



***The International Math
Workshop
Virtual meeting
Chania 7-10 June 2021***

Co-funded by the
Erasmus+ Programme
of the European Union



Καλημέρα

Good Morning

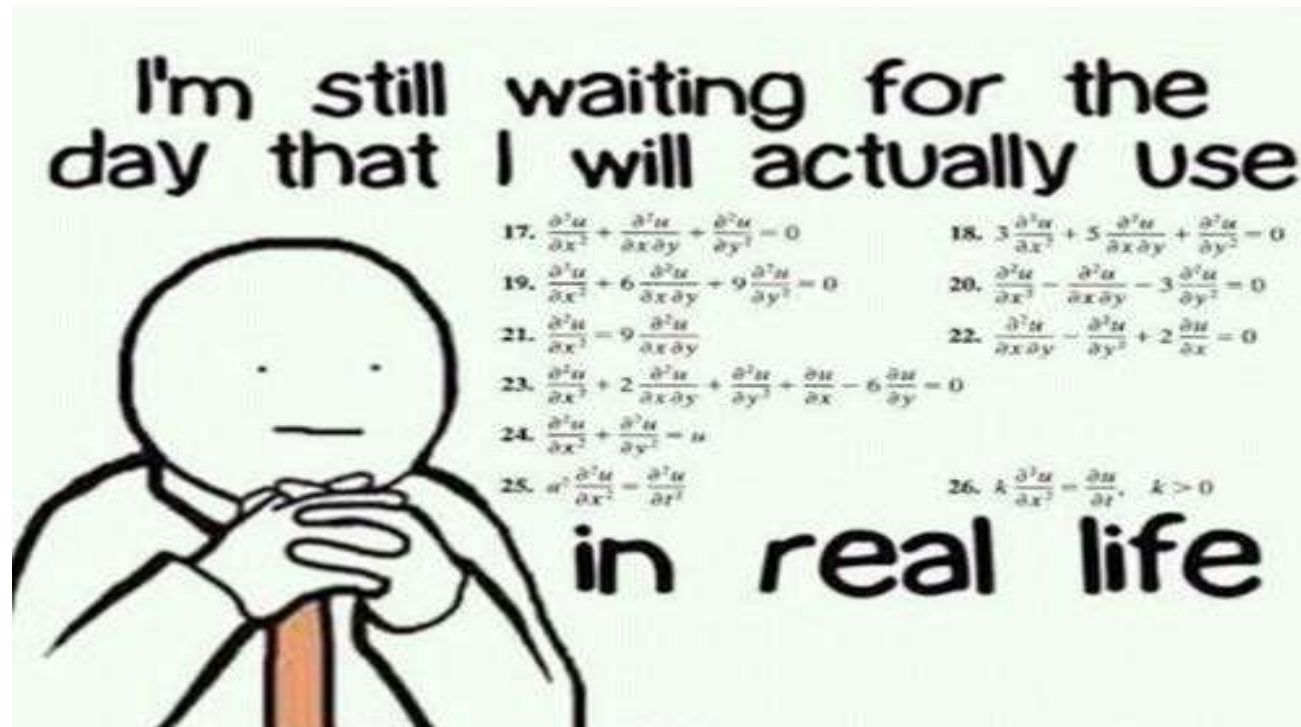
dobré ráno

buna dimineata

Measurement of unknown height from a distance



Many people say:
Maths are useless
They exist to torture
the pupils



Is it true? Or not?

Let see a little application of
mathematics in real life

Measurement of a height

First way





Distance

d

angle

ϕ

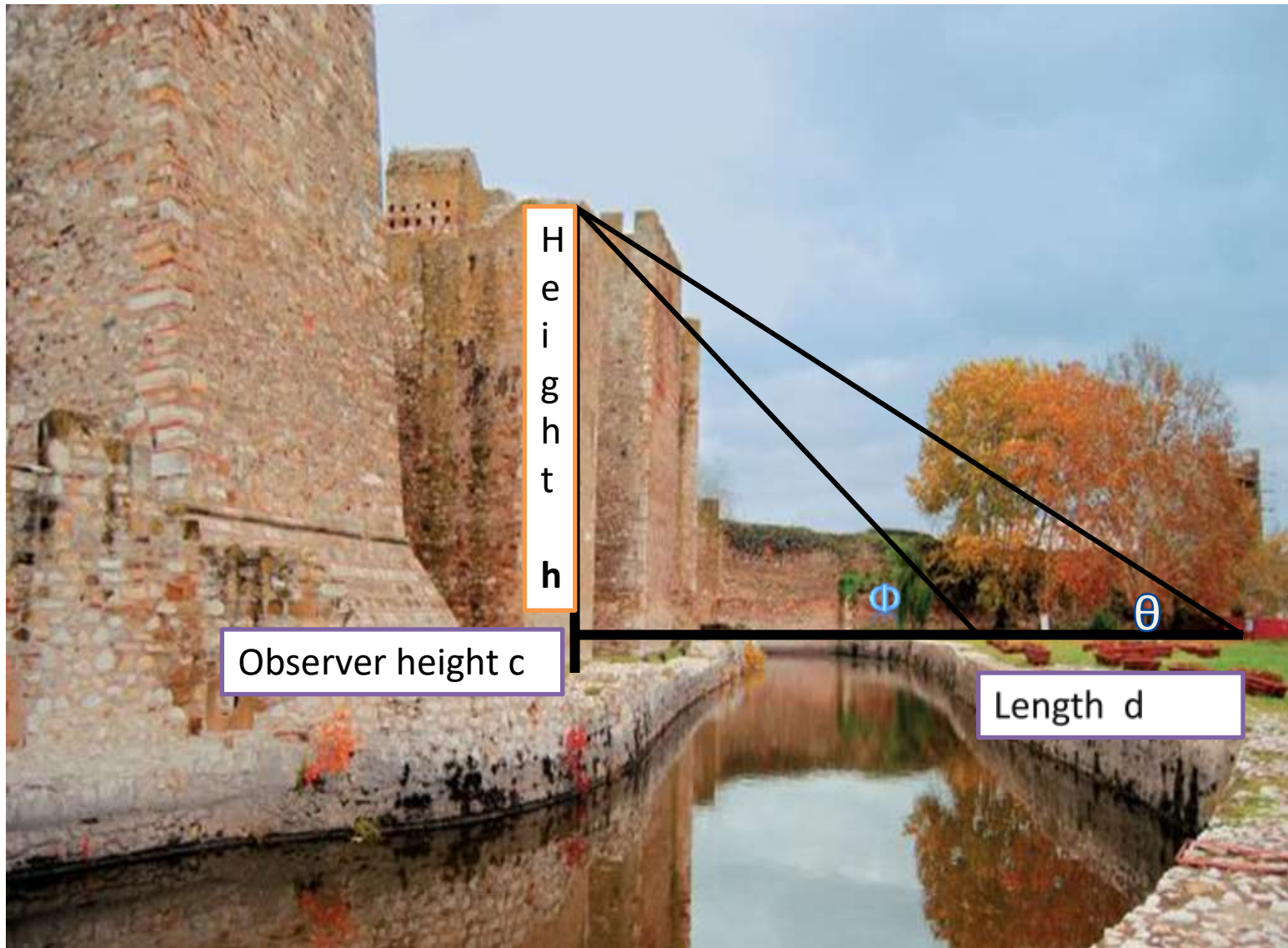
It is easy enough to measure:

- a) Our distance d from the height
- b) The measure of the angle ϕ that we see the building
- c) Our height h

After that with little knowledge of trigonometry and with the help of a calculator we can evaluate the height

Second way Evaluating a height which we can not approach





H
e
i
g
h
t

h

Observer height c

Length d

φ

θ

How can we find the height of the tower if we know only the length d and the angles ϕ and θ ?

You have much time to find this with your knowledge in math.

Don't you solve the problem until now? It's a piece of cake.

I 'll give you the solution , many important people push me

to do this.

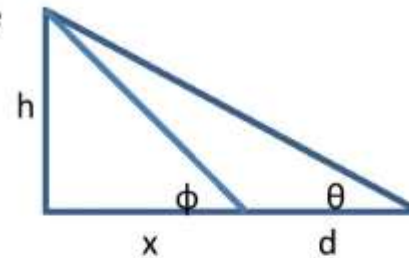


Tasos give us the solution!!!

Otherwise you feel my tremendous anger

Solution

From the right triangles we have



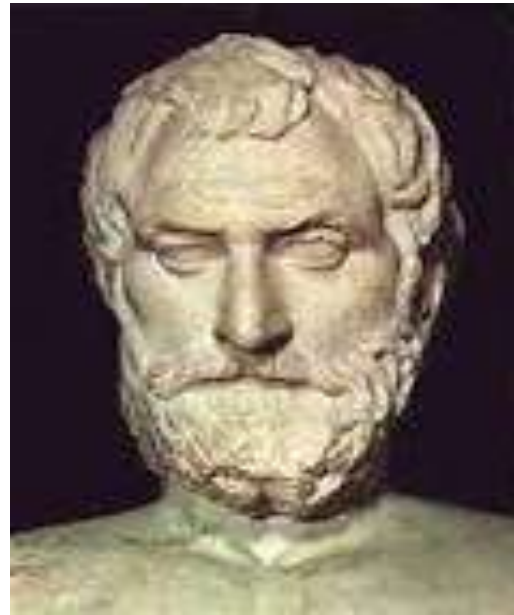
$$\begin{cases} \tan\phi = \frac{h}{x} \\ \tan\theta = \frac{h}{x+d} \end{cases} \Rightarrow \begin{cases} \frac{1}{\tan\phi} = \frac{x}{h} \\ \frac{1}{\tan\theta} = \frac{x+d}{h} \end{cases} \Rightarrow \begin{cases} \frac{1}{\tan\phi} = \frac{x}{h} \\ \frac{1}{\tan\theta} = \frac{1}{\tan\phi} + \frac{d}{h} \end{cases} \Rightarrow$$

$$\frac{1}{\tan\theta} - \frac{1}{\tan\phi} = \frac{d}{h} \Rightarrow \frac{\tan\phi - \tan\theta}{\tan\theta \cdot \tan\phi} = \frac{d}{h} \Rightarrow \mathbf{h = d \frac{\tan\theta \cdot \tan\phi}{\tan\phi - \tan\theta}}$$

Of course, at the end we must not forget to add the height of the observer c . So

$$\mathbf{Height\ of\ the\ tower = h + c}$$

Third way
Do it like Thales of Miletus!!



Some elements of History of maths

We know that the mathematics was first developed by the Egyptians and the Babylonians .

For example in **Rhind papyrus** there 87 problems many of them are simple arithmetic

but there are also problems of area measurement as well as volume measurement.

It seems to know how to solve equations first and second degree.

The Babylonians seem to have known various geometric theorems such as Pythagora's theorem.

they did not formulate the theorems but used them in some applications for calculating lengths and areas.

They also knew how to solve first and second degree equations.

In addition, they knew the meaning of the square root.

But the Egyptian and Babylonian mathematics has an empirical form and a practical purpose!

Thales' era

Thales was born in Miletus in Greek Ionia.

by profession he was a merchant. But he had many interesting.

He was mathematician , astronomer , pre – Socratic philosopher,

Historically he recognized as the first individual in western

civilization known to have entertained and engaged in scientific philosophy.

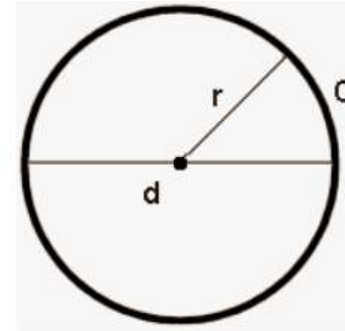
Also he is the first person who wrote mathematic theorems in the way we know today.

Although the theorems are simple for its time it was a great innovation

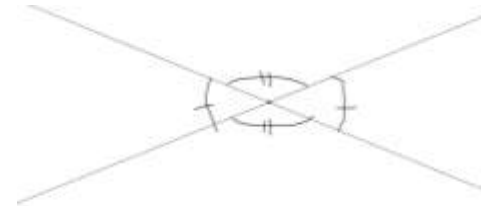


The theorems that he wrote , and some of them he proved are:

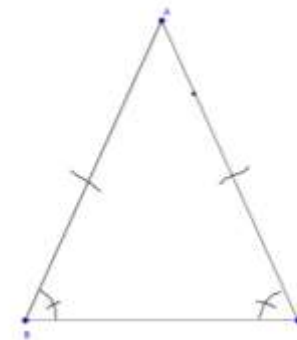
- 1) A diameter of the circle is a straight line drawn through the centre and terminated in both directions by the circumference of the circle; and such a straight line also **bisects** the circle (Proclus, 124). >



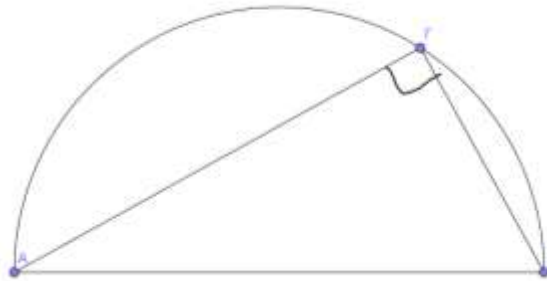
- 2) 'If two straight lines cut one another , they make the vertical angles equal to one another' (Proclus, 298.12-13).



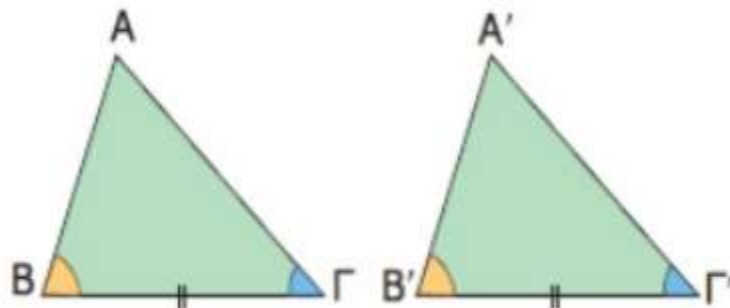
- 3) In an isosceles triangle the angles at the base are equal.



4) 'The angle in a semicircle is a right angle



5) 'If two triangles have the two angles equal to two angles respectively, and one side equal to one side, namely, either the side adjoining the equal angles, or that subtending one of the equal angles, they will also have the remaining sides equal to the remaining sides and the remaining angle equal to the remaining angle'



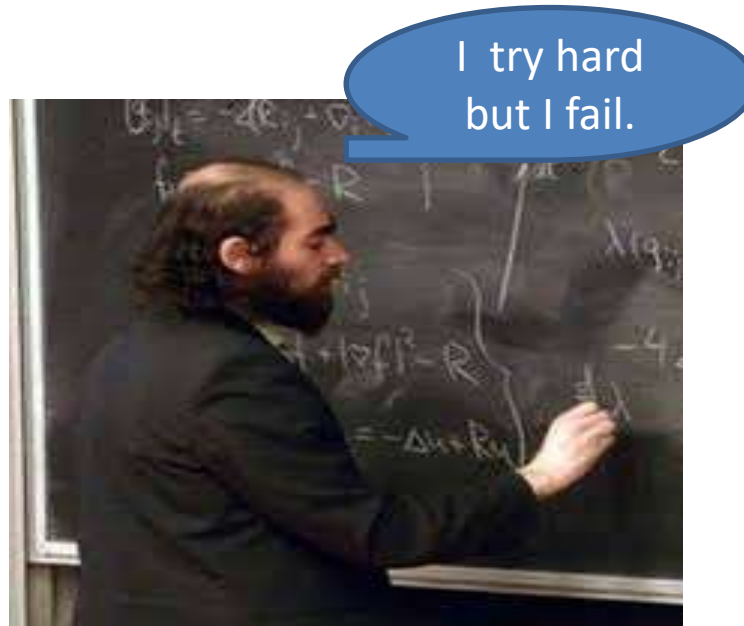
About 600 b.C.

- Thales about 600 b.C. travelled to Egypt and met Pharaoh Amasi.

Amasi challenged Thales to measure the height of his pyramid

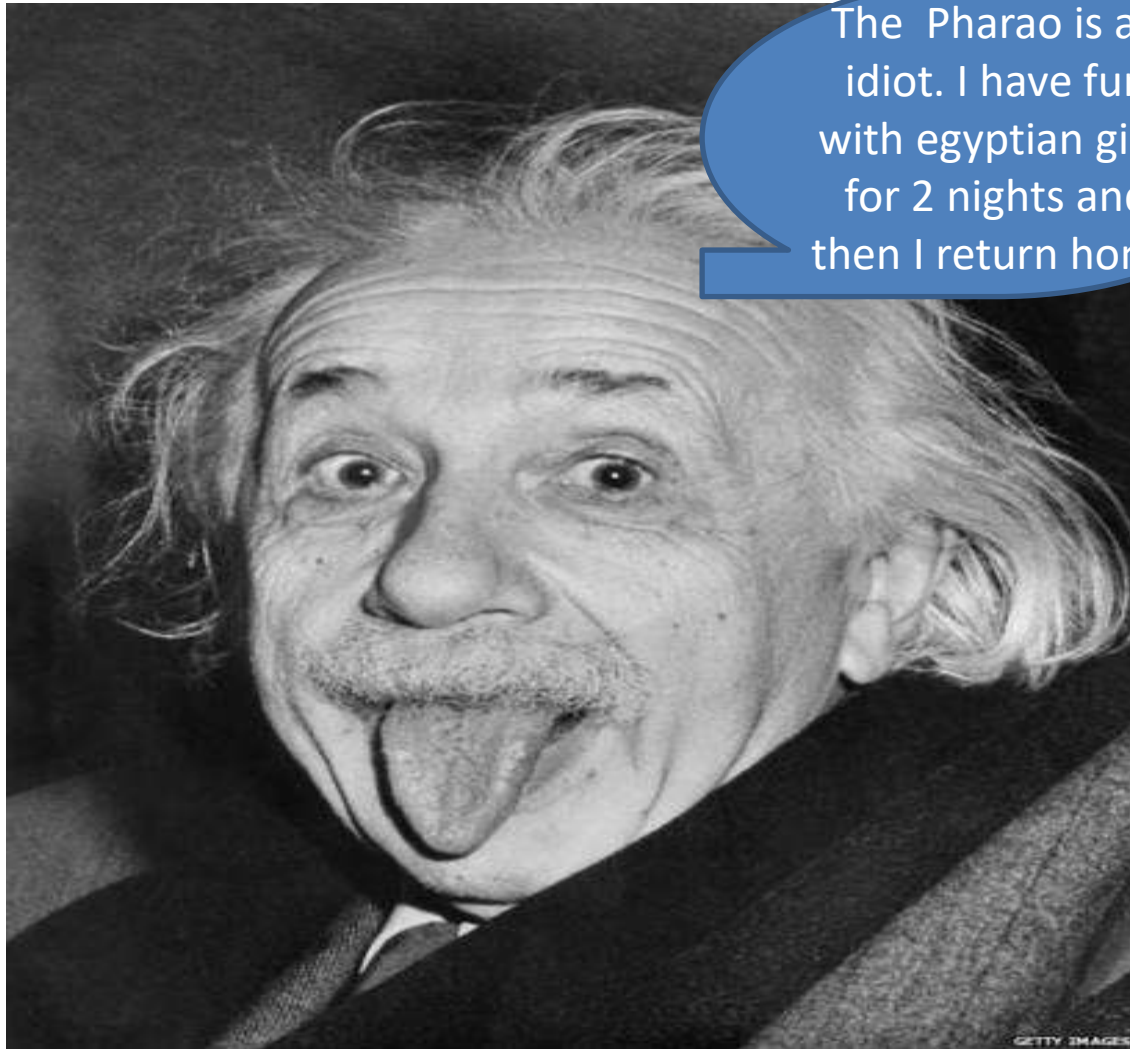


Many people disappointed would say:



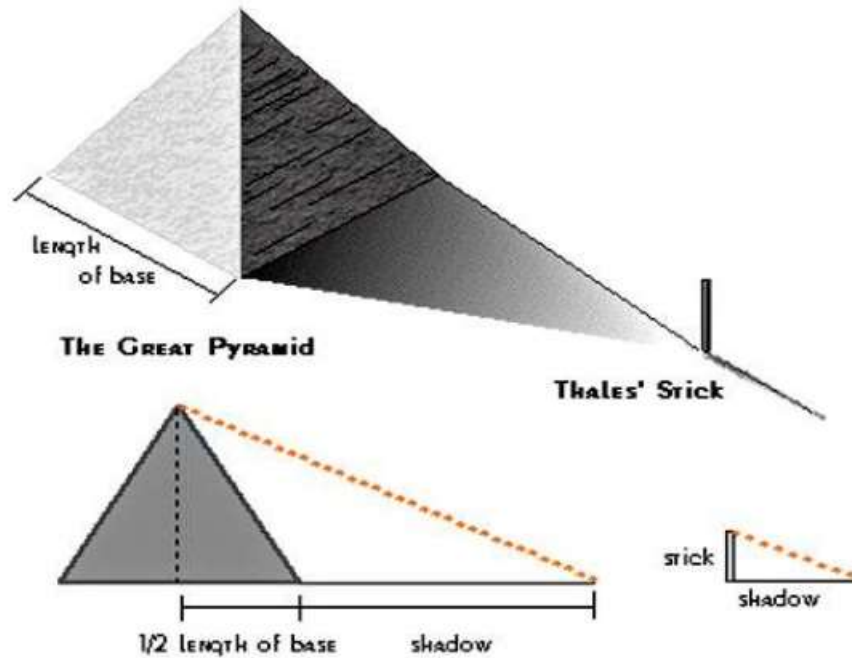
In the photo is one of the most intelligent mathematician of the century, Gregory Perelman (Russian) who solve the **Poincare Conjecture** and in 2006 he denied to take **1.000.000 \$** as a prize from Clay Mathematic Institute

Or someone who is foxy:

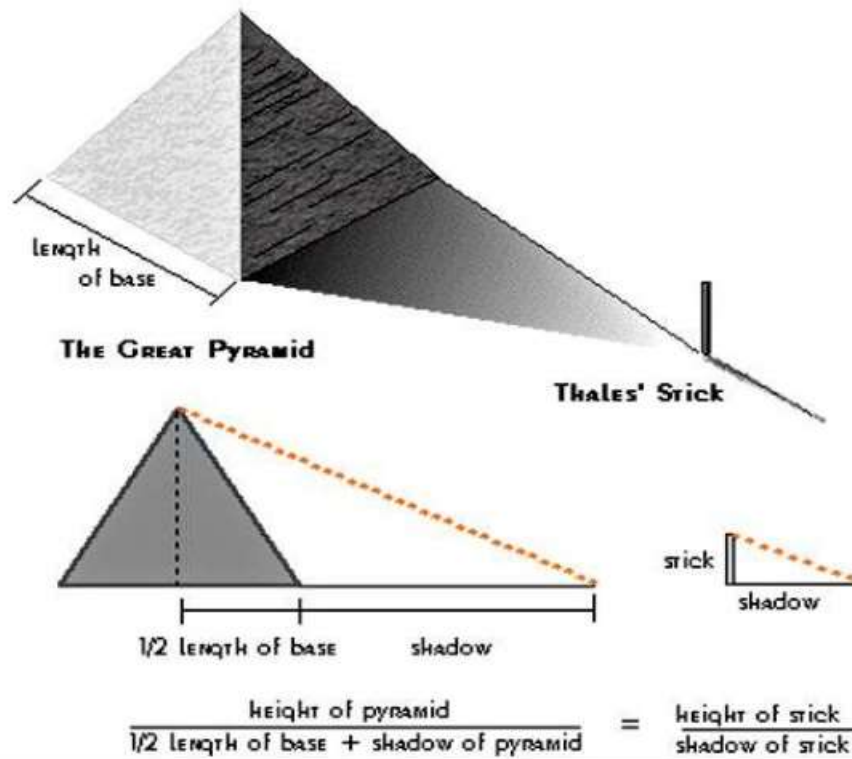


The Pharaoh is an idiot. I have fun with Egyptian girls for 2 nights and then I return home

But Thales succeeded



But Thales succeeded



What must you do?

Only to measure the height of a building near to you with the three ways.

Just separate in teams (every country) and do the three ways.

Solution from Czech teams

1. First way , result:
- 2) Second way , result :
- 3) Third way , result :
- 4) Actual size:

Photo of the building you choose to measure

Solution from Romanian teams

1. First way , result:
- 2) Second way , result :
- 3) Third way , result :
- 4) Actual size:

Photo of the building you choose to measure

Solution from Greek teams

1. First way , result:
- 2) Second way , result :
- 3) Third way , result :
- 4) Actual size:

Photo of the building you choose to measure

Μόνο αγάπη

only love

jediná láska

numai iubire