countless fragments of the nature of nebulous stars.

### 3. Mathematics

- He discovered seven different ways of finding the direction of the North and South and discovered mathematical techniques to determine precise the beginnings of the season.

- Many centuries, before the rest of the world, Al-Biruni discussed that the earth rotated on its axis and made accurate calculations of latitude and longitude.

- He was the first to conduct elaborate experiments and stated that the speed of light is immense as compared with the speed of sound.

### 4. Physics

- He introduced scientific experiments to mechanics and created hydro-dynamics.

- In physics, Al-Biruni pioneered the study of angles and trigonometry.

- He worked on shadows and chords of circles and developed a method for trisecting an angle.
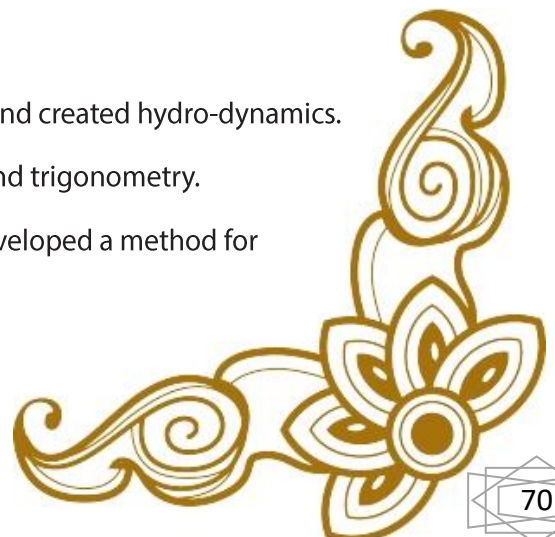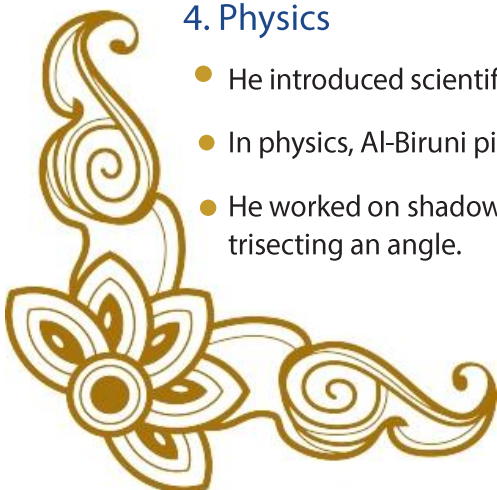
## 5. Geography

- Al-Biruni devised a method of determining the radius of the earth by means of the observation of the height of a mountain.

- He explained the working of natural springs and artesian wells by the hydrostatic principle of communicating vessels.

## 6. Pharmacology and Mineralogy

Al-Biruni constructed an apparatus for determining the specific gravity of a certain number of metals and minerals with remarkable accuracy.

## 7. History of Religion

He was a pioneer in the study of comparative religion which included the studies of Zoroastrianism, Judaism, Hinduism, Christianity, Buddhism, Islam and other religions. His underlying concept was that all cultures are at least distant relatives of all other cultures because they are all human constructs.
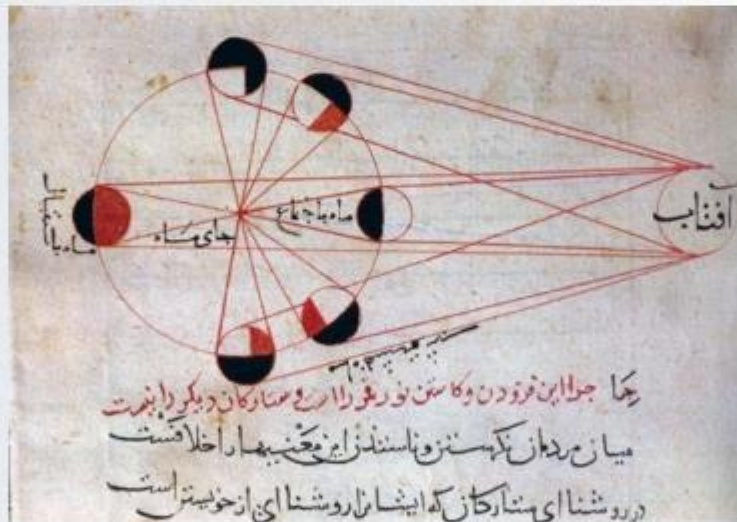


*Diagram by Al-Biruni showing eclipses of the sun*

## LEGACY

1    The Lunar crater Al-Biruni and the asteroid 9936 were named in his honour.

2    In June 2009, Iran donated a scholar pavilion to the United Nations office in Vienna, which has statues of four Iranian scientists – Avicenna, Zakariya Razi, Omar Khayyam and Al-Biruni.

3    The Al-Biruni University has been established and named after him in Afghanistan.

4    In 1973, the then Soviet Union issued a postage stamp depicting Al-Biruni.

# STUDY QUESTIONS

1. Summarise the life of Abu Rayha Muhammad Al-Biruni.

   _____

2. List his contributions.

   _____

3. Evaluate the impact of his work on contemporary society.

   _____

4. Explain why learning about Al-Biruni is important for understanding astronomy, mathematics, medicine, geography and history?

   _____

5. Explain what has inspired you about his life, work and legacy?

   _____

6. Explain what surprised you about his life?

   _____

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

   _____

8. Construct a diagram, and/or map/timeline/model of his work.

   _____

9. Draw a map of where he used to live and compare it to a map used today.

   _____

10. Research the Islamic World during his time and present your findings.

   _____
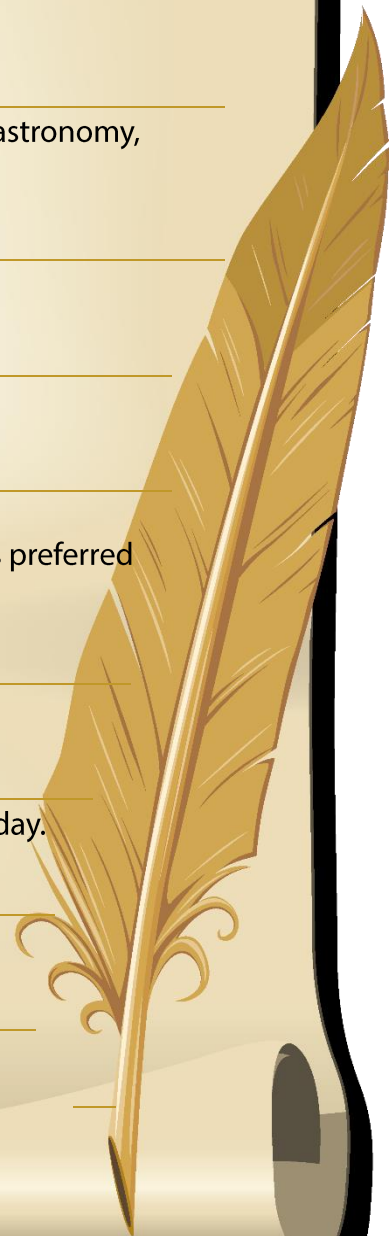
# Abu Mansur Ibn Tahir Al-Baghdadi

## Mathematician

# Who was Abu Mansur Ibn Tahir Al-Baghdadi?

- Born in 980 in Baghdad, Iraq.

- Died in 1037 in Isfahan, Iran.

- He was a prominent Shafi scholar, heresiologist and mathematician.

- Al-Baghdadi was considered one of the great teachers of his time.

- Coming from a wealthy family, he taught for many years in the mosque and took no payment for his teachings.

## CONTRIBUTIONS

1. Abu Mansur Ibn Tahir Al-Baghdadi's writings were mainly on theology and mathematics.

2. He wrote the treatise, "Al-Takmila fil Hisab", which considers different systems of arithmetic. In this book, he discusses counting on the fingers, the sexagesimal system (based on 60 systems - under this system the day was divided into 12 hours. This was replaced later by the Egyptian system that divided the days into 24 hours). Arithmetic of the Indian numerals and fractions is also featured.

3. He developed the number theory and in al-Takmila Al-Baghdadi, he provides insight into abundant, deficient, perfect and equivalent numbers. He was the first to define and study equivalent numbers.

4. He wrote, "He who affirms that there is only one perfect number in each power of ten is wrong; there is no perfect number between ten thousand and one hundred thousand. He who affirms that all perfect numbers end with the figure 6 or 8 is right".

5. He taught 17 subjects, including law, arithmetic, and the law of inheritance and theology in Khorasan, Iran.

# LEGACY

First edition in Italian of Al-Baghdadi's work on mensuration and the division of surfaces.
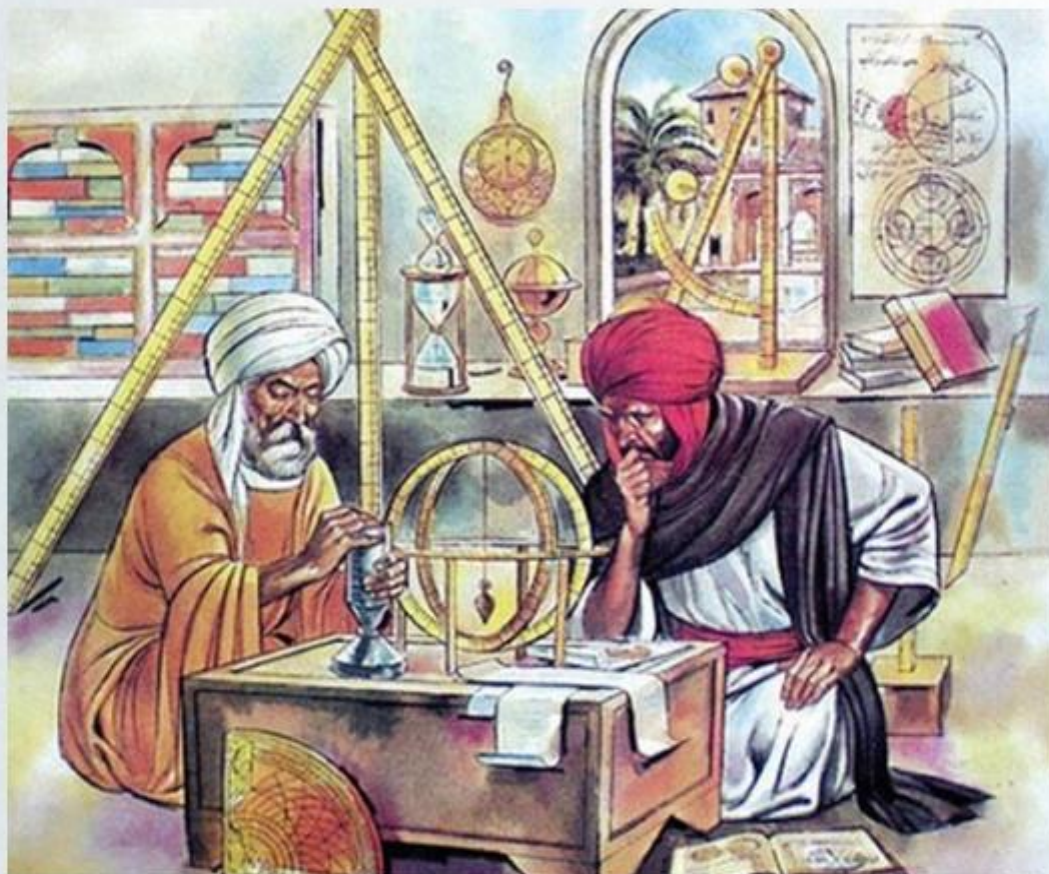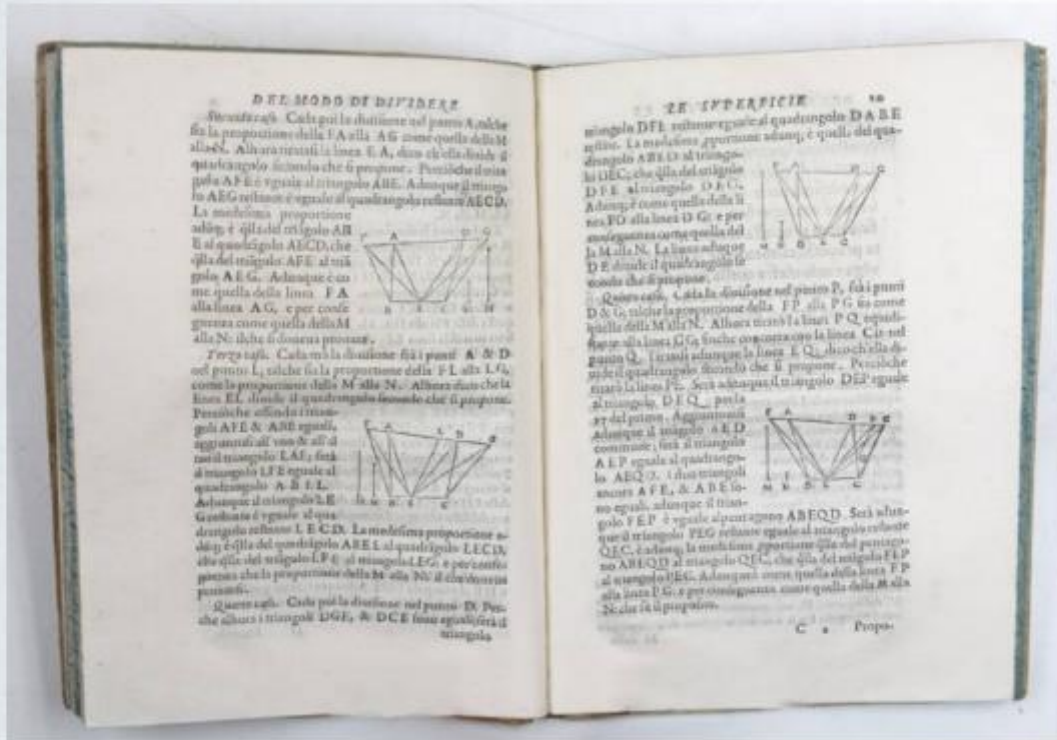
# STUDY QUESTIONS

1. Summarise the life of Abu Mansur Ibn Tahir Al-Baghdadi.

   _____

2. List his contributions.

   _____

3. Evaluate the impact of his work on contemporary society.

   _____

4. Explain why learning about Al-Baghdadi is important for understanding mathematics?

   _____

5. Explain what has inspired you about his life, work and legacy?

   _____

6. Explain what surprised you about his life?

   _____

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

   _____

8. Construct a diagram, and/or map/timeline/model of his work.

   _____

9. Draw a map of where he used to live and compare it to a map used today.

   _____

10. Research the Islamic World during his time and present your findings.

   _____

## Abu Ali Al-Hussain Ibn Abdallah Ibn Sina

### Physician, Philosopher, Encyclopaedist, Astronomer and Mathematician

# Who was Abu Ali Al-Hussain Ibn Abdallah Ibn Sina?

- Born in 980 in Afshana, near Bukhara Iran.

- Died in 1037.

- Abu Ali Al-Hussain Ibn Abdallah Ibn Sina, known in the West as Avicenna, is the most recognised medical scholar of the era.

- Apart from philosophy, Ibn Sina's other contributions lie in the fields of medicine, the natural sciences and musical theory.

- Ibn Sina was a Persian polymath (a person whose expertise spans over a significant number of subjects) who is regarded as one of the most significant thinkers and writers of the Islamic Golden Age.

## CONTRIBUTIONS

1. Ibn Sina wrote 450 works of which 240 have survived, including 150 on philogophy and 40 on Medicine.

2. His major work 'Al Qanun fil Tibb', known as 'The Canon' in the west, was taught as a medical textbook in Europe until the early modern period. 'Al Qanun' remained supreme for six centuries. It is an encyclopaedia of medicine extending over a million articles. It surveyed the entire medical knowledge available. The book deals with diseases affecting all parts of the body, especially pathology and pharmacopoeia. It is rich with Ibn Sina's original contributions, particularly his advances for recognition of the contagious nature of phthisis and tuberculosis, distribution of diseases by water and soil.

3. He was also the first to describe meningitis and made rich contributions to anatomy, gynaecology and child health.

4. Ibn Sina offers the minute and graphic description of different parts of the eye such as conjunctive sclera, cornea, choroid, iris, retina, layer lens, aqueous humour and the optic nerve.

5. In anatomy, he observed that aorta at its origin contains three valves which open when the blood rushes into it from the heart during contraction.

6. Ibn Sina also contributed to mathematics, physics, music and other fields.

7. In physics, he defined different forms of energy, heat, light and mechanical and described concepts as force, vacuum and infinity, investigated on specific gravity and used an air thermometer.
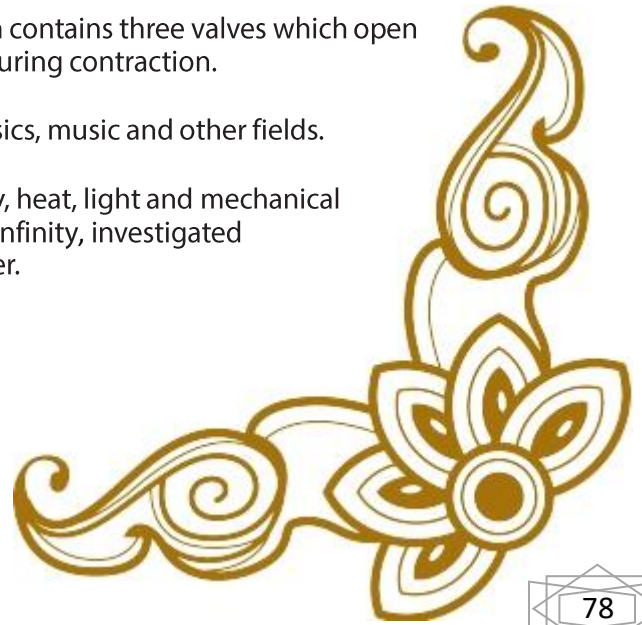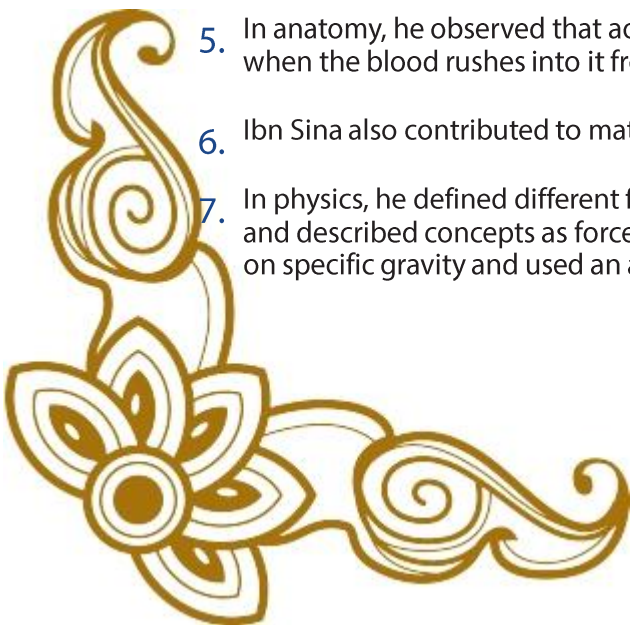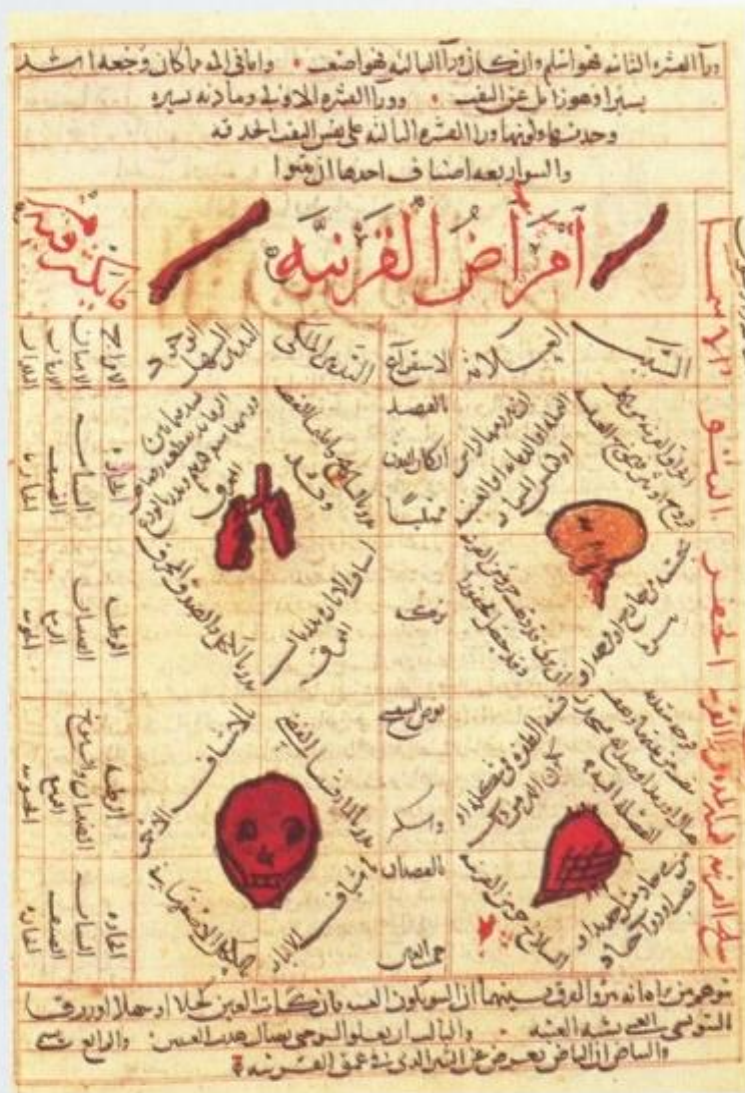
*Drawing by Ibn Sina from his book 'Al Qanun Al-Tibb (The Cannon)*

## LEGACY

1  A Lunar crater lying on the far side of the moon is named Avicenna.

2  The United Nations office displays the Scholar Pavilion donated by Iran in 2009, which shows four outstanding scholars of Iran.

- Avicenna (Ibn Sina)
- Zakariya Razi
- Omar Khayyam
- Al-Biruni

# STUDY QUESTIONS

1. Summarise the life of Abu Ali Al-Hussain Ibn Abdallah Ibn Sina.

2. List his contributions.

3. Evaluate the impact of his work on contemporary society.

4. Explain why learning about Abdallah Ibn Sina is important for understanding medicine, philosophy, astronomy, mathematics and anatomy?

5. Explain what has inspired you about his life, work and legacy?

6. Explain what surprised you about his life?

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

8. Construct a diagram, and/or map/timeline/model of his work.

9. Draw a map of where he used to live and compare it to a map used today.

10. Research the Islamic World during his time and present your findings.
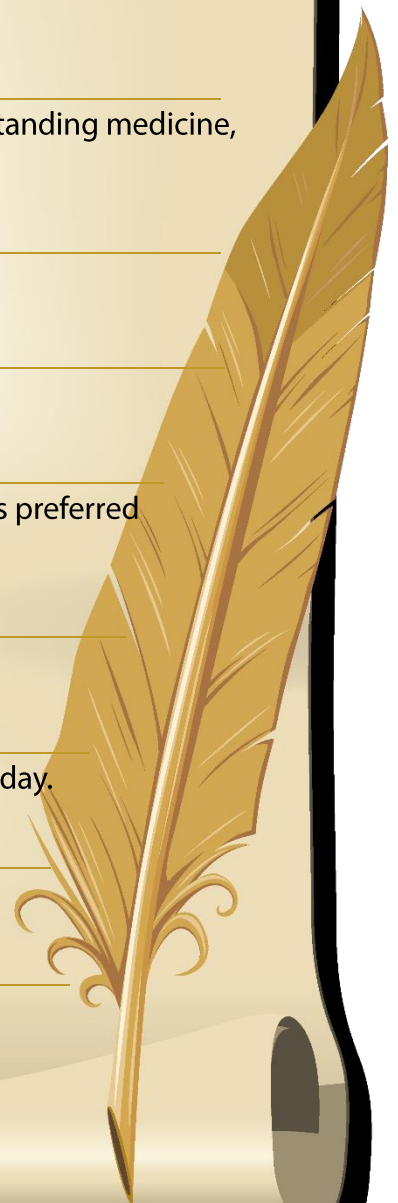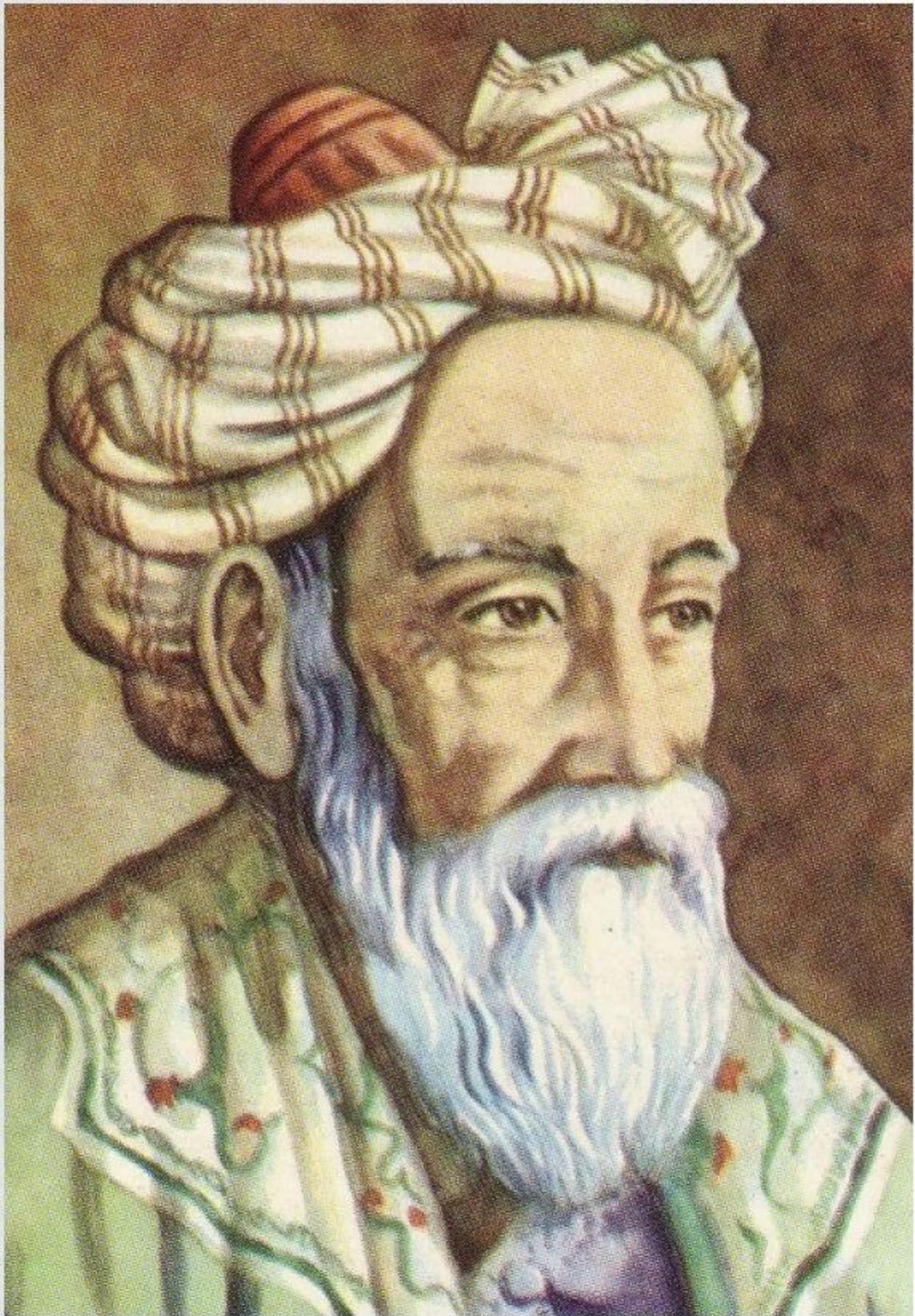
# Omar Al-Khayyam

**Mathematician, Physician, Astronomer, Philosopher**

# *Who was Omar Al-Khayyam?*

- Born in 1044 in Nishapur, Iran.

- Died in 1123 in Nishapur, Iran.

- Omar Al-Khayyam was an outstanding Mathematician, Astronomer, Philosopher and Poet, who wrote numerous treatises on mechanics, geography, mineralogy, astronomy.

- He reformed the solar calendar in 1079.

- His work on algebra was highly valued throughout Europe in the Middle Ages.

- He is known in the West for his poetic work 'Rubaiyat' (quatrains).

# CONTRIBUTIONS

## 1. Mathematics

- Omar Al-Khayyam is the author of the most important treatises on algebra written before modern times.

- His book in Algebra demonstrates problems of Algebra, which includes 13 different forms of cubic equations by intersecting a hyperbola with a circle.

- He created important works on geometry, specifically in the theory of proportions, the theory of parallels, geometric algebra, the binomial theorem, the binomial coefficients and the extraction of roots.

- He was involved in building an observatory along with other distinguished scientists.

## 2. Astronomy

Al-Khayyam's measurements led to a calendar, which contained eight leap days every 33 years (for a year length of 365.2424 days). His calendar has proved to be more accurate than the Gregorian calendar of 500 years later.

## 3. Physics

He developed a method for accurate determination of the specific gravity and wrote two books in metaphysics.
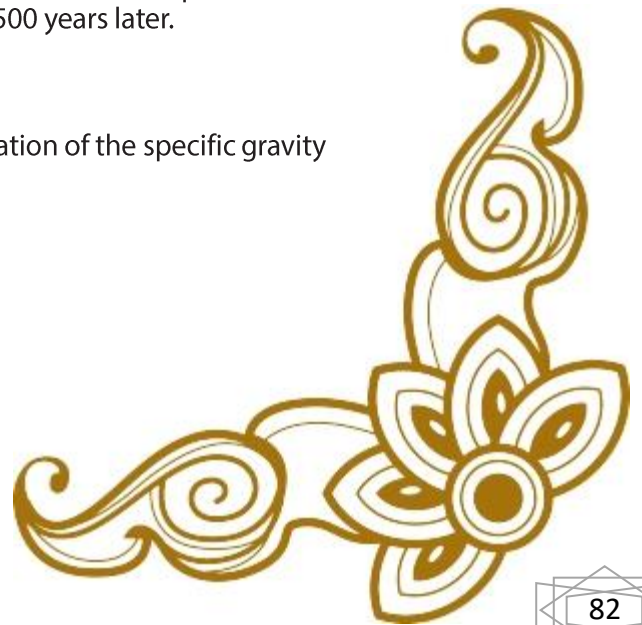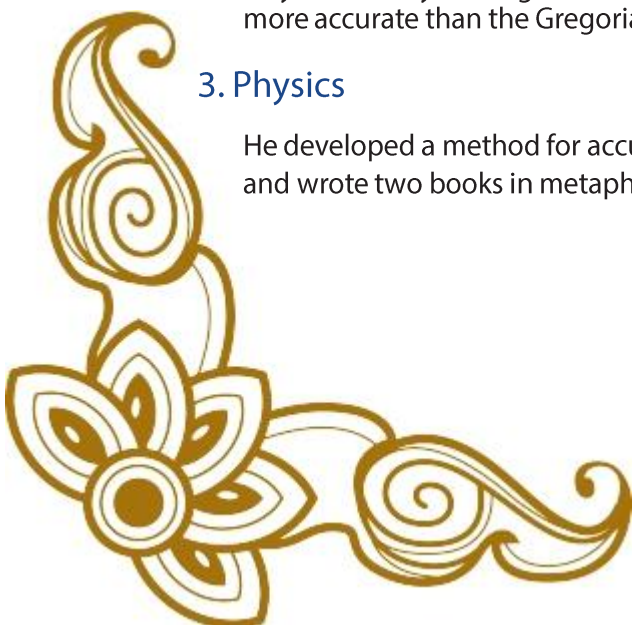
## 4. Poetry

- Al-Khayyam wrote more than 1000 four-line verses called Rubaiyat. His poetry has been translated into several languages. Edward Fitzgerald translated many quatrain's (Persian Rubaiyat) which had a profound influence in the west.

- A passage from the poem Rubaiyat:

    *"With them the Seed of Wisdom did I sow,*
    *And with my own hand labour'd it to grow:*
    *And this was all the Harvest that I reap'd*
    *"I came like Water, and like Wind I go."*

- As a Sufi Muslim, Omar Al-Khayyam revered Prophet Muhammad (PBUH) as demonstrated by his writings. He praises God and Prophet Muhammad (PBUH) in his poetry entitled "On Existence". He always refers to Prophet Muhammad (PBUH) as his master.

## 5. Philosophy

- Al Khayyam's philosophical work is spread throughout the world through his Rubaiyat, which are poetic, full of deep meaning and promoting Sufism.

- His most important philosophical work is entitled. "Al Risale fil Wujud" which is a treatise that begins with Quranic verses and asserts that all things come from God and that there is an order to all things.

## LEGACY

1  Omar Al-Khayyam's Mausoleum is a masterpiece of Iranian Architect in Nishapur, Iran.

2  Edward Fitzgerald described Omar Khayyam as the most famous poet of the East in the West.

3  Al-Khayyam's Calendar contained eight leap year days every   (33) years (for a year of 365.2424 days).

*Front cover 'Rubaiyat of Omar Al-Khayyam' translated by Edward Fitzgerald,*
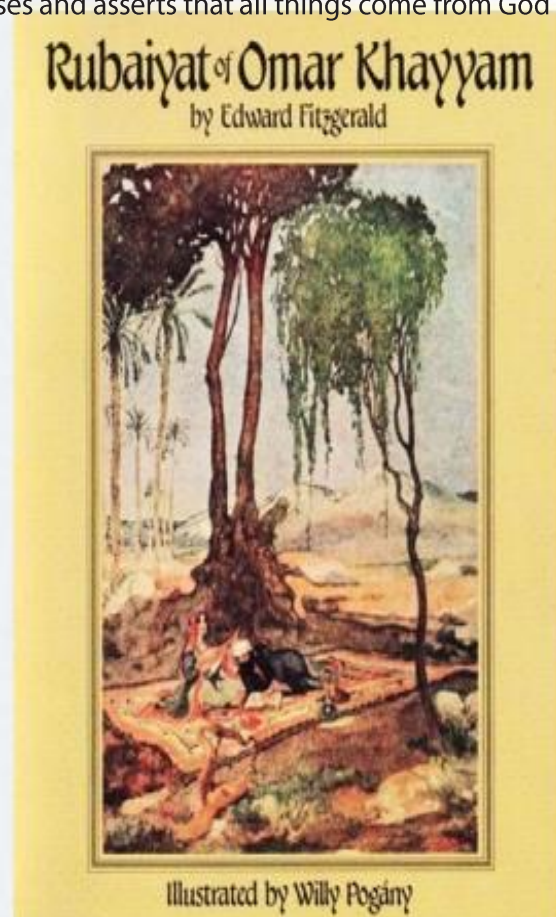
# STUDY QUESTIONS

1.  Summarise the life of Omar Al-Khayyam.

    _____

2.  List his contributions.

    _____

3.  Evaluate the impact of his work on contemporary society.

    _____

4.  Explain why learning about Al-Khayyam is important for mathematics, medicine, astronomy and philosophy?

    _____

5.  Explain what has inspired you about his life, work and legacy?

    _____

6.  Explain what surprised you about his life?

    _____

7.  Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

    _____

8.  Construct a diagram, and/or map/timeline/model of his work.

    _____

9.  Draw a map of where he used to live and compare it to a map used today.

    _____

10. Research the Islamic World during his time and present your findings.

    _____
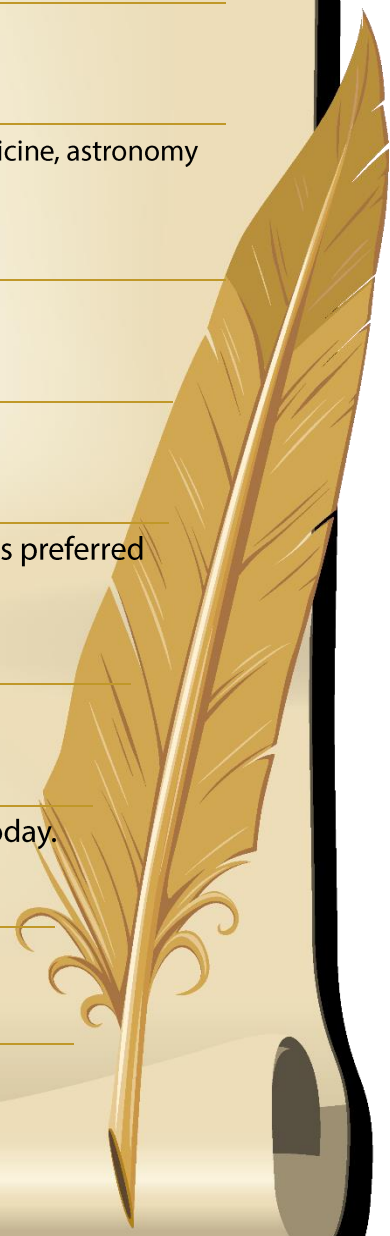
## Abu Ishaq Ibrahim Ibn Yahya Al-Zarqali
**Astronomer and Mathematician**

## *Who was Abu Ishaq Ibrahim Ibn Yahya Al-Zarqali?*

- Born 1028 in Toledo in Spain.

- Died in 1087.

- Abu Ishaq Ibrahim Ibn Yahya Al-Zarqali, known in the west as Arzachel, was a famous Spanish astronomer.

- He was renowned for his skills in instrument making.

- He was famous for his Toledan Tables.

## CONTRIBUTIONS

### 1. Mathematics

- Al-Zarqali constructed the famous clocks of Toledo. The clocks constituted a precise lunar calendar and were predecessors of the planetary calendar devices that were used six centuries later in Europe.

- Al-Zarqali is famous for his Toledan Tables which was translated into Latin in the 12th century.

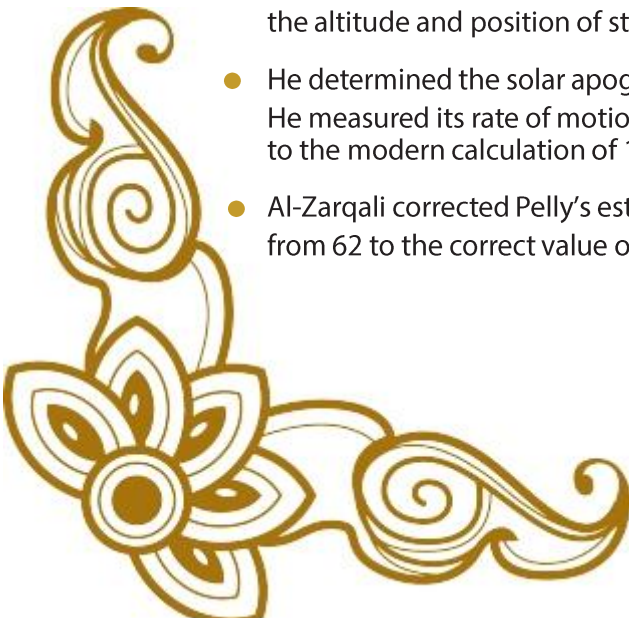- The Tables include the determination of the right ascensions and the equations of the sun and the moon and the planets, parallax, eclipses and setting of the planets; theory of trepidation of accession and recession.

- All subsequent tables for different locations in Europe were based on Al-Zarqali's measurements. The Tables of Marseilles were based on Al-Zarqali's Toledan Tables. Al-Zarqali's tables were adapted to the meridians of London, Paris and Pisa.

### 2. Astronomy

- His Toledan Tables were responsible for invigorating the science of astronomy because it made possible the calculation of planetary positions at any time based on observations.

- He developed a flat astrolabe, called Safihah, which is used to find the altitude and position of stars.

- He determined the solar apogee relative to the fixed background of the stars. He measured its rate of motion as 12.9 seconds per year, which is remarkably close to the modern calculation of 11.6 seconds.

- Al-Zarqali corrected Pelly's estimate of the length of the Mediterranean Sea from 62 to the correct value of 42 degrees.

*The flat astrolabe 'Safihah' invented by Al-Zarqali*

## LEGACY

**1** He invented a perfected kind of Astrolabe (determines the position of the sun, moon and stars) known as the Table of  Al-Zarqali which was famous in Europe under the name Saphaea.

**2** The Spanish Government recognised Al-Zarqalis scholarship by printing postage stamps with his picture and his famous astrolabe.

**3** Copernicus expressed his indebtedness to Al-Zarqali and quotes his work several times in his writings.



*Al-Zarqali depicted on a Spanish postage   stamp*

# STUDY QUESTIONS

1. Summarise the life of Abu Ishaq Ibrahim Ibn Yahya Al-Zarqali.

2. List his contributions.

3. Evaluate the impact of his work on contemporary society.

4. Explain why learning about Al-Zarqali is important for understanding astronomy and mathematics?

5. Explain what has inspired you about his life, work and legacy?

6. Explain what surprised you about his life?

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

8. Construct a diagram, and/or map/timeline/model of his work.

9. Draw a map of where he used to live and compare it to a map used today.

10. Research the Islamic World during his time and present your findings.

## Abu Hamid Al-Ghazali
**Muslim Theologian, Jurist, Philosopher, Mystic**

# Who was Abu Hamid Al-Ghazali?

- Born in 1058 in Khorasan, Iran.

- Died in 1111 in Tous, Iran.

- Abu Hamid Al-Ghazali, known in the West as Algazel, was a Muslim theologian, jurist, philosopher and mystic.

- Among the greatest thinkers in human history.

- He calls for the revival of faith.

- Al-Ghazali opposed Aristotelians philosophy, and argued against excessive rationalism and sought to create a balance between religion and reason.

## CONTRIBUTIONS

1. Abu Hamid Al-Ghazali was appointed Professor at the Nizamiyah, University of Baghdad.

2. Al-Ghazali wrote more than 70 books on the sciences, Islamic philosophy and Sufism.

3. When the observance of obligatory prayers and duties of Islam were being avoided, he sought to rectify this both in philosophy and Sufism.

4. Al-Ghazali's major work is "Ihya Ulum al-Deen",   The Revival of the Religious Sciences which covers almost all fields of Islamic sciences such as:

    i.   Fiqh (Islamic) jurisprudence.
    ii.  Kalam.
    iii.  Sufism.

These works contain four sections.

    **a**   Acts of Worship (Rub al -Ibadat}).
    **b**   Norms of Daily Life. (Rub al-Adat)
    **c**   The ways of perdition (Rub al-Muhilkat) The   behaviour which is likely to lead to failure and disaster
    **d**   The Ways to Salvation (Rub al Munjiyat).

The revival of religious sciences is the most frequently quoted Islamic text. Its greatest achievement is to bring orthodox Sunni theology and Sufi mysticism together in a useful guide regarding every aspect of Muslim life and death.
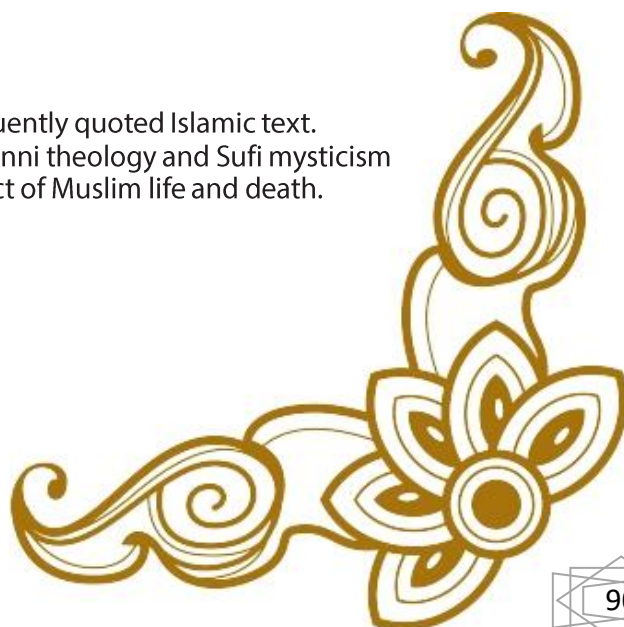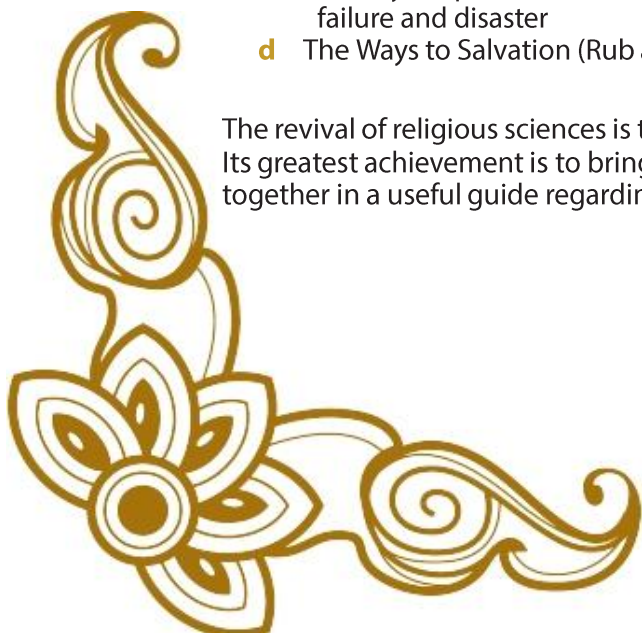
5. His doctrines penetrated Europe and influenced Christian and Jewish scholasticism His arguments seem to have been adopted by St Thomas Aquinas.

6. Quote from Al-Ghazali:

*'The true greatness of humanity lies in its capacity for eternal progress, otherwise in this temporal sphere he is the weakest of all things, being subject to hunger, thirst, heat, cold and sorrow.*

*Those things he takes most delight in are often the most injurious to him and those things that benefit him are not obtained without toil and trouble.'*



*Copy of Al-Ghazali's manuscript*
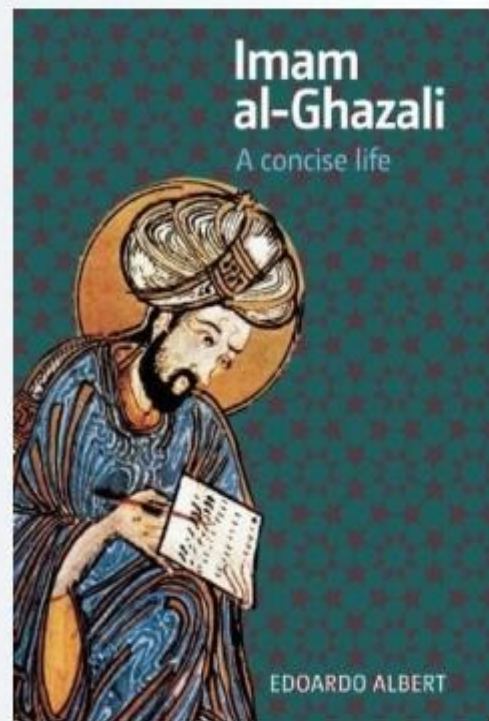


*A Biography of the life of Al-Ghazali*

## LEGACY

1  Ghazali was awarded the honourable title of "Proof of Islam".

2  He brought the Orthodox Islam of his time in close contact with Sufism.

3  He received many titles such as

- Sharaf-ul-Aimma
- Zayn-ud-din
- Hujjat-ul-Islam

# STUDY QUESTIONS

1. Summarise the life of Abu Hamid Al-Ghazali.

2. List his contributions.

3. Evaluate the impact of his work on contemporary society.

4. Explain why learning about Al-Ghazali is important for understanding theology, philosophy and mysticism?

5. Explain what has inspired you about his life, work and legacy?

6. Explain what surprised you about his life?

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

8. Construct a diagram, and/or map/timeline/model of his work.

9. Draw a map of where he used to live and compare it to a map used today.

10. Research the Islamic World during his time and present your findings.

# Abu Marwan Abd Al-Malik Ibn Zuhr
## Physician

## Who was Abu Marwan Abd Al-Malik Ibn Zuhr?

- Born in 1091 in Seville, Spain.

- Died in 1161 in Seville, Spain.

- Abu Marwan Abd Al Malik Ibn Zuhr, known in the West as Avenzoar was a Muslim Arab physician. He studied medicine with his father Abul-Ala Zuhr and graduated from Cordoba Medical University.

## CONTRIBUTIONS

1. Ibn Zuhr had developed several procedures.

   - He introduced animal testing as an experimental method of testing surgical procedures, before applying them to humans.

   - He performed the first experimental tracheotomy (an incision in the windpipe to relieve breathing) on a goat.

   - He made the earliest description of bezoar (small stones found in the stomach of some animals) as medical items.

2. Ibn Zuhr is regarded as the first Parasitologist, as he was the first to identify scabies mites, which contributed to the scientific advancement of microbiology.

3. He presented an accurate description of stomach cancer, as well as lesions (wounds).

4. He was the first to give a full description of the operation of tracheotomy and practiced direct feeding through the gullet.

5. Ibn Zuhr provided clinical descriptions of intestinal phthisis, inflammation of the middle ear, peri-carditis and mediastinal tumours.

6. He wrote, 'The book of Simplification concerning Therapeutics and Diet' and 'The Book of Food Stuffs', which discusses numerous drugs and the importance of food and nutrition.

7. His books were in use until the 18th century in Europe

*Original transcripts of Ibn Zuhr research*

## LEGACY

Ibn Zuhr's photo was depicted on a 1968 stamp issued in Syria.
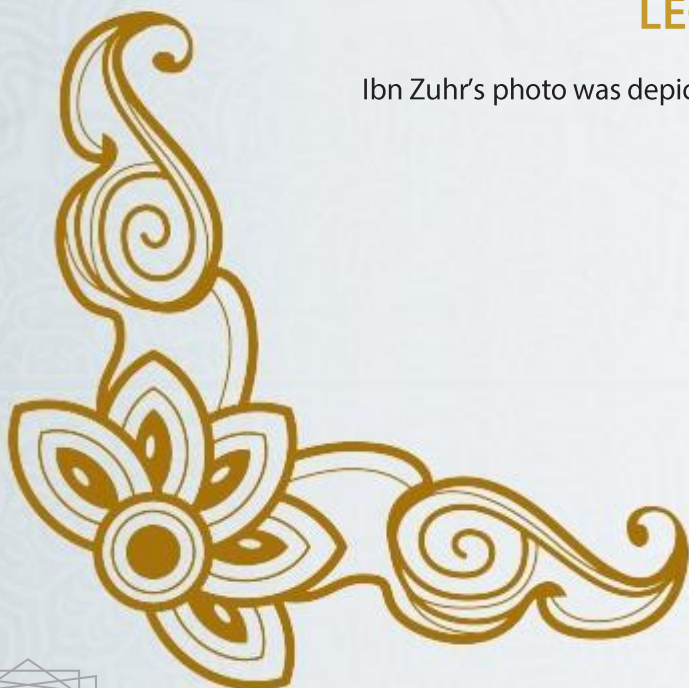
# STUDY QUESTIONS

1.  Summarise the life of Abu Marwan Abd Al-Malik Ibn Zuhr.

    _____

2.  List his contributions.

    _____

3.  Evaluate the impact of his work on contemporary society.

    _____

4.  Explain why learning about Al-Malik Ibn Zuhr is important for understanding medicine?

    _____

5.  Explain what has inspired you about his life, work and legacy?

    _____

6.  Explain what surprised you about his life?

    _____

7.  Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

    _____

8.  Construct a diagram, and/or map/timeline/model of his work.

    _____

9.  Draw a map of where he used to live and compare it to a map used today.

    _____

10. Research the Islamic World during his time and present your findings.

    _____
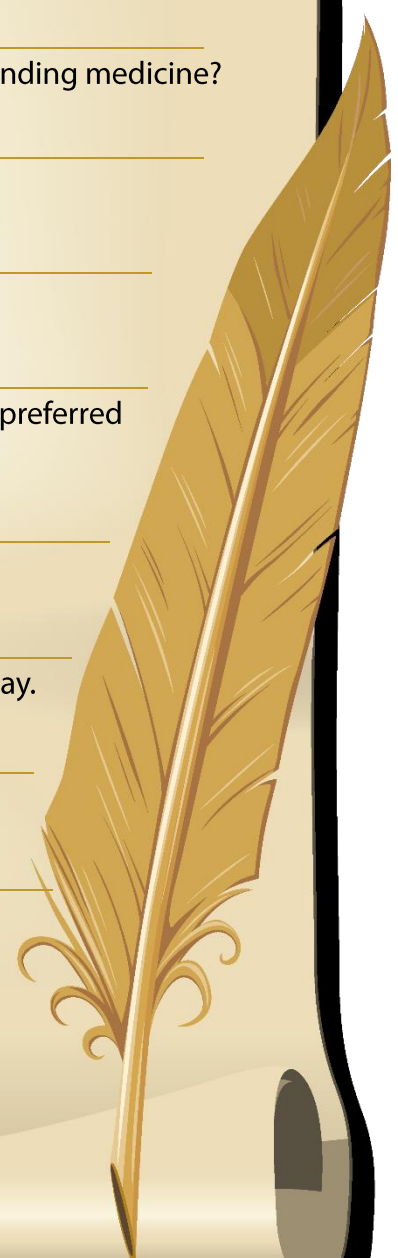
# Abu Abdullah Muhammad Ibn Idrisi

### Physician

- Born in 1099 in Ceuta, Spain.

- Died in 1166 in Al-Fustat, Egypt.

- Abu Abdullah Muhammad Ibn Idrisi, known in the West as Dreses, was educated in Cordova and was a Muslim geographer, cartographer (the science of making maps) and an Egyptologist.

# CONTRIBUTIONS

1. Tabular Rogeriana, drawn by Ibn Idris in 1154 is regarded as the most advanced world map of that time consisting of 70 sections.

2. Ibn Idrisi produced a silver planisphere, which is a star chart in the form of two adjustable discs that rotate on which he depicted a map of the world. This was accompanied with a geographical text intended as a key to the planisphere.

3. He presented the world as a sphere. Ibn Idrisi is known as the geographer who made a globe of a silver sphere weighing 400 kilograms and an accompanying book for King Roger II of Sicily. The globe meticulously recorded the seven continents with trade routes, lakes and rivers, major cities and plains and mountains. It also included the distance, length and height as appropriate.

4. As well as maps, Ibn Idrisi produced a compendium of geographical information with the book titled, 'The book of Pleasant Journey into Faraway Lands'.

5. He also made major contributions in the science of medicinal plants. In one of his publications, he reviewed and synthesized all the literature on medicinal plants and associated drugs available to him.

6. Christopher Columbus used a map, which was originally taken from Ibn Idrisi's work.

# LEGACY

1   A statue of Ibn Idrisi is in Ceuta, Spain.

2   Abu Abdullah Muhammad Ibn Idrisi developed the science of 'Fiqh' unifying revealed sources – the Quran and Hadith with clear human reasoning to provide a basis in law. With this systemisation of the Shariah, he provided a legacy of unity for all Muslims and forestalled the development of an independent, regionally based legal system.

3   Salahudin built a Madrasa and a shrine on the site of his tomb.

4   Salahudin's brother, Afzal built a mausoleum for him in 1211.



*One of the early maps of the world*

# STUDY QUESTIONS

1. Summarise the life of Abu Abdullah Muhammad Ibn Idrisi.

2. List his contributions.

3. Evaluate the impact of his work on contemporary society.

4. Explain why learning about Muhammad Ibn Idrisi is important for Medicine?

5. Explain what has inspired you about his life, work and legacy?

6. Explain what surprised you about his life?

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

8. Construct a diagram, and/or map/timeline/model of his work.

9. Draw a map of where he used to live and compare it to a map used today.

10. Research the Islamic World during his time and present your findings.

## Abul-Waleed Muhammad Ibn Rushd

**Judge and Physician**

# Who was Abul-Waleed Muhammad Ibn Rushd?

- Born in 1128 in Cordoba, Spain.

- Died in 1198 in Marrakesh, Morocco.

- Abul-Waleed Mohammad Ibn Rushd, known in the West as Averroes, was an Islamic theologian, philosopher, mathematician, astronomer, geographer, psychologist and celestial mechanic.

- He also studied religious law (Shariah) and medicine.

- As Chief Judge of Cordova, Ibn Rushd was a religious man who tried to reconcile philosophy and religion in many of his works.

## CONTRIBUTIONS

### 1. Philosophy

He translated the works of Aristotle and became a great commentator of his. As such, he was a defender of Aristotelian philosophy while Al-Ghazali opposed Aristotelians philosophy. Al-Ghazali believed that any individual act or natural phenomenon occurred only because God willed it to happen, while Aristotle insisted that phenomena followed natural laws that God created. Ibn Rushd proved that philosophy and revelation do not contradict each other and are essentially different means of teaching the same truth.

### 2. Religion

Ibn Rushd is also a highly regarded legal scholar of the Maliki School.
He wrote a textbook of Maliki doctrine in a comparative format.

### 3. Physics

In physics, he developed the notion that all bodies have an inherent resistance to motion, which  was later termed inertia by Kepler.

### 4. Optics

In optics, he explained that a rainbow is due to reflection, not refraction.

### 5. Astronomy

- In astronomy, Ibn Rushd argued for a strictly concentric model of the universe.
- He was credited with the discovery of sunspots.
- He was also credited for the scientific reasoning for the occasional opaque colour of the moon.

## 6. Medicine

- In one of Ibn Rushd's writings, he says, "Anyone who studies anatomy will increase his faith in the omnipotence and oneness of God the Almighty".
- In medicine, he expounded on diagnoses, cures and the prevention of diseases.
- He wrote a medical encyclopaedia, 'Generalities' on general medicine.

## LEGACY

1 The statue of Averroes (Ibn Rushd) is constructed in Cordoba, Spain.

2 The asteroid 8318 Averroes was named in his honour.

3 A lunar crater, Ibn Rushd was named in his honour.

4 The Ibn Rushd prize for 'Freedom of Thought' was awarded in 1999.



*Latin translation of Aristotle's de Anima with commentaries by Ibn Rushd*

# STUDY QUESTIONS

1. Summarise the life of Abul-Waleed Muhammad Ibn Rushd.

2. List his contributions.

3. Evaluate the impact of his work on contemporary society.

4. Explain why learning about Muhammad Ibn Rushd is important for understanding medicine and the court/Jury system?

5. Explain what has inspired you about his life, work and legacy?

6. Explain what surprised you about his life?

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

8. Construct a diagram, and/or map/timeline/model of his work.

9. Draw a map of where he used to live and compare it to a map used today.

10. Research the Islamic World during his time and present your findings.

**Abu Muhammad Abdallah Ibn Al-Baitar**

Botanist and Pharmacist

## Who was Abu Muhammad Abdallah Ibn Al-Baitar?

- Born in 1176 in Malaga, Spain.

- Died in 1248 in Damascus.

- Abu Muhammad Abdallah Ibn Al-Baitar, was a botanist, scientist, pharmacist and physician.

- He is famous for the scientific classification of oncology (tumours).

## CONTRIBUTIONS

1. He conducted research on plants collected from Arabia, Palestine and Syria.

2. In 1224, he entered the service of Al-Kamil, the Egyptian Governor and was appointed Chief herbalist.

3. His main contribution was to systematically record the additions made by Islamic physicians in the Middle Ages which added between 300 to 400 types of medicine to the one thousand (1000) previously known.

4. Ibn Al-Baitar's major contribution is "Kitab al Jami fi al-Adwiya al-Mufrada", which is considered one of the greatest botanical compilations in history dealing with medicinal plants in Arabic and was a botanical authority for centuries. This work was regarded as a pharmaceutical encyclopaedia and contained details of more than 1400 plants.

5. His second monumental treatise 'Kitab al-Mughni fi al-Adwiya al-Mufrad is an encyclopaedia of medicine. It contains 20 different chapters that deal with plants bearing significant therapeutical value and significance to diseases of head, ear and eye.
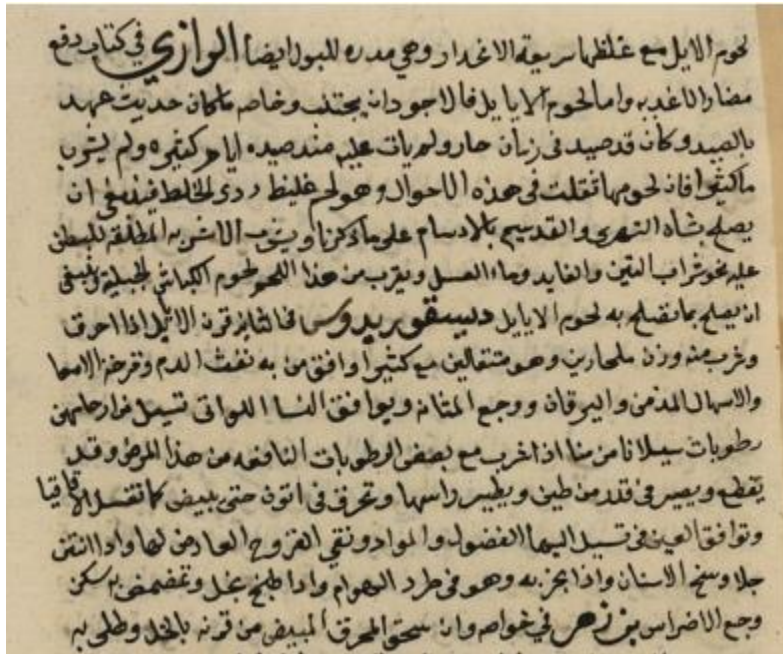


This manuscript is a copy of Kitab Al-jami li-mufradat al-adwiya wa al-aghdhiya (The book of medicinal and nutritional terms) writtente by Abu Muhammad Abdallah Ibn Al-Baitar.

# LEGACY

A statue has been erected in honour of Ibn Al-Baitar, in Benalmadena in Costa Rica, Spain.



*The opening page of the*
*Treatise on simple drugs By Ibn Al-Baitar*



*Ibn Al-Baitar sculpture,*
*Benalmádena, Málaga, Spain*

# STUDY QUESTIONS

1.  Summarise the life of Abu Muhammad Abdallah Ibn Al-Baitar.

2.  List his contributions.

3.  Evaluate the impact of his work on contemporary society.

4.  Explain why learning about Al-Baitar is important for understanding botany and pharmacy?

5.  Explain what has inspired you about his life, work and legacy?

6.  Explain what surprised you about his life?

7.  Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

8.  Construct a diagram, and/or map/timeline/model of his work.

9.  Draw a map of where he used to live and compare it to a map used today.

10. Research the Islamic World during his time and present your findings.

## Nasir Al-Din Al-Tusi

### Scientist, Philosopher, Mathematician, Astronomer, Theologian and Physician

## Who was Nasir Al-Din Al-Tusi?

- Born in 1201 in Tous, Iran.

- Died in 1274 in Kadhimiya, Iraq.

- Nasir Al-Din Al-Tusi, was a Persian mathematician, writer, architect, astronomer, biologist, chemist,philosopher, physician, physicist, scientist and theologian.

- He was of the Ismaili belief.

# CONTRIBUTIONS

## 1. Books

Al-Tusi wrote a five-volume summary of trigonometry, a memoir on the Science of Astronomy and the following major works:
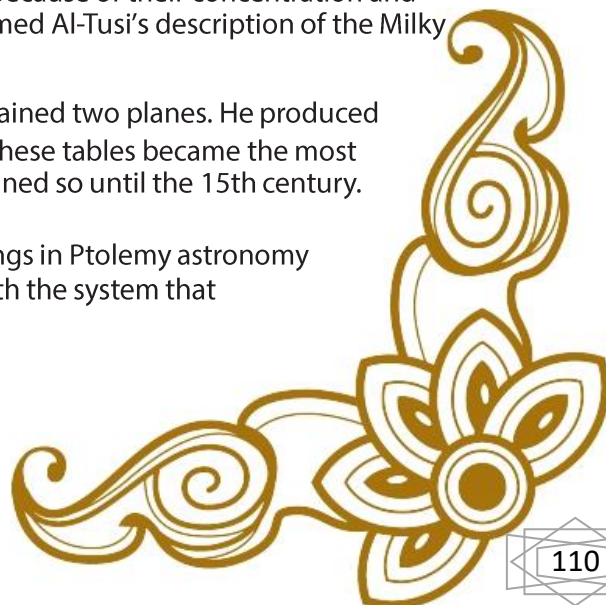
- A work on ethics
- A treatise on a scholar
- A major Astronomical Treatise
- A short mystical, ethical work in Persian
- A commentary of Shia doctrines

## 2. Mathematics

- In mathematics, Al-Tusi's major contribution is in trigonometry, which he compiled as a new subject for the first time.

- He also developed the subject of spherical trigonometry, including six fundamental formulas for the solution of spherical right -angled triangles.

## 3. Astronomy

- As the chief scientist at the observatory established under his supervision at Maragha, he made significant contributions to astronomy.

- Al-Tusi explained the Milky Way, made of a very large number of small, lightly clustered stars, seems to be cloudy particles, because of their concentration and smallness. Three centuries later Galileo confirmed Al-Tusi's description of the Milky Way using advanced telescopes.

- He invented an instrument 'turguet' that contained two planes. He produced new astronomical tables called 'Al-Zijlkhani'. These tables became the most popular tables among astronomers and remained so until the 15th century.

- Al-Tusi pointed out several serious shortcomings in Ptolemy astronomy and foreshadowed the later dissatisfaction with the system that culminated in the Copernican reforms.

## 4. Philosophy

In philosophy, his work on ethics entitled 'Akhlaq-iNasri' became the most important book on that subject and remained popular for centuries.



*The opening page to the commentary on the "Elements of Euclid" by Nasir Al-Din Al-Tusi*

## LEGACY

1   Iran and Azerbaijan have honoured Al-Tusi by issuing stamps with his photo.
2   The Iranian stamp was issued for the 700th anniversary of his death.
3   A 60km diameter lunar crater on the moon is named after him as Nasireddan.
4   A minor planet "10269 Tusi", discovered by Soviet astronomer in 1979 is named after him.
5   The  Al-Tusi University of Technology is built in Iran.
6   The observatory of Shamakhy in Azerbaijan is also named after him.
7   Google celebrated his 812th birthday with a doodle calling it Al-Tusi.



*Postage stamps in honour of the works carried out by Al-Tusi*

# STUDY QUESTIONS

1. Summarise the life of Nasir Al-Din Al-Tusi.

2. List his contributions.

3. Evaluate the impact of his work on contemporary society.

4. Explain why learning about Al-Tusi is important for understanding science, philosophy, mathematics, astronomy, theology and medicine?

5. Explain what has inspired you about his life, work and legacy?

6. Explain what surprised you about his life?

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.
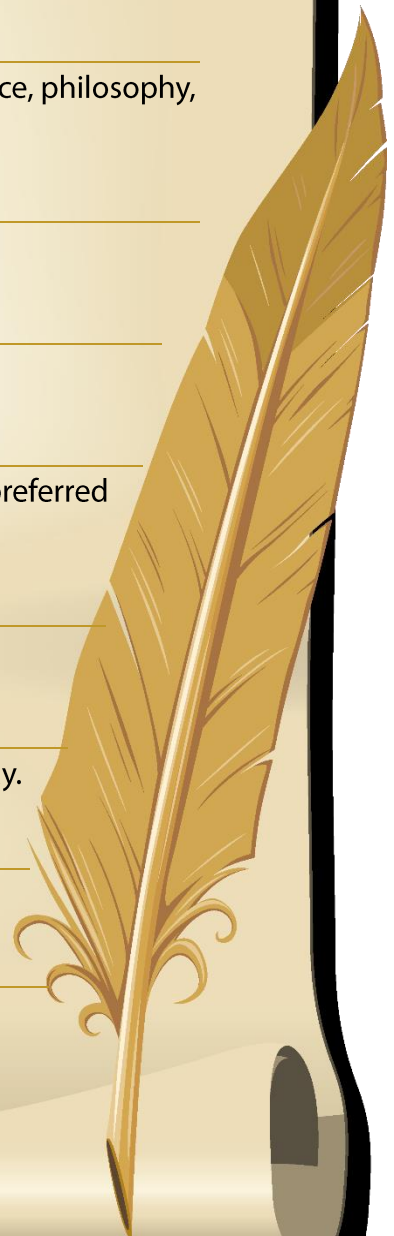
8. Construct a diagram, and/or map/timeline/model of his work.

9. Draw a map of where he used to live and compare it to a map used today.

10. Research the Islamic World during his time and present your findings.

**Alaa Al-Din Ibn Al-Nafis**

Physician and Jurist

# Who was Alaa Al-Din Ibn Al-Nafis?

- Born in 1213 in Damascus, Syria.

- Died in 1288 in Cairo, Egypt.

- Alaa Al-Din Ibn Al-Nafis was a Physician (specifically in the field of Anatomy) and was educated at the Medical College and hospital founded by Nur Al-Din Zangi.

- He was the first physician to describe the pulmonary circulation of the blood.

- Besides medicine, Ibn Al-Nafis learned jurisprudence, literature and theology.

- He wrote several books on Sharia Law and was an expert on the Shafi school of jurisprudence.

## CONTRIBUTIONS

1. Al-Nafis was the first physician to discover and describe the pulmonary circulation. This was nearly 300 years before Sir William Harvey of Kent was wrongly credited with this discovery.

2. He elaborated on the function of the coronary arteries, as feeding the cardiac muscle.

3. He explained that blood was purified in the lungs where it was refined on contact with the air inhaled.

4. He placed much emphasis on food and nutrition to maintain a healthy life and wrote a book on this subject.

5. Al-Nafis made the earliest known dissection of the human brain and made other human dissections and discovered how blood circulates through it.

6. He was the first physician to correctly present the anatomy of the bile duct and gall bladder which physicians in Europe learned in the 16th Century.

7. Al-Nafis authored the medical encyclopaedia, 'The Comprehensive Book on Medicine'. His encyclopaedia is considered the largest collection of work in the history of medicine comprising of 300 volumes on medicine. It describes in detail surgical procedures and surgical instruments.

8. He wrote a treatise on environmental science covering air and water pollution and soil contamination.

9. He wrote several commentaries on Hippocrates' books.
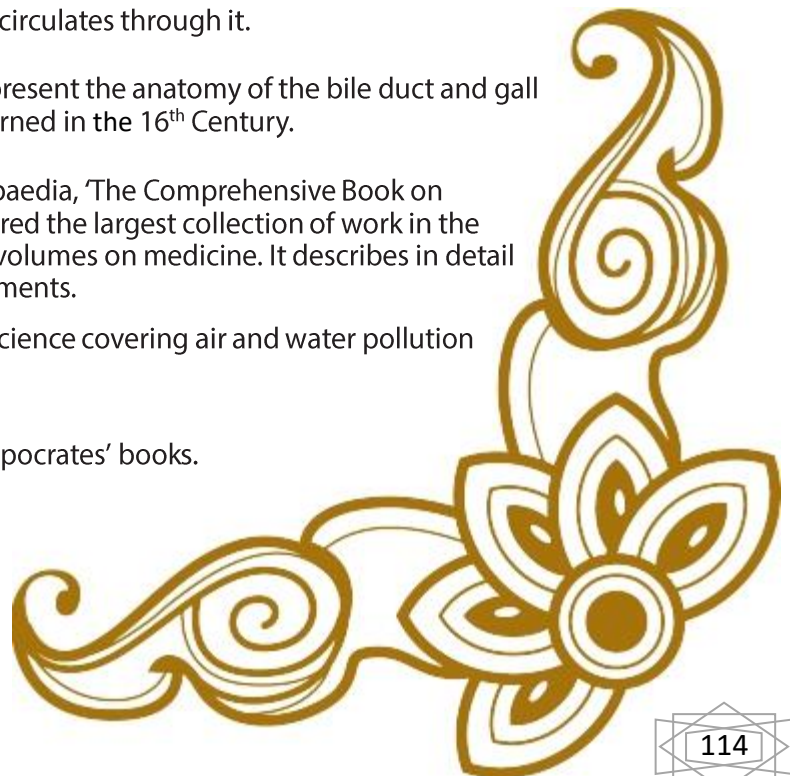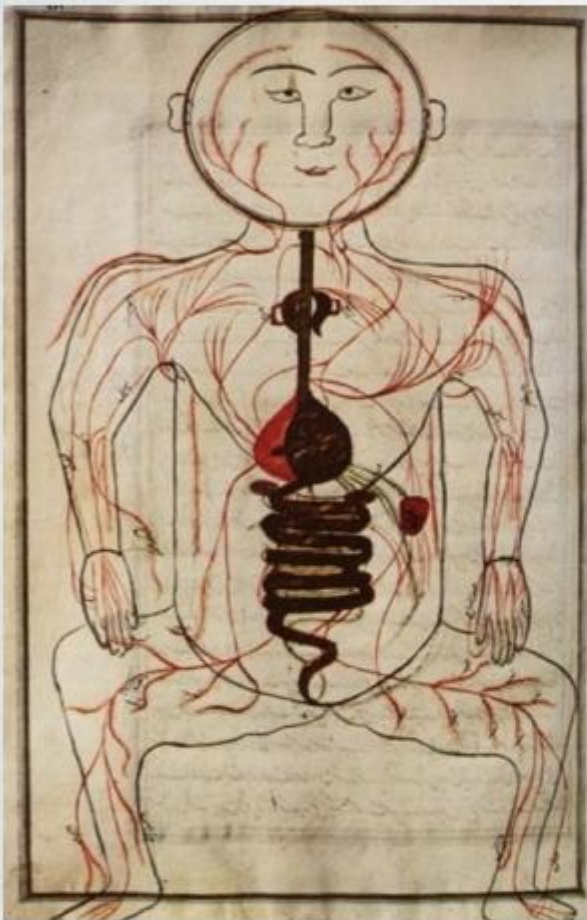
*Ibn Al-Nafis manuscript, pulmonary circulation and the digestive system*
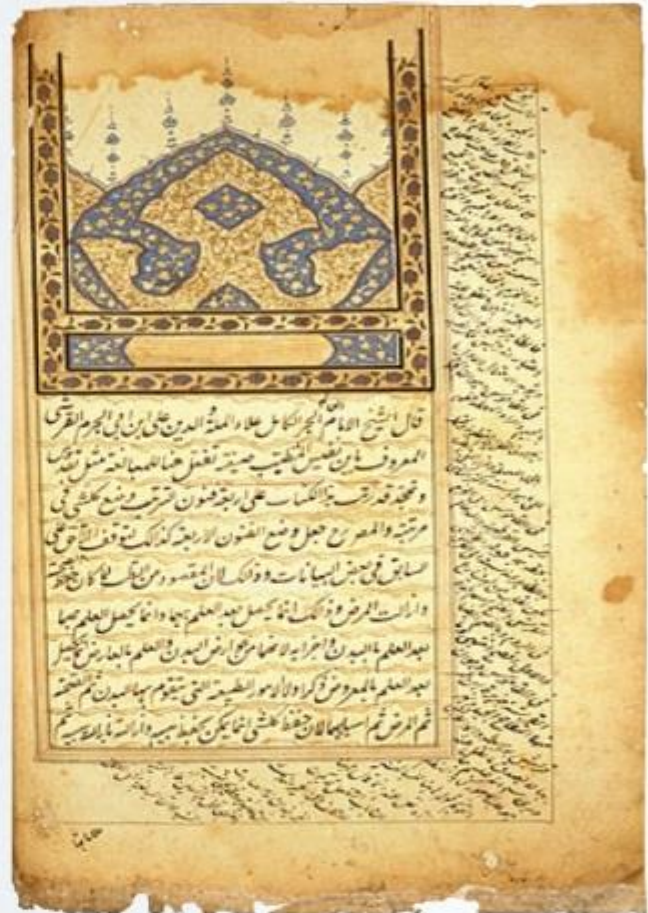
*The opening page of one of Ibn Al-Nafis's medical works. This is probably a copy made in India during the 17th or 18th century*

## LEGACY

1.  Two stamps were issued by Syria in 1967 to commemorate science week depicting Al-Nafis and the heart.

2.  A stamp of Al-Nafis was issued Libya in 1989.

3.  As part of his will, Ibn Al-Nafis donated his house library and clinic to the Mansuirya Hospital.

## STUDY QUESTIONS

1.  Summarise the life of Alaa Al-Din Ibn Al-Nafis.

    _____

2.  List his contributions.

    _____

3.  Evaluate the impact of his work on contemporary society.

    _____

4.  Explain why learning about Al-Nafis is important for understanding medicine and judiciary process/procedures?

    _____

5.  Explain what has inspired you about his life, work and legacy?

    _____

6.  Explain what surprised you about his life?

    _____

7.  Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

    _____

8.  Construct a diagram, and/or map/timeline/model of his work.

    _____

9.  Draw a map of where he used to live and compare it to a map used today.

    _____

10. Research the Islamic World during his time and present your findings.

    _____
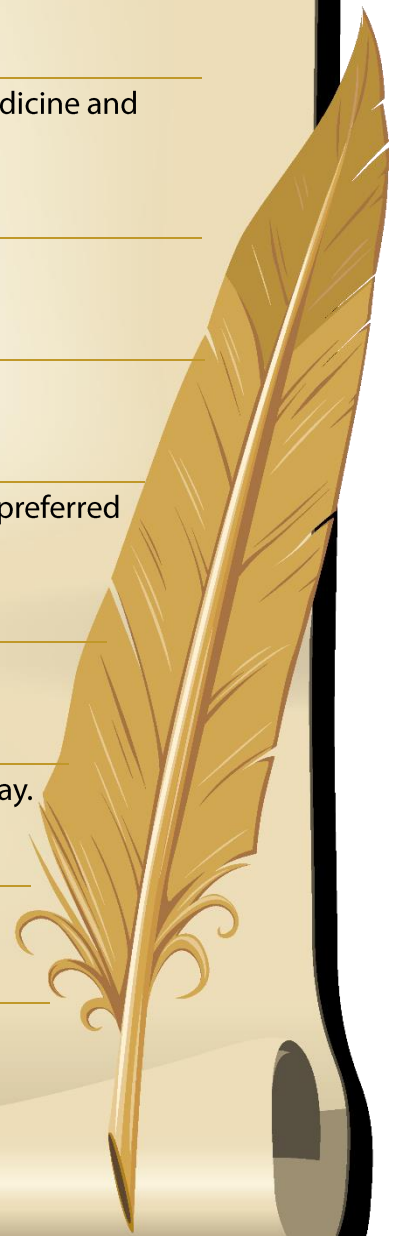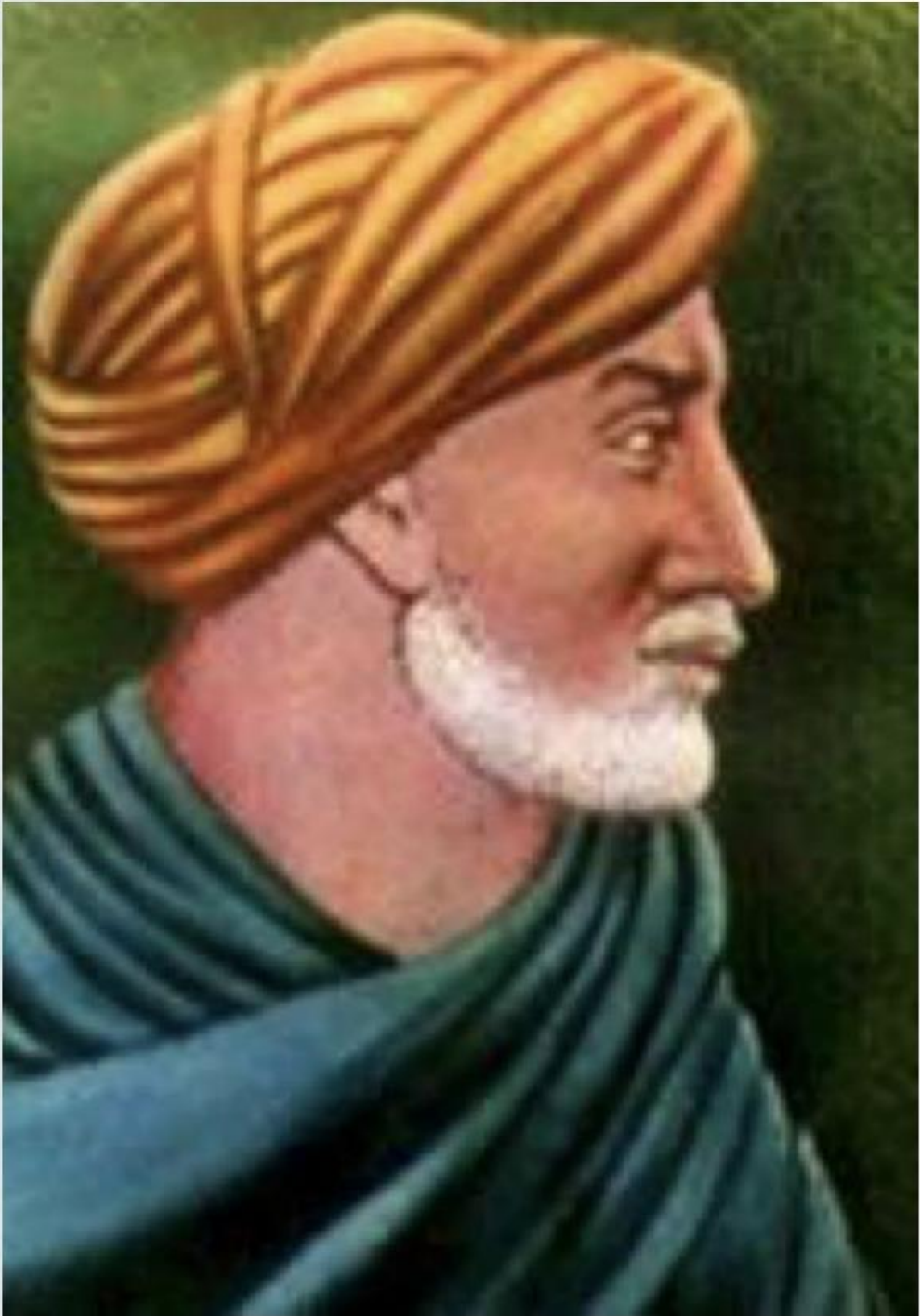
# Ibn Khaldun
**Sociology and Scientist of History**

# Who was Ibn Khaldun?

- Born in 1322 in Tunisia.

- Died in 1395 in Cairo, Egypt.

- Ibn Khaldun was educated at Tunis and Fez where he studied the Qur'an, Prophet Muhammad's traditions, Arabic literature and philosophy.

- He was the greatest Arab historian who developed non-religious philosophies of history.

- He was outstanding in his knowledge of Arabic and had a great understanding of poetry in its different forms.

- He memorised the Quran, studied its principles, commentaries, and gained a high level of understanding of Muslim laws.

- His study of society and social change led him to devolve "the science of culture" which is now called sociology.

# CONTRIBUTIONS

1. Ibn Khaldun wrote a masterpiece, the "Muqaddimah" which is an introduction to history. The main theme of the book is identifying psychological, economic, environmental and social facts that contribute to the advancement of human civilisation and history. His work has been described in the 20th century as the philosophy of history.

2. He wrote many books on sociology including:
   - Sociology of policies
   - ociology of urban life
   - Sociology of knowledge

   His publications are based on his concept of social cohesion and his observations of hyetography, economics, policies and education.

3. Ibn Khaldun analysed the dynamics of group relationships and showed how group feelings produce the ascent of a new civilisation and political power.

4. He identified an almost rhythmic repetition of the rise and fall in human civilisation, and analysed factors contributing to it.

5. He analysed many concepts of history that his work is considered superior in scholarship to Machiavelli's 'The Prince' written a century later.

6. Ibn Khaldun became the Chief Malakite Judge in Egypt, and lectured at the Al Azhar University.

# LEGACY

Ibn Khaldun's statue was erected in Independent Square in Tunisia



*Statue of Ibn Khaldun in Tunisia.*

*Circle of Justice from Ibn Khaldun, al-Muqaddimah, 15th century.*



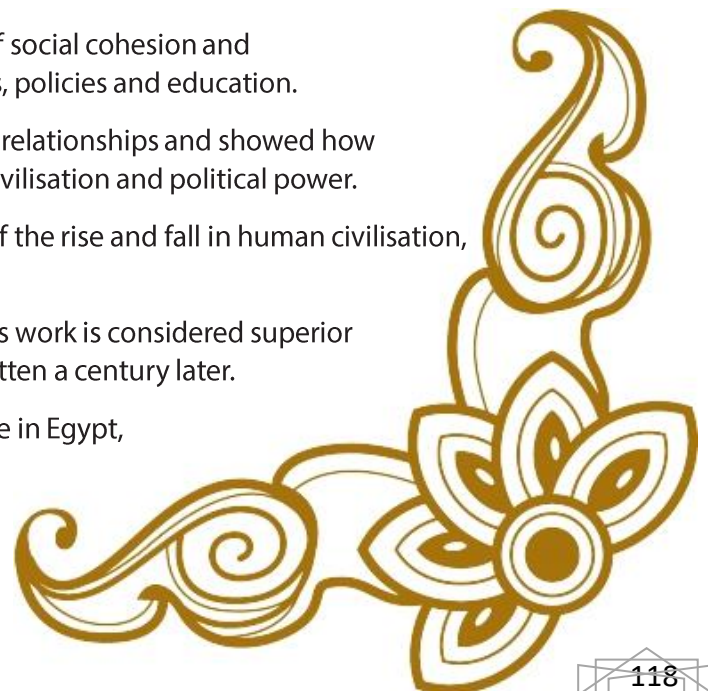*Life-size bronze bust sculpture of Ibn Khaldun that is part of the collection at the Arab American National Museum*

# STUDY QUESTIONS

1. Summarise the life of Ibn Khaldun.

   _____

2. List his contributions.

   _____

3. Evaluate the impact of his work on contemporary society.

   _____

4. Explain why learning about Ibn Khaldun is important for understanding sociology and science of history?

   _____

5. Explain what has inspired you about his life, work and legacy?

   _____

6. Explain what surprised you about his life?

   _____

7. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

   _____

8. Construct a diagram, and/or map/timeline/model of his work.

   _____

9. Draw a map of where he used to live and compare it to a map used today.

   _____

10. Research the Islamic World during his time and present your findings.

    _____
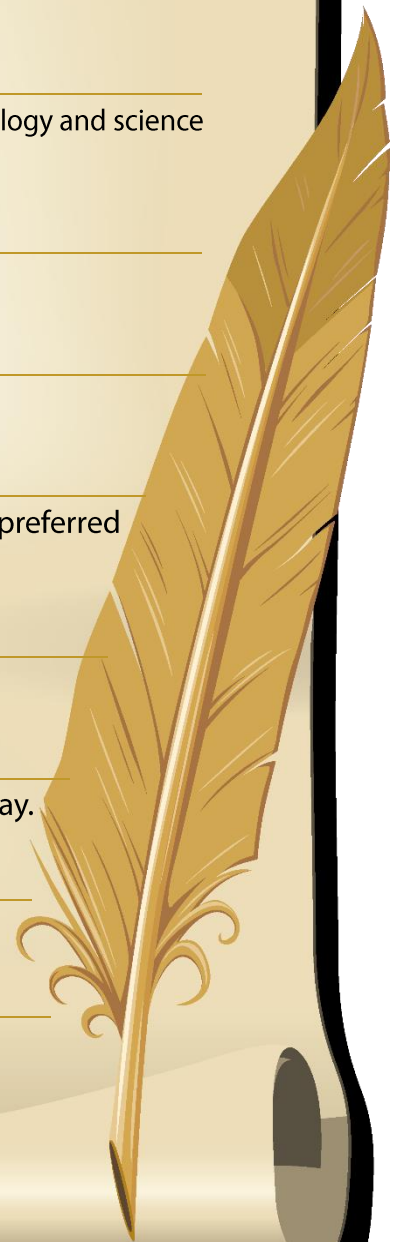
**Zheng He (Hajji Mahmud Shams)**

The Chinese Muslim Admiral

# Who was Zheng He (Hajji Mahmud Shams)?

- Born in 1371 in Kunyung, China.

- Died in 1433 in Kunyung, China.

- Zheng He, was born to a poor ethnic Hui family and grew up speaking Arabic and Chinese.

- He was a skilled mariner, explorer, diplomat and fleet admiral during the early Ming Dynasty.

# CONTRIBUTIONS

1. Over 28 years Zheng He commanded seven fleets that visited 37 countries, through South East Asia, Africa and Arabia.

2. He played an important part in developing a relationship between China and Muslim countries.

3. Zheng He's treasure ships which were capable of accommodating 500 passengers, were the largest wooden ships ever built by any nation.

4. On his travels, Zheng He built mosques. Although he did not perform Hajj, he sent sailors to Makkah on his last voyage.

5. In 1405, Zheng He led the largest naval expedition at that time in history. With 27,870 men on 317 ships including scholars, clerks, interpreters, soldiers, artisans, medical staff and meteorologists. He sailed as far as Vietnam, across to Java, Sumatra and Sri Lanka.

6. In 1413, Zheng He, set out with 30,000 men to Arabia. From Hormuz, he coasted around to Aden. The arrival of the fleet caused a sensation in the region and 19 countries sent ambassadors to accompany Zheng He back to China.

7. In 1420, the Ming Navy, dwarfed the combined navies of Europe.

8. He made a seventh voyage at the age of 62 and died on his return from India.
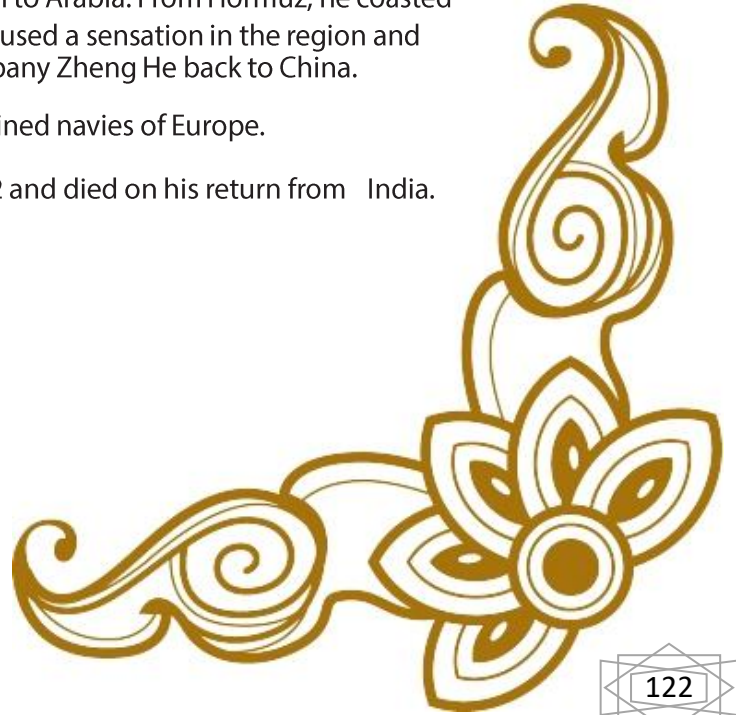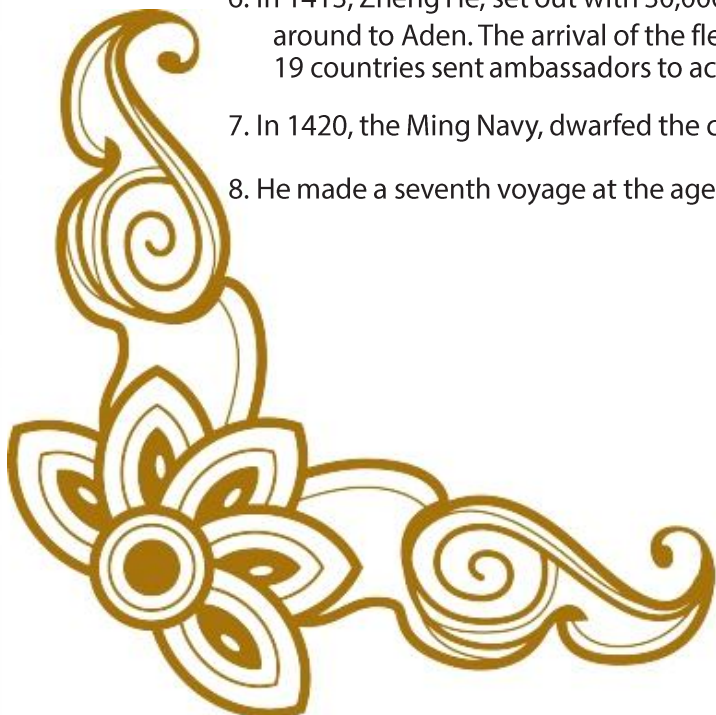
# LEGACY

**1**    A statue of Zheng He, is displayed in the Stadthuys Museum in Malacca, Malaysia.

**2**    A stamp of Zheng He, was issued in Indonesia commemorating Zheng He's voyages securing the maritime routes.

**3**    The Zheng He Mosque in Surabaya, is named after Him.

**4**    Zheng He's museum was built in Nanjing in his honour.

**5**    Zheng He's statue was built in the Quanzhou Maritime Museum.

**6**    China celebrates Maritime Day in memory of Zheng He's first voyage.



*Zheng He is arguably China's most famous navigator. He was believed to tower 8 feet high.*

*Replica of Zheng He's ship compared to those of Columbus*



*A map outlining the many voyages undertaken by Zheng He*

# STUDY QUESTIONS

1.  Summarise the life of Zheng He (Hajji Mahmud Shams).

    _____

2.  List his contributions.

    _____

3.  Evaluate the impact of his work on contemporary society.

    _____

4.  Explain why learning about Zheng He is important for understanding exploration and mariner?

    _____

5.  Explain what has inspired you about his life, work and legacy?

    _____

6.  Explain what surprised you about his life?

    _____

7.  Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

    _____

8.  Construct a diagram, and/or map/timeline/model of his work.

    _____

9.  Draw a map of where he used to live and compare it to a map used today.

    _____

10. Research the Islamic World during his time and present your findings.

    _____

## Muhammad Taragai Ulugh Beg

**Astronomer**

# Who was Muhammad Taragai Ulugh Beg?

- Born in 1393 in oltaniyeh, Iran.

- Died in 1449.

- Muhammad Taragai Ulugh Beg who was the grandson of Timur (Tamerlane).    He was an Astronomer, Mathematician (specialised in the field of trigonometry and spherical geometry) and the Sultan ruler of Central Asia.

## CONTRIBUTIONS

1. Ulugh Beg ruled Uzbekistan, Tajikistan, Turkmenistan, Kyrgyzstan and most of Afghanistan for 40 years (1411 -1449).

2. He set up Ulugh Beg Madrasahs in 1417-1420 in Samarkand and Bukhara, transforming the cities into cultural centres of learning in Central Asia where they taught astronomy.

3. Ulugh Beg made Samarkand famous as one of the leading cities of Muslim civilisation.

4. He built the great Ulugh Beg Observatory in Samarkand during 1424 – 1429. It was one of the first observatories of the fourteenth century. He equipped it with the most accurate astronomical instruments that were available at that time, which included Fakhri sextant (made of marble) that were used for determining the inclination of the ecliptic to the equator, the point of the vernal equinox, and the length of the tropical year.

5. Ulugh Beg compiled 994 star catalogues in 1932 predetermining correct longitudes. He also added 27 more stars to Abd Al-Rahman al Sufi's catalogue of stars.

6. He worked out that the length of the sidereal year is 365 days 5 hours and 4 minutes, 13 seconds, which had an error of +30 seconds. It was however, more accurate than Copernicus estimate of the fourth century.

7. Ulugh Beg determined that the axial tilt of the earth equal to 23.52 degrees which remained the most accurate for hundreds of years.

8. He prepared tables of planetary motions and studied the yearly movements of the five bright planets: Saturn, Jupiter, Mars, Venus and Mercury.

9. He compiled a star catalogue giving the positions of 992 stars. His compilation of tables of sines and tangents at one-degree intervals are accurate to eight decimal places.

10. In 1437 Ulugh Beg published his most famous work, which was a new catalogue of stars entitled, 'Zidj-I-Djadid Sultani'. An English translation of his work was published in 1917.
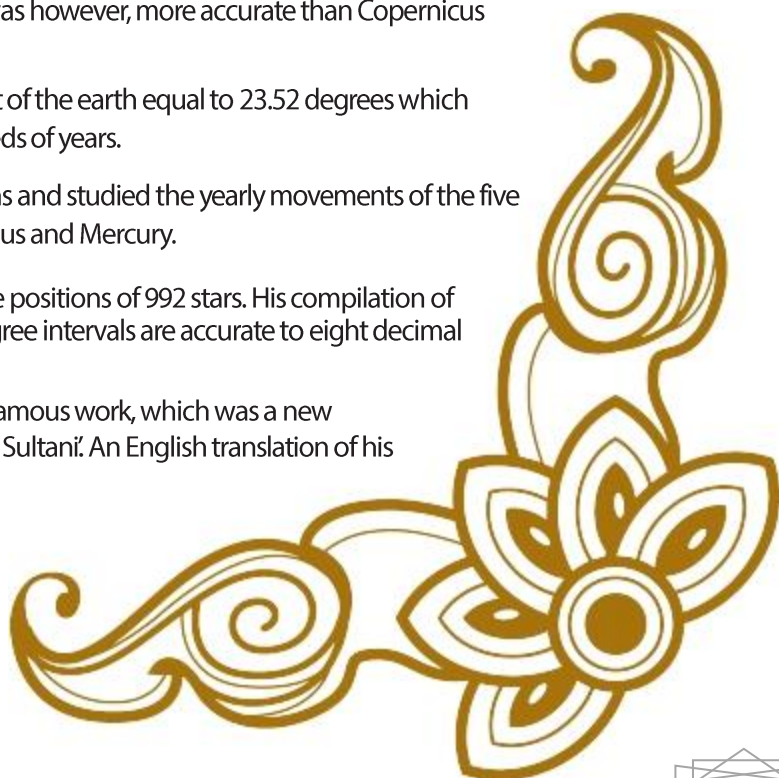
## STUDY QUESTIONS

11. Summarise the life of Muhammad Taragia Ulugh Beg.

_____

12. List his contributions.

_____

13. Evaluate the impact of his work on contemporary society.

_____

14. Explain why learning about Ulugh Beg is important for understanding astronomy?

_____

15. Explain what has inspired you about his life, work and legacy?

_____

16. Explain what surprised you about his life?

_____

17. Obtain evidence based information about him, utilizing your teacher's preferred sources such as books, articles, documentaries and websites.

_____

18. Construct a diagram, and/or map/timeline/model of his work.

_____

19. Draw a map of where he used to live and compare it to a map used today.

_____

20. Research the Islamic World during his time and present your findings.

_____

# Muslim Contributions
## That Changed the World

### Coffee

The history of coffee is quite interesting. An Arab shepherd named Khalid from Ethiopia noticed that his goats had more energy after eating a special berry. Khalid boiled these berries – and the result was coffee! From Ethiopia coffee spread to Yemen. Here it was used for religious purposes; the Sufis would drink coffee to stay awake all night and pray on special occasions. Coffee arrived in Turkey and Makkah in the late 15th century, Italy in 1645, and England in 1650. The Arabic name "qahwa" became "kahve" in Turkish, then "caffé" in Italian – and of course "coffee" in English.

### Flight

The first person to 'fly' was Abbas ibn Firnas in 852AD. He was a poet, astronomer and an engineer. His first attempt consisted of a cloak covering a wooden frame. He jumped from a minaret of the Grand Mosque in Cordoba. His contraption worked liked a parachute instead, creating what is thought to be the first parachute. He walked away with minor injuries. In 875, at age 70, he tried again after perfecting a machine made of silk and eagles feathers and managed to stay in the air for around 10 minutes - however, the landing did not go well. He surmised that the problem was the lack of a tail to help soften the landing. He is honoured by having both a crater on the moon and Baghdad international airport named after him.

### Vaccination

Children in Turkey were vaccinated with cowpox to prevent smallpox, establishing the technique of inoculation which is now essential in many aspects and occasions in life. Around 50 years later, in 1724, the wife of the English ambassador to Turkey introduced this practice into Europe.

### Fountain Pen

In 953, the Sultan of Egypt demanded a writing tool which would not leak ink or stain his clothes. The 'fountain pen' was devised. Just like modern pens, this pen had a reservoir which held the ink, gravity and capillary action moved the ink to the writing tip of the pen, enabling it to write.

### Camera

The first camera was invented by Ibn Al-Haitham in the 10th century. He was a mathematician, a physicist and an astronomer. He understood that light enters the eye - whereas previously people believed, as the ancient Greeks did, that our eyes emit rays which allow us to see. By observing how light came in through a hole in window shutters, Ibn Al-Haitham realised that a smaller hole yielded a better picture. He created the first 'Camera' Obscura, named so from the Arabic word "qamara" meaning a 'dark room'.

### Soap

Muslims perfected a recipe for soap, which is still in use today. Washing and bathing are important religious obligations before prayer, hence the need to formulate something to aid this. The Ancient Egyptians and the Romans had a form of soap but used it more as pomade. Arab experimenters created a vegetable oil and sodium hydroxide base to which they added fragrant oils e.g. thyme oil. When the Crusaders entered the Arab lands, they earned a reputation of being 'pungent smelling invaders' as they did not bathe regularly! In 1759, shampoo was introduced to England by a Muslim entrepreneur who opened Mahomed's Indian Vapour Baths at the beach in Brighton.

### Surgery

A Muslim surgeon named Al-Zahrawi constructed around 200 surgical instruments in the 10th century, many of which are still recognised today. These include scalpels, forceps, needles, precision scissors etc. When his pet monkey ate his lute strings, he realised that catgut could be used in the form of a capsule to allow medication to be ingested and also be used for stitching internal organs, as it dissolves away naturally. Al-Zahrawi devised 'fine scissors' for eye surgery. Another Muslim doctor developed the 'hollow needle' technique to extract cataracts from the eye – A technique still used today.

### Quilting

Quilting - sewing two pieces of cloth together with a layer in-between, was brought back to Europe by the Crusaders when they noticed the Muslim armies did not wear armour, but instead wore canvas quilted shirts filled with straw. This was quite an improvement over the chafing that resulted from the metal armour the Crusaders were wearing. Quilted shirts also provided a good deal of insulation and warmth – and hence quilting became very popular in colder regions of Europe like Britain.

### Architecture

Roman and Norman buildings, which used 'round arches' were adapted with the discovery of 'pointed arches' used in the Islamic World. These were more stronger and able to bear more weight. These can be seen on Gothic cathedrals across Europe. Other Islamic architectural methods utilised include the rose window and ribbed vaulting. The Islamic World's Dome and Castle-building techniques were introduced to European buildings, including parapets, round towers, battlements and arrow slits. Henry V enlisted a Muslim to construct his castle.

### Chemistry

Islam's most prolific scientist, Jabir Ibn Hayyan, pioneered many of the basic processes and equipment still used by chemists today. He established the systematic approach to chemical experimentation, also still used today, and is known for separating liquids by taking advantage of the differences in their boiling points. A process known as "distillation". Jabir Ibn Hayyan also established liquefaction, filtration, evaporation, purification, crystallisation and oxidisation. He also discovered sulphuric acid, nitric acid and created the alembic still which is used to create perfumes and rosewater.

### Windmills

Windmills were devised and constructed to draw up water from streams to irrigate vegetation and also to grind corn. The first windmill was created in 634 for a Persian Caliph – 500 years before the first ones were introduced in Europe.

### Printing Press

In 1454, Gutenberg developed the most sophisticated printing press of the Middle Ages. However, movable brass type were in use in Islamic Spain 100 years prior, and that is where the West's first printing devices were made.

### Mechanical Engineering

In 1206 a Muslim engineer named Al-Jazari published a book called "Knowledge of Ingenious Mechanical Devices". In it he described more than 50 inventions, including a combination lock and mechanical clocks powered by water and weights. He also explained the use of valves an pistons. He is most famous for discovering the crank-shaft, a key mechanism in nearly all mechanical inventions, which turns rotary motion into linear motion – this can be used for internal combustion engines and to raise water to irrigate crops.

### Mathematics

Around 825AD, there were two Muslim mathematicians known as Al-Khwarizimi and Al-Kindi they were amongst the first to write down a style of Arabic numerals which became the standard in use all over the world. The work of these and other Muslim Math scholars were later established into Europe by Italian mathematician Leonardo Fibonacci. Many of the works of Al-Khwarizmi and Al-Kindi formed mathematical theories and methodology which are still used today including algorithms, trigonometry etc. 'Algebra' was named after al-Khwarizmi's book 'Al-Jabr wa Al-Muqaabilah'. Al-Kindi discovered encryption decoding, number patterns and frequency analysis – these helped decipher the codes of the ancient civilisations.

CMYK

Part 1

132

# Muslim Contributions
## That Changed the World

### Astrolabe

Astrolabes, originally thought to be invented in the Hellenistic world in 150 BC, were further developed by Muslim astronomers, by introducing angular scales and adding circles indicating azimuths on the horizon. It was widely used throughout the Muslim world, chiefly as an aid to navigation and as a way of finding the Qiblah (Muslim direction of prayer facing Makkah). The first person credited with building the astrolabe in the Muslim world is reportedly the 8th century mathematician Muhammad Al-Fazari. Astrolabes were used to find the times of sunrise and the rising of fixed stars, to help schedule morning prayers. In the 10th century, Abd Al-Rahman Al-Sufi first described over 1,000 different uses for an astrolabe, in areas as diverse as astronomy, astrology, horoscopes, navigation, surveying, timekeeping, Muslim prayer, Qibla, etc. Astrolabes were introduced to Europe in the early 1100s and had become the most popular astronomical instrument by 1650.

### Trigonometry

Trigonometry remained largely a theoretical science amongst the Greeks. It was developed to a level of modern perfection by Muslim scholars, although the weight of the credit must be given to Al-Battani. The words describing the basic functions of this science: sine, cosine and tangent – are all derived from Arabic terms. Thus, original contributions by the Greeks in trigonometry were minimal.

### Algebra

Muslim mathematicians, the inventors of algebra, introduced the concept of using letters for unknown variables in equations as early as the 9th century A.D. Through this system, they solved a variety of complex equations, including quadratic and cubic equations, and equations with letters such as the now familiar x and y's. They used symbols to develop and perfect the binomial theorem. The word "algorithm" comes from mathematician Al-Khwarizmi, known as the father of Algebra. 'Algebra' is from the Arabic word for equation (Al-Jabr).

### Astronomy

Muslim astronomers made numerous improvements upon Ptolemy's findings as early as the 9th century. They were the first astronomers to dispute his archaic ideas. In their critic of the Greeks, they synthesised proof that the sun is the centre of the solar system and that the orbits of the Earth and other planets might be elliptical. They produced hundreds of highly accurate astronomical tables and star charts. Many of their calculations are so precise that they are regarded as contemporary. The Alphonsine Tables are little more than copies of works on astronomy transmitted to Europe via Islamic Spain; specifically, the Toledo Tables.

### Optometry

Ibn Firnas of Islamic Spain invented eyeglasses during the 9th century, and were manufactured and sold throughout Spain for over two centuries. Any mention of eyeglasses by Roger Bacon was simply a regurgitation of the work of Al-Haytham (d. 1039), whose research Bacon frequently referred to.

### Matter

The concept of the finite nature of matter was first introduced by Muslim scholar Al-Biruni. He discovered that, although matter may change its form or shape, its mass always remains the same. Thus, for instance, if water is heated to steam; if salt is dissolved in water etc., the total mass remains unchanged. The principles of this discovery were elaborated centuries before by Islamic Persia's great scholar, Al-Biruni (d. 1050). Lavoisier was a disciple of the Muslim chemists and physicists and referred to their books frequently. Antione Lavoisier later introduced these principles to Europe during the 18th century.

### Gunpowder

The Chinese developed saltpetre ("Chinese snow") for use in fireworks and knew of no tactical military use for gunpowder, nor did they invent its formula. Research by Reinuad and Fave has clearly shown that gunpowder was formulated initially by Muslim chemists. Furthermore, these historians claim that the Muslims developed the first fire-arms. Notably, Muslim armies used grenades and other weapons in their defence of Algericus against the Franks during the 14th century. Jean Mathes indicates that the Muslim rulers had stock-piles of grenades, rifles, crude cannons, incendiary devices, sulfur bombs and pistols decades before such devices were used in Europe. The first mention of a cannon was in an Arabic text around 1300 A.D.; Roger Bacon learned of the formula for gunpowder from Latin translations of Arabic books.

### Geography

Muslim geographers produced untold volumes of books on the geography of Africa, Asia, India, China and the Indies during the 8th through to the 15th century. These writings included the world's first geographical encyclopaedias, almanacs and road maps. Ibn Battutah's 14th century masterpieces provide a detailed view of the geography of the ancient world. The Muslim geographers far exceeded the output by Europeans regarding the geography of these regions well into the 18th century.

### Pendulum

The pendulum was discovered by Ibn Yunus Al-Masri during the 10th century, who was the first to study and document its oscillatory motion. Its value for use in clocks was introduced by Muslim physicists during the 15th century.

### Navigation

Muslim geographers and navigators learned of the magnetic needle, possibly from the Chinese, and were the first to use magnetic needles in navigation. They invented the compass and passed the knowledge of its use in navigation to the West. European navigators relied on Muslim pilots and their instruments when exploring unknown territories. Gustav Le Bon claims that the magnetic needle and compass were entirely invented by the Muslims and that the Chinese had little to do with it. Neckham also states that the Chinese probably learned of it from Muslim traders. It is noteworthy that the Chinese improved their navigational expertise after they began interacting with the Muslims during the 8th century.
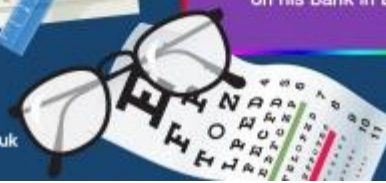
### Glass Mirrors

Glass mirrors were in use in Islamic Spain as early as the 11th century. The Venetians learned of the art of fine glass production from Syrian artisans during the 9th and 10th centuries.
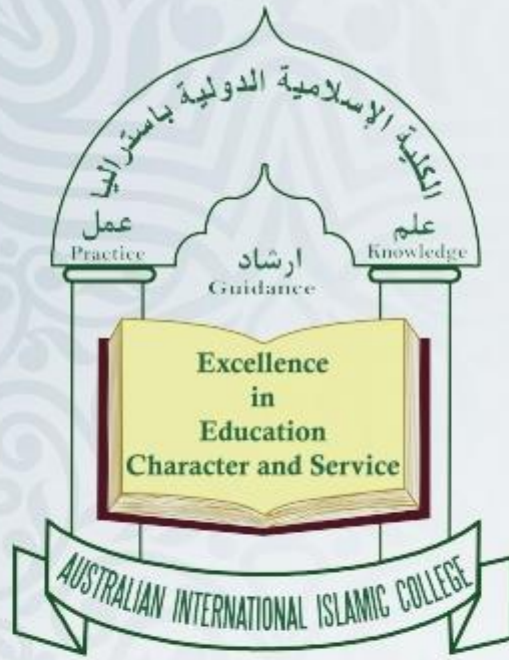
### Clocks

A variety of mechanical clocks were produced by Spanish Muslim engineers, both large and small, and this knowledge was transmitted to Europe through Latin translations of Islamic books on mechanics. These clocks were weight-driven; designs and illustrations of epicycle and segmental gears were provided. One such clock included a mercury escapement. The latter type was directly copied by Europeans during the 15th century. In addition, during the 9th century, Ibn Firnas of Islamic Spain, according to Will Durant, invented a watch-like device which kept accurate time. The Muslims also constructed a variety of highly accurate astronomical clocks for use in their observatories.

### Cheques

The modern cheque comes from the Arabic 'saqq', a written vow to pay for goods when they were delivered, to avoid money having to be transported across dangerous terrain. In the 9th century, a Muslim businessman could cash a cheque in China drawn on his bank in Baghdad.

133

Part 2