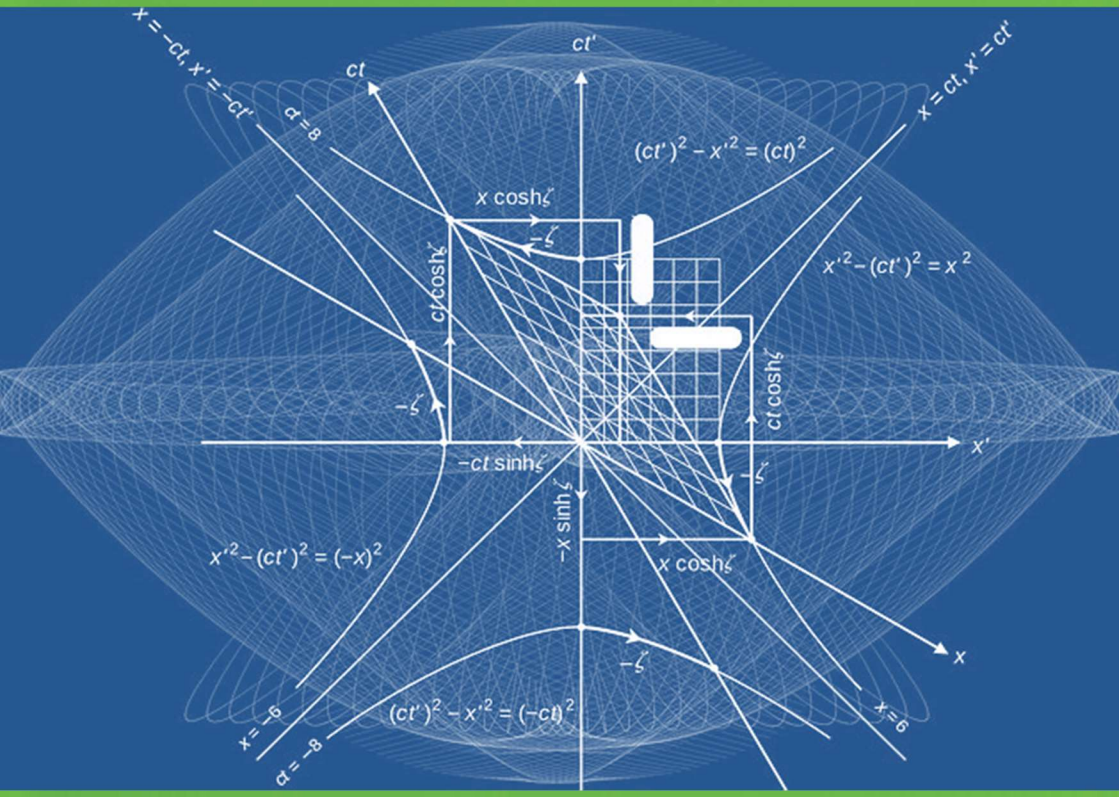
Math Quest



Vol IV

2021 - 2022

Dear Readers,

The speciality of this issue is most of the editorial and technical works are being carried out by our students. All the content articles are also from our students. This issue includes many facts on mathematics like Pascals triangle, Secrets behind numbers, The Revolving number, Black hole number & Infinity etc. Mathematical Puzzles and Riddles are also there to entertain you. Human Computer + Magic Number talks about the famous Indian Mathematician Sakunthala Devi. Sudoku's present here will be a good exercise to your brain. An article on solving crimes with Maths: Bloodstain Pattern Analysis proves the Application of Mathematics in day-to-day life. Have a happy reading!

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By
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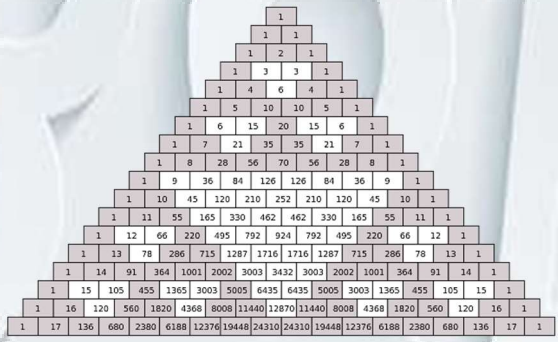
Thoothukudi

Content

Facts About Pascal's Triangle



1. ***Who invented Pascal's Triangle?***

   Blaise Pascal

   It is named after for the 17th Century French Mathematician Blaise Pascal, but it is far older. Chinese Mathematician Jian Xian devised a triangular representation for the coefficients in the 11th Century.

2. ***What is Pascal's Triangle Formula?***

   Sum = 2^n, where n is the number of the row.

   For example: the sum of the elements in the 20th row is 1048576.

3. ***Which jobs use Pascal's Triangle?***

   Jobs that often use the Pascal's triangle would be architects, graphic designers, finance, mapping, etc.

4. ***What is Row 7 of Pascal's Triangle?***

   n! Prime Numbers.

   If the 1st element in a row is a prime number, all the numbers in that row are divisible by it.

   For example: in row 7 (1 7 21 35 35 21 7 1), 7, 21 and 35 are all divisible by 7.

5. ***What are Pentelope Numbers?***

A Pentelope Number is a number in the fifth cell of any row of Pascal's Tringle starting with the 5th term, row 14641, either from left to right or from right to left.

6. ***Is Pascal's Triangle Infinite?***

Pascal's Triangle is a never-ending equilateral triangle of numbers that follow a rule of adding the two numbers above to get the numbers below. Two of the sides are "all 1's" and because the triangle is infinite.

7. ***What is 100th row of Pascal's Triangle?***

An Arithmetic Approach.

There are eight odd numbers in the 100th row of Pascal's Triangle, 89 numbers that are divisible by 3 and 96 numbers are divisible by 5.

8. ***Does each row correspond to Binomial expansion?***

The coefficients or numbers in front of the variables, are same as the numbers in that row of Pascal's Triangle.

For example: $(x+y)^2 = \mathbf{1}x^2 + \mathbf{2}xy + \mathbf{1}y^2.$

$$(x+y)^3 = \mathbf{1}x^3 + \mathbf{3}x^2y + \mathbf{3}xy^2 + \mathbf{1}y^3$$

9. ***What gives when if it is a decimal expansion?***

In a given row, we treat each number as a part of decimal expansion. In other words, row two is

$$(1 \times 1) + (2 \times 10) + (1 \times 100)$$

We get 121 which is 11^2. *Do the same thing to row six,*

$1\ 6\ 15\ 20\ 15\ 16\ 1 = 1{,}771{,}561$ *which is* 11^6 *and so on.*

10. ***What is the*** $\mathbf{10^{th}}$ ***term in the sequence of tetrahedral numbers?***

The tetrahedral numbers are: 1,4,10,20,35,56,84,120,165, 220, …

11. ***What is Sierpinski's Triangle?***

The Sierpinski Triangle are also called ***Sierpinski gasket (or) Sierpinski Sieve,*** *is a fractal attractive fixed set with the overall*

shape of an equilateral triangle, subdivided recursively into smaller equilateral triangle. From the above triangle, the shaded region is called as the ***Sierpinski's Triangle****.*

By

S. Pushpa Lakshmi, II M.Sc

Maths Riddles

- *Using only addition, how can you add 8's to get the number 1000?*
  Answer: 888 + 88 + 8 + 8 + 8 = 1000
- *I am an odd number. Take an alphabet away from me and I become even. Who I am?*
  Answer: Seven (Seven – S = Even)
- *Why do plants hate math?*
  Answer: Math gives them a square root.
- *How many volumes of dirt are in a PVC Pipe of 50 meter long and 30 meter wide?*
  Answer: The volume is zero because the pipe is empty.
- *A's income is 60% more than of B's. By what percent is B's income less than A's?*
  Answer: 37.5%

By

P. Dharshana Mishal, I M.Sc Mathematics

Global Mathematics

By

R.Brundha, III B.Sc

Solving Crimes with Maths: Bloodstain Pattern Analysis (BPA)

Countless movies and TV dramas have taught us the importance of crime scene investigation. What's less well-known, though, is the fact that maths has an important role to play in this. In this article we will explore how basic Trigonometry is used in this context.

HOW DO BLOODSTAINS TELL US WHERE A CRIME IS COMMITTED?

Bloodstains provide a lot of clues about what happened on the crime scene. Bloodstain pattern analysis (BPA) is the interpretation of bloodstains at a crime scene to recreate the actions that caused bloodstains. Elements of biology, physics and mathematics are used to help determine the source blood and the positions of the victim and perpetrator.

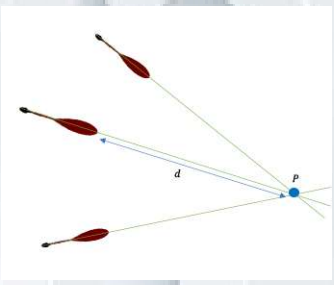
We will be looking at impact stains and passive stains. Impact stains result from blood projected through the air, whereas passive stains result from the effect of gravity on a body. These can result from stabbings, beatings, and gunshot injuries.

When blood droplets strike a surface, the shape of the bloodstain depends on the angle of impact and the distance travelled.

DIRECTION AND DISTANCE

The shape and tail of the bloodstain indicates the direction the blood was travelling in. Imagine there are three bloodstains on the floor, as shown in the diagram below. Also imagine all these stains came from the same source (e.g., someone being hit over the head).

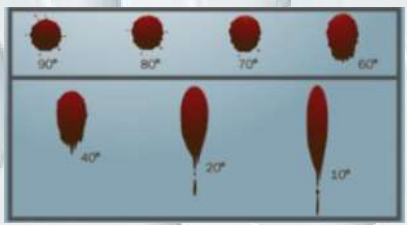
Looking down at three bloodstains on the floor. The source of the blood will be somewhere vertically above *P*.



Now imagine drawing lines through the bloodstains in accordance with their direction of travel: these lines will meet in a point P. The true source of the blood (e.g., the head of the person who was hit) will have been somewhere vertically above P. to find out at exactly what height, we need to do a little more geometry.

THE ANGLE OF INCIDENCE

If blood were to drop vertically down onto a smooth surface, so that the trajectory of the blood makes a 90° *angle with the surface, it would create a circular shaped drop. If blood were to drop obliquely to the floor, at an angle less than about* 70°*, it would form an elliptical shape with a tail.*

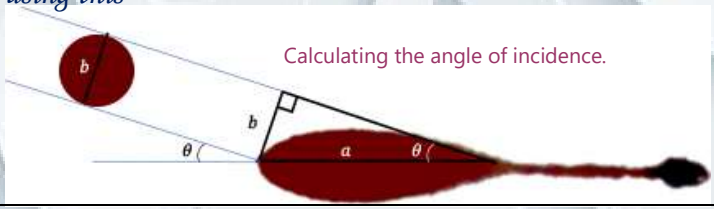


Shape of bloodstain for different angles of incidence.

Investigators can measure the length, a*, and width,* b*, of the bloodstain:*

Measuring width and length of the bloodstain.

They can then calculate the angle at which the blood drop hit the surface, which is called the ***angle of incidence****, with the help of a right-angled triangle, using this*



Calculating the angle of incidence.

Here a blood droplet travels towards a surface with the angle of incidence equal to θ. The diameter of the droplet before impact is assumed to be equal to the width, b, of the droplet (this may not be exactly true in reality but provides a good approximation). By moving this diameter as shown, we can form a right-angled triangle. The width, b, is opposite the angle θ in this triangle and the length a is the hypotenuse. We therefore have

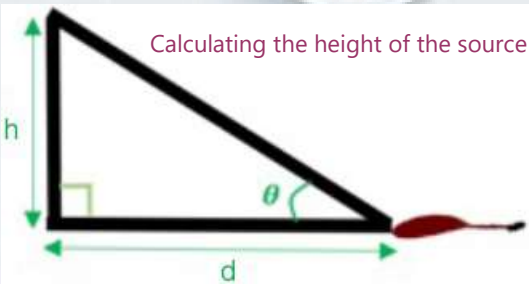
$$sin(\theta) = \frac{b}{a}$$

Since we know a and b from measuring the bloodstain, we can work out θ as

$$\theta = sin^{-1}\left(\frac{b}{a}\right)$$

THE HEIGHT OF THE SOURCE

We are now ready to calculate the height of the source of the bloodstains. We can form a right-angled triangle whose sides are the line from one of our bloodstains to the point P we identified earlier, the line that goes vertically up from P at right-angles to the flood, and the line starting at the bloodstain and forming an angle θ with the floor.



The height h of the vertical line is given by

$$\frac{h}{d} = tan(\theta)$$

So

$$h = d\,tan(\theta)$$

Since we know the value of θ and the distance d (see the first figure above), we can work out h, the height of the source. If you already know for example, that the blood comes from a victim being hit over the head, this information can indicate whether the person was standing up while this happened, or was beaten while already lying on the floor.

The outputs produced with blood pattern analysis can be used to corroborate witness statements and laboratory findings. It is surprising that something as basic as trigonometry can tell us a lot about what happened at the crime scene.

By

E. Murugeshwari, I M. Sc

Do You Know? - I

- ***If you fold a piece of paper in half 103 times it would be the thickness of the observable universe.***

  In practice, the world record for folding a piece of paper in half is only 12 times.

- ***The number 0.999999…. is exactly equal to 1.***

  Proof:

  Let $x = 0.9999\ldots$

  Then $10x = 9.9999\ldots$

  $10x - x = (9.9999\ldots) - (0.9999\ldots)$

$9x = 9$

$x = 1$

- ***You can cut a cake into 8 pieces by using only 3 cuts.***

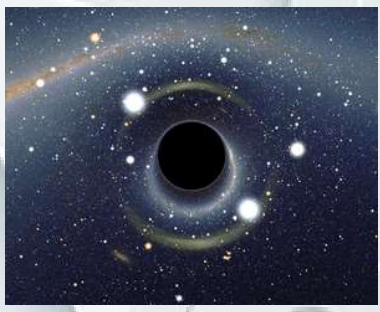
  You just need to make two cuts in a vertical plane and one in a horizontal plane.

- ***555*** *is used by some in Thailand as slang for* ***'hahaha',*** *because the word for* ***'five'*** *is pronounced* ***'ha'****.*
- *In* ***2010*** *on* ***World Maths Day, 1.13*** *million students from more than* ***235*** *countries set a record correctly answering* ***479,732,613*** *questions.*

By

T. Anushiya, II M.Sc

Black Hole Number & Infinity



A ***black hole*** *is a region of spacetime where gravity is so strong that nothing –* ***no particles or even electromagnetic radion such as light – can escape from it.***

Did you know that ***mathematics also has a black hole?***

Think of any word, thing, name, etc.

For e.g: the word ***Mathematics*** *has* ***11*** *letters.*

Now, ***Eleven*** *in turn has* ***6*** *letters.*

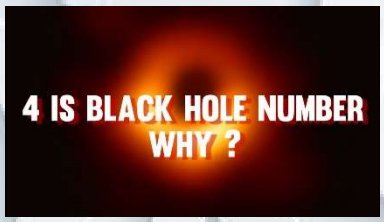
Six *has* ***3*** *letters.*

Three *has* ***5*** *letters.*

Five has 4 letters.

*And how many letters does **Four** have?*

FOUR!!!



*Think of any other word or name, and you'll arrive at the same dead end. Yes!!! **4** is designated as the **Black Hole Number.***

*Let's talk about **INFINITY***

*Infinity is a number so large we cannot even imagine it. But **are all infinities equal?***

Let's visualize three sets:

$\mathbf{A} = 1 + 2 + 3 + \ldots$ *(i.e) Sum of all positive integers.*

$\boldsymbol{B} = 2 + 4 + 6 + \ldots$ *(i.e) Sum of all positive even integers.*

$\boldsymbol{C} = 1 + 3 + 5 + \ldots$ *(i.e) Sum of all positive odd integers.*

All the sums approach to infinity, but if you look carefully,

$$\boldsymbol{A = B + C}$$

Thus, $\boldsymbol{A > B}$

For a long sum B *and* C *will approach each other, (i.e)* $\boldsymbol{B \simeq C}$*, so we can write*

$$\boldsymbol{A \simeq 2B} \ldots\ldots \textit{(1)}$$

*Thus, we can say that not **all infinities are equal**. The infinity from set* $\boldsymbol{A}$ *is greater than infinity from set* $\boldsymbol{B}$*.*

But wait,

If you look more closely each number (or object) in set $\boldsymbol{B}$ *is exactly twice of each number in set* $\boldsymbol{A}$.

So, we can write,

$$\boldsymbol{B = 2A} \ldots\ldots. (2)$$

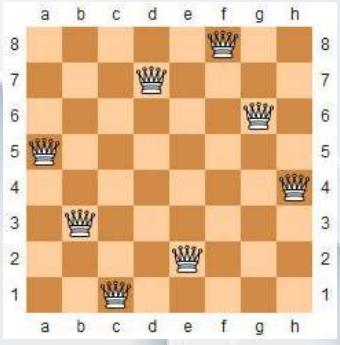
But we had just proved $\boldsymbol{A = 2B}$ *from (1). So, how it is possible.*

It turns out ***actually all infinities are equal.*** *Infinities are such big number we cannot measure, and physically* ***we cannot assign one set to be bigger than other unless we measure them first.***

By

R. Synthiya Roselin, I M.Sc

Laurel for the logician – Million dollars prize for a solution to a problem

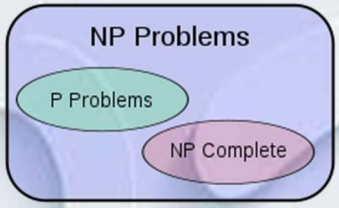


Take a standard chessboard and try to place two Queens on it so that they aren't attacking each other. Easy, right? You just have to make sure they aren't in the same row column or diagonal. Now try to place another Queen on the same board. Keep adding Queens tell you have placed 8 such pieces. That conform to the given constraint. If you have just found a method to achieve this, how many more methods can you find? How many methods exist? This is an example of a puzzle from 1850 called the ***8 Queen completion problem****. In spite of being more than a century old, we only recently discovered the inheritance complexity of the riddle when it was scaled up allowing board of any size with any number of Queens pre placed on them*

giving us a much harder version of the personal journal or Artificial Intelligence research or what brought this to the world's attention. Sadly, the solution to this isn't the one up for a million dollars.

The n Queen completion is a type of mathematical problem that is common in Computer Science and known as ***"NP Complete"****. These are an interesting bunch because if we can find a solution to NP COMPLETE problem, we can use it to find all of them. That is simply their nature. Lucky for us, the n-Queen complete is one of the simplest, NP complete problems to explain Especially to people familiar with the rules of chess the others are not so easily ingrained into the minds of laymen.*

The underlying issue though, is that nobody knows, even roughly, just how difficult NP complete problem is. To put it simply, they could be as easy as alphabetically organising a list of names or exponentially harder figuring out which of the two is the P vs NP problem – one of the greatest mathematical problems that have been left unsolved. The significance of this problem is mirrored in this fact the clay mathematics Institute is offering a price of one million dollar for the solution of a P vs NP.

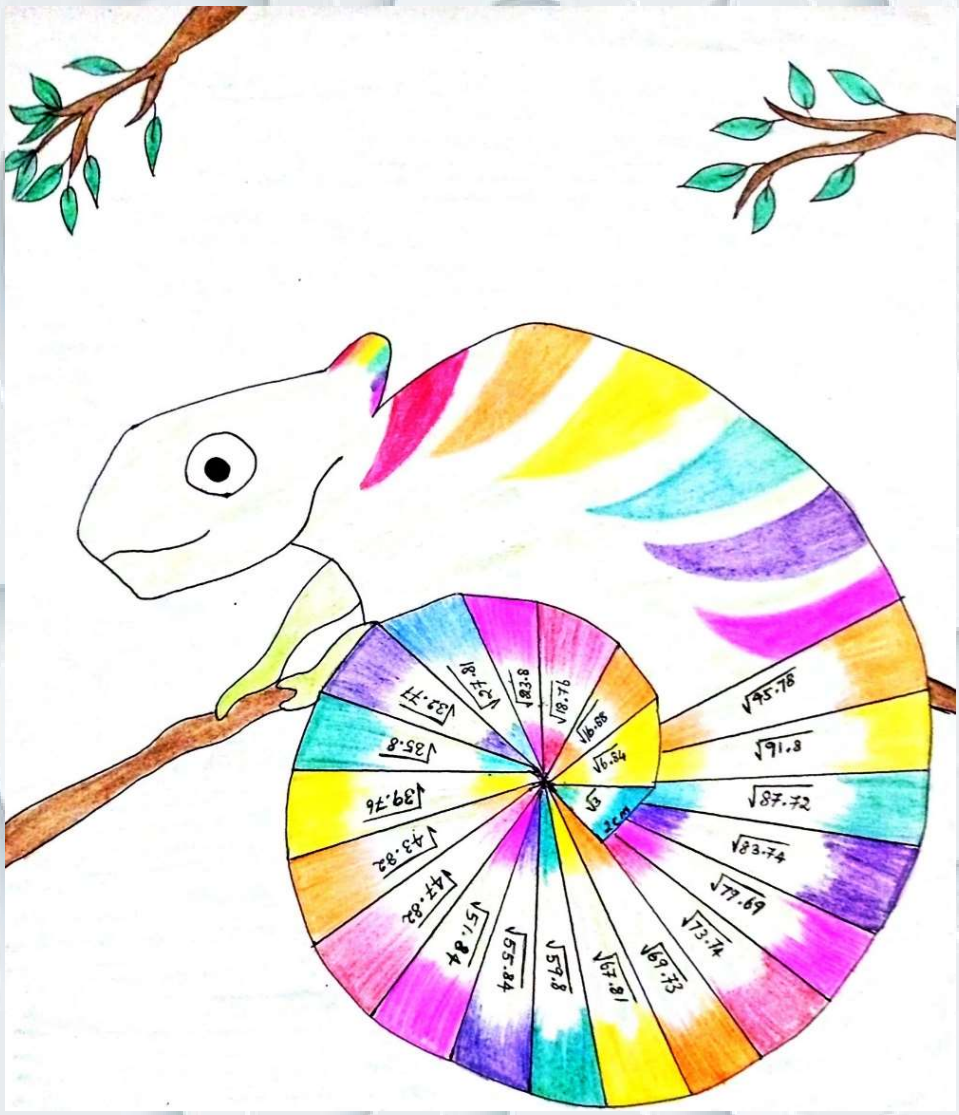


The paper by Chris J Peter N, and Ian P.G shows that the n Queens completion problem is NP complete. Anyone able to show whether it is an easy pontifical problem could then in turn potentially win a million dollar. Try not to be under the impression that the difficulty of P vs NP problem is less than or equal to the n Queens one P vs NP is far harder and potentially unsolvable. We can have hope so because the word impossible has never stuck quite right with humankind.

By

P. Anu Preethi, III B. Sc

Mathematical Modelling – Golden Ratio



By

P. Chithiraikani, III B. Sc

Sudoku

1	2	3
4	5	6
7	8	9

The long and interesting history of the Sudoku is quite a puzzle in itself.

*The name **Sudoku** comes from Japan and consists of the Japanese characters **Su** (meaning 'number') and **Doku** (meaning 'single') but it was not invented in Japan. Sudoku originated in Switzerland and then travelled to Japan by way of America.*

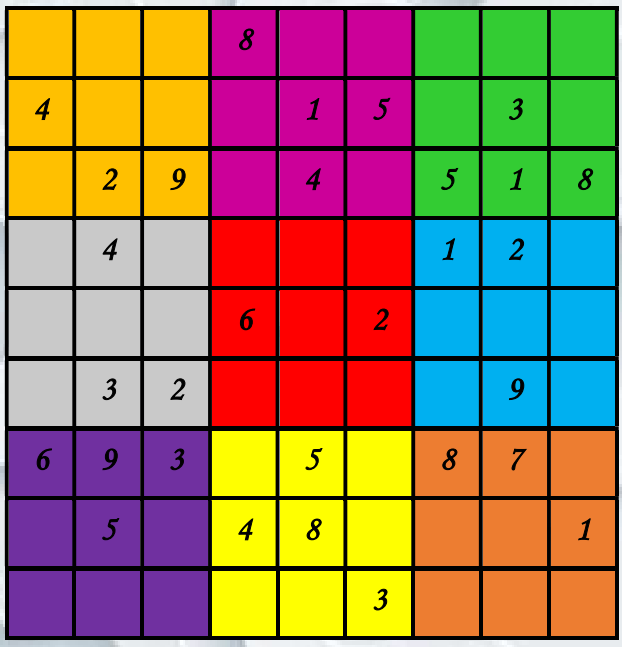
*The Sudoku story began in 1783 when **Leonhard Euler**, a **Swiss mathematician** devised **"Latin Squares"**, which he described as '**a new kind of magic squares**'. Euler had come up with a grid in which every number or symbol appears once in each row or column. We called the puzzle number place and still do today.*

The standard version of Sudoku consists of a 9×9 square grid containing 81 cells. The grid is subdivided into nine 3×3 blocks. Some of the 81 cells are filled in with numbers from the set $\{1,2,3,4,5,6,7,8,9\}$.

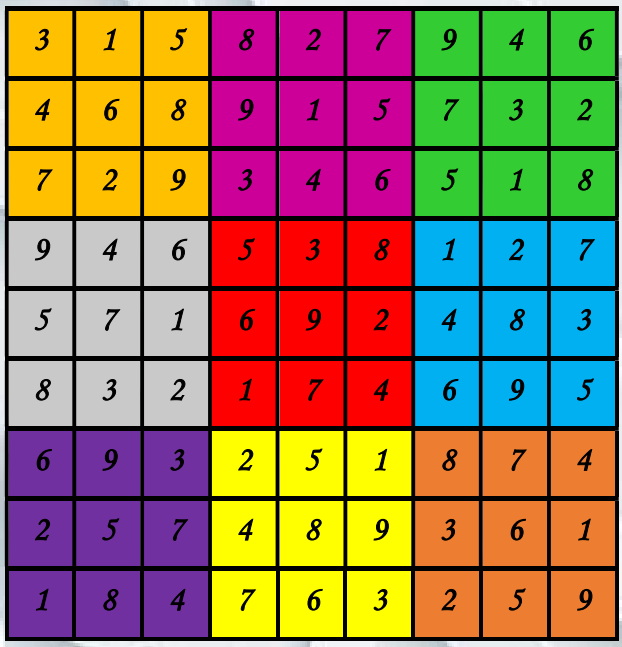
*These filled-in cells are called **givens.** The goal is to fill in the whole grid using the nine digits so that each row, each column, and each block contains each number exactly once. We call this constraint on the rows, columns and blocks the **One Rule.***

*The above – described puzzle is called a **Sudoku of rank 3**. A Sudoku of **rank n** is an $\mathbf{n^2 \times n^2}$ square grid subdivided into $\mathbf{n^2}$ blocks, each of size $\mathbf{n \times n}$. The numbers used to fill the grid $\mathbf{n}$ are $\mathbf{1, 2, 3, \ldots n^2}$ and the One Rule still applies.*

Here is an example of Sudoku puzzle.



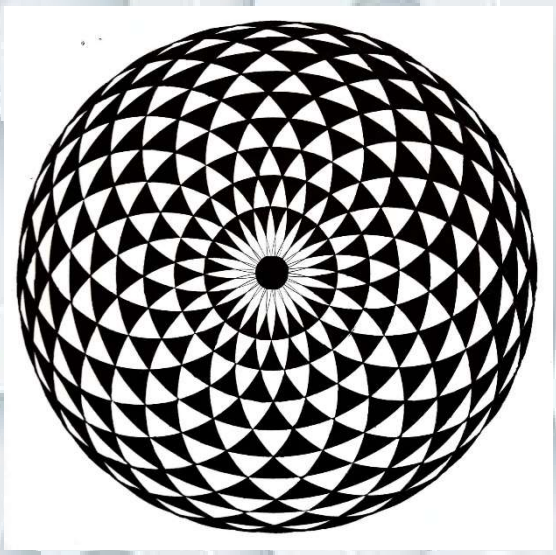
			8					
4				1	5		3	
	2	9		4		5	1	8
	4					1	2	
			6		2			
	3	2					9	
6	9	3		5		8	7	
	5		4	8				1
					3			

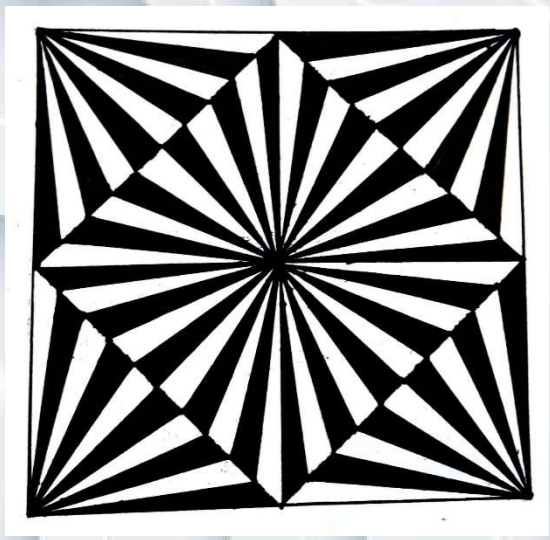


3	1	5	8	2	7	9	4	6
4	6	8	9	1	5	7	3	2
7	2	9	3	4	6	5	1	8
9	4	6	5	3	8	1	2	7
5	7	1	6	9	2	4	8	3
8	3	2	1	7	4	6	9	5
6	9	3	2	5	1	8	7	4
2	5	7	4	8	9	3	6	1
1	8	4	7	6	3	2	5	9

By
G.MuthuLakshmi, II M. Sc

Geometrical Eye





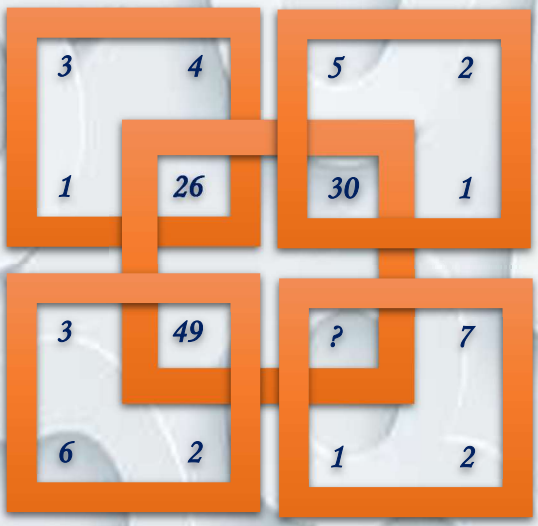
By

G. Srilakshmi, III B. Sc,

R. Soundarya, II M. Sc

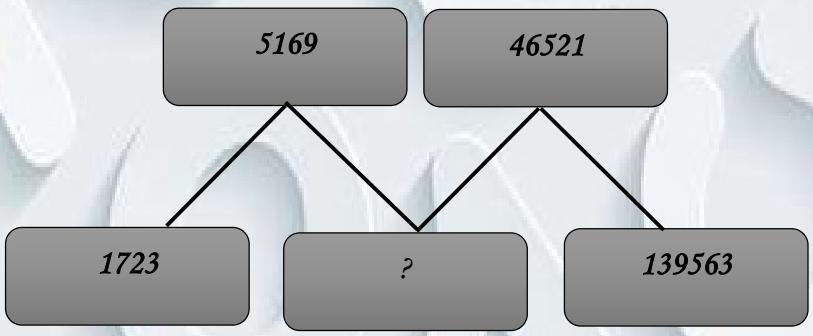
Puzzles

Which number should replace the question mark?



Ans: 54

In each square, the sum of the squares of the three outer numbers equals the number bounded by the central square.

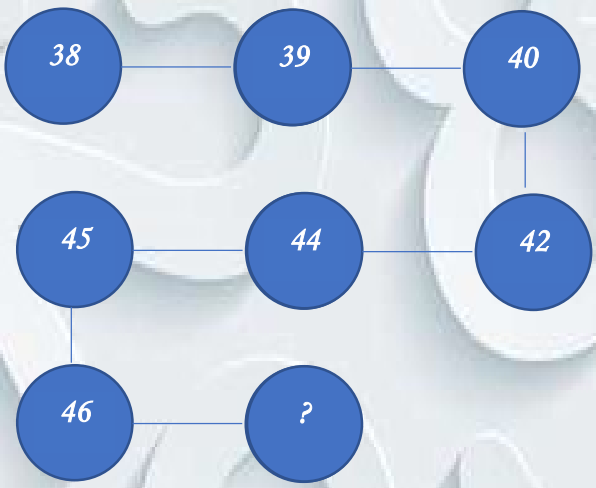


Ans: 15507

Each number × 3.

Ans: 0

Each circle adds to 89



Ans: 48

Non-prime numbers between 38 and 48.

By
K, Malavika, I M.sc

Inauspicious Number 13?

There is a popular maxim which states that the best way to predict the future is to look into the past. History has time and again proven the number 13 to be a diabolical entity, sneaking in corners, ready to cause bad omens and accidents, so much so that the fear of this number over the centuries has compounded manifold to the point of causing looks of horrors at the prospect of residing at the "13th floor" of a building.

*The fear of this number has its own personalised jargon known as **"Triskaidekaphobia"**. It is a combination of Greek words **"tris"** meaning **"three"**, **"kai"** meaning **"and"**, **"deka"** meaning **"ten"** and **"phobia"** meaning **"fear"**.*

- *Apollo 13 was launched on 11 April and it underwent explosion on 13th April (2 thirteens).*
- *Zoroastrian tradition predicts chaos in the 13th millennium.*
- *Another example is the Columbia Space Shuttle. This one went into space on 1/16/2003. Add all the numbers and you will get the number 13. During its re-entry into Earth, it exploded. All the crew members died.*
- *Many hotels in China and America don't have a 13th floor. After 12th, either they have 12 and a half or 14th. Same goes for the number of houses too.*
- *Even Microsoft considers the number 13 very unlucky and that is the reason why there is no version 13 of Microsoft Office. The version 12 is Microsoft Office 2007 and the next version Microsoft Office 2010 is actually version 14. Thus, the company skipped number 13 altogether.*

But just because some superstition is blindly acknowledged, does it make it true? Does this number really deserve this notoriety?

I beg to differ:

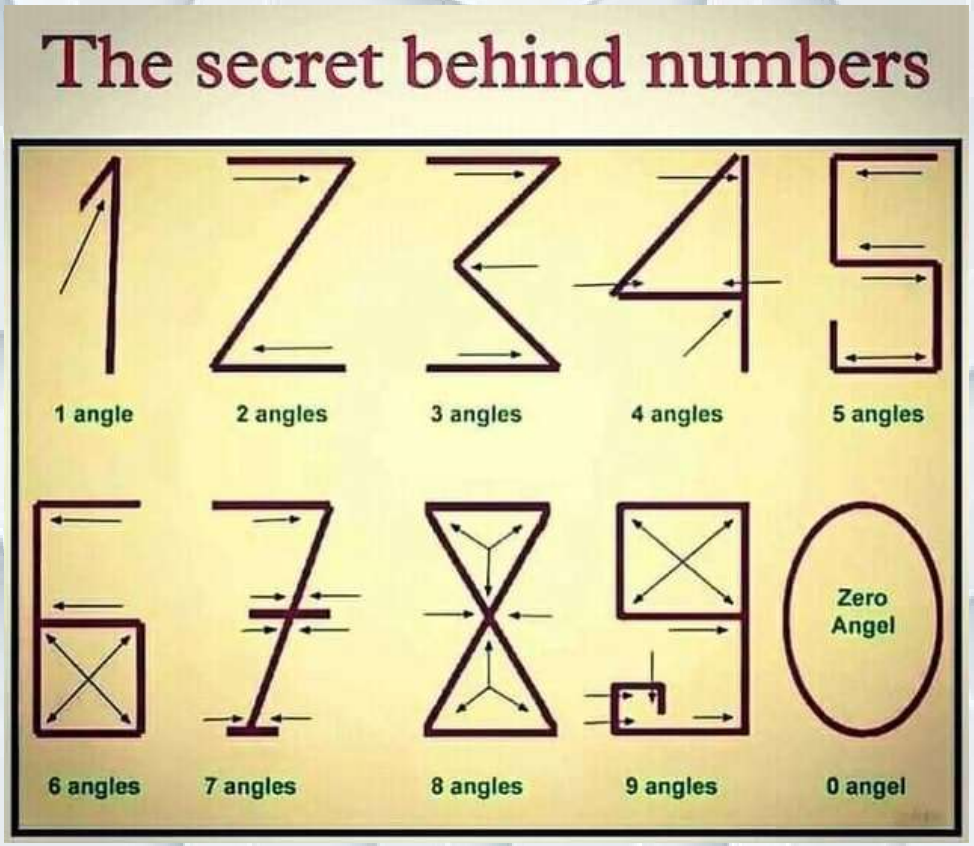
- *In ancient Greece, Zeus is considered as the thirteenth and the most powerful God. This thirteenth God seems to be associated with totality, completion and attainment.*
- *The ladder to eternity has thirteen steps, on reaching the 13th step, it is assumed that your soul attains spiritual completion.*
- *13 is a prime number, which means it cannot be divided by any number other than itself. Hence, symbolizes qualities of incorruptible nature and purity.*
- *In one of the most powerful civilizations of history, the Aztecs decided to have 13 days in a week as they considered 13 to be an extremely lucky number. Each day was ruled by one God and the God who ruled the thirteenth day was associated with mystery, psyche and magic.*
- *13 is the age of change of transition for every girl (or) boy. It is the age when children officially become teenagers.*
- *The US flag has 13 strips, that represent the union of 13 colonies to fight the British rule, later these 13 colonies became first thirteen states of United States of America.*
- *The Thai New Year (Songkran Day) is celebrated on 13th April. It is considered to be a day of washing away all the bad omens by splashing water on people, friends and relatives.*
- *In Hindu mythology, Maha Shivratri is celebrated on the thirteenth night of the Magha month, which is very sacred and a holy night for all the Shiva devotees.*
- *In the sacred book of the sikhs, the **"Guru Granth Sahib"**, the word **"Waheguru"** which means eternal guru appears 13 times.*

Being a student of Mathematics, the first thing I learnt was that for a phenomenon to be true, there must be no exceptions. The phenomenon must

be proved for every single condition. The fact we are able to find numerous exceptions to this phenomenon is proof enough for it to be baseless superstition.

By

S. R. Shimony Rathna Kumari, III B. Sc



By

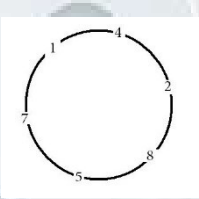
G. Abinaya, I B. Sc

142857 – The Revolving Number

- *Multiply 142857 by any number between 1 and 6 and see what happens:*

$$1 \times 142857 = 142857$$
$$2 \times 142857 = 285714$$
$$3 \times 142857 = 428571$$
$$4 \times 142857 = 571428$$
$$5 \times 142857 = 714285$$
$$6 \times 142857 = 857142$$

The same digits recur in each answer, and if the products are each written in the form of a circle, you will see that the order of the digits remains the same.



- *Multiply 142857 by 7 and things suddenly change:*

$$142857 \times 7 = 999999$$

- *For instance, if we divide 142857 into two groups, 142 and 857, the second figure of the first group, multiplied by the third figure of the first group gives the first figure of the second group:*

$$4 \times 2 = 8$$

The sum of the first two figures of the first group gives the second figure of the second group:

$$1 + 4 = 5$$

And the sum of all three figures of the first group gives the third figure of the second group:

$$1 + 4 + 2 = 7$$

- *Table of the products of the number 142857 when multiplied by 1,2,3,4,5, and 6:*

1	4	2	8	5	7	=	27
2	8	5	7	1	4	=	27
4	2	8	5	7	1	=	27
5	7	1	4	2	8	=	27
7	1	4	2	8	5	=	27
8	5	7	1	4	2	=	27
27	27	27	27	27	27		

Horizontally and vertically the digits all add up to 27.

- *For 1/7, expressed as a decimal is: 0.142857 142857 142857 142857 and so on to infinity.*

By E. Lincy, I M. Sc

The Full Form of Mathematics……

M – Miracle of nature

A – Art of arithmetic

T – Tool of knowledge

H – Habit of problem solving

E – Evaluation of civilization

M – Magic of numbers

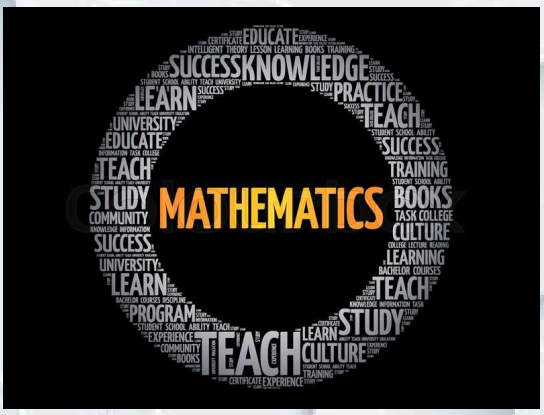
A – Application of rules

T – Talent

I – Ideas of intellect

C – Creativity of algebra

S – Science of learning

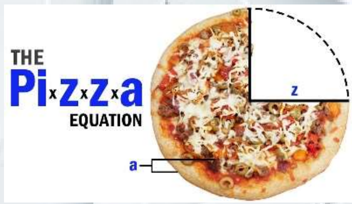


By G. Vaishnavi Devi, II B. Sc

Do You Know? – II

1. ***PIZZA and PI***

   Pi multiplied by the radius squared to find the area and multiply area by height to find the volume, that means the volume of a pizza that has a nominal radius of (z) and height (a) will, of course, be: Pi × z × z × a.



2. *If you multiply 111,111,111 × 111,111,111 you get 12,345,678,987,654,321 – a palindrome number that reads the same forwards (or) backwards.*

   111,111,111 × 111,111,111 (9 NUMBERS × 9 NUMBERS) We will always get a palindrome ranging from 1 to 9. And that works all the way back down to 11 × 11 (121) (or) just 1 × 1 (1).
3. ***Googol***

   A googol equals 10 followed by 100 zeros, therefore, to put things into perspective, think the following number: 10, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, or you can just be normal and think of it this way:
4. ***Digit 9***

   Dividing the digits by 9 will always give us the same digit repeated to infinity, examples:

   a) 1 / 9 = 0.1111
   b) 3 / 9 = 0.3333
   c) 7 / 9 = 0.7777

5. *In binary 73 is a palindrome, 1001001, which backwards is 1001001.*
6. *If you count to a trillion dollars one by one at a dollar a second, you will need 31, 710 years.*

7. ***Word 'Hundred'***

The word "Hundred" is actually derived from the Old Norse word "hundrath", which actually means 120, not 100.

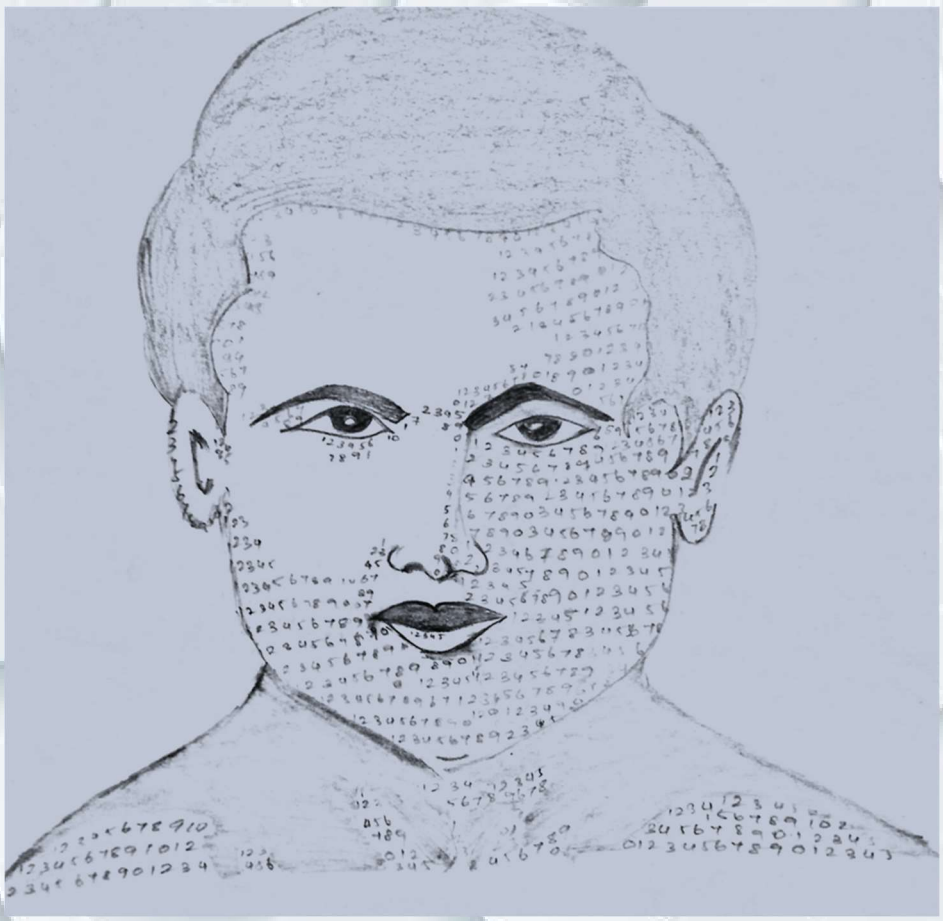
8. ***Pythagoras' Constant***

The square root of 2 (1.41) is known as Pythagoras' Constant. It's also the very first irrational number ever to be discovered.

By

S. Nivetha, Research Scholar

Human Computer + Magic Number



By

M. Subashree, III B. Sc

P. Chithiraikani III B.Sc

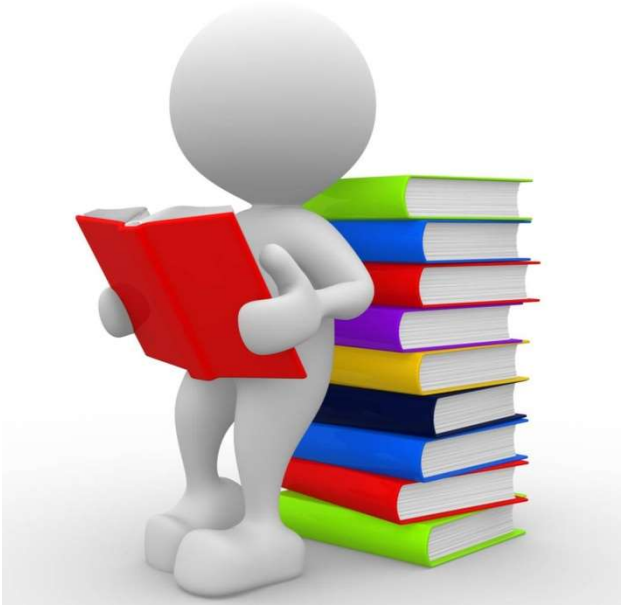
"Mathematics is not about numbers, equations, computations, or algorithms, it is about Understanding." – William Paul Thurstan.

"Life is a maths equation. In order to gain the most, you have to know how to convert the negatives into positives."

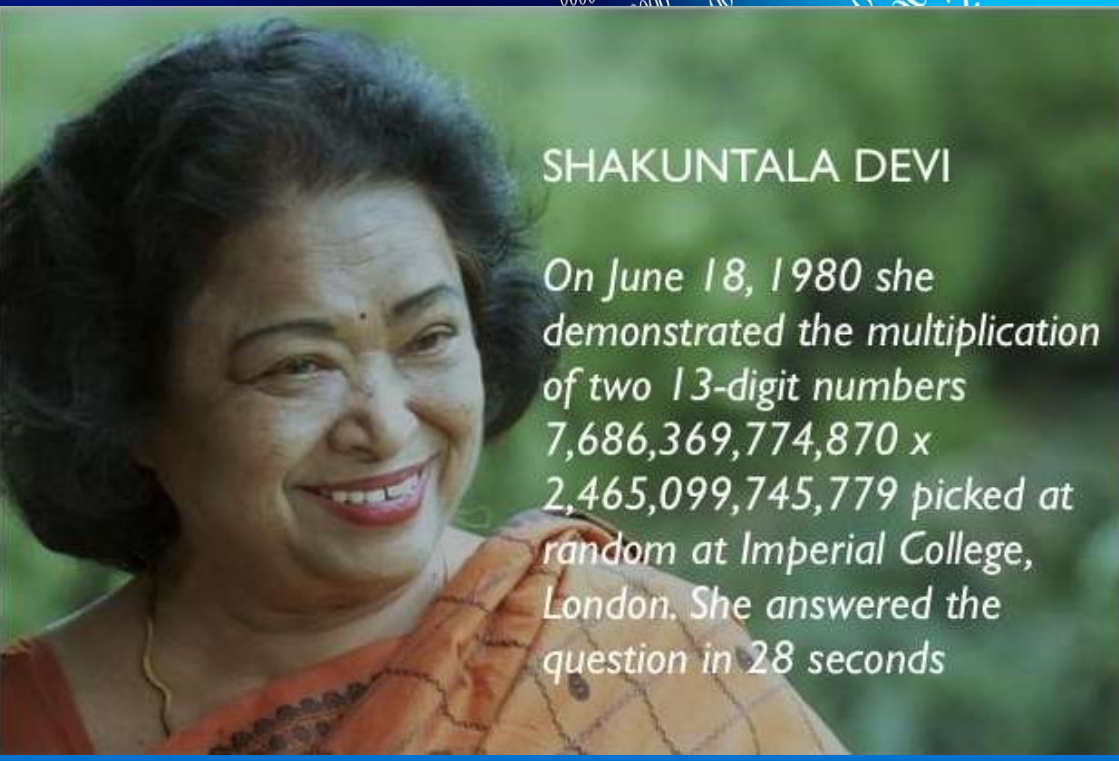
By S. Vasandha Gomathy, I B. Sc

"It's not the end of the book,

It's just the beginning of a new chapter."



$$P(X = k) = \binom{n}{k} p^k \cdot (1-p)^{n-k}$$



In 1970, she was invited by an institute in Germany where she bet a computer in calculation. Impressed by her performance, the institute gifted her a Mercedes Benz.