THE 2023 YOUNG MATHEMATICAL STORY AUTHOR (YMSA) COMPETITION

THE CINDY NEUSCHWANDER AWARD
(THE 12-15 YEARS OLD CATEGORY)

LONGLISTED

'June's Trigono-Adventure!' by Malka Shiyad (15 years old)
at Sharafuddin School (Maldives)

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#YMSAMaths

June's Trigono-Adventure!

By Malka Shiyad Shaugy

Sharafuddin School

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June is a soon to be hero who is a trainee at one of the most renowned superhero academies of all time.

On this particular day she was walking down the cobblestone path to her home after school when she heard someone call her name.

"June! Wait for me!"

She turned around to see her close friend Maya running towards her.

"Maya? What's wrong?" said June, after Maya had caught up with her. Maya was panting and took a minute to catch her breath before speaking.

"Ethan just told me a villain had captured Penelope!" she said. Her brow was furrowed and she was fiddling with her hands.

"Where are they now?" June asked, her eyes widening. She had met Penelope at the academy and they had been friends since.

"At the abandoned tower near here" Maya's voice trembled as she replied.

June gasped. That tower had been abandoned a long time ago because of the crocodiles that inhabited the moat around it.

"Have you reported this yet?" June asked.

"Yes, Ethan has, but it's not likely anyone'll be able to come quick," Maya replied. "They're all busy with another incident that's gone on around the time this happened"

June was silent for bit. "Then should we just...go ourselves?" she said finally. She glanced at Maya to see her reaction.

"That's what I was thinking too," she groaned, covering her face with her hands. "But we haven't even finished our training and we might get in serious trouble"

June agreed. "But say, we didn't go and something bad were to happen to Penelope..." she said slowly. Her statement seemed to hang heavy in the air.

"Alright," Maya said, breaking the silence. "Let's go. It's within walking distance so we can get there quickly if we hurry."

The two made their way to the tower as fast as they possibly could.

"Look! There it is." Maya said, pointing to a run-down tower in the distance that looked like it was about to crumble at any second. There were a few crocodiles lounging in the shore, basking in the sun, and the moat surrounding the tower was a muddy green colour.

They crouched behind some bushes in hopes that the crocodiles wouldn't be able to see them, and discussed the rescue plan.

"Ok," June started, "We've no chance of getting across the moat with the crocodiles there, so our best bet would be to get to the top somehow"

"Exactly," Maya replied. "I've got about 40 meters of rope with me so we can maybe attach it to your crossbow grappling hook and you can shoot it to the top"

"I'm not even going to ask why you have 40 meters of rope with you just on hand"

"It pays to be prepared." Maya said, grinning.

"But the thing is we don't know whether the distance from the top of the tower to where we are is more or less than 40 meters," said June.

"Maybe we can use some math to figure that out." Maya said, taking out her notebook and a pen from her bag.
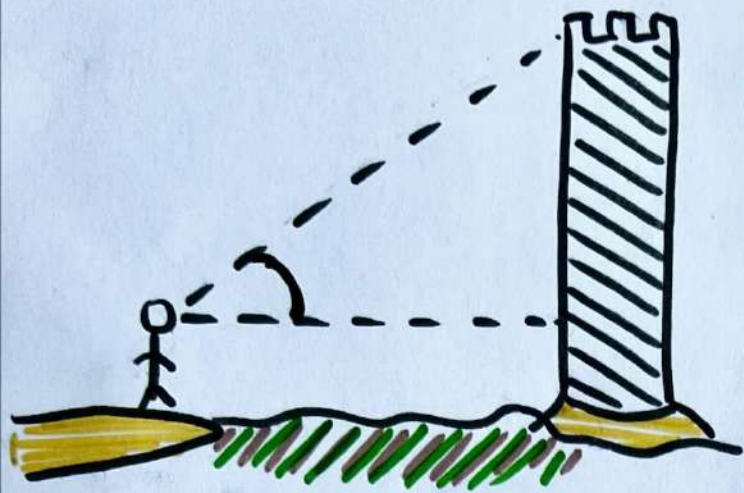
"Math?" June scrunched up her nose.

"Oh c'mon" Maya laughed. "Just listen!"

"We're going to use trigonometry. More specifically something called angle of elevation," she began. "Trigonometry deals with the angles in a triangle and its sides."

"Then what's angle of elevation?" asked June.

"Angle of elevation is simply the angle that is formed between the horizontal line of sight and the line from the object to the viewers eye."
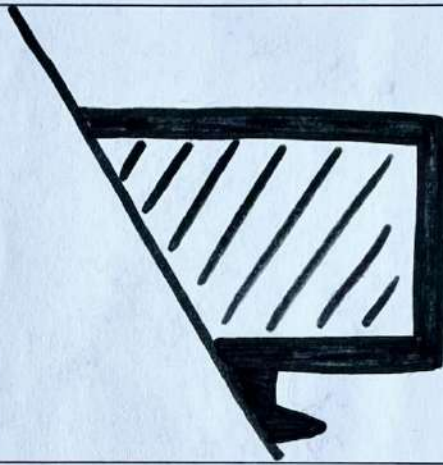
"Using the angle of elevation, we're going to calculate the distance from the top of the tower to our line of sight" Maya continued.

"Oh, so first we need to find the angle?" pondered June.

"Yes, and before that we need the height of the tower and the distance from the base of the tower to us." Maya replied, taking out her earpiece. "And luckily I know exactly who to ask."

Maya asked Ethan about the information they needed and he gave it to them right away.

"...so, the height of the tower is 30 meters high and it's 22 meters away from you guys." Ethan said.
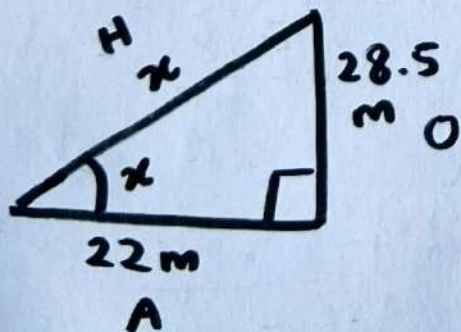

"Now we need to find the angle," Maya said, handing the notebook to June. "We currently have measurements of the opposite and adjacent sides of the triangle so we are going to use the tangent function."

"But since we want to know the distance from eye level, we have to subtract our height from the height of the tower to get an approximate value, don't we?" said June.

"Yes exactly"

"Tan is equal to opposite over adjacent," June muttered, writing it down. "Substitute the values, take tan inverse and done!"

$$h = 30 - 1.524$$
$$= 28.5 \text{ m}$$

$$\tan \theta = \frac{o}{A}$$
$$\tan x = \frac{28.5}{22}$$
$$\tan^{-1} 1.3$$
$$= 52.4°$$

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"Now we find the distance from the tower," Maya said. "Since we are finding the hypotenuse side, we can either take the sine function or the cosine function."
"I'll take cosine then. So cos is equal to adjacent over hypotenuse," said June.
"Now I'll just substitute the angle and values"

$$\cos \theta = \frac{A}{H}$$

$$\cos 52.4 = \frac{22}{x}$$

$$\frac{\cos 52.4}{1} \times \frac{22}{x}$$

$$x \cos 52.4 = 22$$

$$\frac{x \cos 52.4}{\cos 52.4} = \frac{22}{\cos 52.4}$$

$$x = 36 \, m$$

"36 meters!" said June, smiling widely.
"I'm so glad we have enough rope," said Maya, feeling relieved. "Now we just have to get up there and save Penelope."
June attached the rope to her grappling hook crossbow and got ready to fire it.
"Remember not to let go of me or you'll fall into the moat." June said, just before they went whizzing through the air. They made it to the top safely and went down a few flights of stairs through a trap door.

They stopped in front of a door they heard a sound from.
"What do we do?" whispered maya. "Do we break the door down?"
"I don't think that's necessary," June chuckled. "let's just equip ourselves and take them by surprise."
"Great idea."

"Get ready to go in one...two...three!" said June as she flung open the door.
"PENELOPE!" Maya yelled. "WE'VE COME TO SAV- "
Her words stopped abruptly at the sight she saw.

Penelope was sat there in the middle of drinking tea with a puzzled look on her face. A girl wearing a green cape and braids was sitting in front of her and they were at a table in front of a window overlooking the hills behind the tower. The table was filled with an assortment of delicious looking pastries and desserts.
"What are you guys doing here?" asked Penelope.
"We thought you'd been captured by a villain!" said June. "Are you alright?"

"Did you just call me a villain?" the girl wearing the cape asked, her eyes narrowed.
"Are you?" Maya said hesitantly.
"No! absolutely not!" she said.
"This is my dearest friend, Cindy!" Penelope laughed, "And I'm quite fine. Cindy, meet June and Maya."
"Nice to finally meet you?" Cindy grumbled.
"Uhm nice to meet you too I suppose." Maya said sheepishly.
"Cindy and I came here to say hi to the crocodiles." said Penelope. "Why did you guys think I'd been captured?"
"Well, Ethan told me he heard you screaming." Said Maya.
 "Oh that must've been when I snuck in on her from behind to surprise her" Cindy chuckled. "She was definitely not expecting it!"

"So it was all for nothing?" maya said, slumping into a chair. "What a wasted effort!"
"At least we learned a lot of things today." June sighed.

They went home after having some tea and told Ethan about what happened.
"How did you guys get back though?" he asked.
June and Maya looked at each other and burst out laughing.
"It turns out the crocodiles are actually nice," said June gleefully.

June is an aspiring hero who always ready to help out a friend in need. One day she ends up having to do just that after her friend Penelope is captured by a villain. June and her close friend maya work together to devise a plan and save Penelope with the help of trigonometry. Will they be successful?

About the author

My name is Malka and I am 15 years old. I'm from Maldives and I go to sharafuddin school. I enjoy learning math and writing so I had a lot of fun making this.