**THE 2024 YOUNG MATHEMATICAL STORY AUTHORS (YMSA) COMPETITION**

**THE CINDY NEUSCHWANDER AWARD**

**(THE 12-15 YEARS OLD CATEGORY)**

# SHORTLISTED

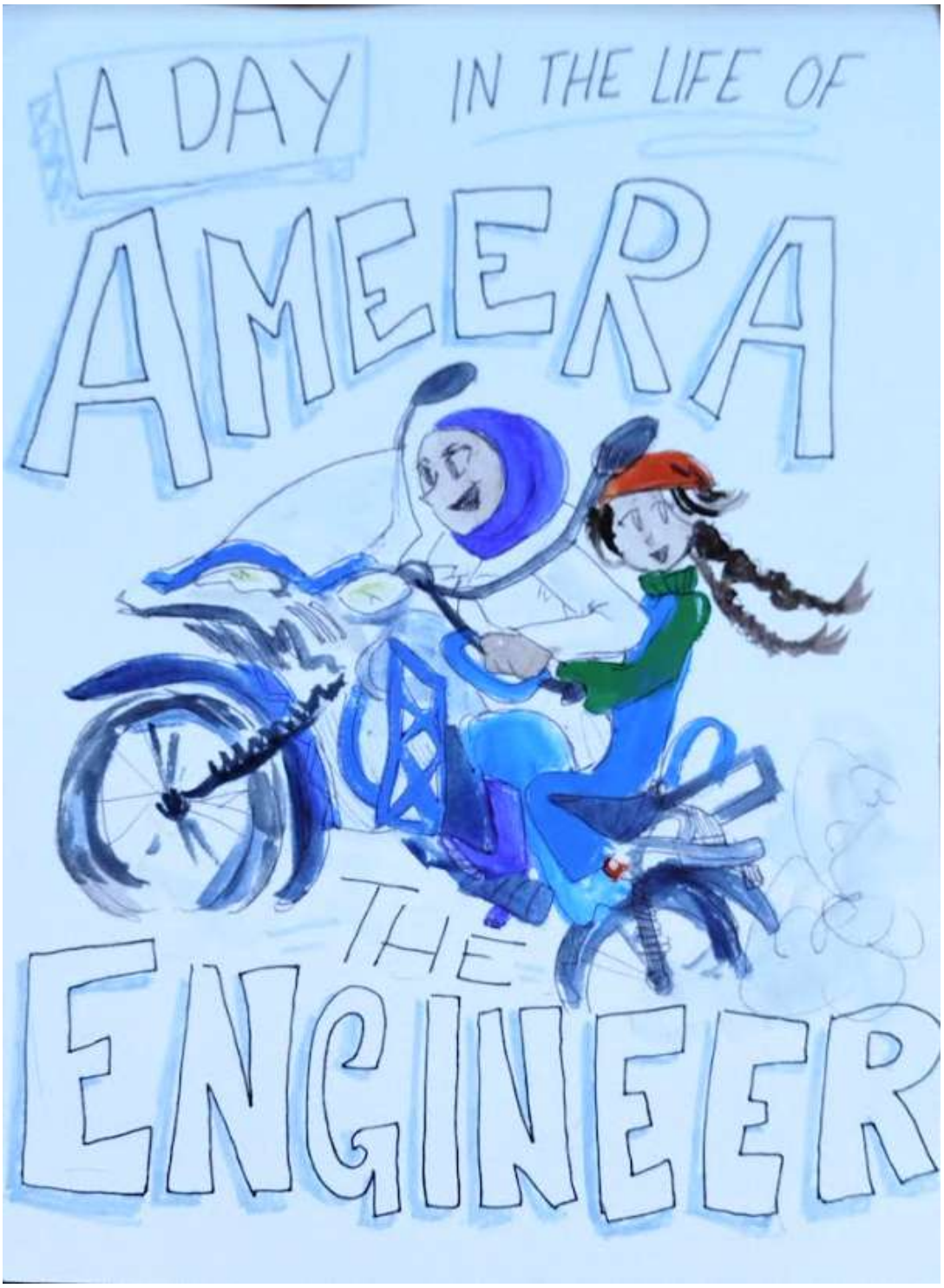
‘A Day in the Life of Ammera the Engineer’ by Jeem Naseer (15 years old)

at Sharafuddin School (Maldives)

You can read the author’s inspiration for the story and the judges’ comments on:

**www.mathsthroughstories.org/ymsa2024**

**#YMSAMaths**




By Jeem Mohamed Naseer
Sharafuddin School

The sun dawned bright and early. The birds sang and the wind danced. It was take-your-younger-sibling-to-work day!

However, Quraysha wasn't feeling so happy about it. Her sister Ameera was an engineer. And everyone knew they used maths all day, everyday, for the most useless things imaginable!

(In Quraysha's opinion, maths was really boring.)

Mami was clearing up after breakfast. 'Cheer up Quraysha! I'm sure Ameera's job is pretty exciting.'

'Maths isn't exciting, Mami...' Quraysha said.

'It doesn't matter! You shouldn't look so sad about spending some quality time with your sister,'

*HONK HONK!*

'There she is! Now have you got your helmet?'

'Yes Mami..'

'Smile, sweetheart! Your sister's gonna be so excited to see you again,'

'Okay Mami. Love you!'

Quraysha hugged Mami, got her helmet and left.

Outside, she saw a lady in a blue hijab and a white coat on a blue motorbike. When she saw Quraysha, she got off and waved. That must be Ameera! She'd changed so much!

'Quraysha?? Is that you? Oh look how tall you are now! I love your braids, did you do them yourself?' Ameera grinned.

'Yeah!' Quraysha smiled. 'Your ride is really cool. Can you do a wheelie on it?'

'Yes, actually! I've managed to wheelie up to 1.45 metres high' she grinned again.

'Wait.... How do you know?' Quraysha asked. 'Did someone measure the height, or...?'

'Nope. It was all maths!'

'Maths? But it's so useless!' Quraysha frowned.

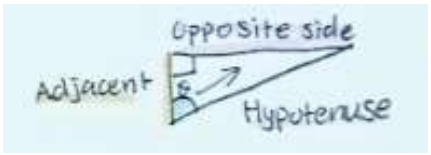
'Oh! You certainly won't think that after today...' Ameera said.

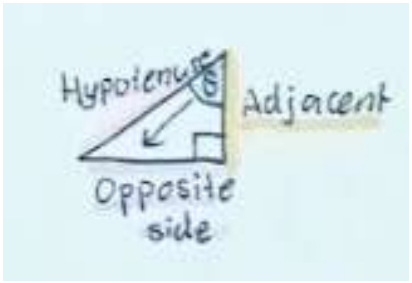
'Let me introduce you to a branch of maths called trigonometry... take these Maths-Vision goggles! You'll need these!''

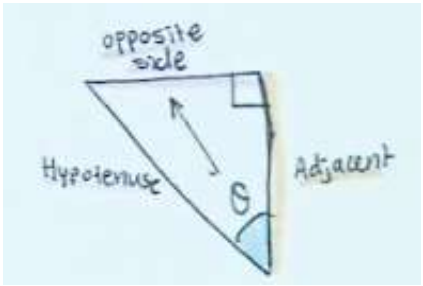
‘Trigonometry is a branch of maths related to right angle triangles and their properties. I use trigonometry all the time while doing my job.’ Ameera explained.

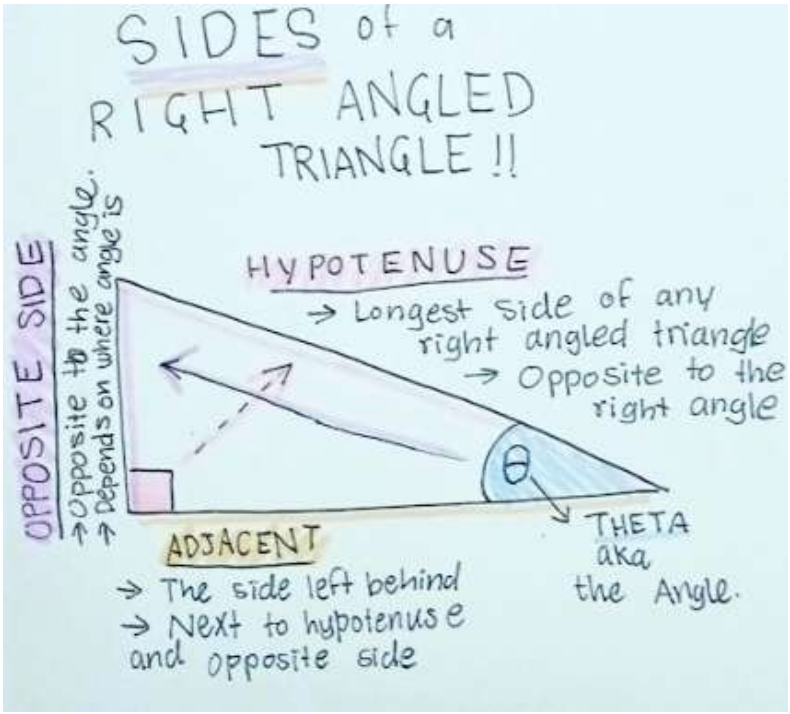
‘Right angled triangles are the triangles with one right angle, right?’ asked Quraysha.

‘Yes, precisely! Their sides have names- that's how special they are. See here?’
Quraysha turned on her Maths-Vision goggles. They projected an image of a labelled right angled triangle into the air.




‘Right angled triangles pop up everywhere! You wouldn't believe it, really.’ Ameera continued.
‘The special thing about right angled triangles is that if they have the same acute angle, the ratios of their sides will be the same.

‘For example-for any right angle triangle with the angle 60 degrees, the ratio of opposite to hypotenuse is always 0.866.’
‘Really?’ Quraysha asked.
‘Yeah! You can try it out later! It's cool isn't it?’

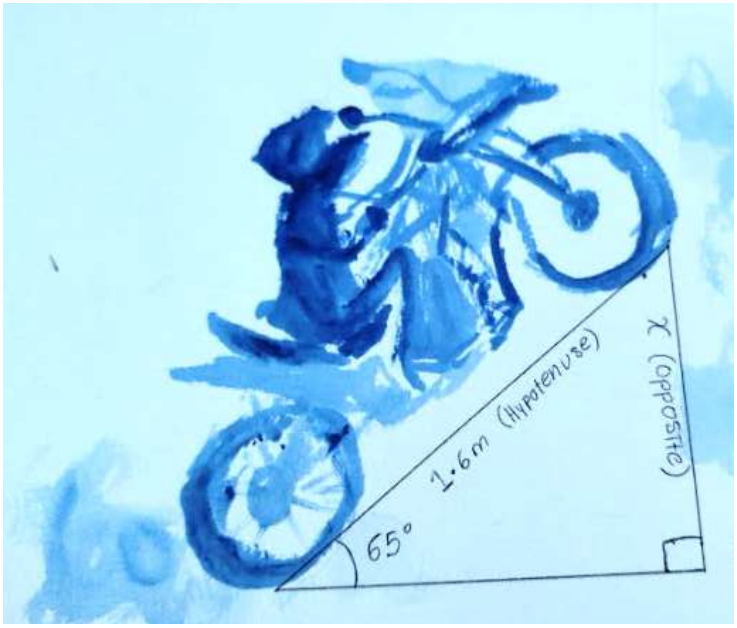
‘Mathematicians discovered that there are three ratios of a right angled triangle.

‘Sin, which is the ratio of opposite side to the hypotenuse- we write it as sin theta (aka the angle) = Opposite side/Hypotenuse
Cos, which is the ratio of adjacent to hypotenuse- cos theta = Adjacent/Hypotenuse
And tan, which is the ratio of opposite to adjacent- tan theta = Opposite/Adjacent

‘An easy way to remember the ratios is using the mnemonic Soh-Cah-Toa!

| |
|---|
| Sin θ = Opposite/Hypotenuse<br>Cos θ = Adjacent/Hypotenuse<br>Tan θ = Opposite/Adjacent |

‘The cool thing is, these ratios will be the same for all right angled triangles everywhere! If we know the value of one side and one angle of the triangle (besides the right angle of course) we can find the missing value.’




‘Okay back to the question at hand. How did I find out how high the wheelie was?’

‘See this amazing shot of me doing a wheelie?’
It was projected on the goggles.
‘When you connect the wheels with the ground it forms.. You guessed it- a right angled triangle.’ Ameera laughed.

‘We know the value of the hypotenuse of the triangle, which is the distance between the wheels of the bike- it’s 1.6 metres’ she pointed at the diagram. ‘The height of the wheelie forms the opposite side of this triangle.’

Let's look at our triangle again. Here, we can use the ratio sin to find the opposite side, aka the height.
Lets plug in the values to the formula!
Sin theta = o/h

Sin 65 = o/1.6  -to find o, we have to cross multiply, so
O = sin 65 x 1.6
O= 1.45m

So, that's how I found out how high I can wheelie! Not too difficult, right? Now hop on!
~
'Here we are!' Ameera took off her helmet and smiled. They had arrived at the University of Maths.


'This place is pretty cool! What are we gonna do here?' Quraysha asked.
'Well, my friend Andy is an aerospace engineering student, and he needs help with his homework! There he is now, waving at us.'


Ameera introduced Andy to Quraysha, then asked him about his homework.

'Well.. I need to figure out how far one litre of fuel can carry my spaceship model,' Andy said. 'This project's worth half our grade...'

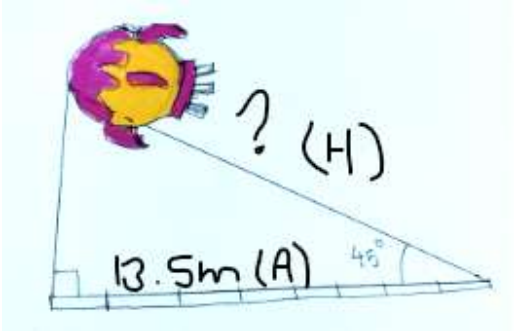
'Did you try launching it parallel to the ground and measuring the distance with a measuring wheel?' Ameera asked him.

'That's the issue- I can't! The engine has to take off at a 45 degree angle. The professor was very strict about that bit for some reason...' he explained, taking them to his set-up.

*WHOOOSHH*
'There she goes!' he smiled,
'WAIT-DUCK!!'
But it was too late- a brightly coloured rocket shot out from god knows where and took off a chunk of machinery strapped to Ameera's bike.

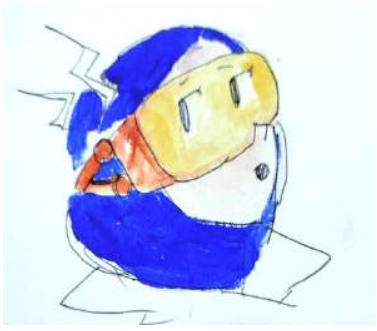
‘There goes my sat nav..’ she muttered.
‘Anyway, back to the problem at hand.. Let’s record some measurements, everybody!’
Andy collected the rogue rocket and readied it for launch. Quraysha laid out a tape measure, and Ameera recorded with her maths vision goggles.

As they were reviewing the footage, Quraysha noticed something.
‘Hey, that looks like a right angled triangle! Ameera, can we use trigonometry to find the distance the rocket travelled?’
‘Bingo! Andy, can I borrow your clipboard for a second?’
‘Sure.’
Ameera drew a sketch of the rocket.
‘Here, this is the launch angle, at 45 degrees. That angle is theta. The distance we measured was 13.5 metres long- that's the adjacent side of this triangle. And the distance the rocket travelled- before it fell, of course- is the value we need to find.’




‘Is that the opposite side, Ameera?’ Quraysha asked.

‘You see, it's opposite to the little box, (which represents the right angle) so it’s the hypotenuse. Remember, the side opposite to the right angle is always the Hypotenuse, but the Opposite side is always opposite to the angle.’
‘Quraysha, can you figure out which trigonometric ratio we need to use?’
She thought for a minute. Which ratio had both adjacent and hypotenuse? She remembered the mnemonic SohCahToa...
‘Oh! It's cos!’ she smiled.
‘Yes! You’re right. Lets plug in the values into the formula...’
Cos theta = a/h
Cos 45 = 13.5/h now, we cross multiply
cos 45 x h = 13.5 -divide both sides by cos 45 to find the value of h!
h= 13.5/cos 45
19.09 metres
‘So one litre of fuel can carry my rocket 19.09 metres! Thank you so much Ameera!’ Andy smiled.



‘You're welcome my friend,’ Ameera smiled back. ‘Come on Quraysha, we just got another call!’

~

‘*Take another left turn- blep beep burp- another right turn through the next forest- beeeeeep*’


‘Ameera... i think your sat-nav might be broken..’ Quraysha said.

‘Oh? So that's why it's been making such weird noises.’ Ameera stopped the motorbike. They were in a green forest, in the middle of who knows where. ‘I suppose that rocket must have done some real damage. My sat nav is supposed to be unbreakable!’

‘Now what do we do? Do you have a map somewhere?’ Quraysha asked.

‘I do... but we need to find out where on the map we are first.’ Ameera said, opening the trunk of her bike. ‘Can you spot any landmarks? We could figure out where we are then.’

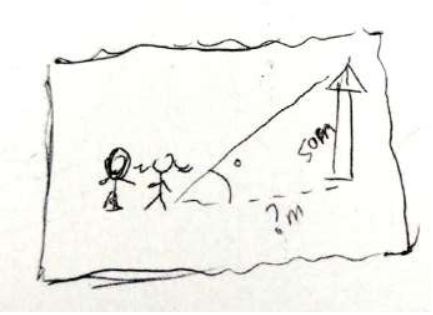
Qurysha spotted a large white tower. ‘That seems like a landmark,’

Suddenly, an idea popped into her head. ‘Ameera? Do you know how tall that tower is?’

She poked her head out of her bike’s trunk. You mean The Big Belltower? It's 50 metres tall. Why do you ask?’

‘We could use trigonometry to find out how far away we are from the tower! That could work, right? Oh.. but we need to know the angle between the top of the tower and our location right now...’

‘You perfect little genius, Quraysha! That's a great idea! My goggles have a new feature that could help with finding the angle…’ Ameera took off her maths vision goggles and laid them on the ground and said, ‘Find angle of elevation!’




‘*65 degrees!!*’ the goggles said.

‘Here's a notebook, let's sketch it out!’ Ameera said, taking one out of her bike.
‘The height of the tower is the opposite side, since the angle of elevation is opposite to it. The distance between us and the tower is the adjacent side. So the ratio would be…’

‘Tan!’ Quraysha said excitedly. She was finding it easier and easier to remember the ratios now!

‘Lets plug in the values then…’

Tan theta = o/a
Tan 65 = 50/a -cross multiply…
Tan 65 x a = 50 -divide both sides by tan 65…
A = 50/tan 65
A = 23.3 metres away from The Big Belltower

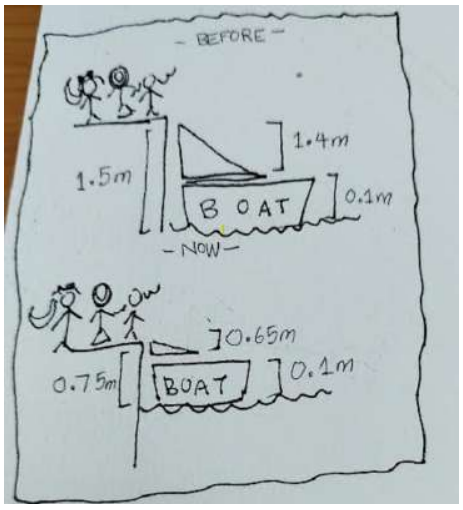
Ameera found their location on her map, and they swiftly rode out of the green forest.
~

‘What are we doing at the harbour, Ameera?’ Quraysha asked.

‘My friend Adhfa asked us to meet her here.’ she replied. ‘She’s a famous athlete, and her brother is one too. He was training for the Paralympics, last time I heard! I guess being sporty runs in the family. Here she is!’
After introducing Quraysha to Adhfa, Ameera asked her what happened.

‘Well, my brother was playing a football match overseas, when he broke his prosthetic leg. He’s coming back this evening on a wheelchair! There aren't any ramps at this harbour, so I made him one- but the tide changed, and now the ramp is too low!’


‘Don't worry, we can make him a new one! First, we need to take measurements.’ Ameera whipped out her trusty tape measure and made her way to the harbour. Adhfa and Quraysha tagged along.
‘What was the tide level before?’
‘A metre and a half.’ Adhfa replied.
‘Hmm... the tide has gone up- now it's at 0.75 metres.’ Ameera observed.
‘The height of the boat is about 0.10 metres,’ Adhfa added helpfully.



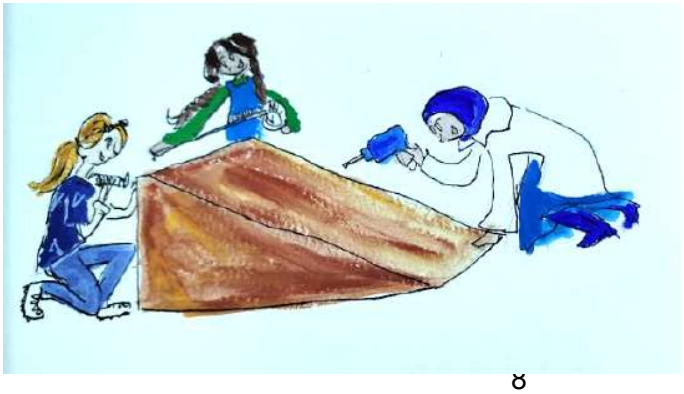

‘When in doubt, make a sketch! Let me draw it out.’ Adhfa and Quraysha looked over Ameera’s shoulder as she drew a quick sketch of the harbour, boat and the ramp on her notebook.

‘The angle of elevation on the ramp has to be 5 degrees, to make it safe.’ Ameera explained.
‘The distance between the harbour and the tide right now is 0.75 metres. When the height of the boat, 0.1 metres, is subtracted, we get 0.65 as the height the ramp should be!’

‘We have to use trigonometry to find the length of the base of the ramp,’ Quraysha said. "We have to use tan. That's because the base of the ramp is the adjacent side, and the height of the ramp is the opposite side!’

‘Look at you, getting the hang of it! I'm so proud of you Quraysha! Come on, let's plug the values in together.’

Tan theta =o/a
Tan 5 = 0.65/a -Quraysha: we cross multiply here!
Tan 5 x a = 0.65 -now we divide both sides by tan 5
A = 0.65/tan 5
a=7.4 metres.



‘Now that we know the dimensions of the ramp, let's get to making it!’ Ameera said. Together, Ameera, Quraysha and Adhfa made a good, sturdy ramp- and just in time too!

‘Here comes the boat!’ Quraysha said. ‘The captain is telling us to lower the ramp!’

It was done, and everyone was glad to find that it fit perfectly.

‘Whoa! ‘ said Adhfa’s brother, Ayham. ‘This might just be the best fitting ramp I have ever tried wheelchairing on. Who made it?’

The three girls proudly announced that they had.

‘It was all thanks to trigonometry!’ Adhfa told her brother.

‘Really? I thought trigonometry was really useless!’ he was surprised to know.

‘It's really interesting, when you learn how to use it!’ Quraysha smiled.

~

‘So was your day as boring as you thought it would be, Quraysha?’ Mami asked, as she tucked her in that night.

‘No! Actually, maths is really interesting. I learned a lot today! All about triangles and trigonometry...’

Mami laughed. ‘See, I told you!’

BLURB

It’s take-your-younger-sibling-to-work-day! Quraysha’s sister Ameera is an engineer, and takes Quraysha on an adventure. Together, they use trigonometry to launch rockets, escape from a forest, and solve all kinds of problems!

ABOUT THE AUTHOR

I’m Jeem, a mathematical story author and future engineer from Maldives! I’ve always wanted to be an engineer, but I didn't have many role models to look up to in that field. My goal was to write a story where a hijabi engineer inspires and helps others to solve problems in their lives, using maths of course!