



# The Trigonometric Expedition

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**Topic:** Mathematics

**Level:** Secondary education (15 years old)

**Concepts:** Trigonometry

**Time required:** +/- 40 min

**Summary of the activity:** Embark on an adventure with Lily and Max as they explore the labyrinth of ancient Egyptian pyramids to rescue their grandpa. Guided by trigonometry challenges posed by gods like Thoth and Ra, they unlock mysteries, uncover connections between ancient Egypt and math, and triumph over Set's chaos to reunite their family!

**Material needed:** Paper, pen, calculator, ruler, math knowledge and... motivation!

### 1

## Introduction

Ancient Egypt had a rich history of mathematics and geometry. Even though they might not use trigonometry in the way we do today, there are connections between their mathematical knowledge and the concepts related to trigonometry. This was well known by Richard, a retired architect, who was passionate with ancient Egypt, since the ancient Egyptians were skilled in construction and architecture, particularly in building structures like pyramids, temples, and tombs. They used basic geometry principles for surveying and laying out these monumental structures. The Egyptians had knowledge of right triangles and used concepts related to angles and ratios to create precise structures.

 **Go to paragraph 5.**

### 2

"I'm sorry", says Thoth, "but your answer is wrong". "Please!" says Max, "we need to find our grandpa! Can you at least let us pass?". "I can't", answers Thoth, "but you are welcome to try again. Remember this:"

$$\sin(30^\circ) = \frac{1}{2}$$

 **Go back to paragraph 12.**

### 3

## A dream awakens



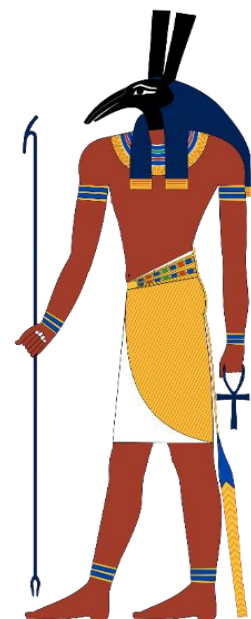
Photo by Nina Aldin Thune, Wikipedia Commons

As the first rays of the sun kiss the majestic pyramids in the Giza pyramid complex, the trio of adventurers marvel at the wonders before them. Grandpa's eyes twinkle as he gestures toward the entrance of the Pyramid of Khufu, adorned with intricate hieroglyphs. "Let's explore," he declares, and they venture into the pyramid's labyrinthine passages. Grandpa's insatiable curiosity leads him to an unmarked crypt tucked away from the main path.

Before he could react, the entrance seals shut, leaving him trapped. The room fills with dense smoke, its tendrils curling around Grandpa. Lily and Max start getting worried. They call for their grandpa to no avail. Suddenly, a chilling laugh echoes through the chamber. From the smoky mist emerges Set, the enigmatic god of chaos.

"Greetings, mortals!", he says in his deep voice.

"Welcome to the Pyramids! I am Set, the god of chaos, and as such, I decided to add some chaos to your adventure-to be fair, it wouldn't be such an adventure



otherwise!" says with a smirk on his face. "Where is our grandpa?" says Lily, "What have you done to him?" shouts Max. "Don't worry" says Set, "he is safe - for now. He is locked in a crypt in the center of the labyrinth. His rescue lies in your hands. You will be shown the entrance to the labyrinth and will work your way to the center. If you make it, the crypt will unlock, and your grandpa will be free!". "Will you give us a map?" asks Max. "No!" answers Set, "but on each crossroad you will be given a problem. If you answer correctly the right direction will be given to you by one of the Egyptian gods!". "And if not?" asks Lily. Set starts laughing again with his chilling laugh and disappears in the shadows.




 **Go to paragraph 12.**

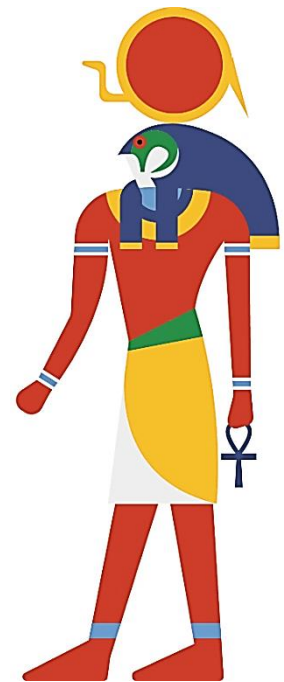
4

### Ra's light

As they journey deeper into the labyrinth, the flickering torchlight reveals the radiant figure of Ra, the sun god. "Greetings, young travellers," Ra intones. "To progress, answer me this: an observer stands 30 meters away from a building and measures the angle of elevation to the top as 45 degrees. Find the height of the building."

Lily and Max exchange knowing glances. With a gleam in his eye, Max says, "The building's height is \_\_ meters!"

- 20 m  **Go to paragraph 15.**
- 30 m  **Go to paragraph 13.**
- 60 m  **Go to paragraph 7.**



5

### The adventurous trio

Richard's passion for ancient Egypt was known amongst his friends and family, and especially his grandchildren Max and Lily, with whom he had a special bond. Max and Lily used to spend their summers at their grandpa's house in the hills, since their parents were working, and school was closed.

There, they spent a lot of time in Richard's library, reading books about the Egyptian gods and ancient architecture. Along with the tales their grandpa spun around campfires and the countless bedtime stories, harboured their fascination with ancient Egypt – a passion ignited by the mystique of the pyramids and the enigma of the ancient Egyptian gods.

Richard always talked about visiting the pyramids together one day when they had the chance to view the glory of this ancient civilisation with their own eyes, something that had become Max and Lily's dream. This summer was different - Richard had finally found the opportunity to fulfil his promise. When the siblings came back from school on the last day for summer vacation, Richard was waiting there with a surprise. They would go to Egypt!



**Go to paragraph 3.**

6

"I'm sorry", says Thoth, "but your answer is wrong". "Please!" says Max, "we need to find our grandpa! Can you at least let us pass?". "I can't", answers Thoth, "but you are welcome to try again. Remember this:"

$$\sin(30^\circ) = \frac{1}{2}$$



**Go back to paragraph 12.**

7

"I'm afraid you cannot pass", says Ra to their disappointment. As he sees the despair in the kids' eyes, he says: "Remember the tangent of 45 degrees is 1, right?"

 **Go back to paragraph 4.**

8




### Anubis' guidance

Their footsteps echo off the stone walls as they reach the next crossroad, where they encounter Anubis, the jackal-headed guardian.

"Only those who grasp the Law of Sines may proceed," Anubis intones. "In a triangle with angles 30, 60, and 90 degrees, where the side opposite the 30-degree angle has a length of 6 meters, calculate the length of the hypotenuse."

Max's brow furrows as he traces the angles in the air with his finger. Lily whispers, "The hypotenuse is \_\_\_ meters."



- 12 m  **Go to paragraph 24.**
- 13 m  **Go to paragraph 17.**
- 14 m  **Go to paragraph 10.**

9

“That’s correct!” says Thoth as his eyes glow with approval. “The right way to the crypt is on your left.”, he says. Then he disappears.

 **Go to paragraph 4.**

10

Anubis shakes his head negatively. He takes out a papyrus and hands it to them. Max opens it and finds out it’s empty. The kids look at him, puzzled. He looks at them back dead in the eye and says, “Draw the triangle”.

 **Go back to paragraph 8.**

11

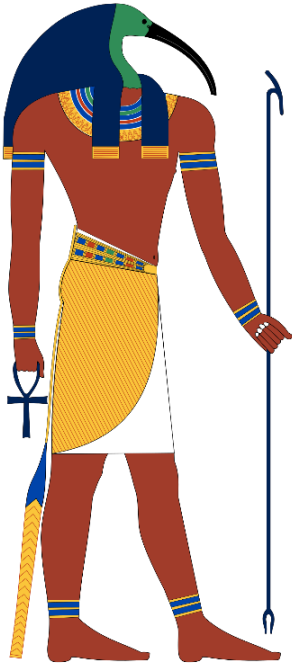
Set starts laughing again, like he is taking pleasure at the kids’ confusion. “It seems like you don’t want to save your grandpa enough” he says. “That’s unfair!” Max shouts, “This problem is too hard!”. “Oh, come on” answers Set, “Who doesn’t know that  $\cos 60^\circ = \frac{1}{2}$ ?”

 **Go back to paragraph 20.**



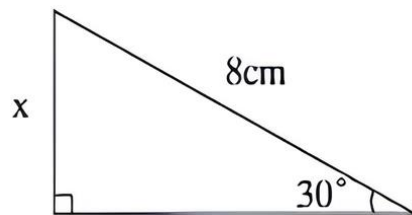
12

### Thoth's wisdom



As the room clears from the smoke and the kids find themselves at the start of the labyrinth, their hearts pound with both fear and a strange anticipation. They had always yearned for the secrets hidden within these ancient walls, and now they are part of their enigma, just as they had dreamed. The air is thick with their knowledge, their years of research, and their grandpa's whispered stories. Undaunted by the predicament, Lily and Max, guided by their grandpa's legacy of fascination, embark on a quest to save him. Armed with torches, they follow the winding paths of the labyrinth. At the first crossroad, they encounter Thoth, the god of wisdom.

"To pass, you must solve my riddle," Thoth declares as he hands them a papyrus with the following problem:



Find the value of x in the following triangle:

As Max's fingers dance over the paper, his calculations mirroring those his grandpa had taught him, Lily looks at the picture, a smile playing on her lips.

"The value of x is \_\_", Lily exclaims!

- $x = 2$            **Go to paragraph 6.**
- $x = 3$            **Go to paragraph 2.**
- $x = 4$            **Go to paragraph 9.**

13

“That’s right!” says Ra. “You must turn right”, he instructs them as his smile illuminates their path forward, revealing intricate carvings on the walls that seem to dance in the torchlight.

 **Go to paragraph 8.**

14

“You should give it more thought” says Osiris. Max, looking exhausted, begs him to show them the way. “No”, says Osiris, “the rules are rules. What is the cosine of the  $\omega$  angle?”, he asks. The kids start working on the problem again.

 **Go back to paragraph 16.**

15

“I’m afraid you cannot pass”, says Ra to their disappointment. As he sees the despair in the kids’ eyes, he says “Remember the tangent of 45 degrees is 1, right?”

 **Go back to paragraph 4.**

16

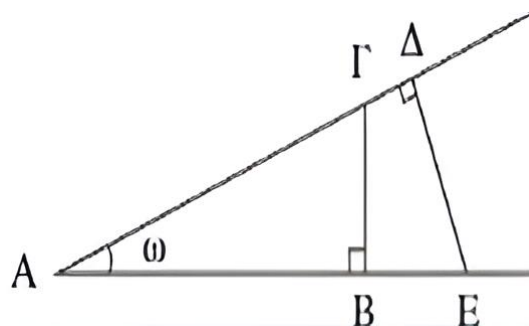
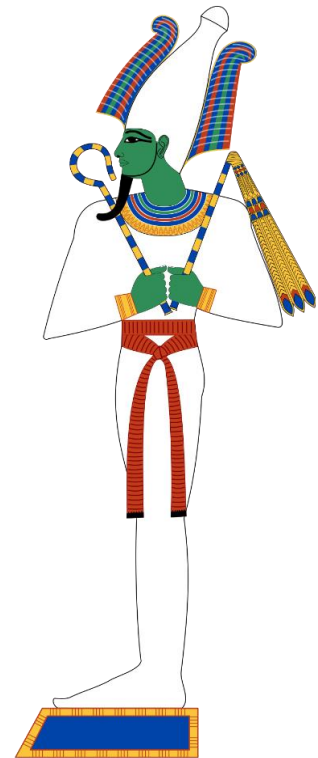
## Osiris' test

Navigating through the depths of the labyrinth, they feel they are getting closer to its heart. At the next crossroad they encounter Osiris, the Egyptian Lord of the Underworld and Judge of the Dead, God of fertility, agriculture, the afterlife, the dead, resurrection, life, and vegetation.

"Your journey nears its end," he says with his strong voice, handing them a papyrus. "Solve this problem and you will meet your grandpa soon".

Max opens the papyrus which contains the following problem:

"On the following shape,  $AG=5$ ,  $BG=3$ , and  $AE=12$  cm. Calculate the distance  $\Delta E$ ."



Lily's eyes sparkle as she works through the calculations in her mind. "The distance is\_\_\_," she answers with confidence.

- 10.4 cm **Go to paragraph 14.**
- 12.3 cm **Go to paragraph 21.**
- 7.2 cm **Go to paragraph 23.**

17

Anubis shakes his head negatively. He takes out a papyrus and hands it to them. Max opens it and finds out it's empty. The kids look at him, puzzled. He looks at them back dead in the eye and says, "Draw the triangle".



**Go back to paragraph 8.**

18

### The reunion

As the door creaks open, their grandpa emerges, his eyes twinkling with gratitude and pride. "My brave adventurers, you've rescued me!" Their joyful embraces filled the chamber, and Grandpa marveled at their journey. "Your knowledge and teamwork have proven invaluable," he says. "But remember, the challenges weren't only in the labyrinth but in your hearts as well."



**Go back to paragraph 22.**

19

Set starts laughing again, like he is taking pleasure at the kids' confusion. "It seems like you don't want to save your grandpa enough" he says. "That's unfair!" Max shouts, "This problem is too hard!". "Oh, come on" answers Set, "Who doesn't know that  $\cos 60^\circ = \frac{1}{2}$ ?"

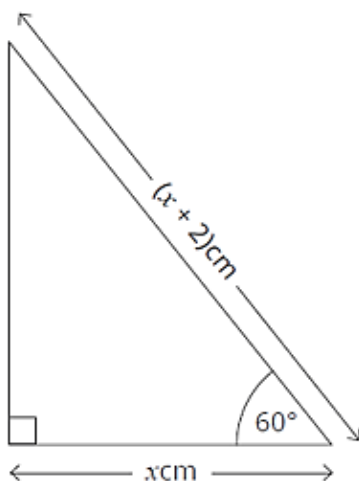


**Go back to paragraph 20.**

20




## The final problem

Emerging from the labyrinth, Lily and Max find themselves before the entrance to the crypt. With their hearts pounding, they push the door to set their grandpa free. To their surprise, the door won't move. The place fills again with smoke and the atmosphere becomes cold. Through the shadows, the figure of Set starts forming. "Did you think it would be that easy?" he asks with a grin on his face. "You tricked us!" says Lily. "Not at all", answers the god, "I just have a final problem for you" says and hands them a papyrus. Lily takes it and reads the following problem:



A right-angled triangle has a hypotenuse of length  $(x+2)$  cm and one of the shorter sides is  $x$  cm. The angle between these two sides is  $60$  degrees. What is the length of the hypotenuse?

This problem seems harder than the previous ones. The kids, determined to save their grandpa, take their time to figure it out. After discussing between them, Max says: "We have the answer. The length is \_\_\_ cm."

- 4 cm            **Go to paragraph 25.**
- 5 cm            **Go to paragraph 19.**
- 6 cm            **Go to paragraph 11.**

21

“You should give it more thought” says Osiris. Max, looking exhausted, begs him to show them the way. “No”, says Osiris, “the rules are rules. What is the cosine of the  $\omega$  angle?”, he asks. The kids start working on the problem again.

 **Go back to paragraph 16.**

22

Photo by  
Ricardo  
Liberato



As they stand outside the pyramid's entrance, Lily and Max gaze at the horizon, forever changed by their adventure. Their journey through the labyrinth had not only tested their trigonometry skills but had also forged a deeper bond between them. The lessons they learned and the memories they created would forever illuminate their path through life's labyrinth, guiding them with the brilliance of discovery, the power of family, and the legacy of the ancient gods' challenges. Set's malevolent laughter still lingers in their memory, a reminder of the forces that sought to disrupt their quest, but their resilience and knowledge had triumphed over chaos. In their hearts, the echoes of their grandpa's passion intertwine with their own, a legacy that would continue to inspire generations to come.

**The end**

23

"That's correct!" says Osiris with a smile. He points his crook and flail to the right, showing them the right direction.

 **Go to paragraph 20.**

24

Anubis nods solemnly, and his hand points them towards the left path. As they continue walking, the walls seem to shift and morph, revealing hieroglyphics and drawings bathed in an eerie blue light.

 **Go to paragraph 16.**

25

Set's chilling laugh fills the room once more. "Well, kids, you are correct this time, but you better keep practising; the next time won't be this easy", he says and vanishes into the shadows once again. The room lights up and the door starts opening.

 **Go to paragraph 18.**



Designed by 6 European organisations, the project intends to create efficient, engaging pedagogical materials and tools for teachers in order to implement an innovative gamified Homework methodology with pupils. In doing so, we wish to contribute to boosting their efficiency and engagement rate in remote work and, more specifically, in Homework.

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