



**THE 2021 YOUNG MATHEMATICAL STORY AUTHOR (YMSA) COMPETITION**

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

**SHORTLISTED**

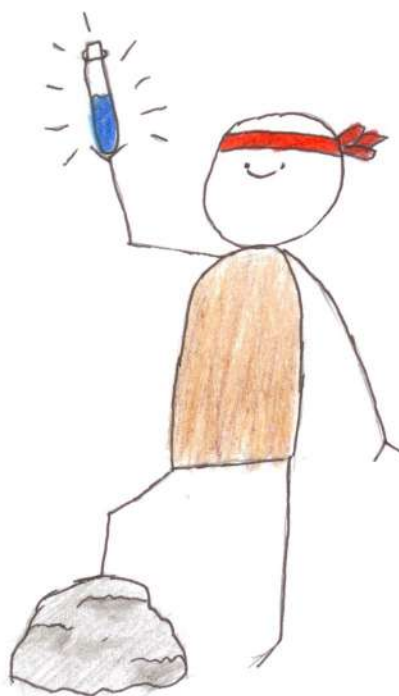
‘Timmy Tom Tom's Trigonometry Adventure’ by Michael Wong (13 years old)  
at Glen Cairn Public School (Canada)

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

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**#YMSAMaths**

Timmy Tim Tom's  
Trigonometry Adventure

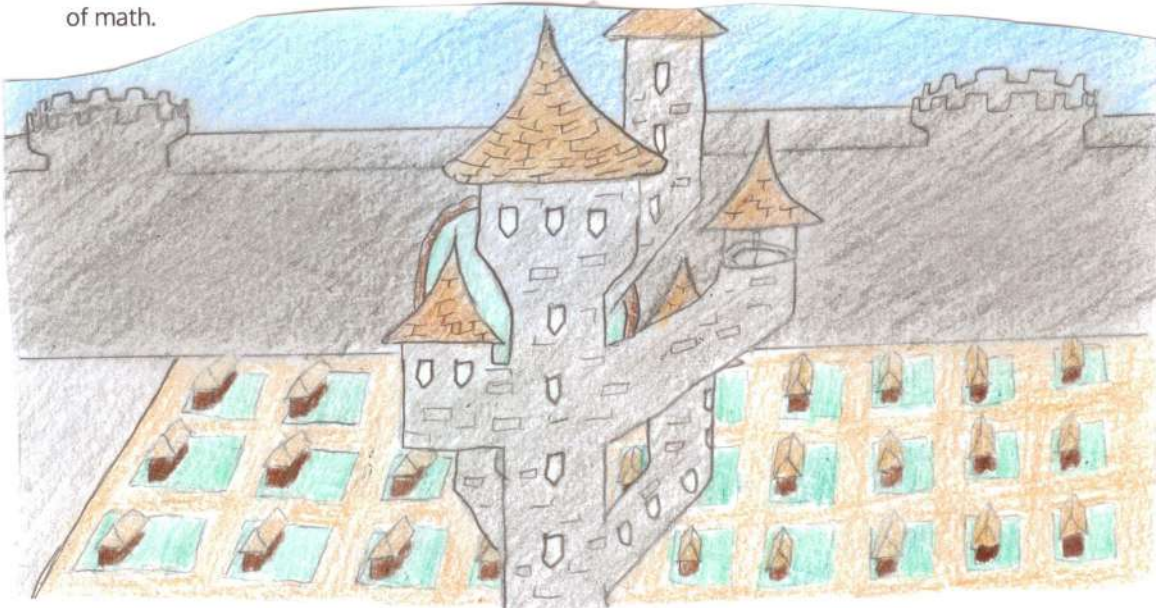


By: Michael Wong, GCPS

It was a warm, sunny day in the mythical land of MonkaS. Flocks of bright-coloured birds soared through the cloudless afternoon sky. The cries of children playing and merchants advertising were faint over the vast, rolling hills bordering the vivacious town of Pogville. On a beautiful day such as this, who wouldn't be outside?

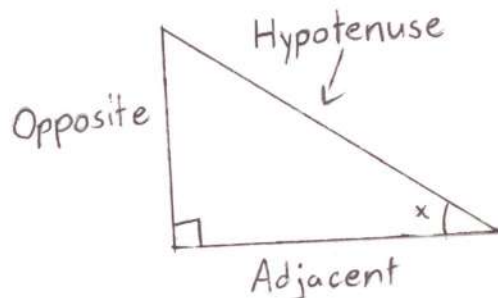
Well, one person wouldn't.

Near the outskirts of the town stood a brick-and-wood tower, a monolith in a city of ants. With various, seemingly gravity-defying extensions, something of this grandeur would cast shadows and block out the sun, much to the neighbours' dismay. There had been several petitions to demolish it, but none of them went through—and for good reason. This was the residence of Scoobalee Bopadoo, a renowned and intelligent wizard who specialized in the art of math.



However, it was Scoobalee Bopadoo's apprentice Timmy Tim Tom that stood on the top floor. He was rubbing his chin while reviewing the trigonometry concepts Scoobalee had recently taught him. Timmy's parents had died when he was very young, so he was quite lucky that Scoobalee offered to take him in.

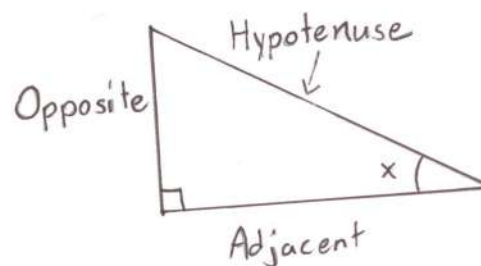
"Alright...so, in a right triangle, the three sides are the **hypotenuse**, **opposite**, and **adjacent**," Timmy mused out loud. "The hypotenuse is the side opposite of the right angle. The opposite is the side across from a given angle other than the right angle. The adjacent is the side next to said angle.



"Epic. Now explain sine, cosine, and tangent," Scoobalee spoke nonchalantly as he seemingly materialized from the shadows.

Timmy started to scribble on the notepad in front of him. "**Sin(x)**, **cos(x)**, and **tan(x)** are the different ratios of two sides on a right triangle. **Sin(x)** is the ratio of the **opposite** to the **hypotenuse** for any angle (x). **Cos(x)** is the ratio of the **adjacent** and the **hypotenuse** for any angle (x). **Tan(x)** is the ratio of the **opposite** to the **adjacent** for any angle (x)."

$$\begin{aligned} \sin(x) &= \text{opposite} / \text{hypotenuse} \\ \cos(x) &= \text{adjacent} / \text{hypotenuse} \\ \tan(x) &= \text{opposite} / \text{adjacent} \end{aligned}$$



"Awesome. And their inversions?" Scoobalee pressed on, not skipping a beat.

"The inversions of sin, cos, and tan are **arcsin**, **arccos**, and **arctan**, respectively. These do the reverse of their normal equivalents; for example with **sin**, you need to **input an angle** to get the **ratio of the opposite and hypotenuse**. However, for **arcsin**, you need to **input the ratio of the opposite and hypotenuse** to get the **angle**. The same applies to arccos and arctan—"

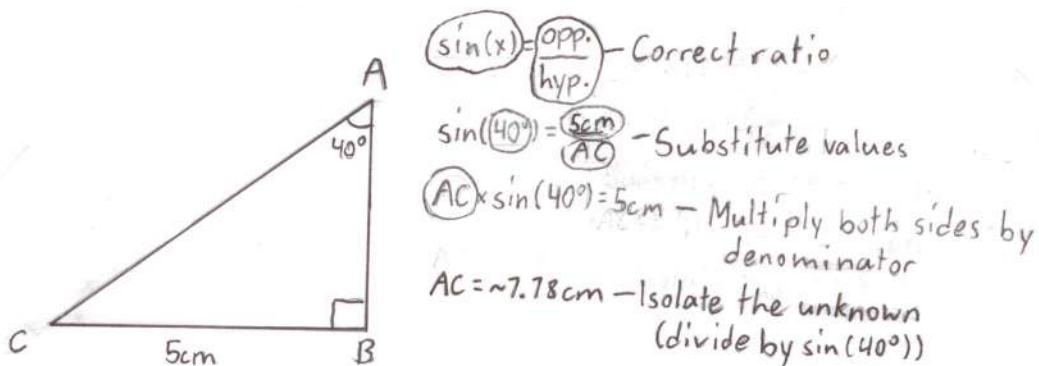
$$\sin(x) = \text{opposite/hypotenuse} \quad \cos(x) = \text{adjacent/hypotenuse}$$

$$\arcsin(\text{opposite/hypotenuse}) = x \quad \arccos(\text{adjacent/hypotenuse}) = x$$

$$\tan(x) = \text{opposite/adjacent}$$

$$\arctan(\text{opposite/adjacent}) = x$$

"Cool. Practice question for ya," Scoobalee interjected. "If I have a right triangle ABC where angle A is 40 degrees, and line BC is 5cm, what is the length of the hypotenuse?"



"Marvelous," Scoobalee congratulated. "Math is pretty wild innit, Timmy?" Timmy just nodded in response.



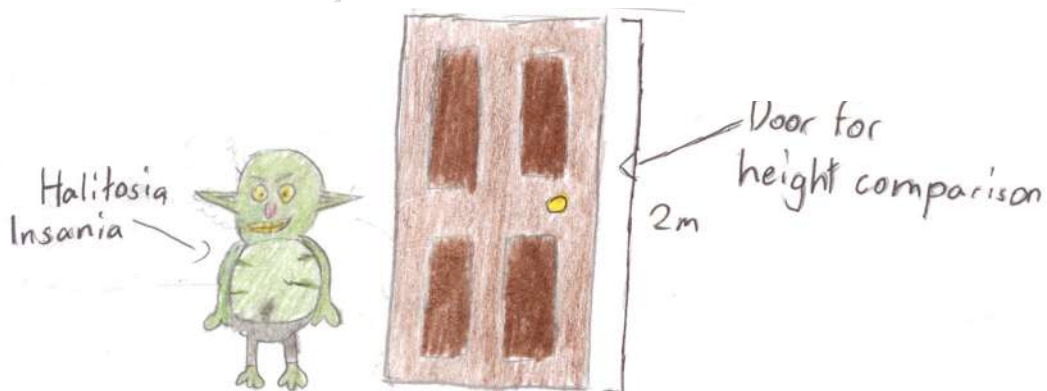
"Anyhow, you've done enough math for today. Go outside and soak up them rays, buddy! Roll down the hills or something, I don't know! Have fun!" suggested Scoobalee.

"Alright, see ya later, Master Scoobalee!" Timmy yelled as he dashed down the spiral staircase. It wasn't until late at night that Timmy returned to the now-quiet abode. Tiredly walking up the stairs to his bed, he couldn't shake the feeling that something bad was going to happen.

It was the bright, golden rays from the sun that woke up Timmy the next morning. The beams illuminated individual dust particles and painted the room a warm, yellow colour. It was peaceful, and yet Timmy's mind was immediately racing. The ground floor was quiet, not even an aroma of breakfast; Scoobalee Bopadoo should've been up and about by now. This, combined with the unshakeable sense of foreboding, was enough for Timmy to jump up and dash to his door.

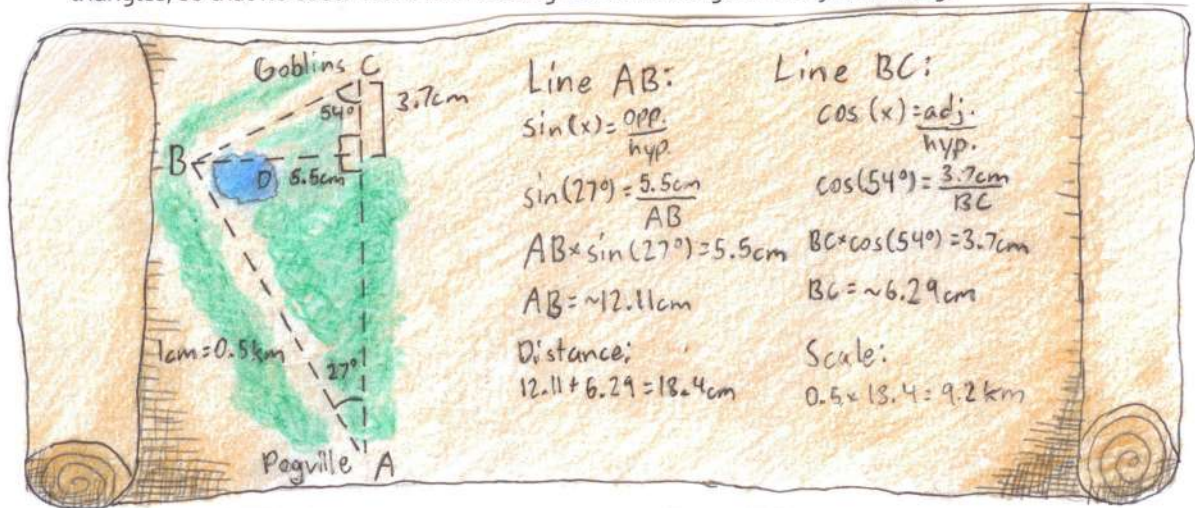
"Master Scoobalee! You in there?" Timmy shouted, knocking on the door. The loudest silence of Timmy's life pierced the air.

Timmy barged in, and the sight confirmed his suspicions. Scoobalee was on the floor, face down and unconscious. Timmy immediately dashed down the spiral stairs towards Alice, the Head of the knights. The perimeters closed. Scoobalee was taken to Lisa the healer. It didn't take long for the knights to apprehend a suspicious goblin trying to scale the walls, and following some...*advanced interrogation techniques*, they learned the culprit was Halitosia Insania, a master assassin for the Goblins, and the antidote was protected in the Goblin Base.

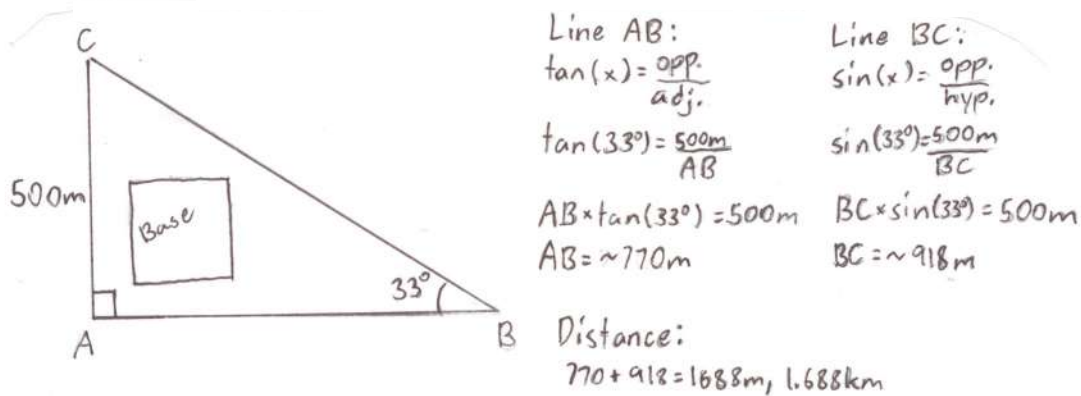


Timmy knew that while the knights in a coordinated attack could probably overwhelm the Goblins, there simply wasn't enough time. So, he started to plan a solo stealth mission using his prowess in trigonometry bestowed upon him by the great Scoobalee Bopadoo.

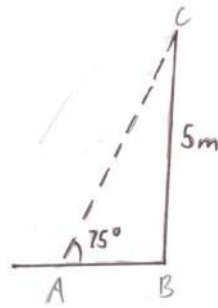
First and foremost, he needed to plan the route he'd take to the Goblin Tribe. The forest blocking the direct path to the Goblin Base was too thick to traverse, and so he needed to find the length of the long way around. Timmy made a 5.5cm line that split the triangle into 2 right triangles, so that he could work with it using his current trigonometry knowledge.



After that came the most important part of the plan: getting into the base. Recent scouts revealed the patrol routes for the guards. He would be approaching the base from the west, and once the guard turned the corner, Timmy would have until the guard came around from the other side in order to execute his plan. It was imperative that Timmy knew how much time he had before the guards would notice something was off. Thus, Timmy needed to calculate the length of lines AB and BC so he could estimate how much time he had.



Estimating he had about 15 minutes, Timmy moved on to step 3. The scout also revealed that the surrounding walls were 5m high. Never being a very proficient rock climber, Timmy needed to figure out how long of a ladder he needed if he propped it up at a 75 degree angle.



Ladder length:

$$\sin(x) = \frac{\text{opp.}}{\text{hyp.}}$$

$$\sin(75^\circ) = \frac{5\text{m}}{AC}$$

$$AC \times \sin(75^\circ) = 5\text{m}$$

$$AC \sim 5.18\text{m}$$

With this information in hand, Timmy was finally ready to set off on his journey for retribution. And so, as a streak of bright orange was painted on the horizon, Timmy exited the gates of Pogville with a ladder in one hand and a bow and arrow in the other. He ventured determinedly into the dark abyss of curled branches and overgrown shrubs. At the turn he was careful to avoid the octopus monster Tentaculus Fibroculus, who was currently enjoying a tea party with his best buddy, Murcofulus Lophophoria. Timmy jogged the final stretch of the woods as the bubbly, gurgly noises of the octopuses faded into the pitch-black sky.





After the longest hour of his life, Timmy could finally see the glimmer of the silvery moonlight filter through the abundance of the abnormally thick leaves on the trees. Lights from the Goblin Base were soon apparent, and Timmy knew this was it. Reviewing the operation as well as approximately how long he had, Timmy rushed to the walls, placed his ladder, and hastily put his plan into motion.

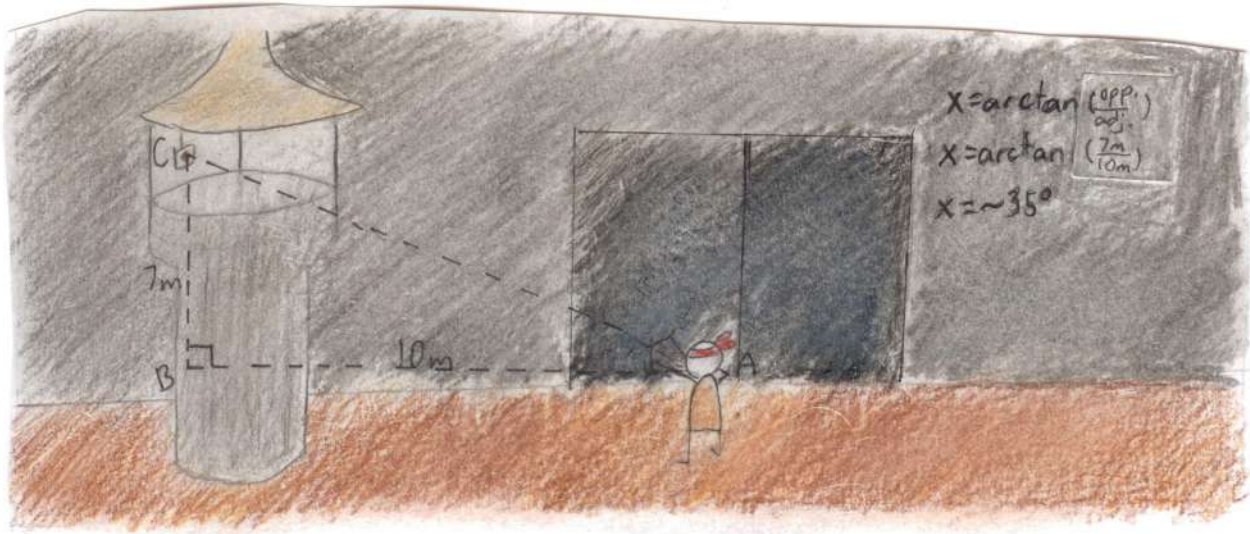


After a smooth run, Timmy had a wrench thrown into his plan. Fortified metal doors, which were undocumented by the scouts, stood between Timmy and the antidote. Timmy started to panic. It wasn't much longer before the guard would turn the corner again and notice his ladder, and if that happened then Timmy would be in some hot water.

After much searching, Timmy decided to try the only thing he had found: a wooden button up in a tower, which he hoped would unlock the door. As for how to press it, Timmy needed something that was on him currently, and that had a lot of range.

Luckily, his bow and arrow fit that job perfectly.

However, Timmy needed to find the correct angle to shoot his arrow so that it would hit the button. He estimated that the distance between him and the tower was 10m, and the height of the tower from his point of view to the button was 7m.



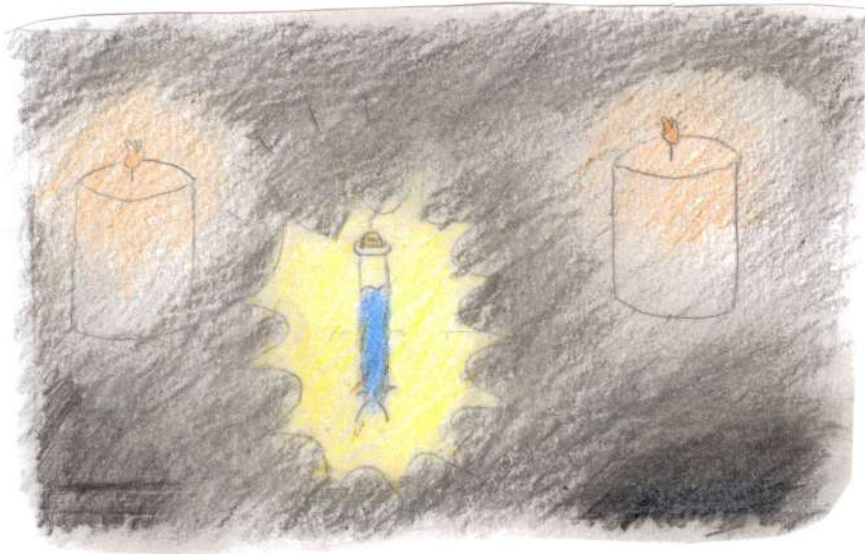
Timmy aimed his bow at a 35 degree angle. He closed his eyes and let go of the bowstring, praying that this button would open the doors.

A sharp crack from the arrow darting through the air.

A thwack.

A loud thump.

When Timmy opened his eyes the metal doors were open, revealing the antidote in a clear vial. The light from the blue, luminous liquid inside was inviting, and it filled him with a certain warmth; a fuzziness. Timmy immediately snagged it, secured it in a vice grip, and dashed back into the forest as the pointed twigs and suspicious mushrooms raced by him.





"Lisa! I've got the meds!" Timmy announced ecstatically as he ran straight through the door, right into the healer's office back in Pogville.

"Stop talking and shove it in his mouth!" Lisa ordered urgently to Timmy. "The effects of the medicine will take a while to set in. Mr. Bopadoo probably won't be up and about until tomorrow," Lisa explained after Timmy fed a sleeping Scoobalee the cure. "You should get some sleep."

"Gotcha, Lisa," Timmy yawned as he exited the office. "See ya tomorrow."

The next day, Timmy was awoken by the cries of battle. Panicked, he peered outside his window and saw an amalgamation of grey armour and green skin out on the field near the front gates. Timmy rushed down to the field below and saw Alice shouting orders.

"What's going on?!" Timmy asked loudly.

"The Goblins noticed the antidote was gone and launched a revenge attack!" Alice shouted, but it was hard to hear over the nasal cries of Goblins getting curb stomped. "Don't worry though, we're absolutely destroying them!" she assured him.

Timmy turned his head and saw Goblins getting sprung in the air, courtesy of the newly-installed traps. Within minutes, all of the Goblin warriors had been taken care of, save for the Goblin King and his knights.



"Gahhhhh, darn Pogvillers! We'll get you one day!" shouted the Goblin King, infuriated. But it was hard to take him seriously, for his pants had been singed in the crossfire leaving only...



...his hot pink unicorn boxers. Even his own knights couldn't help but snicker at the sight at a red-faced Goblin in unicorn underwear waving his fists around wildly. The Pogville knights arrested him with ease, and scattered the remaining Goblin knights.

It was then that Scoobalee Bopadoo dawdled out the front gates feeling refreshed.

"Master Scoobalee!" Timmy shouted, overjoyed.

"Hey-o, Timmy Tim Tom! Thanks for saving my life! You're kinda godly, y'know!"

Scoobalee cheered. "Bro, it's pretty wild that you did it with the trig functions!"

"Anytime, Scoobs," Timmy waved his hand, brushing it off.

"Whatever floats your boat, man. But since you know trigonometry so well," Scoobalee started, "maybe we should move onto quadratic functions!"

Timmy froze like a deer in headlights. His knees slowly dropped down to the soft blades of grass. Scoobalee cautiously backed away confused, as Timmy let out a shout.

"NOOO!"

Yikes, Timmy.





Timmy embarks on an adventure to save his mentor, Scoobalee Bopadoo from a stunt pulled by the Goblins—all while using trigonometry.