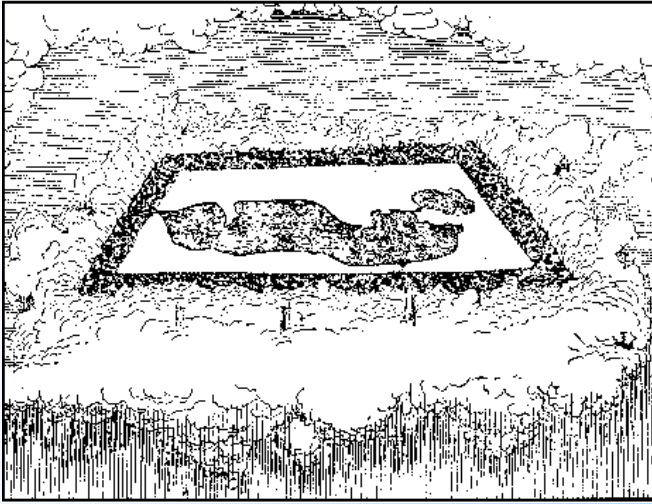
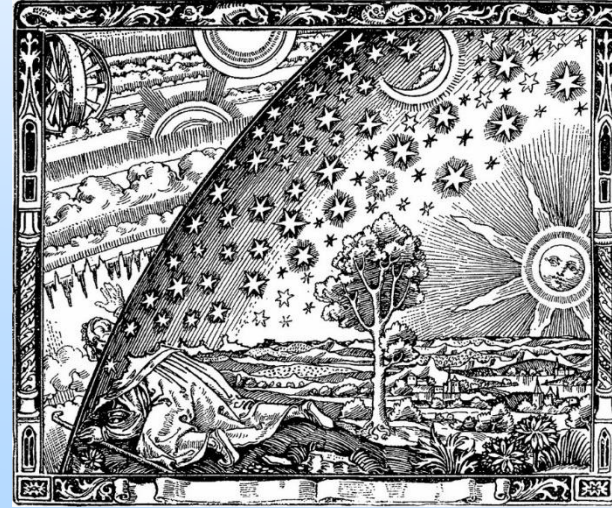


- Shape of Earth
 - Earth is flat, or disk
 - Earth is globe
 - **Measurements of Earth size**
 - Earth is ellipsoid
 - Earth is geoid.

Earth is flat, or disk



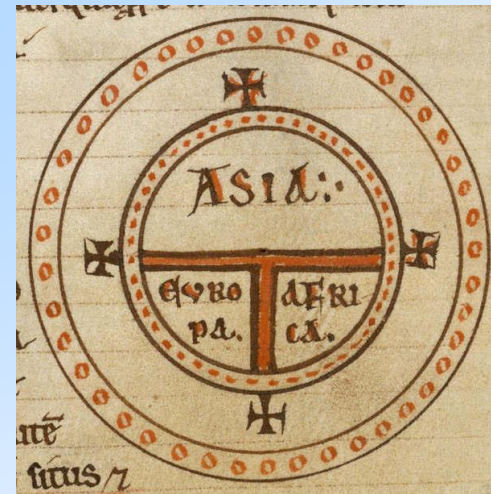
Map drawn by Anaximenes (550-480 BCE) showing that the Earth is flat, rectangular (from L.A. Brown, 1949 - T. Bilgin, 1983).



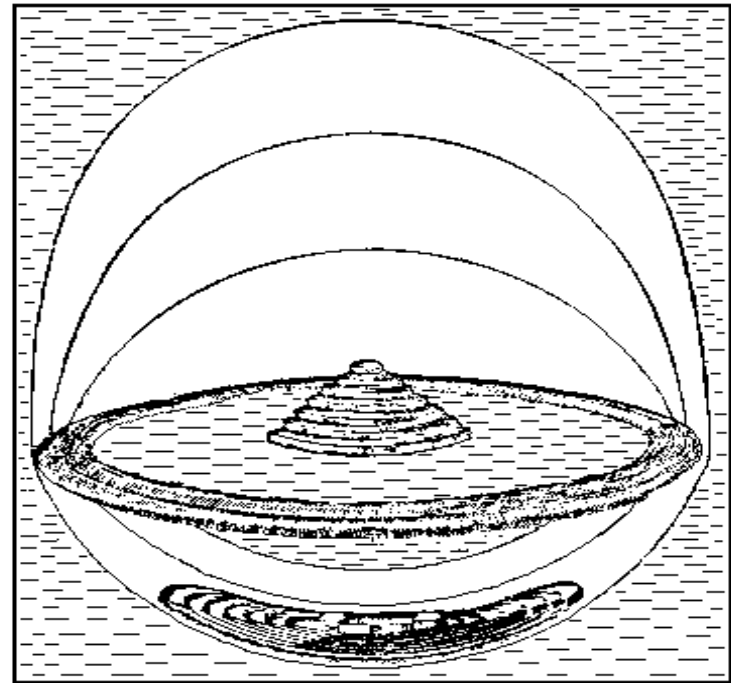
The Flammarion engraving (1888) depicts a traveler who arrives at the edge of a flat Earth and sticks his head through the firmament.



Cosmas Indicopleustes



Isidore T and O Maps



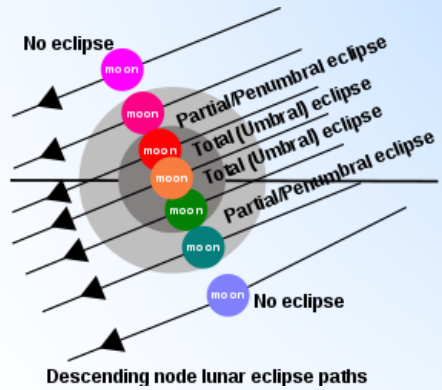
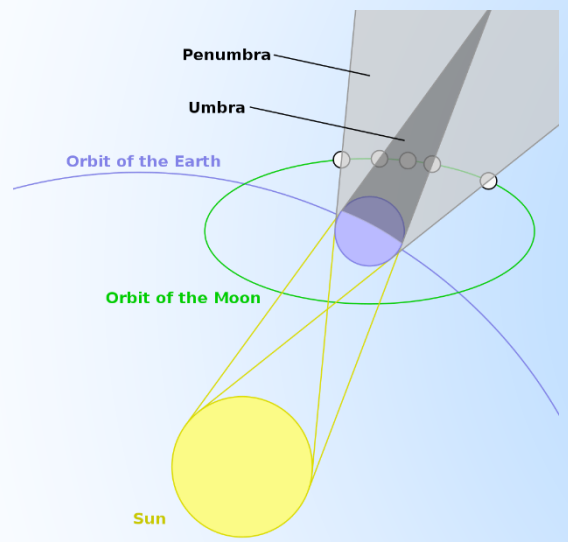
The universe and worldview in ancient Mesopotamian civilizations (İ.H.Akyol, 1951).

1- State of the Earth's Shadow in a Lunar Eclipse

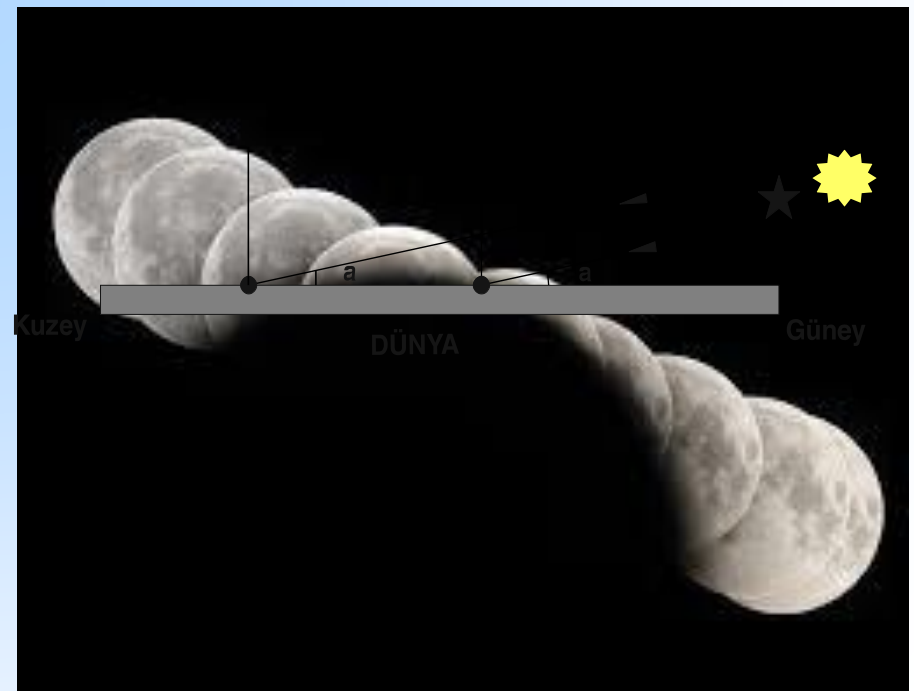
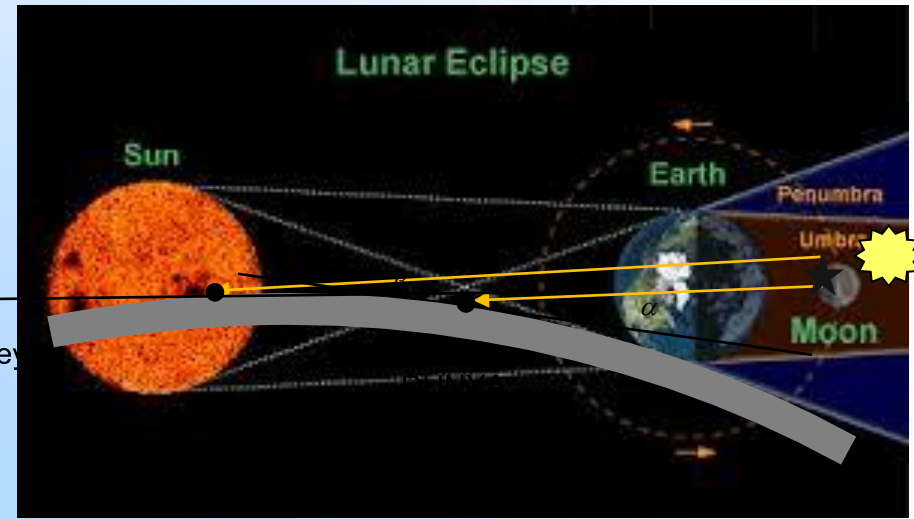
2- Seeing the Stars and the Sun from Different Altitude

How to Calculate The Sun's Altitude

Lights coming From Eternity are parallel to each other.



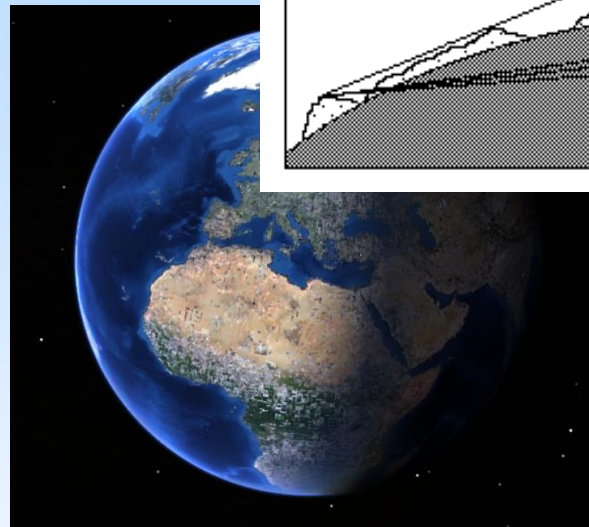
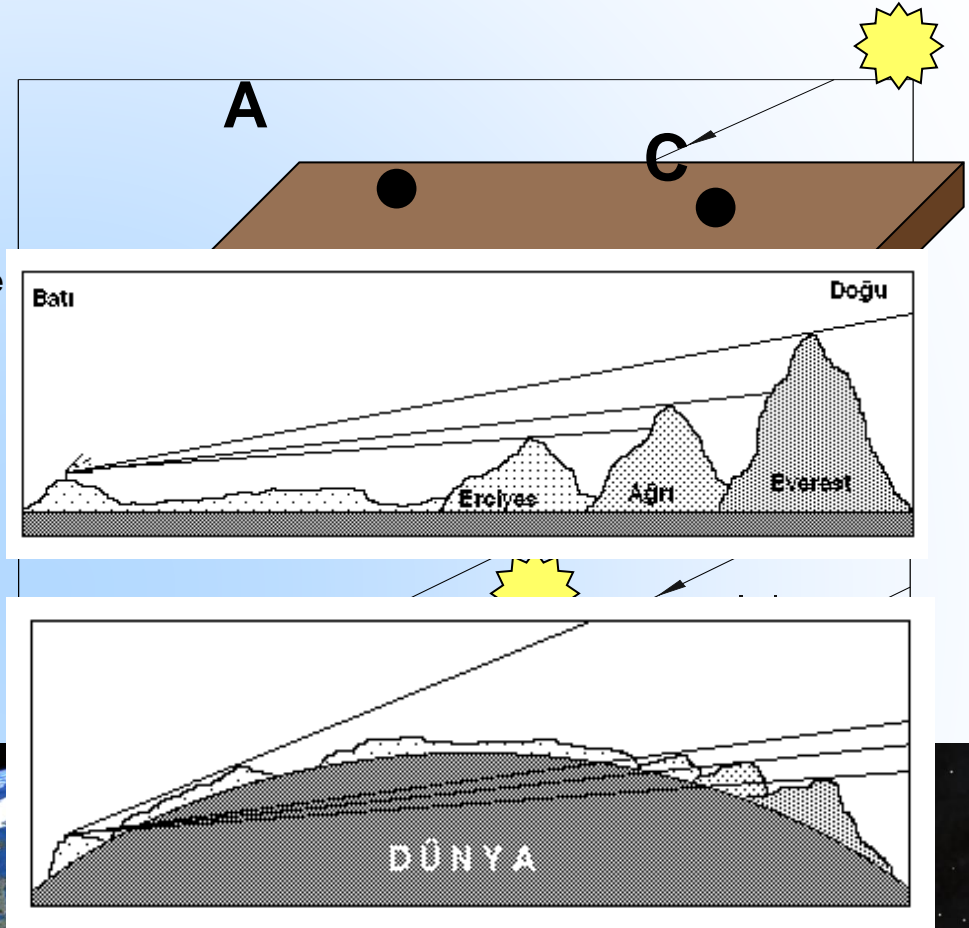
Descending node lunar eclipse paths



BCE. IV.

Earth is Globe

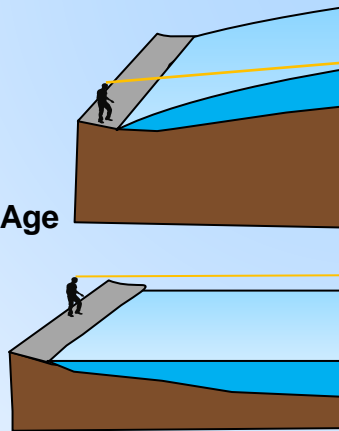
- 1- State of the Earth's Shadow in a Lunar Eclipse
- 2- Seeing the Stars and the Sun from Different Altitude
How to Calculate The Sun's Altitude
Lights coming from Eternity are parallel to each other.
- 3- The Sun Does Not Rise Everywhere At The Same Time
- 4- Elongation of Shadow Length Towards Poles
- 5- High Points Cannot Be Seen From Afar



circle of enlightenment

- 1- State of the Earth's Shadow in a Lunar Eclipse
- 2- Seeing the Stars and the Sun from Different Altitude
How to Calculate The Sun's Altitude
Lights coming From Eternity are parallel to each other.
- 3- The Sun Does Not Rise Everywhere At The Same Time
- 4- Elongation of Shadow Length Towards Poles
- 5- High Points Cannot Be Seen From Afar
- 6- State of the Ship Approaching or Receding from the coasts.
- 7- Bedford Level Experiment
- 8- Images from spaces
- 9- Geographical Travels at Middle Age

Christopher Columbus
The Magellan expedition



Measurements related to the size of the Earth

- Eratosthenes Measurement
- Poseidonios Measurement
- Marzavi - Sanad ibn Ali and Usturlabi - Bukhtari Measurement
- Al Biruni Measurement
- Fernel Measurement

Actual Values

Physical characteristics	
Mean radius	6371.0 km
Equatorial radius	6378.137 km
Polar radius	6356.752 km
Flattening	1/298.257222101
Circumference	•40075.017 km <u>equatorial</u> •40007.86 km <u>meridional</u>

Initial Measurements

According to Aristotle's calculation, the circumference of the Earth is 400,000 stadia. 63,000 km B.C.

According to the calculation in 300, the circumference of the Earth is 300,000 stadia. 47,250 km

Eratosthenes Measurement



Main Logic

CE 3. c
June, 21

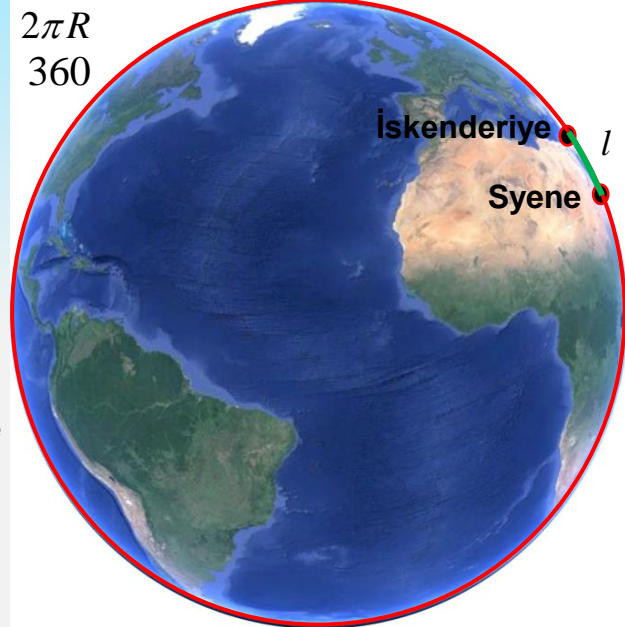
$l = 5000 \text{ stadion}$
 $\alpha = 7^{\circ}12'$

$$\frac{l}{\alpha} = \frac{2\pi R}{360}$$

Geographical coordinate
Decimal degree

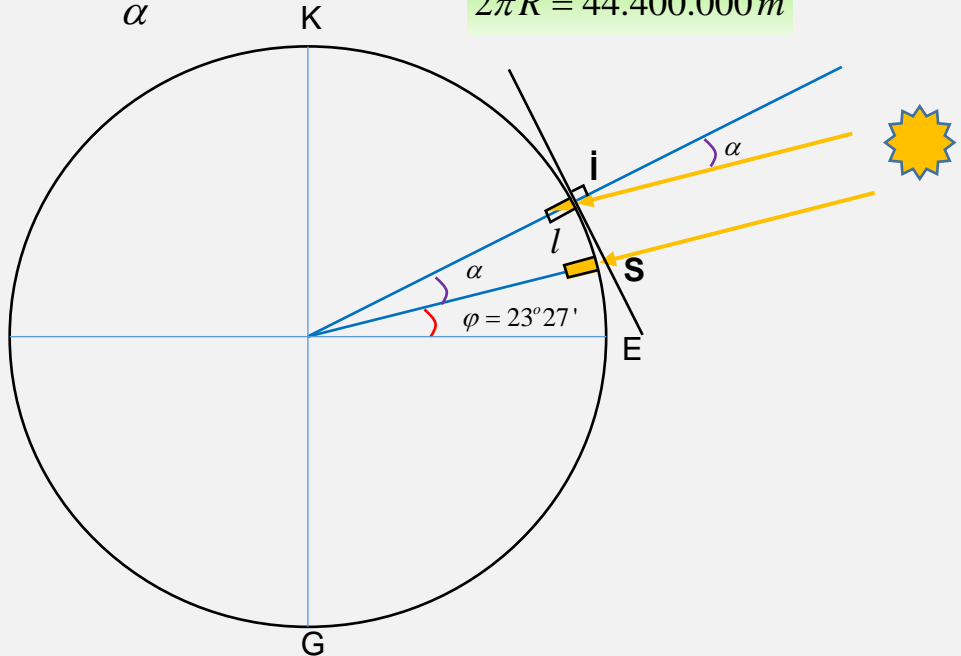
$\alpha = 7,2^{\circ}$
 $\alpha * 2\pi R = l * 360$

$$2\pi R = \frac{l * 360}{\alpha}$$



$2\pi R = 250,000 \text{ stadion}$ $1 \text{ std} = 177.6 \text{ m}$

$$2\pi R = 44.400.000 \text{ m}$$



Poseidonios Measurement

Main Logic



CE. 2 c
 $l = 5000 \text{ stadion}$
 $\alpha = 7^{\circ}30'$

$$\frac{l}{\alpha} = \frac{2\pi R}{360}$$

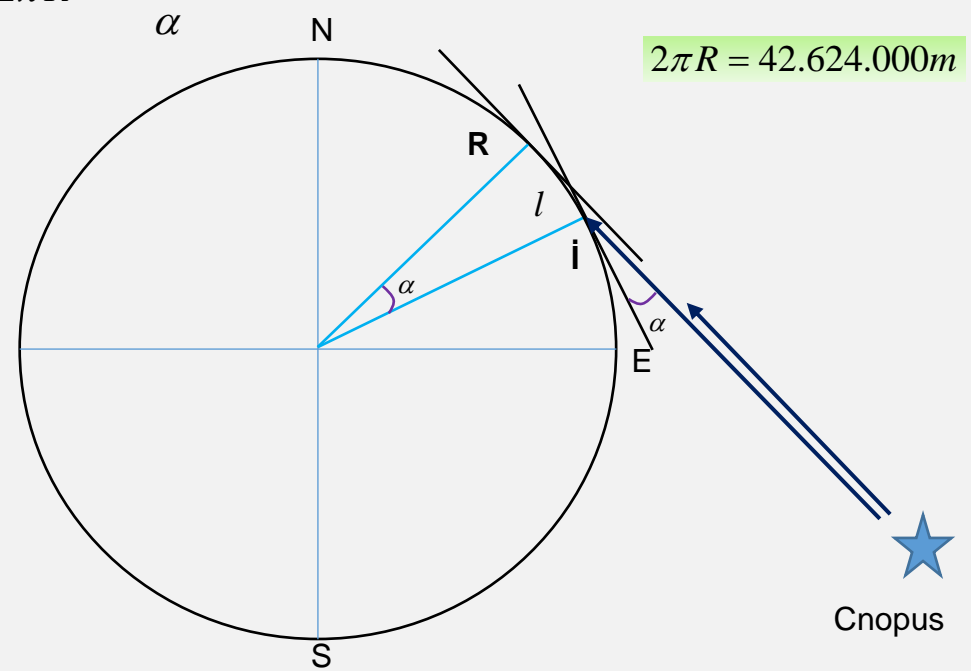
Geographical coordinate
 Decimal degree
 $\alpha = 7,5^{\circ}$

$$\alpha * 2\pi R = l * 360$$

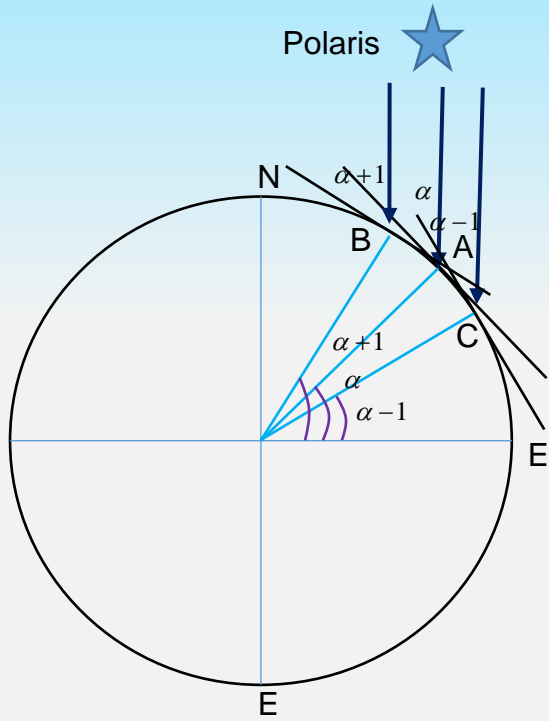
$$2\pi R = \frac{l * 360}{\alpha}$$

$2\pi R = 240,000 \text{ stadion}$ $1 \text{ std} = 177.6 \text{ m}$

$$2\pi R = 42.624.000 \text{ m}$$



Marzavi - Sanad ibn Ali and Usturlabi - Buhtari Measurements



8. and 9. c.

$$1^\circ \text{ arc} = 57 \text{ Arabic Mile} \quad 1 \text{ Arabic Mile} = 1973 \text{ m}$$

$$1^\circ \text{ arc} = 112461 \text{ m}$$

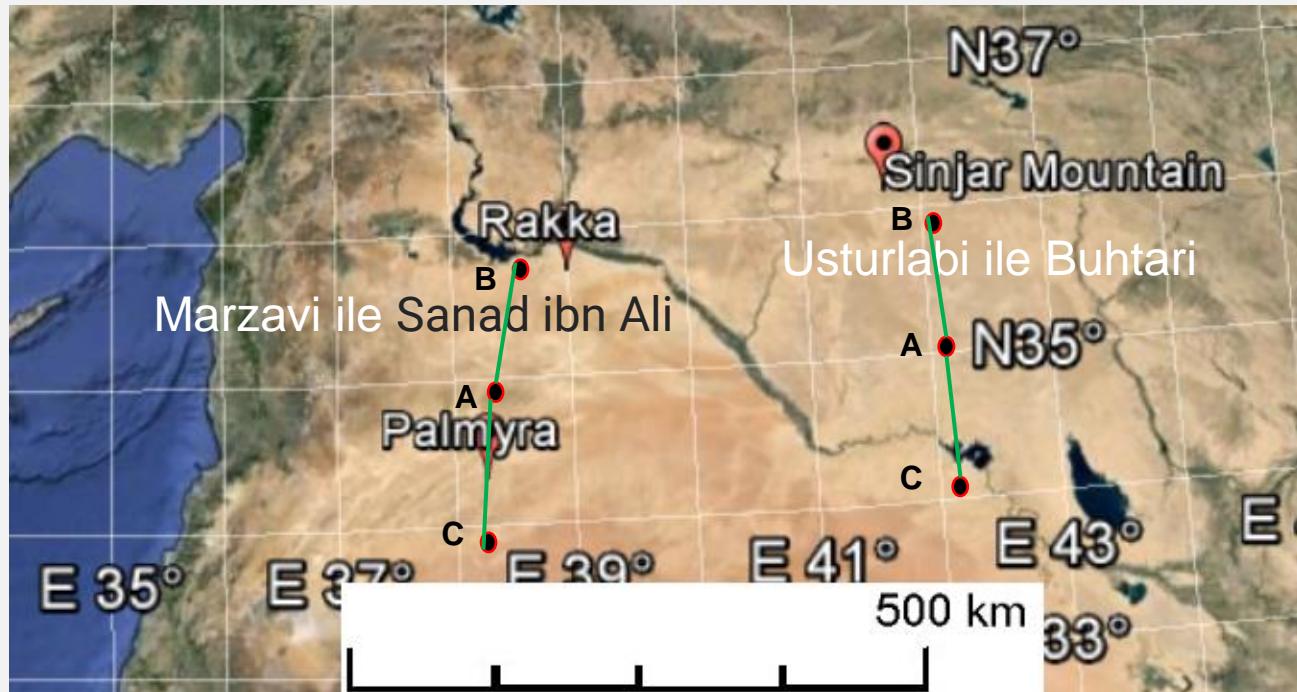
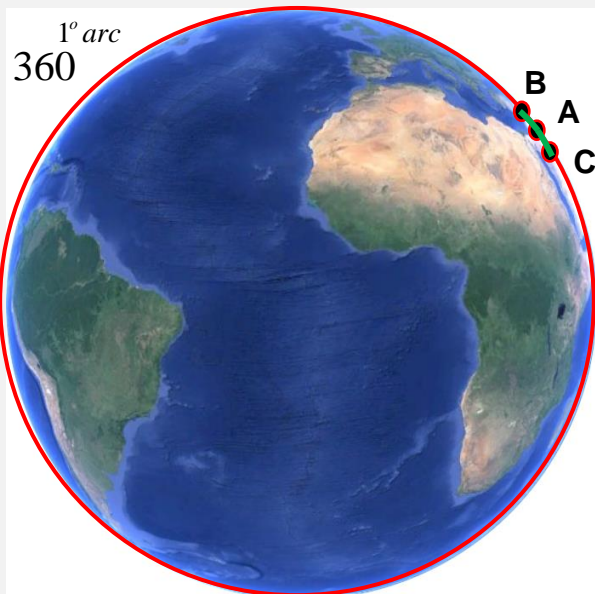
$$1^\circ \text{ arc} = 56.25 \text{ Arabic Mile}$$

$$1^\circ \text{ arc} = 110981,3 \text{ m}$$

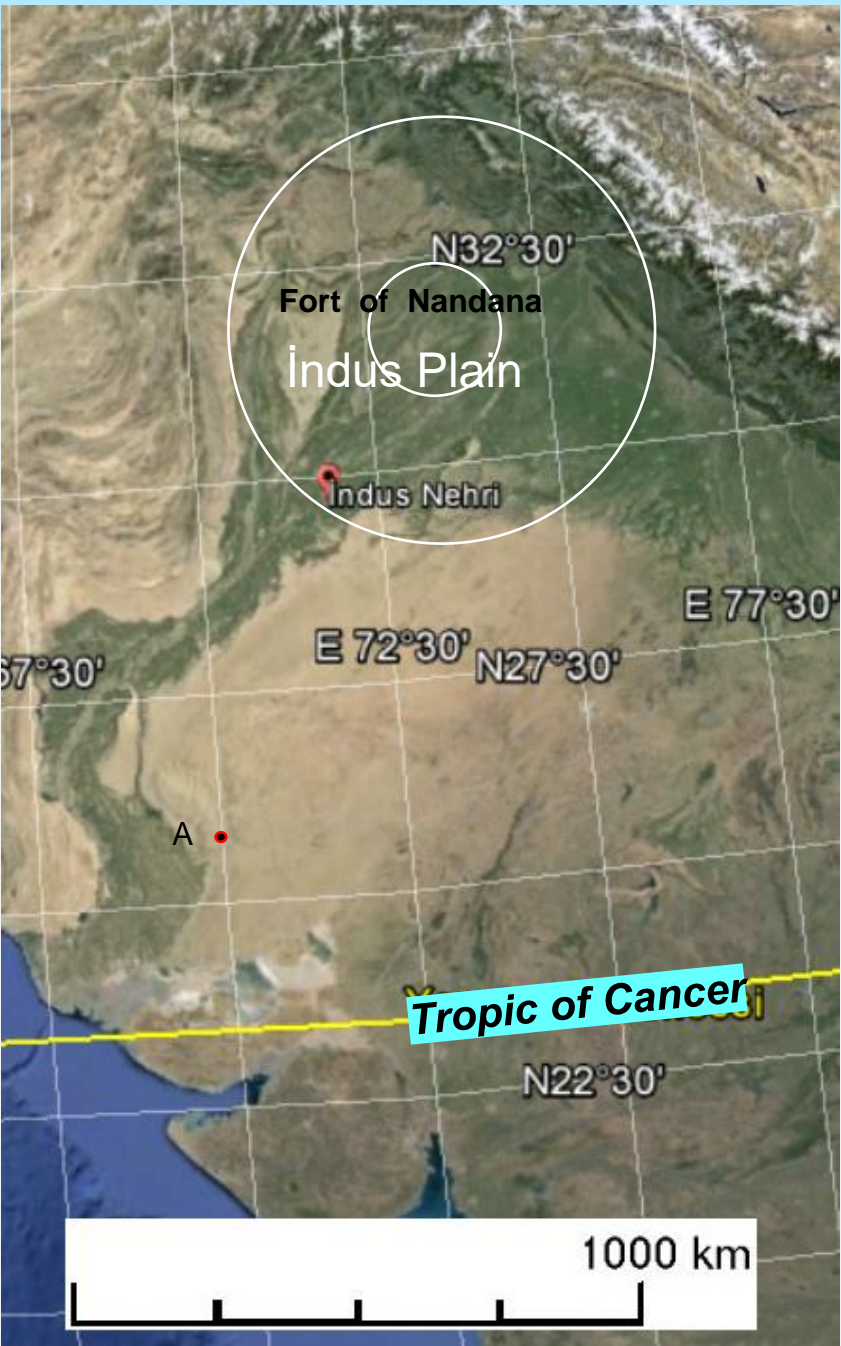
$$\text{Circumference} = 112461 \text{ m} * 360 = 40.485.960 \text{ m}$$

$$\text{Circumference} = 110981 \text{ m} * 360 = 39.953.250 \text{ m}$$

Main Logic

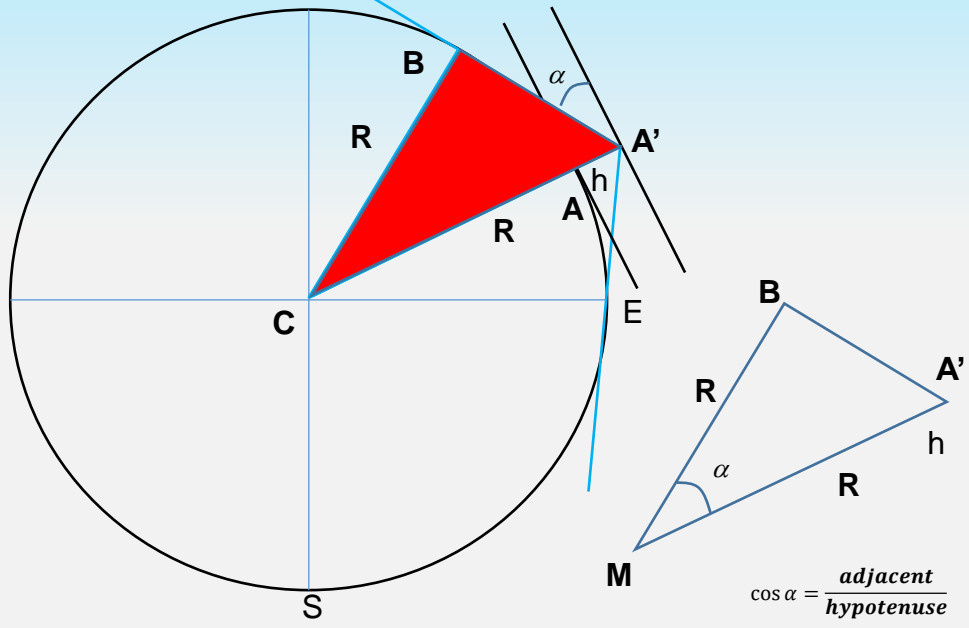


Al-Biruni Measurement



11. c.

Astronomical horizon_N



$$\cos \alpha = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\cos \alpha = \frac{R}{R+h}$$

$$R = \cos \alpha (R+h)$$

$$= \cos \alpha * R + \cos \alpha * h$$

$$R = \frac{(h * \cos \alpha)}{(1 - \cos \alpha)}$$

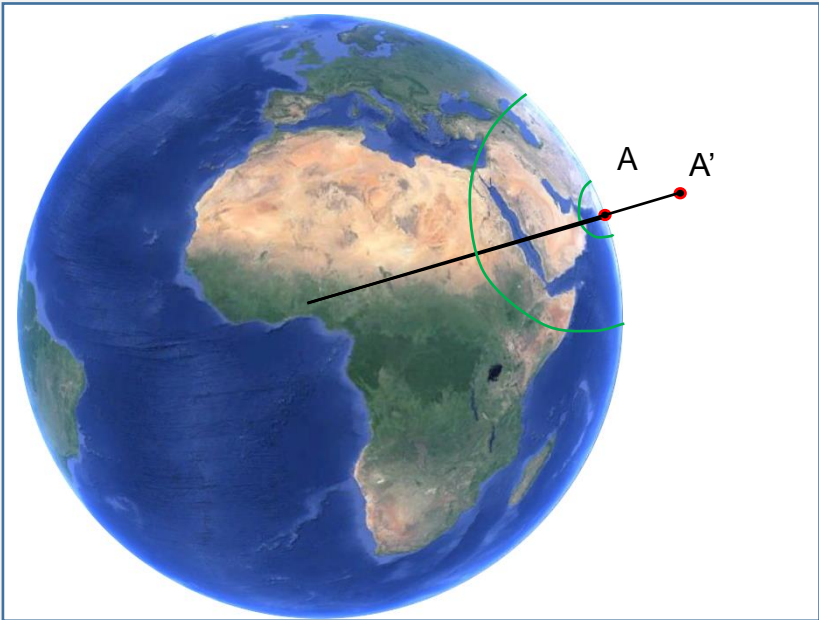
$$R = 3333 \text{ Arabic Mile}$$

$$R = 3333 * 1973m$$

$$= 6576km$$

$$2\pi R = 2 * 3,14 * 6576$$

$$= 41297km$$



Jean Fernel Measurement



Main logic

$$\frac{2\pi R}{360}$$

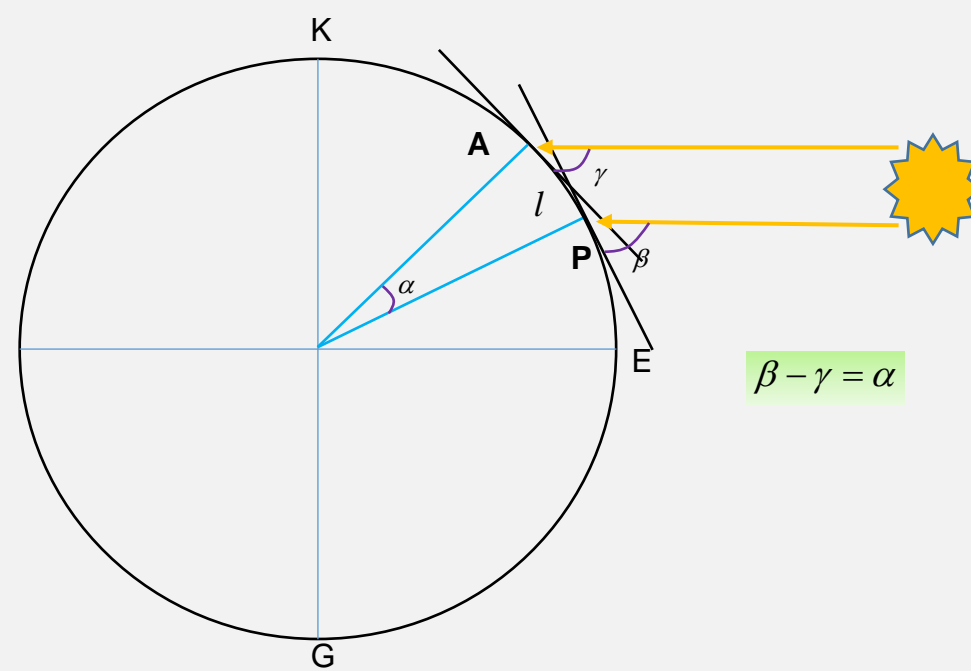
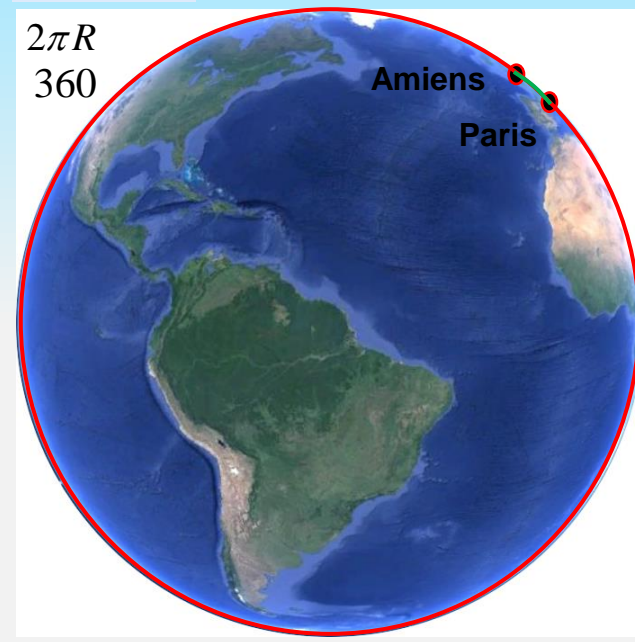
1525

$$\frac{l}{\alpha} = \frac{2\pi R}{360}$$

$$2\pi R * \alpha = l * 360$$

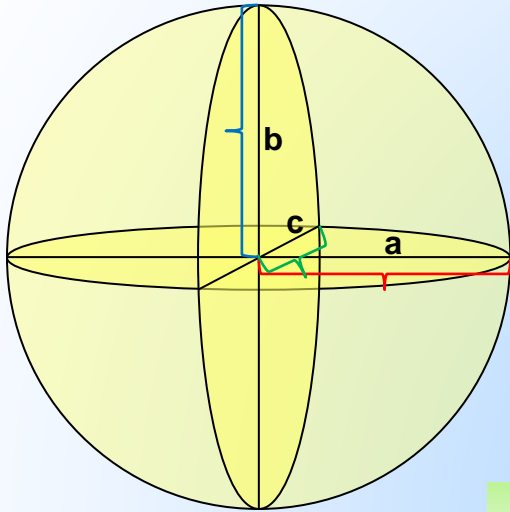
$$2\pi R = \frac{l * 360}{\alpha}$$

1° arc = 110.6 km
CofE = 39,820 km

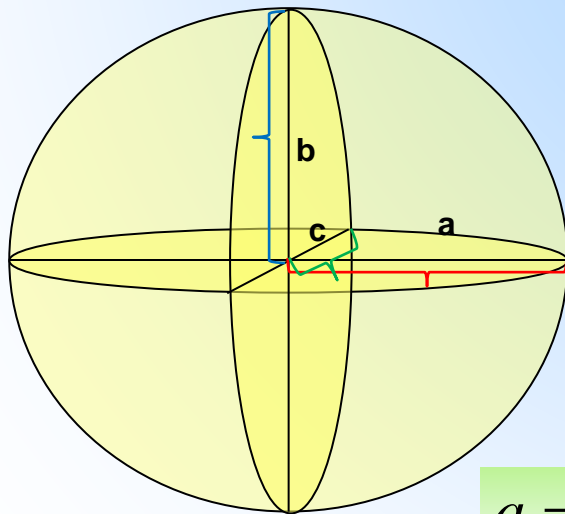
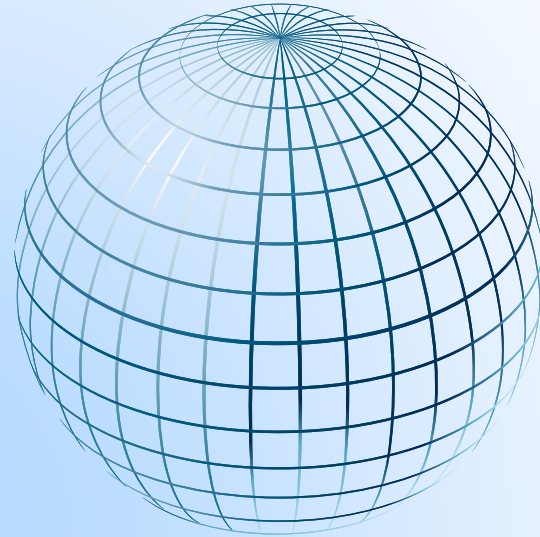


Earth is elipsoide.

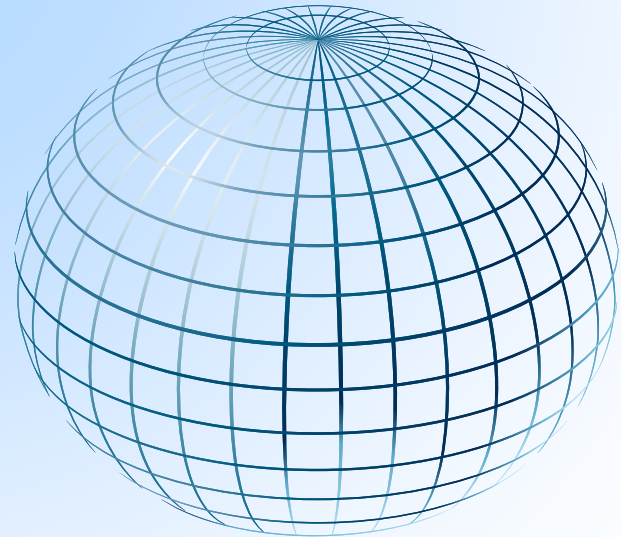
XVII. century



$$a = b = c$$



$$a = c > b$$



Earth is geoid.

While developments in geophysical science continue rapidly, According to the measurements and calculations made in the second half of the XIX. century, the fact that the Earth has a unique shape, which cannot be defined mathematically, has emerged.

This unique shape is determined with the help of measurements made with physics methods in general and it is called geoid.

The shape formed by the surface's perpendicular to the plumb line from every point on the earth is called a geoid.

