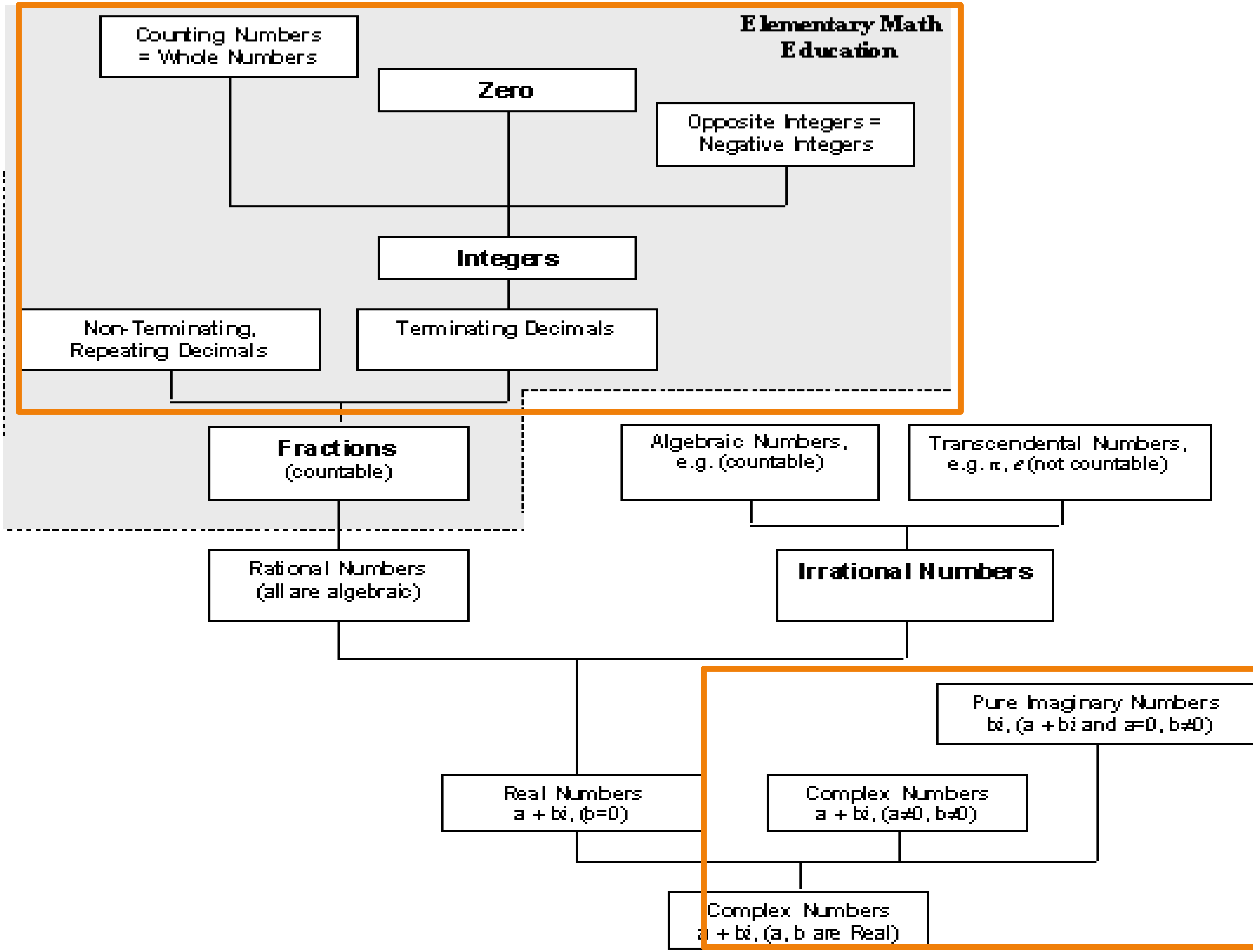
Vedic Numbers

- Number Tree
- LCM HCF
- Divisibility Rules
- Power cycle
- Remainder Theorem
- Remainder of powers $a^n - b^n$
- Last and Second last digit
- Power of Exponents
- Euler's Theorem
- Fermet's Theory
- Wilson Theorem
- Number Systems (decimal binary)

Vedic Numbers

Importance in exams

Number tree



Elementary Math Education
Counting Numbers = Whole Numbers
Zero
Opposite Integers = Negative Integers
Integers
Non-Terminating, Repeating Decimals
Terminating Decimals
Fractions (countable)
Algebraic Numbers, e.g. (countable)
Transcendental Numbers, e.g. π, e (not countable)
Rational Numbers (all are algebraic)
Irrational Numbers
Pure Imaginary Numbers bi, (a + bi and a=0, b≠0)
Real Numbers a + bi, (b=0)
Complex Numbers a + bi, (a≠0, b≠0)
Complex Numbers a + bi, (a, b are Real)

HCF LCM

Factorize the following numbers:

- 42
- 72
- 84
- 65
- 108
- 210

$$42 = 21 \times 2$$
$$= 7 \times 3 \times 2$$

Power cycle

$2^1 = 2$

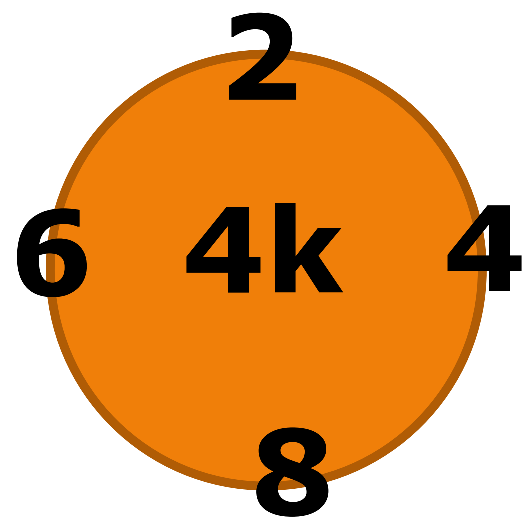
$2^2 = 4$

$2^3 = 8$

$2^4 = 16$

$2^5 = 32$

……



Rules of Divisibility

- Rule of 2
- Rule of 3
- Rule of 4
- Rule of 5
- Rule of 6
- Rule of 7
- Rule of 8
- Rule of 9
- Rule of 10
- Rule of 11
- Rule of 12
- Rule of 13

TESTS OF DIVISIBILITY:

Divisibility By 2 : A number is divisible by 2, if its unit's digit is any of 0, 2, 4, 6, 8.
Ex. 84932 is divisible by 2, while 65935 is not.

Divisibility By 3 : A number is divisible by 3, if the sum of its digits is divisible by 3.
Ex.592482 is divisible by 3, since sum of its digits = (5 + 9 + 2 + 4 + 8 + 2) = 30, which is divisible by 3.
But, 864329 is not divisible by 3, since sum of its digits =(8 + 6 + 4 + 3 + 2 + 9) = 32, which is not divisible by 3.

What is the remainder of 222222222222….(27 times) is divided by 27?

a.0 b.1 b.3 d.4

Check if 376575668469 is divisible by 1001?

Remainder Theorm

Rem (X / A) = Rem (Y/A) x Rem (Z/A)

Where y and z are factors of X

Find the remainder of
24 is divided by 5

a) 4
b) 5
c) 6
d) 7

24/7 x 24/7 x 24/7

Find the remainder of 24^3 is divided by 7

a) 4
b) 5
c) 6
d) 7

24/7 x 24/7 x 24/7

24^3 is divided by 7

$24/7 \times 24/7 \times 24/7$

Find the remainder of 74^6 is divided by 6

a) 4

b) 5

c) 6

d) 7

$74^6 = 14^6 = 2^6$

Find the remainder of 625^{12} is divided by 12

a) 1
b) 5
c) 6
d) 7

624 + 1

Find the remainder when 2^{246} is divided by 7.

a. 1
b. 3
c. 7
d. 9

$2^1/7 = 2$
$2^2/7 = 4$
$2^3/7 = 1$
$2^4/7 = 2$

Cyclic Remainders

Find the right most non zero digit of $(30)^{2720}$

a. 1 b. 3 c. 7 d. 9.

b

Find the remainder when 54^{120} is divided by 7 =

a. 3 b. 1 c.7 d.9.

$54^1 / 7 = 5$
$54^2 / 7 = 25 / 7 = 4$
$54^3 / 7 = 20 / 7 = 6$
$54^4 / 7 = 2$
$54^5 / 7 = 3$
$54^6 / 7 = 1$

b

Find the remainder when 4^{96} is divided by 6 =

CAT 2003

a. 3 b. 4 c.7 d.9.

$4^1 / 6 = 4$
$4^2 / 6 = 4$
……

Euler's Theorem

Theorm Small > Big
Vedic Numbers > Going backward

Euler's Theorem

- Familiar form in $d = \mathbf{3}$ for any polyhedron (Euler, 1752):

$$f - e + v = 2$$

connecting numbers of faces f, edges e, and vertices v.

- For any polytope let f_j denote the number of its j-dimensional "j-faces".

Generalization of Euler's theorem for any $D \geq 1$ (Schläfli, 1901):

$$\sum_{j=0}^{D-1} \mathbf{(-1)}^j f_j = \mathbf{1 - (-1)}^D \ .$$

- j-face enumeration for simplices in D dimensions:

$$f_j = \frac{(D+1)!}{(j+1)!(D-j)!} \ .$$

Find the remainder when 3^{560} is divided by 2.

A) 5 B)2 C)4 D)1

N + 1 / N is always 1
N – 1 / N is always 1, -1

Find the remainder when

9^{560} is divided by 2 =

33^{560} is divided by 2 =

5^{560} is divided by 4 =

N + 1 / N is always 1
N – 1 / N is always 1, -1

Find the remainder when 7^{560} is divided by 2 =

31^{560} is divided by 2 =

3^{560} is divided by 4 =

N – 1 / N is always 1, -1

b

Find the remainder when 2^{256} is divided by 17 =

a. 3 b. 1 c.7 d.9.

16 / 17 = -1, So 2 – 1 = 1

b

Find the remainder when 2^{257} is divided by 17 =

a. 3 b. 2 c.7 d.9.

2.2^{256} > 16 / 17 = -1 > So 2 – 1 = 1* 2 = 2

b

Find the remainder when 4^{96} is divided by 6 =

a. 3 b. 2 c.7 d.9.

2.2^{256} > 16 / 17 = -1 > So 2 – 1 = 1* 2 = 2

Wilson's Theorem

Wilson's Theorem

.Let p be an integer greater than one. p is prime if and only if $(p-1)! = -1 \pmod{p}$.This beautiful result is of mostly theoretical value because it is relatively difficult to calculate $(p-1)!$ In contrast it is easy to calculate a^{p-1}, so elementary primality tests are built using Fermat's Little Theorem rather than Wilson's.Neither Waring or Wilson could prove the above theorem, but now it can be found in any elementary number theory text. To save you some time we present a proof here.

Proof. It is easy to check the result when p is 2 or 3, so let us assume $p > 3$. If p is composite, then its positive divisors are among the integers1, 2, 3, 4, ... , $p-1$
and it is clear that $\gcd((p-1)!,p) > 1$, so we can not have $(p-1)! = -1 \pmod{p}$.

However if p is prime, then each of the above integers are relatively prime to p. So for each of these integers a there is another$b$ such that $ab = 1 \pmod{p}$. It is important to note that this b is unique modulo p, and that since p is prime, $a = b$ if and only if a is 1 or $p-1$. Now if we omit 1 and $p-1$, then the others can be grouped into pairs whose product is one showing$2\cdot3\cdot4\cdot\ldots\cdot(p-2) = 1 \quad \pmod{p}$
(or more simply $(p-2)! = 1 \pmod{p}$). Finally, multiply this equality by $p-1$ to complete the proof.

Highest powers in n!

Find the highest power of 7 which will divide 780!

a. 13

b. 128

c.559

d. 15

780/7 + 780/49 + 780/343

Find the highest power of 25 which will divide 250!

a. 13

b. 127

c.559

d. 31

250/5 + 250/25 + 250/125

Find the highest power of 12 which will divide 20!

a. 13
b. 27
c. 59
d. None of these

20/3 + 20/9 ! 20/2 + 20/4 + 20/8 + 20/12

b

Find the number of zeros in 100!

a. 13 b. 24

c. 59 d. None of these

100/5 + 100/25 = 20+4 = 24

d

N! has 23 zeros in it. Find the value of n

a. 98

b. 24

c. 100

d. None of these

1 – 4! = no zero
5! – 9! = 1 zero
10! – 14! = 2 zero
15 – 19! = 3 zeros
20 – 24! = 4 zero
25! – 29! = 6
30 = 7
35 = 8
40 = 9
45 = 10
50 = 12

55 = 13
60 = 14
65 = 15
70 = 16
75 = 18
80 = 19
85 = 20
90 = 21
95 = 22
100 = 24

$$A^n + B^n$$

Is always divisible by A + B for all odd n

$$A^n - B^n$$

Is always divisible by A - B for all odd n
Is always divisible by A - B for all even n
Is always divisible by A + B for all even n

b

Find the remainder when $35^{23} - 23^{23}$ is divided by 12

a. 3 b. 0 c.7 d.9.

$35^1 - 23^1 = 12$

b

Find the remainder when $35^{22} - 23^{22}$ is divided by 58

a. 3 b. 0 c.7 d.9.

$35^2 - 23^2 = 12, 58$

b

Find the remainder when $16^3 + 17^3 + 18^3 + 19^3$ is divided by 70

a. 0 b. 1 c.69 d.35

Find the remainder when $7^{6n} - 6^{6n}$ is divided by ?

a. 13

b. 127

c. 559

d. All of these

7+6 = 13; $7^3 - 6^3 = 127$

If $R = \dfrac{30^{65} - 29^{65}}{30^{64} + 29^{64}}$

a. $0 < R < 1$ b. $0.5 < R < 1$

c. $0 < 0.1$ d. $R > 1$

Vedic Numbers

Let N=1421*1423*1425.
What is the remainder when N is divided by 12?

a.0 b.9 c.3 d.6

Rem of (n/12*n+2/12*n+4/12) = Rem of (5/12*7/12*9/12)

What is the remainder when $(2^{100} + 2)$ is divided by 101?

a.3 b.4 c.5 d.6

$2^n+2/n+1 = 3$. ! $2^4+2/5=3$. => n can be 2,3 – 4,5 – 6,7 – 10,11

The values of numbers 2^{2004} and 5^{2004} are written one after another. How many digits are there in all?

a. 4008 b. 2003

c. 2005 d. none of these

$2^1 5^1 = 25$
$2^2 5^2 = 425$
$2^3 5^3 = 8125$
2^n & $5n=n+1$.

d

Find the remainder when 2009^{2010} is divided by 2011.

a.2010. b.0 c.1 d.2009

n^{n+1} /n+2 ! Odd/even/prime put n+2 as 5 (prime) = $3^4/5$

b

$111^{111} + 222^{111} + 333^{111} + 444^{111} + \ldots .999^{111}$ is divided by 555?

a.1 b.0 c.2 d.3 e.4

Divide all by 111

$1^1 + 2^1 + 3^1 + 4^1 + \ldots .9^1$ is divided by 5?

45 / 5 = 0

If P=1! +(2*2!) +(3*3!) +(4*4!) ......(12*12!)
Find the remainder when P is divided by 13.

a.11
b.1
c.2
d.12

1! +2*2!/3=rem. is 2

306^6 - 306 is not divisible by which of the following ?

(a) 3 (b) 4 (c) 6 (d) 9

306 is divisible by 3, 6, 9 except 4

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