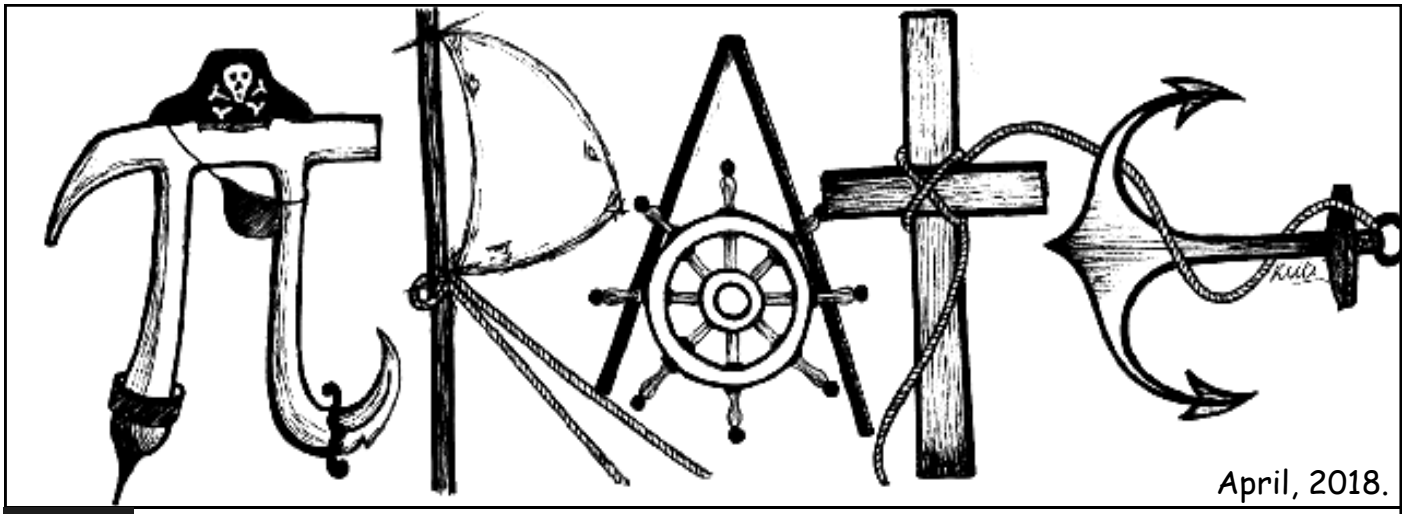



April, 2018.

*"The Pure Mathematician, like the musician, is a free creator of his world of ordered beauty."*
*-Bertrand Russell*

# Editor's note

Dear Reader,

As I bring you the first edition of Pi Rate as editor, I hope to unravel Mathematics in a way to make you see it the way I do. Sometimes, I marvel at how something so uncomplicated could seem so nerve-rackingly impossible to someone. But then again, I want to become history every time I think of it.

Math for me is a stress buster, an excuse to listen to music while studying, a way to pretend to be smart just because I know where to apply the right formulae.

This issue is about nothing in particular and everything in general, just a bunch of ideas put together. Hope you enjoy it.

Be real, be rational, be fearless enough to be the variable amidst constants !

Jagriti Saraf.

# Speed Mathematics

How to find the cube root of a 5-digit number?

Let's take $\sqrt[3]{32768}$ for example.

Step 1: Find the cube root of the last digit of the given number. ($\sqrt[3]{8}$=**2**). Place **2** is at unit's place.
Step 2: Take the first two digits of the number and find the smallest cube closest to the number (Here, 32 > 27).
Step 3: Now, find that the cube root of this perfect cube ($\sqrt[3]{27}$=**3**). Place **3** is at ten's place.

Hence, from the above steps,
We get: $\sqrt[3]{32768}$=**32**

**CONTENTS**

# Juggling

The late computer scientist Claude Shannon, known as the father of information theory, had published the first formal mathematical theorem of juggling in the early 1980s. The avid unicyclist, juggler and tinkerer built his own robotic juggling machine out of parts from an Erector set, programming it to juggle three balls by bouncing them against a drum. Shannon formulated the theorem by correlating the length of the time of the balls in the air with how long each ball stays in the juggler's hand. He gave the equation: *(F+D) H = (V+D) N*

F = Time duration of a ball in the air

D = Time duration of a ball in the hand

H = Number of hands

V = How long a hand is empty

N = Number of balls being juggled.

The theory of juggling narrows down to simple projectile motions of the multiple balls which combine to follow interweaving paths in repeated patterns. It holds aesthetical and intellectual appeal for a mathematician. "The way that I feel when I look at a nice equation is the same way I feel when I look at a nice juggling pattern," said Burkard Polster of Australia's Monash University, who literally wrote the book on the mathematics of juggling in 2002. The advancement in juggling is because of mathematicians' investigations on the possible patterns of non-colliding throws. This has resulted in the discovery of connections between juggling and the algebra of braids.

Your failure to juggle is not that uncommon. Nevertheless, the quickest tip to successful juggling is moving your hands as fast as possible.

–Jagriti Saraf, SC.

Dear Math,

After 12 years of being together I think it's time we finally call it QUITS! I've tried really hard to make the relationship between us work and have put in hours to solve our problems but I came up with no solution. No matter how many times I showed you love, you never showed even Simple Interest in me. Every time I tried adding you back in my life, you subtracted me and divided yourself among others who kept multiplying in your life.

In your love triangle of ABC, I think you never really cared about the mid-point that was me. If you continue to have simultaneous relations, I might have to eliminate you out of our equation.

My love for you has increased in AP but yours seemed to decline in GP. I've worked day and night to find the similarities in our personas but like parallel lines, maybe we are never supposed to meet. Fortunately, for me at least, now we can leave each other's company because we could never be equated together. I hope it leaves a hole in your heart till infinity!

From your most vengeful disciples,

Non-Math Pre Scs.

## Terry Tao

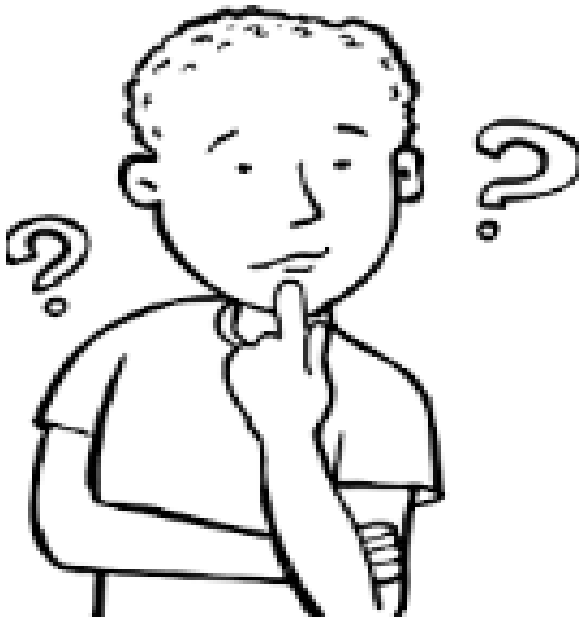
An Australian, Terry Tao presently lives in the US. He has won the **Fields Medal** in 2006.Together with Ben Green, he proved an amazing theory about prime numbers . They proposed that you can find sequences of prime numbers of any length in which every number in a particular sequence is at a fixed distance. For example, the sequence 3, 7, 11 has 3 primes spaced 4 numbers apart. The sequence 11, 17, 23, 29 has 4 primes spaced 6 numbers apart. While sequences like this of any length exist, no one has found more than 25 primes, since the primes by then are more than 18 digits long.

Some interesting facts about **Terry Tao:**

| | |
|---|---|
| **Age 7** | **Begins high school** |
| **Age 9** | **Begins university** |
| **Age 10,11,12** | **Competes in international Olympiads winning gold, bronze and silver medals** |
| **Age 16** | **Honours' degree from Flinders University** |
| **Age 17** | **Masters' degree from Flinders University** |
| **Age 21** | **PhD from Princeton University** |
| **Age 24** | **Professor at University of California in Los Angeles** |
| **Age 31** | **Fields Medal, mathematical equivalent of Nobel Prize** |

*"Pointing out that countless great mathematicians had tried to solve the problem and failed before you came along is in particularly bad taste and should be avoided completely."*

-Terrance Tao




| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ε | μ | | | | | | |
| δ | γ | π | | λ | | | | |
| θ | | | | β | γ | | | |
| π | | β | | | α | | γ | |
| | | | | θ | | | | |
| | δ | | λ | | | β | | π |
| | | | γ | μ | | | | β |
| | | | | δ | | γ | μ | α |
| | | | | | | λ | ε | |

## SUDOKU

Fill a 9x9 grid so that each column, each row, and each of the nine 3x3 boxes (also called blocks or regions) contain the symbols

## MATHDOKU

Fill a 5x5 grid so that each column, and each row contains all numbers from 1 to 5 and also, the equation for each math block (the highlighted boxes) is satisfied.

| | | | | |
|---|---|---|---|---|
| 4÷ | | 9+ | 8+ | |
| 3- | | | 1- | |
| | 15x | | 16x | |
| 9+ | | 30x | | |
| | 5÷ | | | |


# Find the Numbers

- If you split the number 3025 into two parts like - 30 and 25, and add the two parts together : 30+25=55, you get 55*55= 3025, which is the original number. There are two other four digit numbers that you can play with in this way. What are the other two such numbers?

- What are the only existing consecutive positive integers, the sum of whose cubes is itself a perfect square?

- What is the smallest positive integer that can be expressed as the sum of two cubes in two different ways as $a^2 + b^2$ and $c^2 + d^2$?

**Solutions:-**

Find the numbers:-

2025 and 9801; 3,4 and 5; 1729.

Mathdoku:-

| | | | | |
|---|---|---|---|---|
| 1 | 4 | 2 | 3 | 5 |
| 5 | 3 | 4 | 1 | 2 |
| 2 | 5 | 3 | 4 | 1 |
| 3 | 2 | 1 | 5 | 4 |
| 4 | 1 | 5 | 2 | 3 |

Sudoku:-

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ζ | ε | μ | θ | α | ὁ | π | λ | γ |
| θ | ζ | α | ε | λ | μ | γ | ὁ | ζ |
| γ | λ | π | α | ε | ὁ | ζ | θ | μ |
| λ | γ | μ | ὁ | ζ | π | θ | α | ε |
| ε | α | ὁ | π | θ | γ | λ | μ | ζ |
| ζ | θ | λ | μ | γ | ε | ὁ | π | α |
| α | ὁ | ζ | γ | μ | λ | ε | θ | π |
| π | ζ | θ | ὁ | ε | α | μ | γ | λ |
| ὁ | μ | γ | λ | π | θ | α | ε | ζ |

## Math Ninjas

Math is the foundation to successful game development and game design.
It is almost everything when it comes to games. From having the ability of calculating the trajectory of an Angry Bird flying through the sky, to ensuring that a character can jump and come back down to the ground at the press of a button. Without the help of mathematics, games simply wouldn't work. A character wouldn't be able to walk up a slope, slide down a slide, fire a bullet, or even jump. The most basic of games and the most complex ones use at least some form of math in their working.
Math is used in every aspect of game development, including art. *Maya* is a math-based program that plots out the vertices and normals in mathematical form while the artist just uses a tool that allows them to create stunning 3D graphics without worrying about math. Simply put, you could model Godzilla in notepad and push it into Maya, if you knew where to plot the points in numeric form.
A lot of math in gameplay scripting is fairly simple, but math used in a game engine's architecture is far more complex and a lot more mentally taxing. Hence, drifting around some corner in *Need for Speed* at 80mph or making your character run for their life is all made possible only due to mathematics. Math helps out with calculating everything from what a particle's velocity should be to the spread of a shotgun blast, to using gravity or bringing a ball back to the ground, and vice versa. Some of the main branches of math used in game development are Algebra, Trigonometry, Calculus, Reflection, Matrices, Linear Algebra, Applied mathematics and others. Most of these math topics are used all together in advanced games, but in simpler games the only math required may be trigonometry and algebra, or simply, using only scalar multiplication.
Mathematics, thus, allows games to do incredible things that the real world cannot simulate, by allowing new ways for the game script and engine to handle calculations that would not be feasible to do in the real world. So next time when you question your math teacher if you're going to ever use "Algebra" in the real world when you're done with your studies, don't forget that you surely will if you pursue a career in application and game development.

-Ishika Agarwal

Pre SC.

## Welcome Mrs. Sugandha Shingari

Pi Rate welcomes Mrs. Sungadha Shingari, the newest addition to the Department of Mathematics of Welham Girls' School.

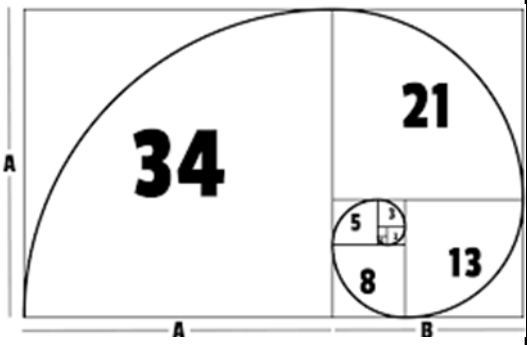
Born and brought up in Dehradun, Mrs. Shingari has been fond of Math since she can recall. It was her favourite subject in school, a relief from the complex sciences. Her all-time mantra for Math has been - "Only if you love Math will it love you back. If you hate it, it will reciprocate the same way."

Not only is she passionate about Math, Mrs. Shingari also has a soft corner for children. "Children", she says, "are a source of joy." Thirteen years into the profession, she believes that a teacher's job is not just to teach but to learn in the process as well.

When asked about Welham, she said that she had heard a lot about the school. It will be different to teach in an all girls boarding school from teaching in a co-ed day school but nevertheless, she is excited to be a part of the Welham Family.

# The Golden Ratio

The golden rectangle is a very beautiful and exciting mathematical object, which extends beyond the mathematical realm. Found in art, architecture, nature and even advertisements, its popularity is not an accident. Psychological tests have shown the golden rectangle to be one of the most pleasing and satisfying objects to the human eye.




The golden ratio, being the building block of nature, can be found in our very own bodies. Measure the length of your body from the top of your head to your toes. Then divide this with length between your waist and your toes. Your answer should be near 1.618 – if you've done it correctly (the value of the ratio is 1.618). Even from your shoulder to fingertips and elbow to fingertips, the ratio is the same.

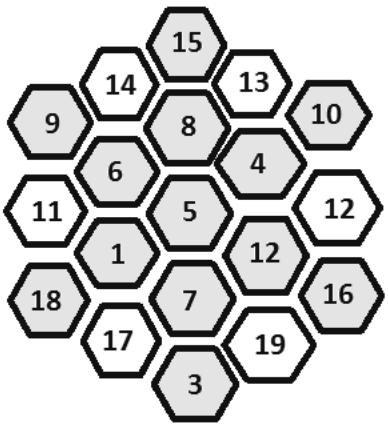
Besides appearing in art, architecture and nature, the golden rectangle is even used today in advertising and merchandising. Many containers are shaped as golden rectangles to possibly appeal to the public's aesthetic point of view. In fact, the standard credit card is nearly a golden rectangle.

-Shanvi Bansal, Aditi Singh,

AIs.

# The Magic Hexagon

Every row of numbers in this hexagon adds up to the same total, 38. Using this, there are 15 different ways by which you can achieve this total. This pattern was discovered by an American railway clerk named Clifford Adams. It took him approximately 47 years to discover this particular arrangement. Later, the European mathematician Charles Trigg proved that no other magic hexagon of any size was possible.




The only possible magic hexagon.

Devna Aggarwal, Archie Khanduja,

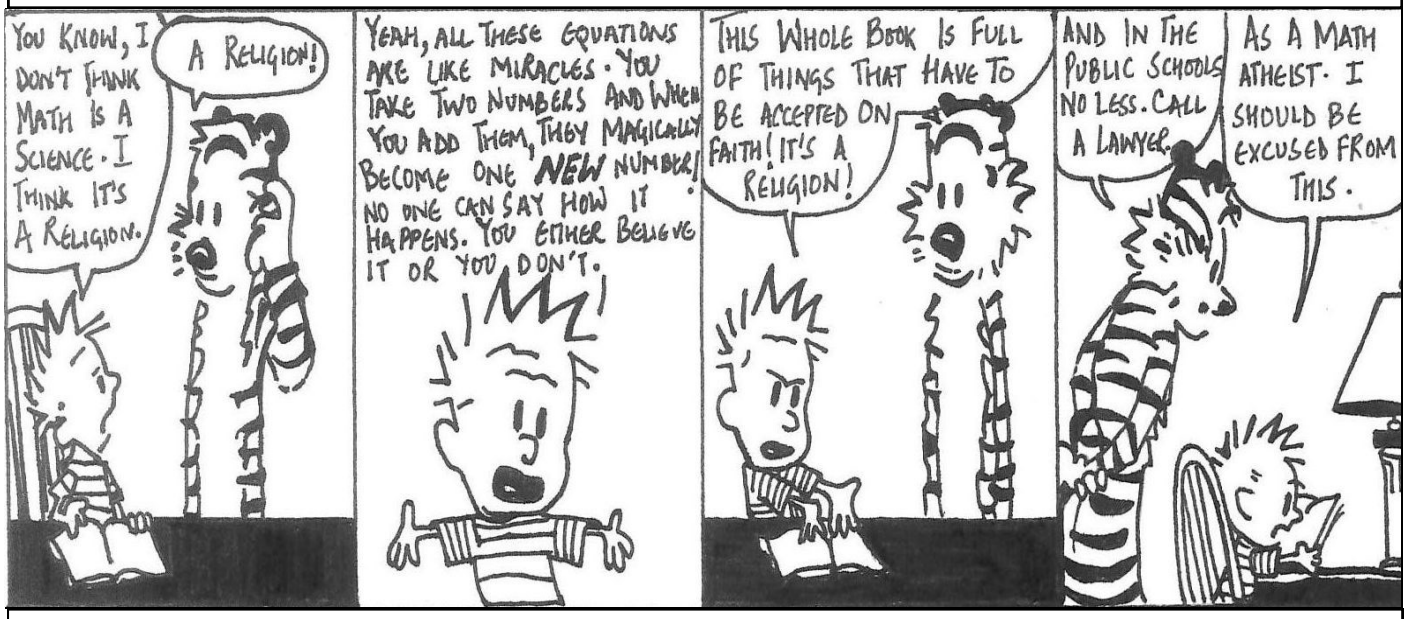
AIIIs.

# Careers in Mathematics

**Actuary:** A person who measures and manages risk and uncertainty of a business firm, relating to the asset and liability management of the same. They provide assessments of financial security systems, with a focus on their complexity, their mathematics, and their mechanisms.

**Biostatistician:** A person who uses or applies mathematics and statistics to varying categories in biology, a major branch being medical biostatistics. They design biological experiments primarily in the field of agriculture and medicine. They collect, dissect, and summarize the data, and release information based on the findings of that data.

**High School Math Teacher:** A person who breaks down the complex knowledge of mathematics she/he has into simpler concepts so that students understand better and maybe, pursue mathematics in their future.

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