# Invest in your child’s future today.

# **Quality education is priceless!**

Why You Should Join Our Learning Program

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We only labor to stuff the memory, and leave the conscience and the understanding unfurnished and void.

**- Michel De Montaigne**

# Knowledge Management (KM)

From grade II to Grade XII

## Say No to Rote Learning!

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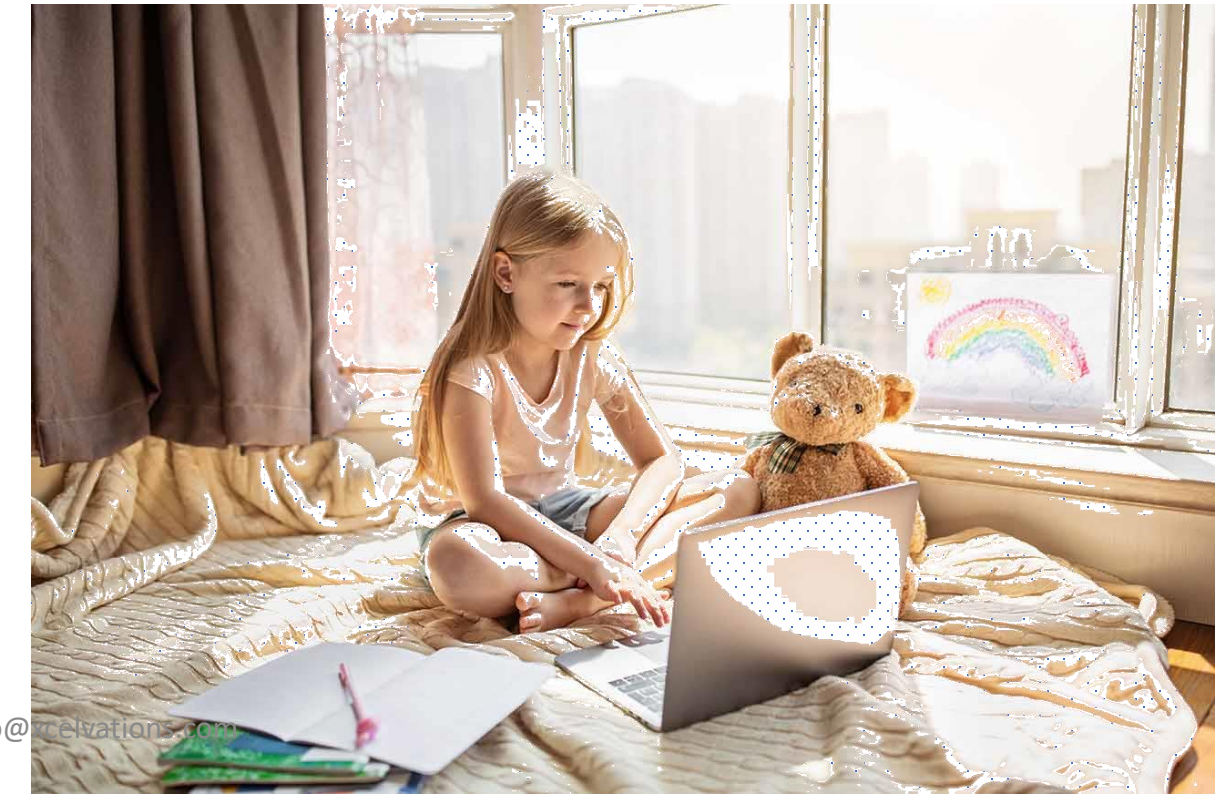
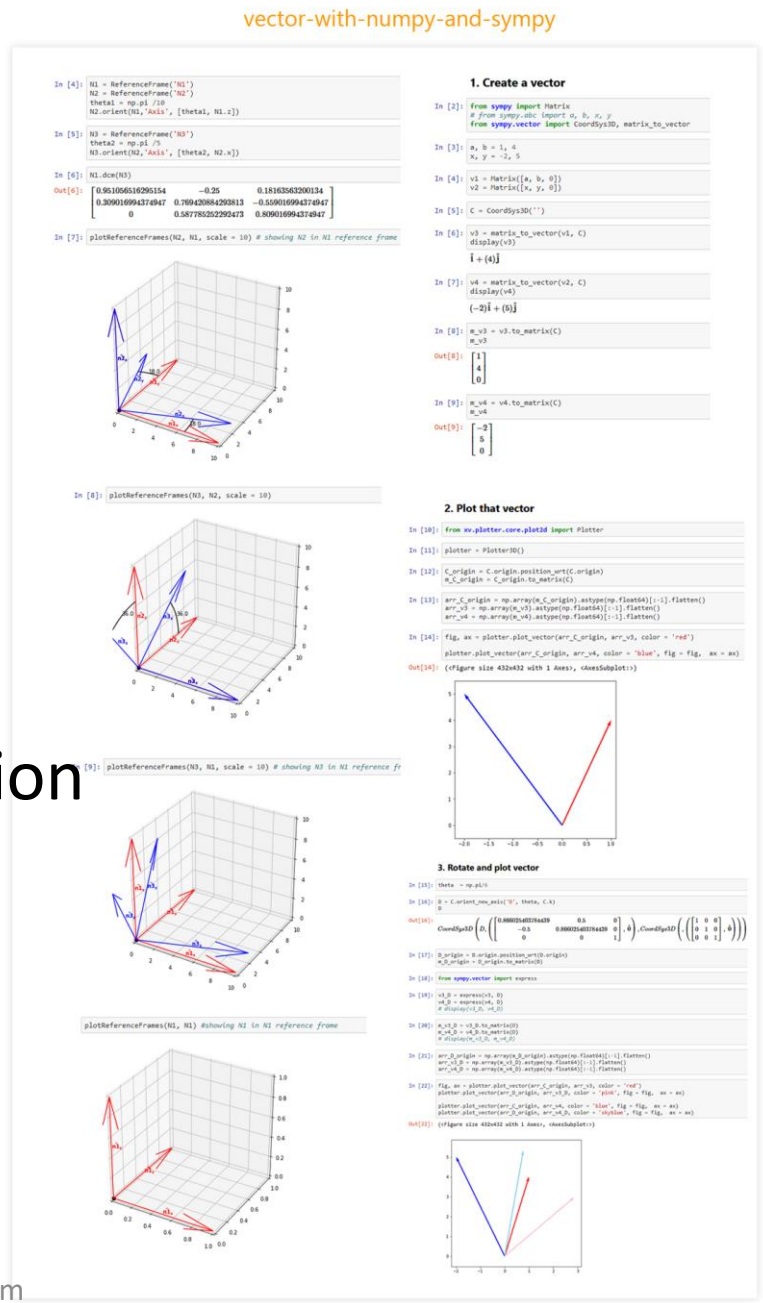


# Highlights

- Online only sessions (Google Meet)
- No memorization
- No homework
- No extra assignments
- Programming as a language of communication
- 12 to 16 one-hour sessions per month



# What is Knowledge Management (KM)?

- KM is our learning software.
- A mix of algorithms, Al, content, and a philosophical change in the learning process.
- Faster and concept-based learning.
- Web and Python Jupyter-based interface.
- The interwoven conceptual content enables faster learning and includes in-built practice.
- Algorithm/Al-generated content and problems make it a never-exhausting resource for learning.

# Curriculum on Offer

- Grade 2 to Grade 12
  - All subjects
  - A specific subject
  - Math, Physics, Chemistry
- SAT Grade 10 and Grade 12
- Art of Problem Solving (Math)
- Math Olympiad
- Science Olympiad
- English Olympiad

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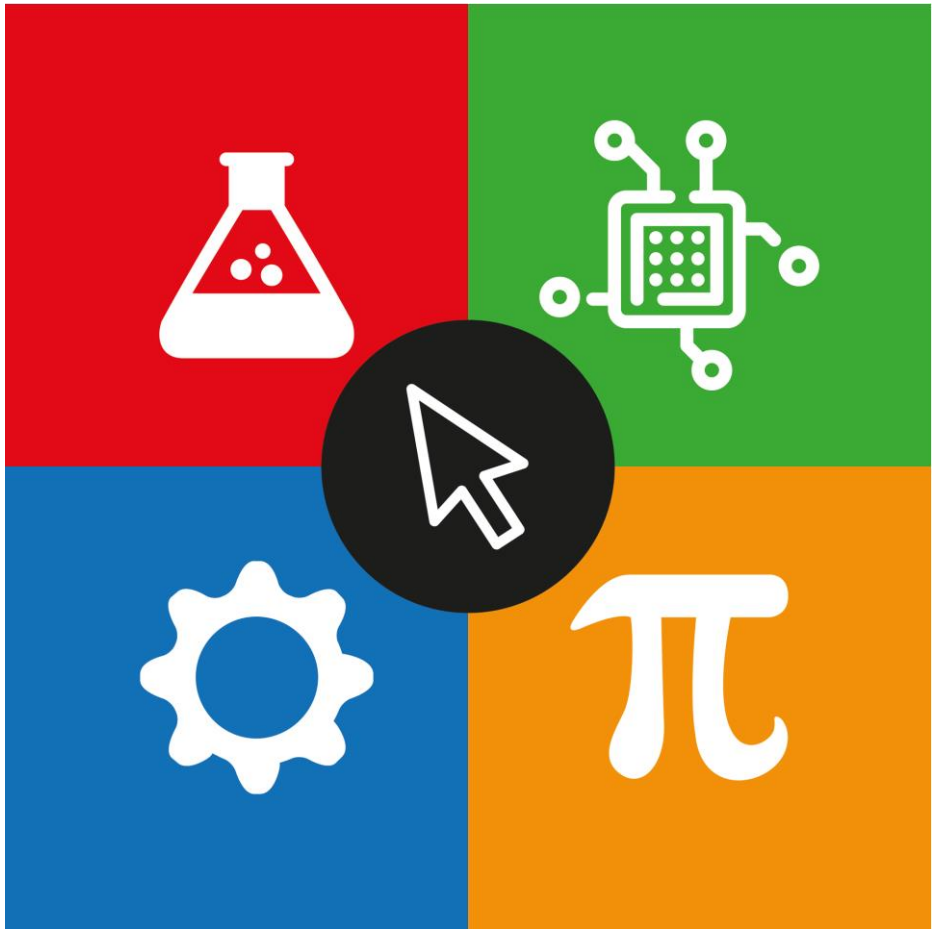
# Subjects Covered

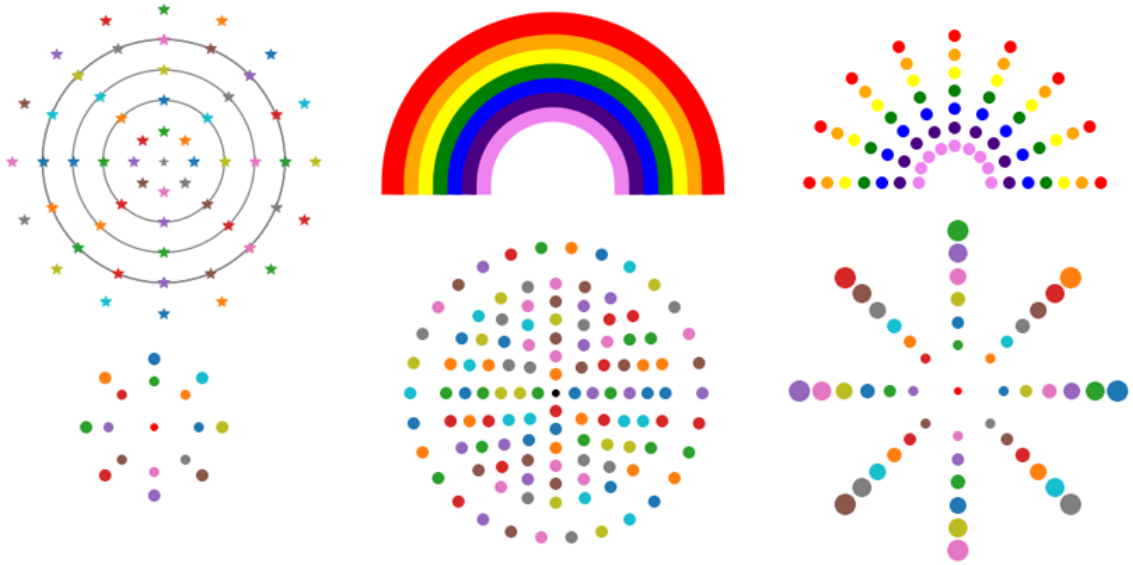
- Math
- Science
  - Physics
  - Chemistry
  - Math
  - Biology (up to Grade 10 only)
  - English
- Social Studies
  - for middle school only



Note: "Grade" refers to "Class“.

# Prerequisite

- We don't require any prior qualification test.
- There is no prerequisite standard or concept level needed to join our classes.
  - All topics start with foundational concepts, allowing students to cover any gaps in their knowledge.

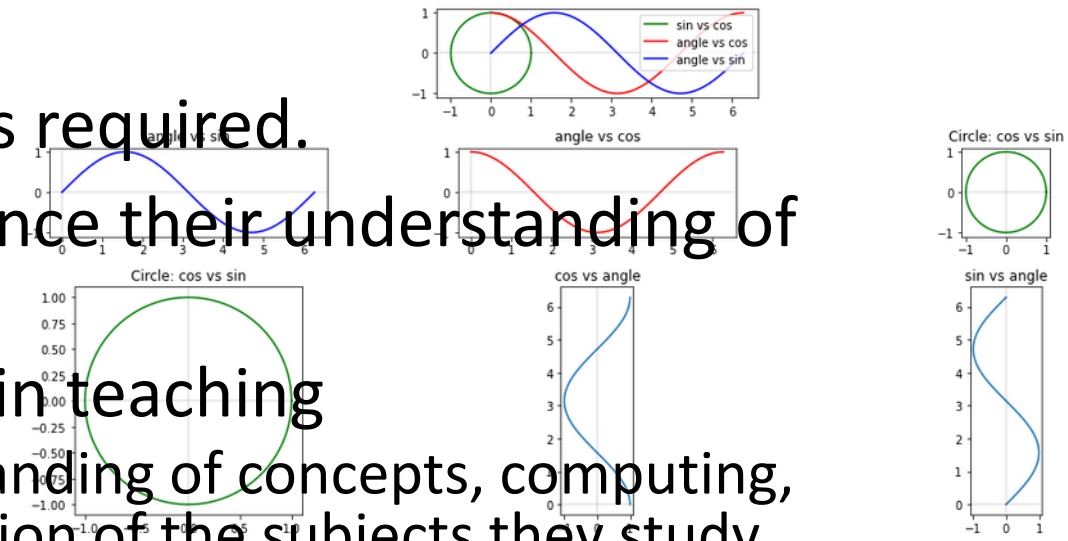


# We Start with Base Zero

- If students are already familiar with a topic, we cover it faster, but we still go through it.
- We aim to cover the current grade curriculum within the first six months of starting classes.
- The concepts may progress to higher-grade topics if:
  - Students continue to learn at a faster pace without difficulty.
  - The learning process remains efficient and effective.

# Programming

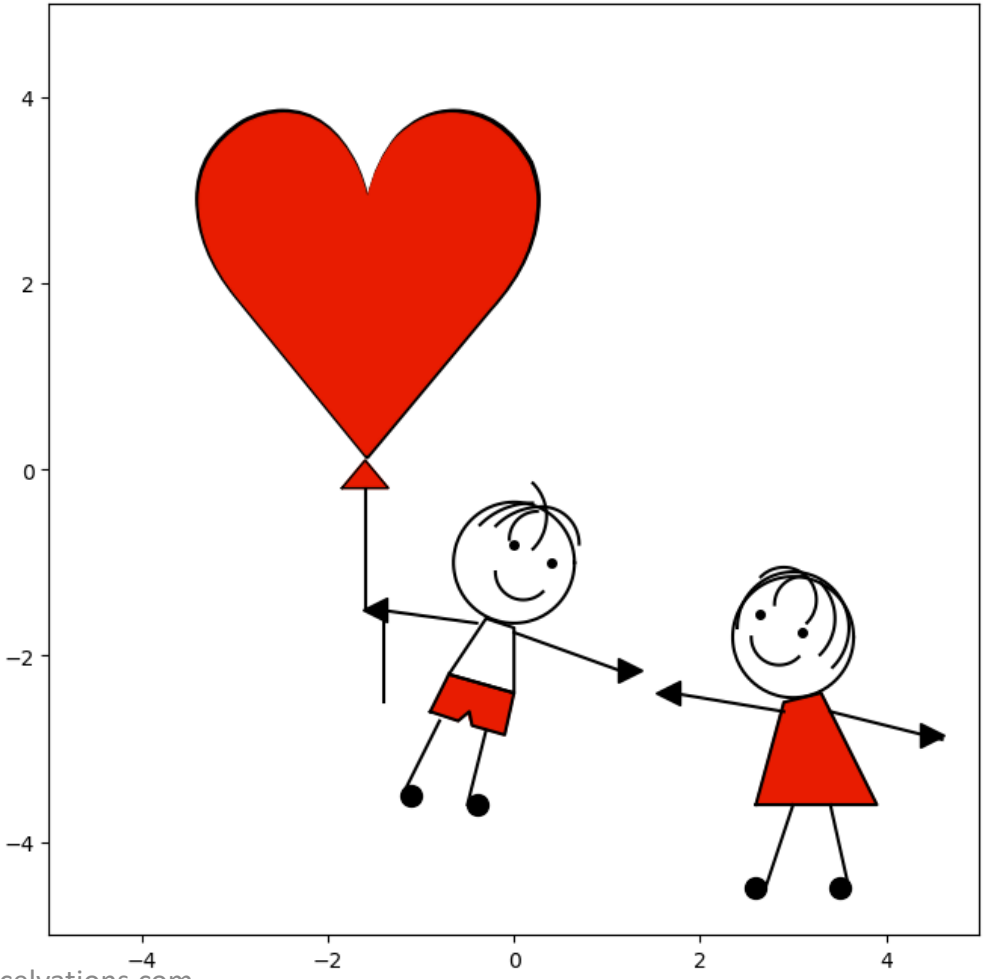
```
65 ax.axvline(x = 0, color = (0, 0, 0, .1))
66 ax.axhline(y = 0, color = (0, 0, 0, .1))
67 ax.legend()
68
69 fig.tight_layout()
70 plt.show()
```




- No prior programming knowledge is required.
- Students use programming to enhance their understanding of subjects.
- Python with Jupyter is widely used in teaching
  - Programming helps in better understanding of concepts, computing, visualization, and theoretical exploration of the subjects they study.
- AI/Machine Learning is taught gradually over a 4-year period
  - to aid in understanding the application of mathematics
  - model building includes concepts of probability, calculus, geometry, statistical distributions, etc.
- We don’t offer a programming only classes.

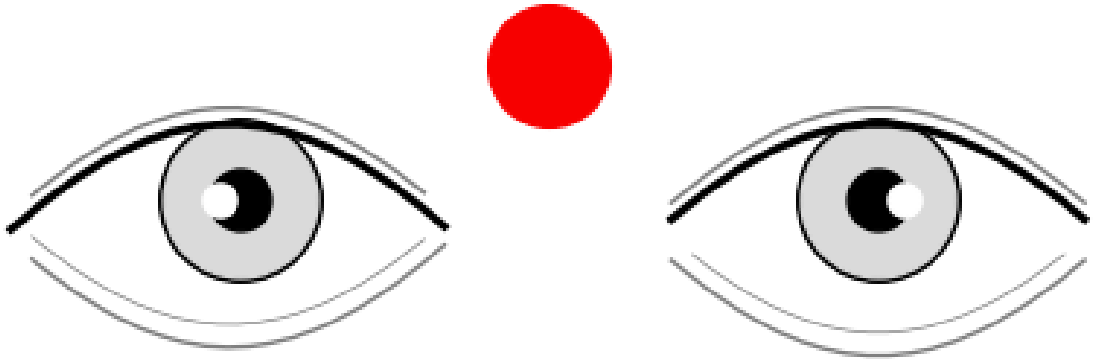
# It is all about having fun while learning

- Programming to learn and have fun
- This image has been created by students of primary grade with matplotlib in Python programming.



# Learning Art and Geometry through Programming

- This image has been created using trigonometric functions (sin, cos etc.) and matplotlib in Python



# Books and Course Material

- KM provides content and questions.
- As mentioned earlier, most of the material is delivered through Python Jupyter.
- It offers extensive content for learning and repeated practice (though we discourage the latter).
- We do not prescribe any specific books.
- A wide range of publicly available videos from various sources is also utilized.

jupyterhub

0 / xv-jupyter-notebooks / managers / math

..
probability
basicmaths
algebra
vector
geometry
calculus
series
trigonometry

0 / xv-jupyter-notebooks / managers / math / basicmaths

..
LogarithmManager.ipynb
NumberUnitManager.ipynb
NumberSystemManager.ipynb
SeriesPatternManager.ipynb
RatioManager.ipynb
SimpleArithmeticManager.ipynb
PowerManager.ipynb
DecimalOperationManager.ipynb
ProfitLossManager.ipynb

In [1]:
```
from xv.math.basicmaths import LogarithmManager
```

In [2]:
```
ke = LogarithmManager()
ke
```

Out[2]:
140448624636592@LogarithmManager
verbose = False

Logarithm Concepts
Example:
ke = LogarithmManager()
ke.getRandomProblem()
ke.getRandomProblem(problem_type = 0)
ke.getRandomProblem(problem_type = 1)
...
ke.printProblem()
ke.printAnswer()
ke.printSolution()

ke.printProblemTypes()

In [3]:
```
ke.printProblemTypes()
```

```
0. _problem_concept_of_log
1. _problem_general_concept_of_log
2. _problem_why_concept_of_log
3. _problem_simple_log_expr
4. _problem_find_log_of_product_series
5. _problem_find_log_of_product_of_pairs
6. _problem_log_of_division
7. _problem_find_log_of_exp_to_exp
8. _problem_find_log_of_exp_product
9. _problem_find_log_of_div_exp_both
10. _problem_log_and_exponent
11. _problem_log_reciprocal
12. _problem_log_chain_rule
13. _problem_product_of_two_terms
14. _problem_div_of_two_terms
15. _problem_simplify_log_in_exponent
16. _problem_log_of_multi_terms
17. _problem_long_expanded_to_simplified
18. _problem_log_of_common_numbers
19. _problem_custom_questions
```

```
In [4]: 1 ke.getRandomProblem(problem_type = 0)
```

Out[4]: Explain the concept of log on base $10$.

```
In [5]: 1 ke.printAnswer()
```

Out[5]:

**Log of numbers:**

log(ten) = 1
log(10) = 1

log(Hundred) = 2
log(100) = 2

log(Thousand) = 3
log(1000) = 3

log(Million) = 6
log(1000000) = 6

log(Billion) = 9
log(1000000000) = 9

log(Trillion) = 12
log(1000000000000) = 12

```
In [6]: 1 ke.printSolution()
```

Out[6]:

**We write numbers like this:**

ten = 10 (1 followed by 1 zero)
Hundred = 100 (1 followed by 2 zeroes)
Thousand = 1000 (1 followed by 3 zeroes)
Million = 1000000 (1 followed by 6 zeroes)
Billion = 1000000000 (1 followed by 9 zeroes)
Trillion = 1000000000000 (1 followed by 12 zeroes)

**If I ask you to tell me only zeroes in the numbe**

Number of zeroes in ten = 1
Number of zeroes in 10 = 1

Number of zeroes in Hundred = 2
Number of zeroes in 100 = 2

Number of zeroes in Thousand = 3
Number of zeroes in 1000 = 3

Number of zeroes in Million = 6
Number of zeroes in 1000000 = 6

Number of zeroes in Billion = 9
Number of zeroes in 1000000000 = 9

**So, let us summarize:**

ten = 10 (1 followed by 1 zero.)
log(ten) = 1
log(10) = 1

Hundred = 100 (1 followed by 2 zeroes.)
log(Hundred) = 2
log(100) = 2

Thousand = 1000 (1 followed by 3 zeroes.)
log(Thousand) = 3
log(1000) = 3

Million = 1000000 (1 followed by 6 zeroes.)
log(Million) = 6
log(1000000) = 6

Billion = 1000000000 (1 followed by 9 zeroes.)
log(Billion) = 9
log(1000000000) = 9

Trillion = 1000000000000 (1 followed by 12 zeroes.)
log(Trillion) = 12
log(1000000000000) = 12

**Log of numbers:**

log(ten) = 1
log(10) = 1

log(Hundred) = 2
log(100) = 2

log(Thousand) = 3
log(1000) = 3

log(Million) = 6
log(1000000) = 6

log(Billion) = 9
log(1000000000) = 9

log(Trillion) = 12
log(1000000000000) = 12

# Some Managers from math.

```
In [1]:  1  from xv.math.algebra import AlgebricExpressionManager

In [2]:  1  ke = AlgebricExpressionManager()

In [3]:  1  ke.printProblemTypes()
         2
```

```
0. _problem_add
1. _problem_add_advanced
2. _problem_subtract
3. _problem_subtract_advanced
4. _problem_multiple_subtracts
5. _problem_multiply
6. _problem_multiply_advanced
7. _problem_divide
8. _problem_divide_advanced_1
9. _problem_divide_advanced_2
10. _problem_divide_advanced_3
11. _problem_division_with_zero
12. _problem_power_with_zero
13. _problem_abs_values
```

Find the absolute value of

if $x < 0,\ y >= 0$

Answer:

$y - x$

Solution:

$\text{abs}\,(x - y)$

$= |x - y|$

Let $x = -8$, and $y = 5$

$= |(-8) - (5)|$

$= |-13|$

$= 13$

Hence,

$|x - y| = y - x$ See r

**Note:**

x + y = -3

x - y = -13

y - x = 13

-(x + y) = 3

$-5v + 8x + 2z$

$-9v - w + x - 2y + 6z$

Answer:

$4v + w + 7x + 2y - 4z$

Solution:

We have to subtract second expression from f

$-5v + 8x + 2z$

$-9v - w + x - 2y + 6z$

The coefficients of variables $v, w, x, y, z$ are:

$$\begin{bmatrix} v & w & x & y & z \\ -5 & 0 & 8 & 0 & 2 \\ -9 & -1 & 1 & -2 & 6 \end{bmatrix}$$

As We have to subtract second expression fro
we will change sign of each coefficient in the

$$\begin{bmatrix} v & w & x & y & z \\ -5 & 0 & 8 & 0 & 2 \\ 9 & 1 & -1 & 2 & -6 \end{bmatrix}$$

Add the columns:

$$\begin{bmatrix} v & w & x & y & z \\ 4 & 1 & 7 & 2 & -4 \end{bmatrix}$$

⇒ The sum of expressions:

$= 4v + w + 7x + 2y - 4z$

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We can rewrite

$\sqrt[3]{261} = \sqrt[3]{(216 + 45)}$ where $x = 216$ an

$f(\Delta x + x) = (\text{Value of function}) + (\text{Rate of ch}$

$$= f(x) + \left(\frac{d}{dx} f(x)\right) \cdot \Delta x$$

$$= f(x) + \left(\frac{d}{dx} \sqrt[3]{x}\right) \cdot \Delta x$$

$$= f(x) + \left(\frac{1}{3x^{\frac{2}{3}}}\right) \cdot \Delta x$$

$$= \sqrt[3]{216} + \left(\frac{216^{-\frac{2}{3}}}{3}\right) \cdot (45)$$

$$= 6 + \frac{5}{12}$$

$$= \frac{77}{12}$$ actual value is $\sqrt[3]{261}$

Solve $\dfrac{(4 - -5)}{6 \times 8 + \frac{(9-5)}{\left(\frac{5}{-8}\right)+(5x-4)}} \times (6 - 2)$

Answer:

$\dfrac{1485}{31552}$

Solution:

$$\frac{(4 - -5)}{6 \times 8 + \frac{(9-5)}{\left(\frac{5}{-8}\right)+(5x-4)}} \times (6 - 2)$$

$$= \frac{9}{6 \times 8 + \frac{(9-5)}{\left(\frac{5}{-8}\right)+(5x-4)}} \times (6 - 2)$$ as $(4 - -5) =$

$$= \frac{9}{4 \times 6 \times 8 + \frac{(9-5)}{\left(\frac{5}{-8}\right)+(5x-4)}}$$ as $(6 - 2) = 4$

Find relation between $a$, $v(s)$ and $s$

where:

$a$ = acceleration

$v(s)$ = velocity

$s$ = displacement

$t$ = time

Answer:

$v^2(s) = 2as + v^2(0)$

Solution:

## First Part:

$$a = \frac{d}{dt} v(s)$$

$$\implies a = \frac{d}{ds} v(s) \frac{d}{dt} s$$

$$\implies a = v(s) \frac{d}{ds} v(s)$$

$$\implies \int_0^s a\, ds = \int_0^s v(s) \frac{d}{ds} v(s)\, ds$$

$$\implies as = -\frac{v^2(0)}{2} + \frac{v^2(s)}{2}$$

$$\implies 2as = -v^2(0) + v^2(s)$$

## Second Part:

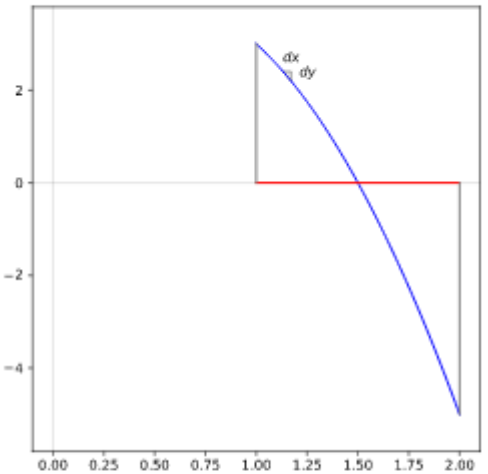
$$a = v(s) \frac{d}{\square} v(s)$$

Find length of the curve $f(x) = -4x^2 + 4x + 3$ between $x = 1$ and $x = 2$.

Answer:

$-\frac{\sqrt{17}}{4} - \frac{\text{asinh}(4)}{16} + \frac{\text{asinh}(12)}{16} + \frac{3\sqrt{145}}{4}$

Solution:




The length of curve

$dL = \sqrt{dx^2 + dy^2}$

$= \sqrt{df(x)^2 + dx^2}$

$= \sqrt{\left(\frac{d}{dx} f(x)\right)^2 + 1}\, dx$

$\rightarrow L = \left| \int_1^2 \sqrt{\left(\frac{d}{dx} f(x)\right)^2 + 1}\, dx \right|$

$= \left| \int_1^2 \sqrt{\left(\frac{d}{dx}(-4x^2 + 4x + 3)\right)^2 + 1}\, dx \right|$

Find surface area of the the cone whose base has radius 1 and height 3.

Answer:

$\pi\left(1 + \sqrt{10}\right)$

Solution:

A cone has one circular base and slant surface area

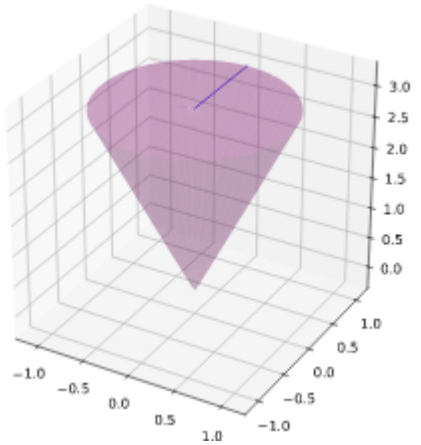
= area of circular base + slant surface area

- $\pi r^2 + \pi r l$

  where l is slant length and is equal to $\sqrt{h^2 + r^2} = \sqrt{(1^2 + 3^2)} = \sqrt{10}$

- $\pi r(r + l)$
- $\pi * 1\left(1 + \sqrt{10}\right)$
- $\pi * 1\left(1 + \sqrt{10}\right)$
- $\pi\left(1 + \sqrt{10}\right)$

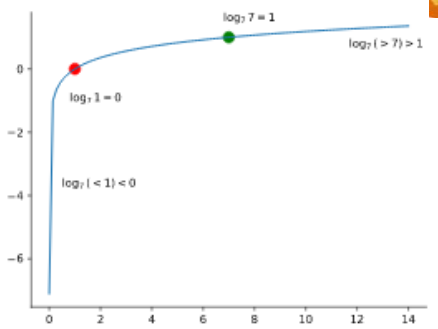
Cone (radius: 1, length: 3, center: (0, 0, 0), theta: 2π)




The value of $\log_7 343.1$ is: -0.2625, 0.04898, 1.007, 2, 3

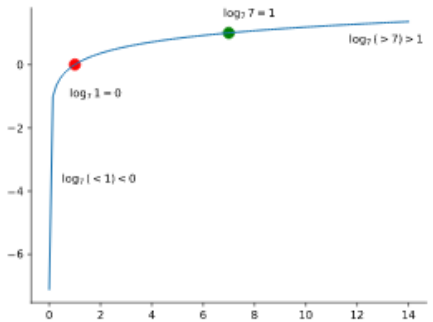
Answer:

3



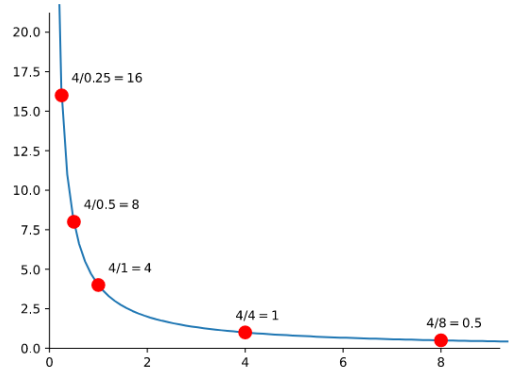

Solution:

$\log_7 343.1 = 3$




```
import matplotlib.pyplot as plt
from matplotlib import pyplot as plt
```

The value of $\frac{4}{3.1}$ is: 11.43, 6.667, 4.706, 3.636, 2.5, 1.905, 1.29




Answer:

1.29

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```
ke.getRandomProblem(problem_type= 18)
```

Simplify the followings:

$$\frac{8.0+0.4}{40.0} * \frac{1}{6.0}$$

```
ke.printAnswer()
```

$\frac{7}{200}$ or

0.035

```
ke.printSolution()
```

$$\frac{8.0+0.4}{40.0} * \frac{1}{6.0}$$

$$= \frac{8.4}{40.0} * \frac{1}{6}$$

$$= \frac{\frac{42}{5}}{40} * \frac{1}{6}$$

$$= \frac{42 * 1}{40 * 5} * \frac{1}{6}$$

$$= \frac{42 * 1 * 1}{40 * 5 * 6}$$

$$= \frac{42}{1200}$$

$$= \frac{7}{200}$$

```
ke.getRandomProblem(problem_type = 19)
```

Prove that
$\frac{2}{5} < \log_{10} 3 < \frac{1}{2}$

```
ke.printAnswer()
```

$\frac{2}{5} < \log_{10} 3 < \frac{1}{2}$

```
ke.printSolution()
```

$\log_{10} 3 \quad ? \quad \frac{2}{5}$

$\Rightarrow 3 \quad ? \quad 10^{\frac{2}{5}}$

$\Rightarrow 3^5 > 10^2,$

Now $\log_{10} 3 \quad ? \quad \frac{1}{2}$

$\Rightarrow \quad 3 \quad ? \quad 10^{\frac{1}{2}}$

$\Rightarrow \quad 3^2 < 10,$ which is true

Hence $\frac{2}{5} < \log_{10} 3 < \frac{1}{2}$

Write arithmetic series of $z^6$ terms, with first term ($t_0$) as $\sqrt[9]{x}$ and the common difference as $-y$

Answer:

$$((\sqrt[9]{x}) + (-y) \cdot 0) + ((\sqrt[9]{x}) + (-y) \cdot 1) + ((\sqrt[9]{x}) + (-y) \cdot 2) + \cdots + ((\sqrt[9]{x}) + (-y) \cdot (z^6 - 2)) + ((\sqrt[9]{x}) + (-y) \cdot (z^6 - 1))$$

It can also be written as $\sum_{k=0}^{z^6-1} ((\sqrt[9]{x}) + (-y) \cdot k)$

Solution:

**next term = (previous term) + (common difference)**

$t_n = t_0 + n *$ **common difference**

Please note that we start count of terms from 0.

$$t_0 = \sqrt[9]{x} = ((\sqrt[9]{x}) + (-y) \cdot 0)$$

$$t_1 = t_0 + (-y) = ((\sqrt[9]{x}) + (-y) \cdot 0) + (-y) = ((\sqrt[9]{x}) + (-y) \cdot 1)$$

$$t_2 = t_1 + (-y) = ((\sqrt[9]{x}) + (-y) \cdot 1) + (-y) = ((\sqrt[9]{x}) + (-y) \cdot 2)$$

...

$$t_{z^6-1} = t_{z^6-2} + (-y) = ((\sqrt[9]{x}) + (-y) \cdot (z^6 - 2)) + (-y) = ((\sqrt[9]{x}) + (-y) \cdot (z^6 - 1))$$

$$t_{z^6} = t_{z^6-1} + (-y) = ((\sqrt[9]{x}) + (-y) \cdot (z^6 - 1)) + (-y) = ((\sqrt[9]{x}) + (-y) \cdot (z^6))$$

Therefore, the series is

$$((\sqrt[9]{x}) + (-y) \cdot 0) + ((\sqrt[9]{x}) + (-y) \cdot 1) + ((\sqrt[9]{x}) + (-y) \cdot 2) + \cdots + ((\sqrt[9]{x}) + (-y) \cdot (z^6 - 2)) + ((\sqrt[9]{x}) + (-y) \cdot (z^6 - 1))$$

$$= x * *(1/9) + x * *(1/9) - y + x * *(1/9) - 2 * y + \cdots + x * *(1/9) - y * (z * *6 - 2) + x * *(1/9) - y * (z * *6 - 1)$$

It can also be written as $\sum_{k=0}^{z^6-1} ((\sqrt[9]{x}) + (-y) \cdot k)$

Solve the followings:

**Q1.** $---9$

**Q2.** $--9$

**Q3.** $9 * 9$

**Q4.** $-9 * 9$

**Q5.** $9 * -9$

**Q6.** $-9 * -9$

**Q7.** $--9 * 9$

**Q8.** $9 * --9$

**Q9.** $--9 * ---9$

**Q10.** $-9 * --9$

**Q11.** $--9 * -9$

**Solution 28.**
$(-2)/(-10) = \frac{1}{5}$

**Solution 29.**
$10^2 = 100$

**Solution 30.**
$2^{10} = 1024$

**Solution 31.**
$10^{-2} = \frac{1}{100}$

**Solution 32.**
$2^{-10} = \frac{1}{1024}$

**Solution 33.**
$(-10)^2 = -100$

**Solution 34.**
$(-2)^{10} = -1024$

**Solution 35.**
$(-10)^{-2} = -\frac{1}{100}$

**Solution 36.**
$(-2)^{-10} = -\frac{1}{1024}$

**Solution 37.**
$log_2 10 = \frac{10}{3}$

**Solution 38.**
$log_{10} 2 = \frac{3}{10}$

```
from xv.math.basicmaths import NumberUnitManager
```

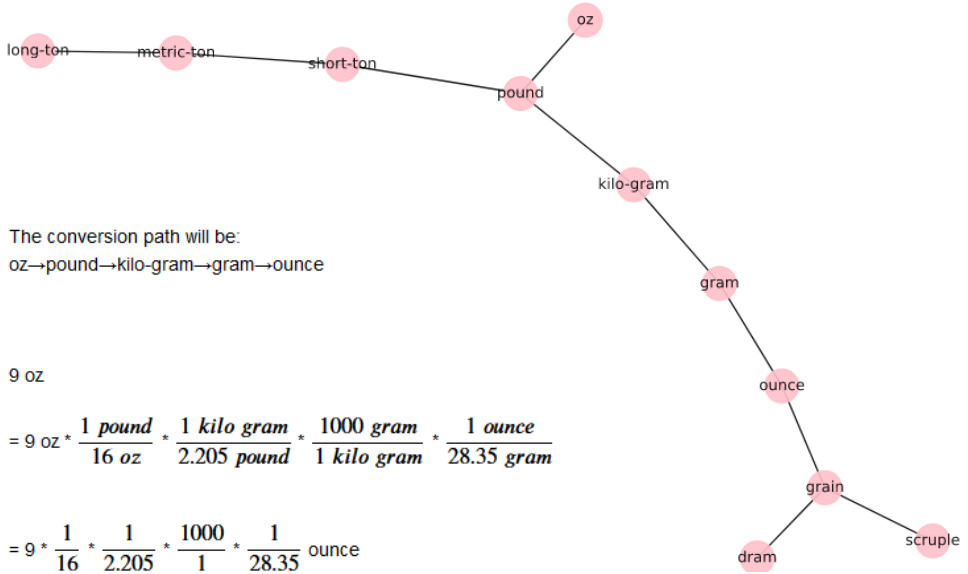
```
ke = NumberUnitManager()
```

```
ke.getRandomProblem(problem_type = 4)
```

Convert 9 oz to ounce.

Note: You may use the following table:

1 ounce = 28.35 gram
1 pound = 16 oz
1 kilo-gram = 2.205 pound
1 pound = 0.0005 short-ton
1 metric-ton = 1.12 short-ton
1 long-ton = 1.016 metric-ton
1 grain = 0.05 scruple
1 grain = 0.01667 dram
1 grain = 0.00208 ounce
1 kilo-gram = 1000 gram




The conversion path will be:
oz→pound→kilo-gram→gram→ounce

9 oz

$$= 9 \text{ oz} * \frac{1 \ pound}{16 \ oz} * \frac{1 \ kilo \ gram}{2.205 \ pound} * \frac{1000 \ gram}{1 \ kilo \ gram} * \frac{1 \ ounce}{28.35 \ gram}$$

$$= 9 * \frac{1}{16} * \frac{1}{2.205} * \frac{1000}{1} * \frac{1}{28.35} \text{ ounce}$$

= 9 * 0.9998120353373564 ounce

= 8.998308318036207 ounce

```
ke.getRandomProblem(problem_type = 11)
```

Form 2-letter words from letters r, k, v, g, f, u, x. The words need not be meaningful

```
ke.printAnswer()
```

84

```
ke.printSolution()
```

ways of selecting 3 from 9 items

$= \binom{9}{3}$

$= \frac{9!}{(9-3)!\ 3!}$

$= \frac{9!}{6!\ 3!}$

$= \frac{362880}{720 * 6}$

$= 84$

```
ke.getRandomProblem(problem_type= 2)
```

Find the ratio of numbers **0.014, 0.031 and 0.58**

```
ke.printAnswer()
```

**14 : 31 : 580**

```
ke.printSolution()
```

The greatest common divisor (GCD) of the numbers **27, 12 and 3** = 3

To get ratio, we have to divide the numbers by the GCD.

Ratio of numbers **27, 12 and 3**

$= \frac{27}{3} : \frac{12}{3} : \frac{3}{3}$

$= 9 : 4 : 1$

```
ke.printSolution()
```

## Numbers:

$\frac{1}{2}, -\frac{2}{7}, \frac{6}{1}, \frac{1}{1}, \frac{1}{2}, -\frac{2}{1}$

## Common Denominators:

Let us make all denominators equal to their LCM = 14

$= \frac{1*7}{2*7}, -\frac{2*2}{7*2}, \frac{6*14}{1*14}, \frac{1*14}{1*14}, \frac{1*7}{2*7}, -\frac{2*14}{1*14}$

$= \frac{7}{14}, -\frac{4}{14}, \frac{84}{14}, \frac{14}{14}, \frac{7}{14}, -\frac{28}{14}$

### Sum:

As we have common denom

$= \frac{80}{14}$

$= \frac{80\ /\ 2}{14\ /\ 2}$

$= \frac{40}{7}$

$= \frac{40}{7}$

### Average:

Average of numbers

$= \frac{\frac{40}{7}}{6}$

$= \frac{1}{6} * \frac{40}{7}$

$= \frac{20}{21}$

### Sorted Numbers:

$-\frac{28}{14}, -\frac{4}{14}, \frac{7}{14}, \frac{7}{14}, \frac{14}{14}, \frac{84}{14}$

$= -\frac{2}{1}, -\frac{2}{7}, \frac{1}{2}, \frac{1}{2}, \frac{1}{1}, \frac{6}{1}$

### Median:

The number of fractions is 6, an even number.

The middle term is, $\frac{6+1}{2} = \frac{7}{2}$ th term.

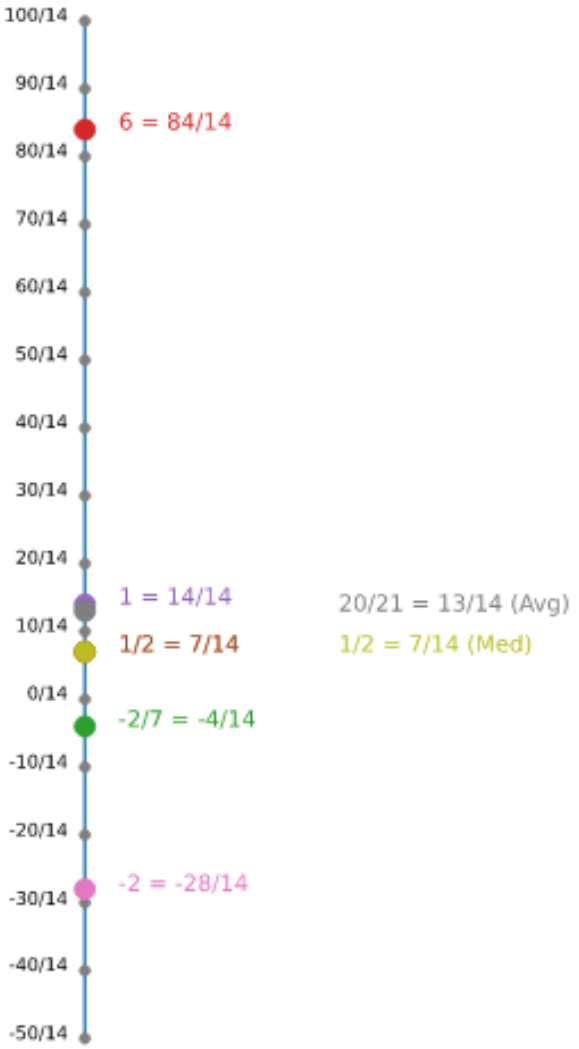
Hence, the median will be average of 3rd and 4th terms.

Median

$= \frac{\frac{1}{2} + \frac{1}{2}}{2}$

$= \frac{1}{2}$

$= \frac{1}{2}$

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```
ke.getRandomProblem(problem_type = 7)
```

Marium has 7 *farm*. Each *farm* has 2 *garden*. Each *garden* has 60 *tree*. Each *tree* has 10 *fruit* cost of maintaining each tree is $0.5. Answer the following questions:

1. What is the total number of farm?
2. What is the total number of garden?
3. What is the total number of tree?
4. What is the total number of fruit?
5. What is the total number of box?
6. What is the total sales value?
7. What is the total cost?
8. What is the net profit?

```
ke.printSolution()
```

**The equation of the question are as follows:**

1 $Mary = 8\ garden$

1 $garden = 20\ tree$

1 $tree = 20\ fruit$

1 $fruit = \frac{1}{12}\ box$

1 $box$ = $800/3 [sell price]

1 $garden$ = $200 [cost price]

**Let us do calculations:**

Total sales revenue

$= 8\ garden$

$= 8\ garden * \frac{20\ tree}{garden}$ So, 160 $tree$

$= 8\ garden * \frac{20\ tree}{garden} * \frac{20\ fruit}{tree}$ So, 3200 $fruit$

$= 8\ garden * \frac{20\ tree}{garden} * \frac{20\ fruit}{tree} * \frac{box}{12\ fruit}$ So, 800/3 $box$

$= 8\ garden * \frac{20\ tree}{garden} * \frac{20\ fruit}{tree} * \frac{box}{12\ fruit} * \frac{\$8}{box}$

$= 8 * 20 * 20 * \frac{1}{12} * \$8$

$= \$6400/3$

Cost

$= \frac{\$200}{garden}$

$= \frac{\$200}{garden} * 8\ garden$

$= \$1600$

Net Profit
= Total Cost - Total Revenue

$= \$6400/3 - \$1600$

$= \$1600/3$

Expand:

$$\left(\frac{x}{3y} + xy\right)^4$$

Answer:

$$= x^4y^4 + \frac{4x^4y^2}{3} + \frac{2x^4}{3} + \frac{4x^4}{27y^2} + \frac{x^4}{81y^4} + \cdots$$

Solution:

$$\left(\frac{x}{3y} + xy\right)^4$$

$$= \sum_{k=0}^{4} \binom{4}{k}\left(\frac{x}{3y}\right)^{4-k}(xy)^k$$

$$= \binom{4}{0}\cdot\left(\frac{x}{3y}\right)^4\cdot(xy)^0 + \binom{4}{1}\cdot\left(\frac{x}{3y}\right)^3\cdot(xy)^1 + \binom{4}{2}\cdot\left(\frac{x}{3y}\right)^2\cdot$$

$$= 1\cdot\frac{x^4}{81y^4}\cdot 1 + 4\cdot\frac{x^3}{27y^3}\cdot xy + 6\cdot\frac{x^2}{9y^2}\cdot x^2y^2 + 4\cdot\frac{x}{3y}\cdot x^3y^3 + 1\cdot$$

$$= \frac{x^4}{81y^4} + \frac{4x^4}{27y^2} + \frac{2x^4}{3} + \frac{4x^4y^2}{3} + x^4y^4 + \cdots$$

$$= x^4y^4 + \frac{4x^4y^2}{3} + \frac{2x^4}{3} + \frac{4x^4}{27y^2} + \frac{x^4}{81y^4} + \cdots$$

**5.** $z = 3 - 3i$

modulus of $z = r = |z| = \sqrt{(3)^2 + (-3)^2} = 4.24$

argument or phase of $z = \phi(z) = tan^{-1}\left(\frac{-3}{3}\right) = tan^{-1}\left(\frac{-3}{3}\right) = -0.785 = -45^o$

Now,

$(3 - 3i)^4$

$= \left(re^{i(2n\pi+\phi)}\right)^4$

$= r^4e^{4(2n\pi+\phi)i}$

$4\ (2n\pi + \phi)$ can be solved for $n = 0, 1, 2, 3, \ldots$

The distinct values are:
$\theta_0 = (2 * 0 * \pi + -45^o) * 4 = 180^o$

Write expression for arranging $k$ items from a collection of $n$ items

$$P_k^n$$

Note: $P_k^n$ is read as $n$ permutation $k$.

Answer:

$$\frac{n!}{(-k+n)!}$$

Solution:

Arranging $k$ out of $n$ things.

As we start with $n$ things and r places:
1. For first place, we can choose any item from $n$ things, so we have $n$ choices.
2. For second place, we can choose any item from remainder $n-1$ things, so we have $n$
3. For third place, we can choose any item from remainder $n-2$ things, so we have $n-$
–
Thus, for $k$th place, the choice will be $n-(k-1) = n-k+1$

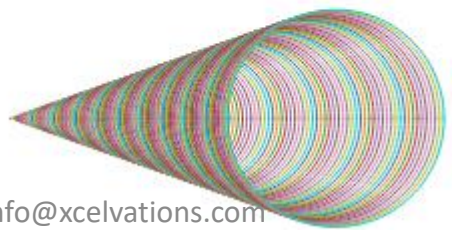
Now, all choices are dependent on each other, so will get a product to get the result.

$$\implies P_k^n = n(n-1)(n-2)\cdots(n-k+2)(n-k+1)$$

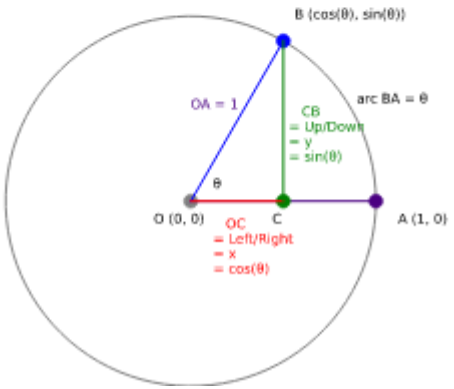
$$\implies P_k^n = \frac{n(n-1)(n-2)\cdots(n-k+2)(n-k+1)(n-k)(n-k-1)\cdots * 3}{(n-k)(n-k-1)\cdots * 3 * 2 * 1}$$

$$\implies P_k^n = \frac{n!}{(-k+n)!}$$

```
for i in np.linspace(0, length_of_curve, number_of_frames):
    r = i
    x = r * cos(theta) + r * move_left_right
    y = r * sin (theta) + r * move_up_down
    plt.plot(x,y)

#optional code
plt.gca().set_aspect('equal')
plt.axis('off')
plt.show()
```



```
#plot point B
plt.plot(cos(theta), sin(theta), marker = 'o', color = 'blue', marker
plt.gca().annotate(f'B (cos(θ), sin(θ))', xy=(cos(theta) * 1.12, sin(

#plot radius OB
plt.plot((0, cos(theta)), (0, sin(theta)), color = 'blue')

#plot point C
plt.plot(cos(theta), 0, marker = 'o', color = 'green', markersize = 1
plt.gca().annotate(f'C', xy=(cos(theta) * .88,  -0.12), xycoords="dat

#plot line OC
label = f'''   OC
= Left/Right
= x
= cos(θ)'''

plt.plot((0, cos(theta)), (0, 0), color = 'red')
plt.gca().annotate(label, xy=(+0.12,  -0.39), xycoords="data", color

#plot line CB
label = f'''   CB
= Up/DOwn
= y
= sin(θ)'''

plt.plot((cos(theta), cos(theta)), (0, sin(theta)), color = 'green')
plt.gca().annotate(label, xy=(cos(theta)+0.03,  sin(theta)/4), xycoor

#optional code
plt.xlim(-1.2, 1.2)
plt.ylim(-1.2, 1.2)
plt.gca().set_aspect('equal')
plt.axis('off')
plt.show()
```



Find formula of $\cos(A-B)$ and $\sin(A-B)$

Answer:

$$\cos(A-B) = \sin(A)\sin(B) + \cos(A)\cos(B)$$

$$\sin(A-B) = \sin(A)\cos(B) - \sin(B)\cos(A)$$

Solution:

$$e^{i(A-B)} = e^{iA}e^{-iB}$$

$$\implies i\sin(A-B) + \cos(A-B) = (i\sin(A) + \cos(A))(-i\sin(B$$

$$\implies i\sin(A-B) + \cos(A-B) = \sin(A)\sin(B) + i\sin(A)\cos($$

Taking real terms of both sides:

$$\implies \cos(A-B) = \sin(A)\sin(B) + \cos(A)\cos(B)$$

Taking imaginary terms of both sides:

$$\implies \sin(A-B) = \sin(A)\cos(B) - \sin(B)\cos(A)$$

Prove

$$e^{i\theta} = \cos(\theta) + i\sin(\theta)$$

Answer:

$$e^{i\theta} = 1 + i\theta - \frac{\theta^2}{2} - \frac{i\theta^3}{6} + \frac{\theta^4}{24} + \frac{i\theta^5}{120} + O\left(\theta^6\right)$$

$$\cos(\theta) = 1 - \frac{\theta^2}{2} + \frac{\theta^4}{24} + O\left(\theta^6\right)$$

$$\sin(\theta) = \theta - \frac{\theta^3}{6} + \frac{\theta^5}{120} + O\left(\theta^6\right)$$

$$\implies e^{i\theta} = \cos(\theta) + i\sin(\theta)$$

Solution:

$$e^{i\theta} = 1 + i\theta - \frac{\theta^2}{2} - \frac{i\theta^3}{6} + \frac{\theta^4}{24} + \frac{i\theta^5}{120} + O\left(\theta^6\right)$$

$$\cos(\theta) = 1 - \frac{\theta^2}{2} + \frac{\theta^4}{24} + O\left(\theta^6\right)$$

$$\sin(\theta) = \theta - \frac{\theta^3}{6} + \frac{\theta^5}{120} + O\left(\theta^6\right)$$

$$\implies e^{i\theta} = \cos(\theta) + i\sin(\theta)$$

Find approximate value of the square root of $1030$.

```
ke.printAnswer()
```

$10.10$

```
ke.printSolution()
```

$$(a+b)^{\frac{1}{3}} = a^{\frac{1}{3}} + \frac{1}{3}a^{\frac{1}{3}-1}\cdot b^1 + \cdots$$

$$= a^{\frac{1}{3}} + \frac{1}{3}a^{-\frac{2}{3}}\cdot b + \cdots$$

Let $x = a^{\frac{1}{3}}$

$$\Rightarrow x^2 = a^{\frac{2}{3}}$$

$$\Rightarrow \frac{1}{x^2} = a^{-\frac{2}{3}}$$

$$\Rightarrow (a+b)^{\frac{1}{3}} \approx x + \frac{1}{3}\frac{1}{x^2}\cdot b$$

The closest perfect $3$ power of a number is $1000 = 10^3$.
Therefore,

$$1030 = 1000 + 30$$

$$\Rightarrow a = 1000$$

$$b = 30$$

$$x = 1000^{\frac{1}{3}} = 10$$

$$(1030)^{\frac{1}{3}} = (1000+30)^{\frac{1}{3}}$$

$$= x + \frac{1}{3}\frac{1}{x^2}\cdot b$$

$$= 10 + \frac{1}{3}\cdot\frac{1}{10^2}\cdot 30$$

$$= 10 + \frac{30}{300}$$

$$= 10 + 0.1$$

$$= 10.1$$

Please note that the actual root is $10.10$.

```
0. _problem_traditional_division
1. _problem_divisible_by_multiples_of_10
2. _problem_divisible_by_4_8
3. _problem_divisible_by_2_5
4. _problem_divisible_by_3_9
5. _problem_divisible_by_6
6. _problem_divisible_by_7_13_17_19_29
7.  problem divisible by 11
```

Is 733100 divisible by 7?

Answer:

False

Solution:

We will apply last digit reduction meth
The reduction factor for 7 is -2.

## Step 1: Number = 733100

-2 times of the last digit of 733100
= -2 * 0 = 0

Remove the last digit from 733100
= 73310

Add 0 from 73310
= 73310 + 0 = 73310

## Step 2: Number = 73310

-2 times of the last digit of 73310
= -2 * 0 = 0

Remove the last digit from 73310
= 7331

Add 0 from 7331
= 7331 + 0 = 7331

## Step 3: Number = 7331

-2 times of the last digit of 7331
= -2 * 1 = -2

Remove the last digit from 7331

# Mode of Teaching

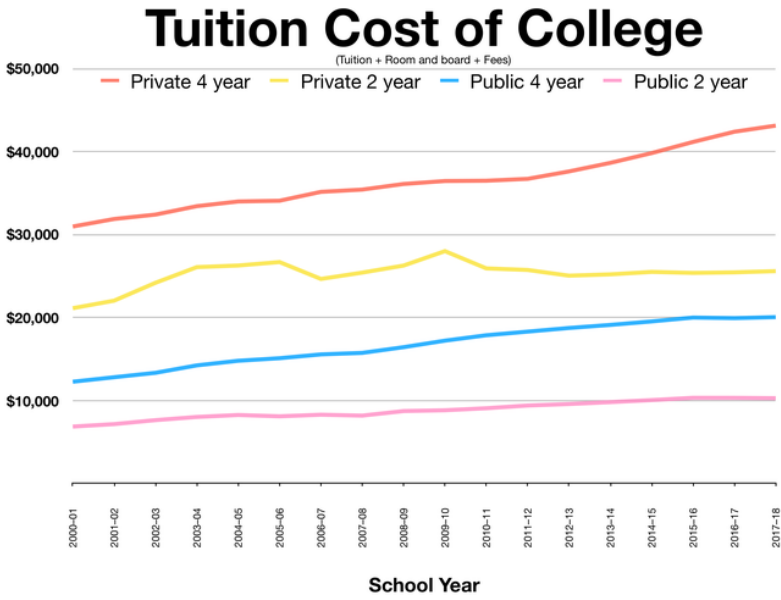
- Although our product is designed for self-learning and encourages it, we provide it exclusively in an instructor-assisted mode, i.e., through teaching sessions only.
- All teaching sessions are conducted online, exclusively through Google Meet.
- Batch sizes may vary from three to six students.
  - We discourage one-to-one sessions, though they are not completely ruled out.
- Online sessions must be attended using a laptop or computer.
  - Mobile devices are not sufficient as students need to write programs.
- For students in primary grades, an individual familiar with using a computer must be present during the sessions for first few days.

# Why You Should Join Us

- Conceptual learning enables faster and more confident self-learning.
- Attending sessions at school becomes stress-free as students already understand the concepts.
- Strong conceptual foundations empower students to solve problems they may not have previously encountered.
- Study time is significantly reduced.
- Most of our students who have been with us for over three years are at least two grades ahead of their peers.

# Does It Make Financial Sense?

- Being ahead allows more time for competition preparation, such as the SAT, significantly increasing the chances of securing near 100% scholarships.
- College fees can range between $120K and $250K, which means a substantial potential saving.
- Students completing Grade 10 with us often cover nearly all Grade 12 curriculum if they stay for a minimum of four years.
- Being ahead and having more time to prepare for tests increases the likelihood of success.




Source: Wikipedia

# A Case for KM in India

- Students completing Grade 10 with us often cover nearly all Grade 12 material if they stay for a minimum of four years.
- Being ahead and having more time to prepare for tests increases the likelihood of success in competitive exams like IIT/NEET.
- It also results in stress-free, shorter study hours with higher productivity.
- Strong conceptual understanding enables self-learning of advanced topics.

# How Much It Costs

- Our fee is competitive with other tutorial programs.
- Fees are billed monthly in advance.
- The subscription will renew automatically until canceled.
- To learn about the current entry subscription fee, please reach out to us directly.
- Once enrolled, a student's subscription fee largely remains unchanged throughout their time in the program.
- Special discounts are available for families with multiple siblings or groups enrolling together.

# Case Studies

- Have a look at a few case studies of our students
  - Grade 2
    - https://xcelvations.com/static/pdfs/grade2-a-case-study.pdf
  - Grade 6
    - https://xcelvations.com/static/pdfs/grade6-a-case-study.pdf
  - Grade 9
    - https://xcelvations.com/static/pdfs/grade9-a-case-study.pdf

Feel free to reach out to us by calling or messaging on WhatsApp at +91 75699 33343, or email us at info@xcelvations.com.

You can also visit our website at http://www.xcelvations.com/ for more information.