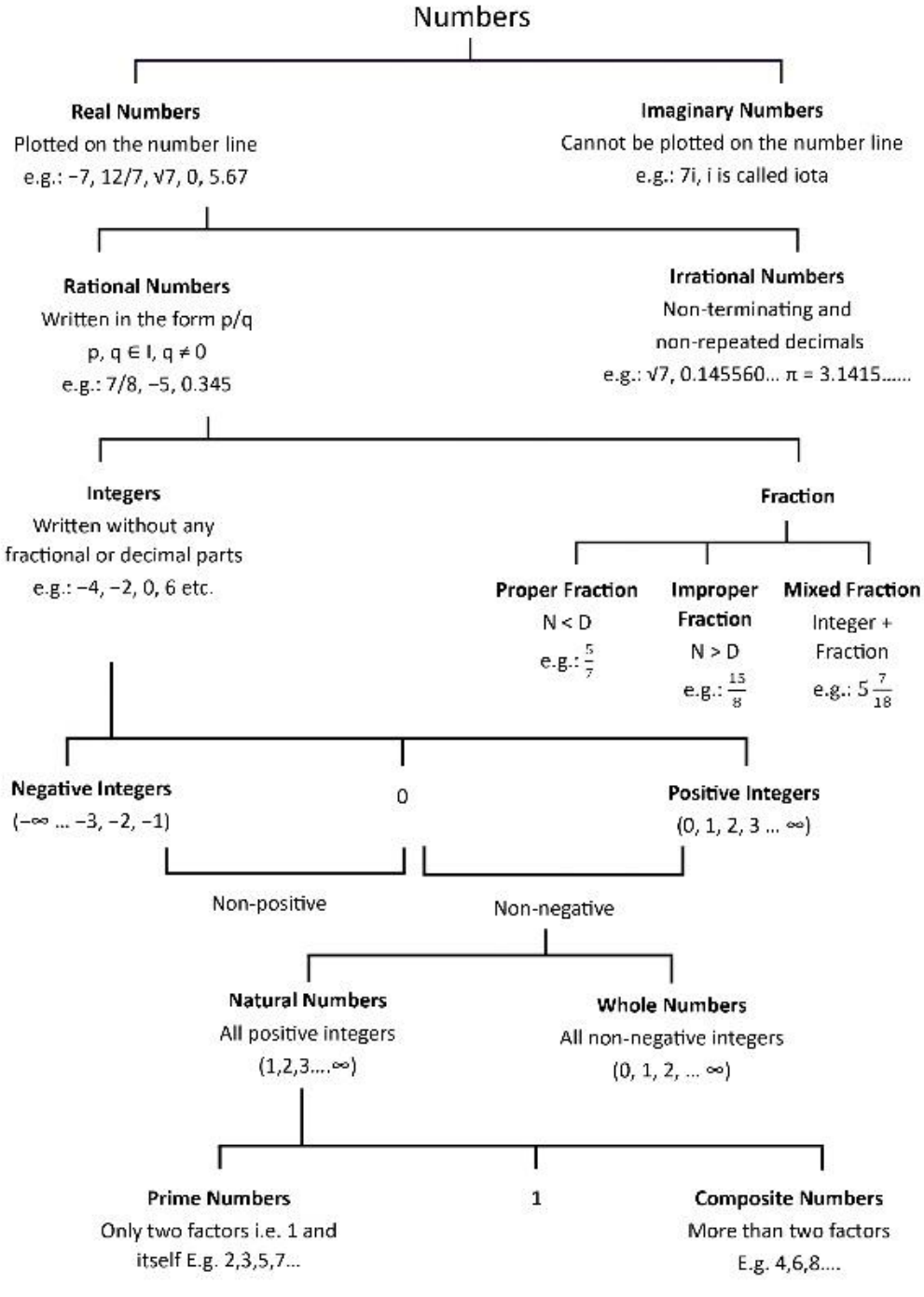

Numbers
Real Numbers
Plotted on the number line
e.g.: −7, 12/7, √7, 0, 5.67
Imaginary Numbers
Cannot be plotted on the number line
e.g.: 7i, i is called iota
Rational Numbers
Written in the form p/q
p, q ∈ I, q ≠ 0
e.g.: 7/8, −5, 0.345
Irrational Numbers
Non-terminating and
non-repeated decimals
e.g.: √7, 0.145560... π = 3.1415.....
Integers
Written without any
fractional or decimal parts
e.g.: −4, −2, 0, 6 etc.
Fraction
Proper Fraction
N < D
e.g.: 5/7
Improper Fraction
N > D
e.g.: 15/8
Mixed Fraction
Integer + Fraction
e.g.: 5 7/18
Negative Integers
(−∞ ... −3, −2, −1)
0
Positive Integers
(0, 1, 2, 3 ... ∞)
Non-positive
Non-negative
Natural Numbers
All positive integers
(1,2,3....∞)
Whole Numbers
All non-negative integers
(0, 1, 2, ... ∞)
Prime Numbers
Only two factors i.e. 1 and
itself E.g. 2,3,5,7...
1
Composite Numbers
More than two factors
E.g. 4,6,8....

A. TYPES OF NUMBERS

Numeral: Numerals are words or symbols used to express numbers.
e.g.- 5, V, Five

Numbers: A number is mathematical values used to count several things.
e.g.- Five

A number is the thought, a numeral is the language used to express that thought.

Prime Number:- Which has only two factors, i.e., 1 and itself.
e.g: 2, 3, 5, 7, 11, … etc.

Some Important Facts

1. 1 is neither a prime nor a composite number.
2. 2 is the only even prime number.
3. 2 is the smallest prime number.
4. Every prime number can be written in the form (6k ± 1), but every number of the form (6k ± 1) may not necessarily a prime number.

Range	Prime Numbers
1 - 50	15
1 -100	25
1 - 200	46
1 - 1000	168

5. (3, 5, 7) is the only set of three consecutive prime numbers.

Twin Prime Numbers:- Two prime numbers whose difference is 2 are called twin prime numbers.
e.g: (3, 5), (5, 7), (11, 13), (17, 19)

Relative Prime / Co-Prime Numbers:- Two integers having no common factor other than 1. **e.g**: (8, 15), (17, 21), (9, 16)

1 is a universal relative prime number.
e.g: (1, 3), (1, 6), (1, 20)

Composite Numbers:- Which has more than two factors.
e.g: 4, 9, 12, 15 …… ……..
4 is the smallest composite number.

Perfect Numbers:- If the sum of all its factors (excluding the number itself) is equal to that number, then it is called a perfect number.
e.g: 6, 28, 496, 8128, … etc.
Factors of 28 are 1, 2, 4, 7, 14, 28
∴ 1 + 2 + 4 + 7 + 14 = 28

Absolute Value of a Integer or Modulus

The distance of an integer from zero on the number line is called its absolute value.

1. $|-a| = |a|$
2. $|ab| = |a||b|$
3. $|a / b| = |a| / |b|$
4. $|a + b| \le |a| + |b|$
5. $|a| \le k \Rightarrow -k \le a \le k$

Check Whether a Number is Prime or Not:

First take the square root of the given number. Round it off to the nearest lower integer. Then divide the given number by all prime numbers less than or equal to the square root. If the number is not divisible by any of them, it is a prime number.

$$\frac{n}{All\ the\ prime\ numbers\ \le \sqrt{n}}$$

Example:- Check whether 337 is prime or not?
$\sqrt{337} \approx 18$
Prime numbers ≤ 18 are: 2, 3, 5, 7, 11, 13, etc.
337 is not divisible by any of these prime numbers.
Therefore, 337 is a prime number.

Integer

Even Numbers (Divisible by 2, 2k form)	Odd Numbers (Not divisible by 2, 2k + 1 form)
e.g: −6, −4, 0, 2, 4	e.g: −5, −3, 1, 7

Odd ± Odd = Even Odd × Odd = Odd
Even ± Even = Even Odd × Even = Even
Odd ± Even = Odd Even × Even = Even
Odd ÷ Odd = Odd Even ÷ Odd = Even
$Even^{Even\ /\ Odd}$ = Even $Odd^{Even/Odd}$ = Even
Even ÷ Even = even / Odd
Odd ÷ Even = Never divisible

B. FACTORRS

Let N be a number whose prime factorization is:
$N = p^a \times q^b \times r^c \times$ ……..
Where p, q, r ….. ……. , are prime numbers.

1. Number of total factors = (a + 1)(b + 1)(c + 1)…….

2. Total number of even factors = a × (b + 1) × (c + 1) ……., where p = 2
3. Total number of odd factors = (b + 1) × (c + 1) ……., where p = 2
4. Sum of factors of a number = $\left(\frac{p^{a+1}-1}{p-1}\right)\left(\frac{q^{b+1}-1}{q-1}\right)\left(\frac{r^{c+1}-1}{r-1}\right)$ …… …… …

   Or $(p^0 + p^1 + \ldots. + p^a)(q^0 + q^1 + \ldots. q^b)(r^0 + r^1 + \ldots. + r^c)$ ……..
5. Sum of even factors of a number = $\left(\frac{p^{a+1}-p}{p-1}\right)\left(\frac{q^{b+1}-1}{q-1}\right)\left(\frac{r^{c+1}-1}{r-1}\right)$ …… …… ……

   Or $(p^1 + p^2 + \ldots\ldots. + p^a)(q^0 + q^1 + \ldots\ldots. q^b)(r^0 + r^1 + \ldots\ldots. + r^c)$ ……..
6. Sum of odd factors of a number = $\left(\frac{q^{b+1}}{q-1}\right)\left(\frac{r^{c+1}-1}{r-1}\right)$ …… …… …… ……

   Or $(q^0 + q^1 + \ldots\ldots\ldots. q^b)(r^0 + r^1 + \ldots\ldots\ldots. + r^c)$ …….. , Where p = 2
7. Sum of perfect square factors of a number = $(p^0 + p^2 + p^4$ ……. $)(q^0 + q^2 + q^4$……. $)(r^0 + r^2 + r^3$ ……..)
8. Sum of factors of a number which is divisible by pq^2r^3= $(p^1 + p^2 + p^3$ …….. + $p^a)(q^2 + q^3 + q^4$……. $q^b)(r^3 + r^4 + r^5$…….. $+r^c$)

Example: Let the number be 720.

$720 = 2^4 \times 3^2 \times 5^1$

1. Total number of factors
   = (4 + 1) (2 + 1) (1 + 1) = 5 × 3 × 2 = 30
2. Total number of even factors
   = 4 × (2 + 1) (1 + 1) = 4 × 3 × 2=24
3. Total number of odd factors
   = (2 + 1) (1 + 1) = 3 × 2 = 6
4. Sum of total factors

   $= \frac{2^{4+1}-1}{2-1} \times \frac{3^{2+1}-1}{3-1} \times \frac{5^{1+1}-1}{5-1}$

   =31 × 13 × 6 = 2418

   Or $(2^0 + 2^1 + 2^2 + 2^3 + 2^4)(3^0 + 3^1 + 3^2)(5^0+5^1)$
   = 31 × 13 × 6 = 2418
5. Sum of even factors

   $= \frac{2^{4+1}-2}{2-1} \times \frac{3^{2+1}-1}{3-1} \times \frac{5^{1+1}-1}{5-1}$

   = 30 × 13 × 6 = 2340

   Or $(2^1 + 2^2 + 2^3 + 2^4)(3^0 + 3^1 + 3^2)(5^0 + 5^1)$
   = 30 × 13 × 6 = 2340
6. Sum of odd factors

   $= \frac{3^{2+1}-1}{3-1} \times \frac{5^{1+1}-1}{5-1}$ = 13 × 6 = 78

   Or $(3^0 + 3^1 + 3^2)(5^0 + 5^1)$ = 13 × 6 = 78
7. Sum of perfect square factors
   $= (2^0 + 2^2 + 2^4)(3^0 + 3^2)(5^0)$ = 21 × 10 × 1
   = 210
8. Sum of factors divisible by 12
   $= (2^2 + 2^3 + 2^4)(3^1 + 3^2)(5^0 + 5^1)$
   = 28 × 12 × 6 = 2016

C. RULES OF DIVISIBILITY

1. Divisible by 2 → last digit is even
2. Divisible by 4 → last two digits divisible by 4
3. Divisible by 8 → last three digits divisible by 8
4. Divisible by 3 → sum of digits divisible by 3
5. Divisible by 9 → sum of digits divisible by 9
6. Divisible by 5 → last digit 0 or 5
7. Divisible by 25 → last two digits divisible by 25.

Divisibility by some special numbers (7, 11, 13, 17, 19):

Divisor	Multiple Ending with 1 or 9	Osculator
7	21 = 2 × 10 + 1	-2
11	11 = 1 × 10 + 1	-1
13	39 = 4 × 10 - 1	+4
17	51 = 5 × 10 + 1	-5
19	19 = 2 × 10 - 1	+1

Divisibility by 7:

Multiply the last digit by 2 and subtract it from the number formed by rest digits of the number. Repeat the process until the resultant value becomes small. Then check divisibility of 7.

Divisibility by 11:

If the difference between the sum of digits at odd places and the sum of digits at even places is equal to zero or multiple of 11, then the number is divisible by 11.

Divisibility by 13:
Multiply last digit by 4 and add the number with the rest of the number. Repeat the process until the resultant value becomes small. Then check divisibility of 13.

Some Important Facts

1. Any digit written three times (e.g., aaa) is divisible by 3, 37, and 111.
2. Any digit written six times (e.g., aaaaaa) is divisible by 3, 7, 11, 13, 37, 111, and 1001.
3. Any number written in the form ababab is divisible by 3, 7, 13, and 37.
4. Any number written in the form abcabc is divisible by 7, 11, and 13.
5. Any number written in the form aaabbb is divisible by 3, 37, and 111.
6. A number is divisible by ab if it is divisible by both a and b.

D. REMAINDER

The integer left over after dividing one integer by another to get an integer quotient.
e.g- Rem77/13= (13×5+12)/13
Remainder = 12

Remainder is always non-negative, but sometimes we take negative remainders to avoid long calculations.

e.g- Rem(77/13) = (13×6 - 1)/13
Remainder = -1 or +ve

remainder = 13 – 1 = 12

Example: When the product of 23 and 29 is divided by 16, find the remainder.

Soln: $\frac{\mathbf{23\times29}}{\mathbf{16}} = \frac{\mathbf{(16+7)(16\times2-3)}}{\mathbf{16}}$

$= = \frac{\mathbf{7\times(-3)}}{\mathbf{16}} = \frac{\mathbf{-21}}{\mathbf{16}} = \frac{\mathbf{-16-5}}{\mathbf{16}} = \frac{\mathbf{-5}}{\mathbf{16}}$

Remainder = 16 – 5 = 11

Dividend = Divisor × Quotient + Remainder

Example- In a division, the divisor is 4 times the quotient and 3 times the remainder. If the remainder is 4, find the dividend?

Soln: Remainder = 4
Divisor = 3 × 4 = 12
Quotient = 12 ÷ 4 = 3
Dividend=12 × 3 + 4 = 40

Remainder Concept
If a number divided by a divisor gives remainder r. If a factor of divisor divides the same number, then the remainder will be: $Rem\left(\frac{r}{\boldsymbol{factor\ of\ divisor}}\right)$

Example: If a number is divided by 36, the remainder is 21. What will be the remainder if the number is divided by 12?
Soln: $\frac{N}{36} \rightarrow Remainder = 21$
$\frac{N}{12} \rightarrow Rem\left(\frac{21}{12}\right) = 9$
∴ 12 is a factor of 36
When two numbers, separately divided by N, leaves remainder a and b respectively. If the sum of two numbers is divided by N, the remainder will be $Rem\left(\frac{\boldsymbol{a+b}}{\boldsymbol{N}}\right)$.

Example: When two numbers separately divided by 19 leave remainders 8 and 13 respectively, If the sum of two numbers is divided by 19, the remainder will be:
Soln: $Rem\left(\frac{\mathbf{8+13}}{\mathbf{19}}\right) = 2$

Example: When a number is divided by 17 leaves remainder 8. If the square of the number is divided by 17, what will be the remainder?
Solution: $Rem\left(\frac{8^2}{17}\right) = 13$

If two numbers are divided by the same divisor, the remainders are r_1 and r_2. If the sum of the two numbers is divided by the same divisor, the remainder is r_3. Then
Divisor = $\mathbf{r_1 + r_2 - r_3}$
Example: r_1 = Rem (27 / 19) = 8
r_2 = Rem (32 / 19) = 13
r_3 = Rem (27 + 32) / 19 = Rem (59 / 19) = 2
Divisor = $r_1 + r_2 - r_3$ = 13 + 8 – 2 = 19

E. FACTORS THEOREM

1. $a^n + b^n$ is divisible by (a+b), if n is odd.

e.g- $Rem\left(\frac{15^{23}+\mathbf{11^{23}}}{13}\right) = \frac{15+11}{13} = \frac{26}{13} = 0$

2. ($a^n + b^n + c^n$ .....) is divisible by (a + b + c .....), if n is odd and a, b, c ..... are in Arithmetic Progression.

e.g- $Rem\left(\frac{5^{23}+6^{23}+7^{23}}{9}\right) = 0$

Here, 5, 6 and 7 are in AP and 5 + 6 + 7 = 18 which is multiple of 9.

3. $a^n - b^n$ is divisible by (a−b), if n is odd or even and (a + b), if n is even.

e.g- $Rem\frac{(97^{79}-79^{97})}{9} = 0$

Here, 97 – 79 = 18 which is multiple of 9.

Example: $25^{18} - 18^{18}$ is divisible by

(a) 43 (b) 301 (c) 7 (d) All of these

Soln: 18 is an even number.

So the expression is divisible by:

25−18=7 and 25+18=43

So 7, 43 and 301 is factor of $25^{18} - 18^{18}$

Correct Answer: (d) All of these

F. UNIT DIGIT CONCEPT

Unit digit: Last digit of the number

How to find the unit digit

e.g- 504 + 608 – 705 + 352 − 403

Add or subtract unit digits only

4 + 8 – 5 + 2 – 3 = 6

e.g- 71 × 72 × 73 × ..... × 79

1 × 2 × 3 × ..... × 9 = 0

The product includes both 2 and 5. When 2 and 5 are multiplied, the last digit will be zero.

For Exponent

When a digit is repeatedly multiplied by itself, it follows a cyclic pattern.

Example: $2^1 = 2$ $2^2 = 4$ $2^3 = 8$ $2^4 = 6$ $2^5 = 2$, $2^6 = 4$ $2^7 = 8$ $2^8 = 6$

Digit	Power1	Power2	Power3	Power4
2	2	4	8	6
3	3	9	7	1
7	7	9	3	1
8	8	4	2	6

Rules

1. Digits 2, 3, 7 and 8 have a length of cyclicity= 4.
2. Unit digit for any power of 0, 1, 5, 6 is the digit itself. Length of cyclicity is 1.
3. Unit digit of $4^{odd} = 4$ and $4^{even} = 6$. Length of cycle = 2
4. Unit digit of $9^{odd} = 9$ and $9^{even} = 1$. Length of cycle = 2

Example: Find the unit digit of $(7543)^{7543}$.

Soln: Take only unit digit of the base and last two digit of the power i.e. 3^{43}

Cyclicity of 3 is 4. Divide the power by cyclicity and find the last position of the number.

$3^{43/4} = 3^3 = 27$ Unit digit = 7

Note: When power is divided by 4 and get remainder zero in any case, then power will be cyclicity i.e. 4

Example: $(37)^{236} = 7^{36} = 7^{36/4} = 7^0 = 7^4 = 1$

Example: The digit in the unit's place of the product $(264)^{263} \times (121)^{121} \times (128)^{128}$

Soln: Unit digit of $(264)^{263} = 4^{odd} = 4$

Unit digit of $(121)^{121} = 1^{121} = 1$

Unit digit of $(128)^{128} = 8^{28/4} = 8^4 = 6$

Required Unit digit = 4 × 1 ×6 = 4

G. PLACE VALUE & FACE VALUE

Face Value: The digit itself.

e.g.- In 43579, the face value of 3 is 3.

Place Value: The value of the digit based on its position.

e.g.- 4357.935

$= 4 \times 10^3 + 3 \times 10^2 + 5 \times 10^1 + 7 \times 10^0 + 9 \times 10^{-1} + 3 \times 10^{-2} + 5 \times 10^{-3}$

Example: What is the difference between positional values of 6 in the number 964362?

Soln: The Positional values of 6 are: 60,000 and 60.

Required Difference = 60,000 − 60=59,940

Note:

1. Sum of a two digit number and the number obtained by interchanging its digits is always divisible by 11.
2. The difference between a two digit number and the number obtained by interchanging its digit is always divisible by 9.

H. NUMBER OF ZERO'S IN EXPRESSION

Zero is made, when there is a combination of 2 and 5.

Example: Find the number of zero in the expression 24 × 15 × 22 × 25.

Soln: $24 \times 15 \times 22 \times 25 = 2^4 \times 3^2 \times 5^3 \times 11$

Here, No. of 5 < No. of 2

Number of zero will depend upon number of 5.
Highest power of 5 = No. of zero = 3

Number of Zero in n!

n! = 1 × 2 × 3 × 4 × ……. × (n-1) × n
Here, number of 5 will be less as compared to 2.
Therefore, the number of zero will depend upon number of 5.
We divide n by 5, n by 5^2, n by 5^3 …….. and so on till we get quotient as 1.

$$\frac{n}{5}+\frac{n}{5^2}+\frac{n}{5^3}\ldots\ldots\ldots\frac{n}{5^x}$$

Example: Find the number of zero at the end of 100!
Soln: $\frac{100}{5}+\frac{100}{5^2}=20+4=24$

Example: Find the number of zero at the end in the expression 1 × 3 × 5 × 7 × ……. × 887.
Since there is no 2, there will be no zero in the expression.

I. COUNTING OF NUMBERS

Example: How many digits are there from 1 to 999?

	Number	Digit
1 – 9	9	9 × 1 = 9
10 – 99	90	90 × 2 = 180
100 – 999	900	900 × 3 = 2700

Total = 9 + 180 + 2700 = 2889

Example: How many times 6 will come from 1 to 1000?

Unit place: | 10 | 10 | 1 | = 10 × 10 × 1 = 100

Ten's place: | 10 | 1 | 10 | = 10 × 1 × 10 = 100

Third place: | 1 | 10 | 10 | = 1 × 10 × 10 = 100

Total = 100 + 100 + 100 = 300 times
{There are 10 digits i. e. 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9}

Example: How many three digit numbers can be formed by using 0, 1, 2, 3, 4 without repetition?

| 4 | 4 | 3 | = 4 × 4 × 3 = 48

Hundred place: 0 can't be placed. So 4-digits available.
Ten's place: Remaining 4-digits available.
Unit place: Remaining 3-digits available.

Example: How many three digit numbers can be formed by using 0, 1, 2, 3, 4 only?

| 4 | 5 | 5 | = 4 × 5 × 5 = 100

Hundred place: 1, 2, 3, 4 = 4 ways
Ten's place: 0, 1, 2, 3, 4 = 5 ways
Unit place: 0, 1, 2, 3, 4 = 5 ways

J. IMPORTANT FORMULAE

1. Sum of first n natural numbers = $\frac{n(n+1)}{2}$
2. Sum of first n odd numbers = n^2
3. Sum of first n even numbers = **n(n+1)**
4. Sum of square of first n natural numbers = $\frac{n(n+1)(2n+1)}{6}$

Based on AP series

Sequence: a, a + d, a + 2d, a + 3d …… , a + nd
Where a be the first term and d be the common difference of the sequence of an AP.
nth term = t_n = a + (n-1)d
Sum of the first n terms = $S_n = \frac{n}{2}[2a+(n-1)d]$
Odd Consecutive terms = ……, a-2d, a-d, a, a+d, a+2d, …….
Even Consecutive terms = ……, a-3d, a-d, a+d, a+2d, ……..

Based on GP series

Sequence: a, ar, ar^2, ar^3, ……., ar^n
Where a be the first term and r be the common ratio of the sequence of a G.P.
nth term = $t_n = ar^{n-1}$
Sum of the first n terms = $S_n = \frac{a(1-r^n)}{1-r}$,
$r \neq 1$ and $r < 1$
or $S_n = \frac{a(r^n-1)}{r-1}$, $r \neq 1$ and $r > 1$

K. BASIC SYMBOL & VALUE

I	V	X	L	C	D	M
1	5	10	50	100	500	1000

When a symbol of greater or equal values comes before a smaller one, its value is added.
e.g.- DL = D (500) + L (50) = 550

When a symbol of smaller values comes before a greater one, its value is subtracted.

e.g.- XL = L (50) - X (10) = 40

Example: In roman notation, 392 can be written as 392 = 300 + 90 + 2 = CCC + XC + II = CCCXCII

EXERCISE

1. A fraction is greater than its reciprocal by $\frac{27}{182}$. What is the fraction?
(a) $\frac{13}{12}$ (b) $\frac{14}{13}$ (c) $\frac{12}{11}$ (d) $\frac{11}{10}$
(OSSC CGL 2021)

2. A fraction is greater than twice its reciprocal by $\frac{17}{28}$. What is the fraction?
(a) $\frac{7}{3}$ (b) $\frac{7}{5}$ (c) $\frac{7}{2}$ (d) $\frac{7}{4}$
(OSSC CGL 2021)

3. A fraction is greater than twice its reciprocal by $\frac{127}{153}$. What is the fraction?
(a) $\frac{17}{9}$ (b) $\frac{18}{11}$ (c) $\frac{20}{17}$ (d) $\frac{19}{13}$
(OSSC CGL 2021)

4. Total number of divisors of 10500 except 1 and itself is:
(a) 48 (b) 46 (c) 42 (d) None of these
(OSSC CGL PRE 2022)

5. Number of zeros at the end of the expression 10 + 100 + 1000 + … + 1000000000 is:
(a) 1 (b) 10 (c) 15 (d) None of these
(OSSC CGL PRE 2022)

6. Find the unit digit of the expression 77×88+66×55.
(a) 7 (b) 6 (c) 5 (d) 0
(OSSC CGL PRE 2022)

7. Find the remainder when (1719 × 1721 × 1723 × 1725 × 1727) is divided by 18 is:
(a) 17 (b) 27 (c) 9 (d) 15
(OSSC CGL PRE 2022)

8. In Roman number system, there are seven symbols used to represent the whole number system. The symbols and their respective values are: I = 1, V = 5, X = 10, L = 50, C = 100, D = 500, M = 1000. Then the value of the Roman numeral MCDXLIV is:
(a) 1666 (b) 664 (c) 1464 (d) 656
(OSSC CGL PRE 2022)

9. What is the number when multiplied by 16 increases by 540?
(a) 30 (b) 36 (c) 42 (d) 46
(OSSC CGL PRE 2023)

10. What is the difference in the place value of 5 in the numeral 754853?
(a) 45000 (b) 44500
(c) 49940 (d) 49950
(OSSC CGL PRE 2023 & CTSRE PRE 2023)

11. How many numbers from 1 to 20 are either a multiple of 3 or 5?
(a) 9 (b) 8 (c) 6 (d) 5
(OSSC CGL PRE 2023)

12. The numerator of a fraction is 3 less than the denominator. If numerator is made 3 times and 20 is added to denominator, the fraction becomes $\frac{1}{8}$. What is the fraction?
(a) $\frac{1}{4}$ (b) $\frac{2}{5}$ (c) $\frac{5}{8}$ (d) $\frac{4}{7}$
(OSSC CGL PRE 2023)

13. The difference between a two-digit number and the number obtained by interchanging the positions of the digits is 27. What is the difference between the digits of that number?
(a) 2 (b) 3
(c) 4 (d) Can't be determined
(OSSC CGL PRE 2024)

14. What is the four-digit number in which the first digit from left is $\frac{1}{4}$ of the second, the third is the sum of the first and second, and last is two times the second?
(a) 1854 (b) 1458 (c) 1548 (d) 8541
(OSSC CGL SPL PRE 2022)

15. What least number must be added to 1056 so that the sum is completely divisible by 23?
(a) 2 (b) 13 (c) 18 (d) 21
(OSSC CGL SPL PRE 2022 & Amin 2023)

16. A certain number when divided by 39 leaves remainder 13. Find the remainder when the same number is divided by 29.
(a) 5 (b) 4
(c) 1 (d) Can't be determined
(OSSC CGL SPL PRE 2023)

17. If you write down all the numbers from 1 to 100, then how many times do you write 3?
(a) 11 (b) 18 (c) 20 (d) 21
(OSSC CGL SPL PRE 2023)

18. The difference between the digits of a two-digit number is one-ninth of the difference between the original number and the number obtained by interchanging the digits. What definitely is the sum of digits of that number?
(a) 5 (b) 14
(c) 12 (d) Data inadequate
(OSSC CGL SPL PRE 2023)

19. The largest 4-digit number exactly divisible by 88 is:
(a) 9944 (b) 9768 (c) 9988 (d) 8888
(OSSC Steno 2023 & 2024 and CHSL PRE 2022)

20. How many 3-digit numbers are completely divisible by 6?
(a) 149 (b) 150 (c) 151 (d) 166
(OSSC CHSL PRE 2022)

21. When we multiply a certain two-digit number by the sum of its digits, 405 is obtained. If we multiply the number written in reverse order of the same digits by the sum of the digits, we get 486. Find the number.
(a) 81 (b) 45 (c) 36 (d) 54
(OSSC CHSL PRE 2019)

22. A number consists of two digits whose sum is 8. If 18 is added to the number, the digits are reversed. Find the number.
(a) 25 (b) 35 (c) 40 (d) 15
(OSSC CHSL PRE 2019)

23. The sum of four consecutive even numbers A, B, C and D is 180. What is the sum of the next four consecutive even numbers?
(a) 176 (b) 204 (c) 212 (d) 214
(OSSC CHSL PRE 2019 & CGL Mains 2024-25)

24. What least value must be given to 'n' so that the number 6135n2 becomes divisible by 9?
(a) 1 (b) 2 (c) 3 (d) 4
(OSSC CHSL PRE 2022)

25. A number when divided by 12 leaves remainder 4. When the square of the number is divided by 16, the remainder is:
(a) 0 (b) 13 (c) 11 (d) 4
(OSSC CTSRE PRE 2022)

26. Total number of factors of 540 are:
(a) 24 (b) 27 (c) 32 (d) None of these
(OSSC CTSRE PRE 2022)

27. The number of zeros at the end of the expression $10\times100\times1000\times10000\times\ldots\times1000000000$
(a) 10 (b) 100 (c) 50 (d) 55
(OSSC CTSRE PRE 2022)

28. What is the product of all the numbers in the dial of a telephone?
(a) 1,58,480 (b) 1,59,450
(c) 0 (d) None of these
(OSSC CTSRE PRE 2022)

29. What is the unit digit in $\{(6374)^{1793}\times(625)^{317}\times(341)^{491}\}$?
(a) 0 (b) 2 (c) 3 (d) 5
(OSSC CTSRE PRE 2022)

30. On dividing 2272 as well as 875 by a 3-digit number N, we get the same remainder. The sum of the digits of N is:
(a) 10 (b) 11 (c) 12 (d) 13
(OSSC CTSRE PRE 2022)

31. A boy multiplied 987 by a certain number and obtained 559981 as the answer. If in the answer both 9 are wrong and the other digits are correct, then the correct answer would be:
(a) 553681 (b) 555181
(c) 555681 (d) 556581
(OSSC CTSRE PRE 2022)

32. A number consists of three digits whose sum is 10. The middle digit is equal to the sum of the other two and the number will be increased by 99 if its digits are reversed. The number is:
(a) 145 (b) 253 (c) 370 (d) 352
(OSSC CTSRE PRE 2022)

33. Which of the following statements are true?
(i) Every whole number is a natural number.
(ii) Every integer is a rational number.
(iii) Every rational number is an integer.
(a) (ii) only (b) (i) and (ii) only
(c) (iii) only (d) All are true
(OSSC CTSRE PRE 2022)

34. A boy was asked to multiply a number by 25 but by mistake multiplied it by 45. If the answer was 200 more than the correct answer, what was the number?
(a) 2 (b) 8 (c) 10 (d) 12
(OSSC CTSRE PRE 2023)

35. What is the unit digit in the product of
853 × 1346 × 452 × 226
(a) 8 (b) 6 (c) 5 (d) 3
(OSSC CTSRE PRE 2023)

36. A two-digit number is four more than three times the sum of its digits. The number formed by reversing the digits is three more than seven times the sum of its digits. Find the difference between the digits.
(a) 3 (b) 5 (c) 2 (d) none of these
(OSSC CTSRE PRE 2023)

37. If the product of two numbers is 60 and the sum of their squares is 169, find the sum of the numbers.
(a) 17 (b) 15
(c) 19 (d) none of the above
(OSSC CTSRE PRE 2023)

38. In a two-digit positive number, the unit digit is equal to the square of the tens digit. The difference between the original number and the number formed by interchanging the digits is 54. What is 40% of the original number?
(a) 15.6 (b) 37.2 (c) 24 (d) none of these
(OSSC CTSRE PRE 2024)

39. The seven-digit number 876P37Q is divisible by 225. The values of P and Q respectively are:
(a) 9, 0 (b) 0, 5 (c) 0, 0 (d) 9, 5
(OSSC CTSRE PRE 2024)

40. The sum of all possible 3-digit numbers formed by digits 3, 0 and 7, using each digit once, is:
(a) 2010 (b) 2220 (c) 1990 (d) 2110
(OSSC CTSRE PRE 2024)

41. The sum of squares of the first ten natural numbers is:
(a) 300 (b) 55 (c) 385 (d) 380
(OSSC CTSRE PRE 2024)

42. If the sum of the first 14 terms of an AP is 1050 and its first term is 10, then find the 20th term from the following?
(a) 170 (b) 180 (c) 190 (d) 200
(OSSC CGL PRE 2023)

43. $(11^2 + 12^2 + 13^2 + \ldots\ldots\ldots + 20^2)$=?
(a) 2575 (b) 2485 (c) 2395 (d) 2295
(OSSC CGL 2021)

44. Find the 11th term from the last term (towards the first term) of the AP. 10, 7, 4, …… -62
(a) -32 (b) -35 (c) -29 (d) 32
(OSSC CTSRE PRE 2022)

45. How many 4-digit number can be formed using the digits 1, 2, 3, 4, 5 and 6?
(a) 300 (b) 360 (c) 340 (d) 320
(OSSC BSSO 2022)

46. If the sum of digits at odd and even places are equal or differ by a number divisible by 11, then the number is divisible by which of the following?
(a) 9 (b) 11 (c) 12 (d) 13
(OSSC CPGL PRE 2023)

47. The expression $5^{2n} - 2^{3n}$ has a factor
(a) 3 (b) 7 (c) 10 (d) 17
(OSSC CPGL PRE 2023 & CGL Mains 2024-25)

48. What is total of all the even numbers from 1 to 400?
(a) 40100 (b) 40200 (c) 40300 (d) 40400
(OSSC CPGL PRE 2023)

49. The sum of the digits of a two-digit number is 8. If the digits are reversed, the number is decreased by 54. Find the number.
(a) 69 (b) 74 (c) 71 (d) 76
(OSSC CPGL PRE 2023 and CGL Mains 2024-25)

50. The ratio between a two-digit number and the sum of the digits of that number is 4 : 1. If the digit in unit place is 3 more than the digit in the ten's place, what is the number?
(a) 32 (b) 36 (c) 38 (d) 42
(OSSC CGL Mains 2024-25 & CPGL PRE 2023)

51. How many numbers up to 200 are divisible by 4 and 3 together?
(a) 12 (b) 14 (c) 16 (d) 18
(OSSC CPGL PRE 2023)

52. What is the largest natural number by which the product of three consecutive even natural numbers is always divisible?

(a) 42 (b) 48 (c) 36 (d) 46
(OSSC CPGL PRE 2023)

53. Which of the following numbers will completely divide $(49^{15} - 1)$
(a) 8 (b) 14 (c) 46 (d) 50
(OSSC Accountant 2023)

54. The sum of all even numbers from 1 to 100 is:
(a) 2550 (b) 5100 (c) 2500 (d) None of these
(OSSC Accountant 2023)

55. The total number of digits used in numbering the pages of a book having 536 pages is:
(a) 1500 (b) 1800 (c) 1611 (d) 1378
(OSSC Accountant 2023)

56. What is the unit digit in $(7^{97} - 3^{53})$?
(a) 0 (b) 4 (c) 6 (d) 7
(OSSC Accountant 2023)

57. How many two-digit numbers satisfy this property: The last digit (unit digit) of a square of the two-digit number is 2?
(a) 11 (b) 24 (c) 34 (d) None of these
(OSSC Accountant 2023)

58. A boy was asked to multiply a number by 7/8 . Instead he divided the number by 7/8 and got the result 15/14 more than what he should have got if he had multiplied the number by 7/8 . The number is:
(a) 4 (b) 7 (c) 8 (d) 9
(OSSC Jr Clerk Mains 2022)

59. How many non-zero digits will there be to the right of the decimal point in the product of 95.75 and 0.2554 ?
(a) 5 (b) 6 (c) 7 (d) 4
(OSSC Jr Clerk Mains 2022)

60. Which of the following numbers is divisible by 12?
(a) 26784 (b) 26785 (c) 26782 (d) 26783
(OSSC SCEW 2021)

61. Find the remainder when 643653 is divisible by 9.
(a) 2 (b) 3 (c) 5 (d) 0
(OSSC SCEW 2021)

62. Find the unit digit in the product (528 × 634 × 825 × 639)
(a) 6 (b) 4 (c) 0 (d) 2
(OSSC SCEW 2021)

63. The sum of two odd numbers is:
(a) an odd number
(b) an even number
(c) sometimes odd sometimes even
(d) cannot be ascertained
(OSSC Amin 2023)

64. Find the largest 3-digit number divisible by 16?
(a) 982 (b) 992 (c) 988 (d) 712
(OSSC Amin 2023)

65. A number consists of two digits. If the digits interchange places and the new number is added to the original, then the resulting number will be divisible by:
(a) 11 (b) 9 (c) 5 (d) 3
(OSSC Statistical Asst. 2024)

66. What is the sum of all odd integers between 2 and 100 which are divisible by 3?
(a) 768 (b) 786 (c) 867 (d) 876
(OSSC Statistical Asst. 2024)

67. When a number is divided by 7 it leaves a remainder of 3. When double (i.e. twice) of that number will be divided by 7, then what would be the remainder?
(a) 3 (b) 2 (c) 6 (d) 0
(OSSC ESI 2023)

68. A number when divided by 6 leaves a remainder 3. When the square of the number is divided by 6, the remainder is:
(a) 0 (b) 1 (c) 2 (d) 3
(OSSC ESI 2023)

69. If you write down all the numbers from 1 to 100, then how many times do you write 1?
(a) 11 (b) 18 (c) 20 (d) 21
(OSSC ESI 2023)

70. The sum of first 24 natural numbers is:
(a) 576 (b) 300 (c) 325 (d) 600
(OSSC VSA 2023)

71. If the sum of two numbers is 55 and their product is 600, then find the sum and product of the reciprocals of the numbers respectively?
(a) 120/11, 600 (b) 1/55, 1/600
(c) 11/55, 1/600 (d) 11/120, 1/600
(OSSC VSA 2023)

72. The sum of the two numbers is 13 and their product is 34. What is the sum of the reciprocals of these numbers?
(a) 34/13 (b) 1/13 (c) 1/34 (d) 13/34
(OSSC VSA 2023)

73. $1^2 + 2^2 + 3^2 + \ldots\ldots + 15^2$ = ?
(a) 620 (b) 1240 (c) 2480 (d) 2870
(OSSC VSA 2023)

74. What is the difference between the greatest 4-digit natural number and the smallest 4-digit natural number?
(a) 8888 (b) 9999 (c) 8999 (d) 9998
(OSSC VSA 2023)

75. The value of 25/10000 in decimal fraction is:
(a) 0.00025 (b) 0.0025 (c) 0.2500 (d) 0.0250
(OSSC VSA 2023)

76. What should replace * in the number 2897*3, so that the number is divisible by 11?
(a) 3 (b) 8 (c) 6 (d) 7
(OSSC VSA 2023)

77. If the difference of two number is 3 and the difference of the squares is 39, then find the smaller number?
(a) 8 (b) 5 (c) 3 (d) 13
(OSSC VSA 2023)

78. 54.327*357.2*0.0057 is the same as:
(a) 54.327*3.572*5.7
(b) 5.4327*3.572*5.7
(c) 54327*3572*0.0000057
(d) 0.54327*3.572*5.7
(OSSC VSA 2023)

79. The difference between the place value of '9' in 1,49,392 is:
(a) 0 (b) 9010 (c) 8910 (d) 90
(OSSC VSA 2023)

80. A number when divided by 13 gives a remainder of 5. If this number is multiplied by 5 and divided by 13 what is the remainder obtained?
(a) 12 (b) 1 (c) 25 (d) 5
(OSSC VSA 2023)

81. What is the product of smallest prime number and smallest composite number?
(a) 6 (b) 2 (c) 4 (d) 8
(OSSC VSA 2023)

82. What is the sum of all two digit numbers that give a remainder of 2 when they are divided by 11?
(a) 425 (b) 398 (c) 550 (d) 412
(OSSC VSA 2023)

83. The sum of the digits of a two-digit number is 12. The number obtained by interchanging the digits exceeds the original number by 54. Find the original number.
(a) 48 (b) 57 (c) 39 (d) 66
(OSSC CGL Mains 2024-25 & Steno 2022)

84. A two-digit number is four times the sum and three times the product of its digit. Find the number.
(a) 22 (b) 24 (c) 26 (d) 28
(OSSC Steno 2022)

85. On dividing a number by 68, we get 269 as quotient and 0 as remainder. On dividing the same number by 67, what will the remainder?
(a) 0 (b) 1 (c) 2 (d) 3
(OSSC Steno 2023)

86. The difference of two numbers is 1365. On dividing the larger number by the smaller, we get 6 as quotient and 15 as remainder. What is the smaller number?
(a) 240 (b) 270 (c) 295 (d) 360
(OSSC Steno 2023)

87. What is the sum of the squares of the numbers from 3 to 18?
(a) 2104 (b) 2105 (c) 2101 (d) 2106
(OSSC Steno 2024)

88. A number when divided by 91 leaves a remainder 65. If the same number is divided by 13, then what is the remainder?
(a) 12 (b) 7 (c) 5 (d) 0
(OSSC ATO 2024)

89. What is the unit's digit in the expression: $71 \times 29 + 27 \times 15 + 8 \times 4$?
(a) 8 (b) 6 (c) 4 (d) 0
(OSSC ATO 2024)

90. Consider a three digit number 7x2, where x is the missing digit. For what value of x, the number is divisible by 6?
(a) 7 (b) 4 (c) 5 (d) 6
(OSSC ATO 2024)

91. If a 7-digit number 5M716M2 is completely divisible by 88, what is the value of $N^2 + M^2$ for the largest possible value of M?
(a) 72 (b) 38 (c) 50 (d) 27
(OSSC JEO & JA 2024)

92. Five persons take part in a tournament. Each one has to play with every other one. How many minimum number of games must they play?
(a) 10 (b) 12 (c) 8 (d) 18
(OSSC CGL Mains 2022)

93. The total number of digits used to number the pages of a book having 366 pages is:
(a) 990 (b) 1002 (c) 889 (d) 664
(OSSC CGL Mains 2022)

94. Find the sum of two consecutive numbers, where four times the first number is 10 more than thrice of the second number?
(a) 27 (b) 33 (c) 23 (d) 17
(OSSC CGL Mains 2022)

95. What is the sum of all two digit number that leaves a remainder of 3 when divided by 7?
(a) 676 (b) 683 (c) 689 (d) 693
(OSSC CGL Mains 2023)

96. What least value can be assigned to P so that the seven-digit number 39P2546 is divisible by 9?
(a) 0 (b) 2 (c) 9 (d) 7
(OSSC CGL Mains 2023)

97. The smallest 1-digit number to be added to the 6-digit number 826920 so that it is completely divisible by 11 is:
(a) 4 (b) 8 (c) 5 (d) 7
(OSSC CGL Mains 2023)

98. It is given that $2^{32} + 1$ is exactly divisible by a certain number. Which of the following is also divisible by the same number?
(a) $2^{96} + 1$ (b) $2^{16} - 1$
(c) $2^{16} + 1$ (d) 7×2^{33}
(OSSC CGL Mains 2024-25)

99. What should be the maximum value of Q in the following equation?
5P9 + 3R7 + 2Q8 = 1114
(a) 9 (b) 7 (c) 5 (d) 4
(OSSC CGL Mains 2024-25)

100. The last digit in the expression $(41)^n - 1$, when n is any positive integer is:
(a) 2 (b) 1 (c) 0 (d) -1
(OSSC CGL Mains 2024-25)

101. What is the first value of n for which $n^2 + n + 41$ is not a prime?
(a) 1 (b) 10 (c) 20 (d) 40
(OSSC CGL Mains 2024-25)

102. The number of prime factors in the expression $6^{10} \times 7^{17} \times 11^{27}$ is equal to:
(a) 54 (b) 64 (c) 71 (d) 81
(OSSC CGL Mains 2024-25)

103. If 'm' and 'n' are natural numbers such that $2^m - 2^n = 960$, what is the value of m?
(a) 10 (b) 12 (c) 15 (d) 18
(OSSC CGL Mains 2024-25)

104. In how many ways the number 10800 can be resolved as a product of two factors
(a) 20 (b) 25 (c) 30 (d) 32
(OSSC CGL Mains 2024-25)

105. To write the number of pages in a book, the digit 1 is used exactly 136 times. Find the number of pages in the book.
(a) 220 (b) 208 (c) 195 (d) 192
(OSSC CTSRE 2025)

ANSWER KEY

01. (b)	02. (d)	03. (a)	04. (b)	05. (a)
06. (b)	07. (c)	08. (c)	09. (b)	10. (d)
11. (a)	12. (a)	13. (b)	14. (b)	15. (a)
16. (a)	17. (c)	18. (d)	19. (a)	20. (b)
21. (b)	22. (b)	23. (c)	24. (a)	25. (a)
26. (a)	27. (d)	28. (c)	29. (a)	30. (a)
31. (c)	32. (b)	33. (a)	34. (c)	35. (b)

36. (a)	37. (a)	38. (b)	39. (*)	40. (d)
41. (c)	42. (d)	43. (b)	44. (a)	45. (b)
46. (b)	47. (b)	48. (b)	49. (c)	50. (b)
51. (c)	52. (b)	53. (a)	54. (a)	55. (a)
56. (b)	57. (d)	58. (a)	59. (a)	60. (a)
61. (d)	62. (c)	63. (b)	64. (b)	65. (a)
66. (c)	67. (c)	68. (d)	69. (c)	70. (b)
71. (d)	72. (d)	73. (b)	74. (c)	75. (b)
76. (d)	77. (b)	78. (b)	79. (c)	80. (a)
81. (d)	82. (d)	83. (c)	84. (b)	85. (c)
86. (b)	87. (a)	88. (d)	89. (b)	90. (d)
91. (c)	22. (a)	93. (a)	94. (a)	95. (a)
96. (d)	97. (c)	98. (a)	99. (a)	100. (c)
101. (d)	102. (b)	103. (a)	104. (d)	105. (c)

SOLUTION

01. Let the fraction be $\frac{a}{b}$
Its reciprocal = $\frac{b}{a}$
According to the question, $\frac{a}{b} - \frac{b}{a} = \frac{27}{182}$
Go through option (b) 182 = 14 × 13
$\frac{14}{13} - \frac{13}{14} = \frac{14^2-13^2}{14\times13} = \frac{27}{182}$

02. According to the question,
$\frac{a}{b} - \frac{2b}{a} = \frac{17}{28}$
Go through option (d) 28 = 4 × 7
$\frac{7}{4} - 2 \times \frac{4}{7} = \frac{17}{28}$

03. According to the question,
$\frac{a}{b} - \frac{2b}{a} = \frac{127}{153}$
Go through option (a) 153 = 17 × 9
$\frac{17}{9} - 2 \times \frac{9}{17} = \frac{127}{153}$

04. $10500 = 2^2 \times 3^1 \times 5^3 \times 7^1$
Number of factors/ divisors
$= (2+1) \times (1+1) \times (3+1) \times (1+1)$
$3 \times 2 \times 4 \times 2 = 48$
∴ Total number of divisors except 1 and itself = 48 – 2 = 46

05. 10 + 100 + 1000 + ……..+1000000000
= 11111111110
∴ Number of zero at the end of the expression = 1

06. To find the unit digit, unit digit is responsible.
77 × 88 + 66 × 55 = 7 × 8 + 6 × 5 = 86
∴ Unit digit of the expression = 6

07. $\frac{1719\times1721\times1723\times1725\times1727}{18}$

$= \frac{(1800-81)(1800-79)(1800-77)(1800-75)(1800-73)}{18}$

$= -\frac{(90-9)\times(72+7)\times(72+5)\times(72+3)\times(72+1)}{18}$

$\frac{9\times7\times5\times3\times1}{18} = \frac{63\times15}{18} = \frac{(72-9)(18-3)}{18} = \frac{27}{18}$

∴ Remainder = 27 -18 =9

08. M = 1000, CD = 500 – 100 = 400, L = 50, X = 10, IV = 5-1 = 4
∴MCDLXIV = 1000 + 400 + 50 + 10 + 4 = 1464

09. Let the number be x.
According to question, $16x - x$ = 540
⇨ x = 540/15 = 36

10. The first occurrence of 5 is in the ten-thousands place, which has a positional value = 50,000
The Second occurrence of 5 is in the tens place, which has a positional value of 50.
So the required difference = 50,000 – 50 = 49,950.

11. Required number = No. divisible by 3 + No. divisible by 5 – No. divisible by 3×5
$= \frac{20}{3} + \frac{20}{5} - \frac{20}{15}$ = 6 + 4 – 1 = 9

12. ATQ, D – N = 3
⇨ D = N + 3
Again $\frac{3N}{D+20} = \frac{1}{8}$

⇨ $\frac{3N}{N+23} = \frac{1}{8}$

⇨ 24N = N +23

⇨ N = 1

Required fraction = $\frac{1}{1+3} = \frac{1}{4}$

13. Let the number be XY.
ATQ, 10X + y – (10y + X) = 27
⇨ 9X – 9Y = 27
⇨ X – Y = 3

14. Let the 4-digit number be $abcd$
ATQ, $a = \frac{b}{4}, c = a + b, d = 2b$
Go through Option (b)
Put $a = 1, b = 4, c = 5, d = 8$
Option (b) satisfy the condition.

15. $\frac{1056}{23} = 45\frac{\mathbf{21}}{\mathbf{23}}$
Least Number = 23 – 21 = 2

16. Let the number be 899k + 63
= 29 ×31k + 29 × 2 + 5
= 29(3k + 2) + 5
∴ Remainder = 5

17. 3 in the tens place : 30, 31, 32, 33, 34, 35, 36, 37, 38, 39 = 10 times
3 in the units place : 03, 13, 23, 33, 43, 53, 63, 73, 83, 93 = 10 times
Total = 10 + 10 = 20 times

18. Let the number be XY.
ATQ, X – Y = $\frac{1}{9}$ (10X + Y – 10Y – X)
⇨ X – Y = $\frac{1}{9}$ (9X -9Y) = X – Y
Therefore Data is not sufficient to answer this questions.

19. $\frac{9999}{88} = 113\frac{55}{88}$
Remainder = 55
∴ Required number = 9999 – 55 = 9944

20. Number of 3-digits numbers
= 999 – 100 + 1 = 900
3–digit numbers divisible by 6
= 900/6 = 150

21. Let the number be XY.
ATQ, (10X + y)(X+Y) = 405
(10Y + X)(X + Y) = 486
⇨ $\frac{10X+Y}{10Y+X} = \frac{405}{486} = \frac{5}{6}$
⇨ $\frac{10X+Y+10Y+X}{10Y+X} = \frac{5+6}{6}$
⇨ $\frac{11(X+Y)}{10Y+X} = \frac{11}{6}$
⇨ 6X + 6Y = 10Y + X
⇨ 5X = 4Y
⇨ $\frac{X}{Y} = \frac{4}{5}$
Required number = 45

22. Let the number be XY.
ATQ, X + Y = 8 ……(1)
Again, 10X + Y + 18 = 10Y + X
⇨ 9Y – 9X = 18
⇨ Y – X = 2 ……(2)
Solving equation 1 and 2, we get
X = 3 and Y = 5
So the number is 35.

23. Let the four consecutive even numbers are x – 3, x – 1, x + 1 and x + 3
ATQ, X – 3 + x – 1 + x +1 + x + 3 = 180
⇨ 4x = 180
Sum of next four consecutive even numbers = x + 5 + x + 7 + x + 9 + x + 11
= 4x + 22 = 180 + 32 = 212

24. A number is divisible by 9, if sum of digits of number is divisible by 9.
6 + 1 + 3 + 5 + n + 2 = 17 + n = 18
∴ n = 1

25. Let the number be $12a + 4$
$(12a + 4)^2 = 144a^2 + 16 + 2 \times 4 \times 12a$
$16(9a^2 + 1 + 6a)$
∴ The number is completely divisible by 16.

26. 540 = $2^2 \times 3^3 \times 5^1$
Total number of factors
= (2 + 1)×(3 + 1)×(1 +1) = 24

27. Number of zeros at the end of the expression = 1 + 2 + 3 + ……+ 10
$\frac{10(10+1)}{2}$ = 55

28. Product of all numbers
= 0 × 1 × 2 … … .× 9 = 0

29. $(6374)^{1793} \times (625)^{317} \times (341)^{491}$
Unit digit of any odd power of 4 is 4.
Unit digit of any power of 5 is 5.
Unit digit of any power of 1 is 1.
Required unit digit = 4 × 5 × 1 = 20

∴ Required unit digit = 0

30. Let the remainder be x.
Both 2272 – x and 875 –x are divisible by n.
∴ 2272 – x – (875 – x) = 1397 is also divisible by n.
1397 = 11 × 127
Required 3 – digit number = 127.
Sum of digit = 1 + 2 + 7 = 10

31. 987 = 3 × 7 × 7 × 7
The number must be divisible by 3 and 7.
Go through option Option (c) 555681
Check for divisibility of 7
681 – 555 = 126 = 7 × 18
Option (c) is divisible by both 3 and 7

32. Let the number be XYZ.
ATQ, X + Y + Z = 10
Y = X + Z
Again, 100Z + 10Y + X – 100X – 10Y – Z =99
⇨ 99Z – 99X = 99
⇨ Z – X = 1
Put X = 2, Y = 5 and Z = 3
Option (b) satisfies the conditions

33. i) Every whole number is a natural number. The statement is incorrect.
Whole numbers = Natural numbers including zero or non-negative integers.
ii) Every integer is a rational number
The statement is correct.
iii) Every rational number is not an integer.
The statement is incorrect.
e.g:- 1.25 is a rational number but not an integer.

34. Let the number be x.
45x - 25x = 200
∴ x = 10

35. 853 × 1346 × 452 × 226
= 3 × 6 × 2 × 6 = 6

36. Let the two digit number be XY.
ATQ, 10X + Y – 3 (X – Y) = 4
⇨ 7X – 2Y = 4.....(1)
Again 10 Y - X – 7 (X + Y) = 3
⇨ 3Y – 6X = 3
⇨ Y – 2X = 1
⇨ 2Y – 4X = 2 .....(2)
Adding equation (1) and (2), we get
⇨ 3X = 6
⇨ X = 2
Put the value of X in equation 2.
⇨ 2Y – 4 × 2 = 2
⇨ Y = 5
The required two digit number = 25
∴ Difference between the digits = 5 – 2 = 3

37. ATQ, xy = 60 and $x^2 + y^2$ = 169
$(x+y)^2 = x^2 + y^2 + 2xy$
169 + 2×60 = 289
$x + y = \sqrt{289}$ = 17

38. Let the two digit number be xy.
ATQ, $y = x^2$
And $10x + y - (10y + x)$ = 54
⇨ $9(x - y) = 54$
⇨ $x - y$ = 6
Possible pairs are (9, 3), (8, 2), (7, 1), (6, 0)
Pair (6, 3) satisfies $y = x^2$
So the two digit number = 93.
∴ 40 % of 93 = 37.2

39. 225 = 9 × 25
The number 876p37q is divisible by 25, if the last two digit is 00, 25, 50, 75.
Last digit = 75
q = 5
Again sum of the digits of the entire number is divisible by 9.
8 + 7 + 6 + p + 3 + 7 + q = 9
⇨ 31 + p + q = 9
⇨ 4 + p + 5 = 9
⇨ p = 0 or 9
∴ (p, q) = (0, 5) or (9, 5)
Option (b) and (d) are correct.

40. Possible 3 – digit numbers are 307, 370, 703 and 730.
∴ 307+370+703+730 = 2110

41. Required sum = $\frac{10(10+1)(2\times10+1)}{6}$
$\frac{10\times11\times21}{6}$ = 385

42. $S_{14} = \frac{14}{2}\{2 \times 10 + (14-1)d\} = 1085$
⇨ 7 (20 + 13d) = 1050
⇨ 20 + 13d = 150
⇨ 13d = 150 – 20 = 130
⇨ d = 10
Again, t_{20} = 10 + (20 – 1) ×10 = 200

43. $(1^2 + 2^2 + 3^2 + \ldots\ldots\ldots\ldots + 20^2) - (1^2 + 2^2 + 3^2 + \ldots\ldots\ldots\ldots + 10^2)$

$= \frac{20\times(20+1)(2\times20+1)}{6} - \frac{10\times(10+1)(2\times10+1)}{6}$

$= \frac{20\times21\times41}{6} - \frac{10\times11\times21}{6}$

$= \frac{10\times21}{6}(2\times41-11)$

$= 35 \times 71 = 2485$

44. 10, 7, 4, …… -62
Here, a = 10 and d = -3
No. of term = [10 – (-62)] /3 + 1 = 25
11th term from last toward first term
= 25 -11 + 1 = 15
t = 10 + (15 – 1)(-3) = -32

45. Required answer = $6 \times 5 \times 4 \times 3 = 360$ ways.

46. Divisibility rule of 11.

47. $(a^n - b^n)$ is always divisible by $(a - b)$
$5^{2n} – 2^{2n} = 25^n – 8^n$
∴ 25 – 8 = 7 is a factor.

48. Sum of even numbers from 1 to 400
$= 2(1 + 2 + 3 + \cdots\ldots\ldots\ldots + 200)$
$= 2 \times \frac{200(200+1)}{2} = 40200$

49. Go through option.
Option (c) 71 – 17 = 54

50. Let the number be xy
ATQ, $\frac{10x+y}{x+y} = 4$
⇨ $10x + y = 4x + 4y$
⇨ $6x = 3y$
⇨ $x : y = 1 : 2$
Again 2 – 1 = 1 unit = 3
x = 1 unit = 3 and y = 2 unit = 6
∴ Required number is 36.

51. 4 ×3 = 12
∴ Required number = Quotient (200/12)
= 16

52. Let the three consecutive even numbers be $(x-2), x \text{ and } (x+2)$
Product = $(x-2)x(x+2) = x(x^2-4)$
Put x = 4, $4(4^2 – 4) = 48$

53. $49^{15} - 1 = (7^2)^{15} - 1 = 7^{30} - 1^{30}$ is divisible by (7 + 1) and (7 - 1)
$\therefore 49^{15} - 1$ is divisible by 8.

54. 2 + 4 + 6 +…….. +100
= 2 (1 + 2 + 3 +…….. + 50)
$= 2 \times \frac{50(50+1)}{2} = 2550$

55. 1 to 9 → 9 numbers = 9 × 1 = 9 digits
10 to 90 → numbers = 90 × 2 = 180 digits
100 to 536 → 437 numbers = 437 × 3 = 1311 digits
Total number of digits = 9 + 180 + 1311 = 1500 digits

56. We know that period of 7 and 3 is 4.

$$7^{4\times24+1} - 3^{4\times13+1} = 7^1 - 3^1 = 4$$

So unit digit is 4.

57. Last digit of a squares are 0, 1, 4, 5, 6 and 9.
Last digit of a square will not be 2.
Option (d) is the answer.

58. Let the number be x.

ATQ, $\frac{8}{7}x - \frac{7}{8}x = \frac{15}{14}$
⇨ $x\left(\frac{8}{7} - \frac{7}{8}\right) = \frac{15}{14}$
⇨ $x\frac{15}{56} = \frac{15}{14}$
⇨ $x = \frac{15}{14} \times \frac{56}{15} = 4$

59. 95.75 × 0.2554
= 5 × 19.15 × 2 × 0.1277
= 10 × 19.15 × 0.1277
= 1915 × 1277 × 10^{-5}
∴ Non – zero digits to the right of decimal points is 5.

60. A number is divisible by 12, when the number is divisible by 3 and 4.
Option (b), (c) and (d) are not divisible by 4.
Option (a) is the answer.

61. Remainder = Digital Sum of 643653
= 6 + 4 + 3 + 6 + 5 + 3 = 27 = 2 + 7 = 9 = 0

62. Required unit digit = $8 \times 4 \times 5 \times 3 = 0$

63. Sum of two odd number is always an even number.

64. Largest 3 –digit number = 999
$999 = 16 \times 62 + 7$
Remainder = 7
∴ Required number is 999 – 7 = 992.

65. Let the number be XY.
ATQ, 10X +Y+10Y+X = 11(X + Y)
∴ The number will be divisible by 11.

66. Integers are: 3, 9, 15, 21 ……99.
Number of term = (99 – 3)/6 + 1 = 17
Sum of numbers = $\frac{3+99}{2} \times 17 = 867$

67. Remainder = $\frac{2\times3}{7} = \frac{6}{7}$
Remainder = 6

68. Remainder = $\frac{3^2}{6} = \frac{9}{6}$
Remainder = 9 – 6 = 3

69. 1 in the tens place : 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 = 10 times
1 in the units place : 01, 11, 21, 31, 41, 51, 61, 71, 81, 91 = 10 times
Total = 10 + 10 = 20 times

70. Sum of first 24 natural numbers
= $\frac{24(24+1)}{2}$ = 300

71. Let the two numbers be X and Y.
Sum of the reciprocals
= $\frac{1}{X} + \frac{1}{Y} = \frac{X+Y}{XY} = \frac{55}{600} = \frac{11}{120}$
Product of the reciprocals = $\frac{1}{XY} = \frac{1}{600}$

72. ATQ, X + y = 13 & XY = 34
Sum of the reciprocals = $\frac{1}{X} + \frac{1}{Y} = \frac{X+Y}{XY} = \frac{13}{34}$

73. $1^2+2^2+3^3+4^2+$……..$+15^2$
$\frac{15(15+1)(2\times15+1)}{6} = \frac{15\times16\times31}{6} = 1240$

74. Greatest 4-digit number = 9999
Smallest 4-digit number = 1000
Difference = 9999 – 1000 = 8999

75. $\frac{25}{10000} = 25 \times 10^{-4}$ = 0.0025

76. A number is divisible by 11, when sum of odd place digit – sum of even place digit = 0 or multiple of 11.
2 + 9 + * - (8+7+3) = 11+* -18 = 0
∴ * = 18 – 11 = 7

77. $(x-y) = 3$……(1)
ATQ, $x^2 - y^2 = (x+y)(x-y) = 39$
⇨ $(x+y) \times 3 = 39$
⇨ $(x+y) = 13$……(2)
Equation (2) – Equation (1)
2y = 13 – 3 = 10
⇨ Y = 5

78. $54327 \times 10^{3-} * 3572 \times 10^{-1} * 57 \times 10^{-4}$
$= 54327 \times 3572 \times 57 \times 10^{-8}$
$= 54327 \times 10^{-4} \times 3572 \times 10^{-3} \times 57 \times 10^{-1}$
= 5.4327 * 3.572 * 5.7

79. The first occurrence of 9 is in thousands place, which has a positional value = 9,000
The Second occurrence of 5 is in the tens place, which has a positional value of 90.
So the required difference = 9,000 – 90 = 8.910

80. Required Remainder = $\frac{5\times5}{13}$
$\frac{25}{13} = 1\frac{12}{13} = 12$

81. Smallest prime number × Smallest composite number = 2 × 4 = 8

82. Numbers = 11k + 2
Where k = 1, 2, 3 ……
13, 24, …… 90
Here a = 13, d = 11
Number of term = $\frac{90-13}{11} + 1 = 8$
Sum = $\frac{13+90}{2} \times 8 = 412$

83. Go through option (c)
3 + 9 = 12 and 93 – 39 = 54

84. Go through option (b)
24 = 4 × (2+4) = 3 × 2 × 4

85. N = 68 × 269 + 0 = 68 × 269
$\frac{68\times269}{67} = \frac{(67+1)(4\times67+1)}{67} = \frac{1\times1}{67} = \frac{1}{67}$
Remainder = 1

86. X – Y = 1365
Again X = 6Y + 15
X - 6Y = 15
Equation 1 – Equation 2
5Y= 1365 – 15 = 1350
Y = 270

87. Sum of the squares of the numbers from 3 to 18
= $18^2 + 17^2 + 16^2 +$ ……$1^2 - 2^2 - 1^2$
$\frac{18(18+1)(2\times18+1)}{6} - 5$

= 3 × 19 × 37 – 5 = 2104

88. Let the number be 91k + 65
= 13 × (7k + 5) + 0
Remainder = 0

89. 1 × 9 + 7 × 5 + 8 × 4 = 6

90. $7x2$ must be divisible by 2 and 3.
7+ x + 2 = 9 + x must be divisible by 3.
x = 0, 3, 6 or 9.

91. 5N716M2 is divisible by 8 and 11.
Last three digit 6M2: 6 is an even number. Last two digit M2 must be divisible by 8.
M = 3 or 7
Again, (5 + 7 + 6 + 2) – (N + 1 + M) must be divisible 11.
(M + N + 1) – 20 = 0 or 11
M + N ≠ 20 or M + N = 8
M = 3, N = 5
or M = 7, N = 1 (M is largest)
$M^2 + N^2 = 7^2 + 1^2 = 50$

92. Number of games = 4 + 3 + 2 + 1 = 10

93. 1 to 9 → 9 numbers = 9 × 1 = 9 digits
10 to 99 → numbers = 90 × 2 = 180 digits
100 to 366 → 267 numbers = 267 × 3 = 801 digits
Total number of digits = 9 + 180 + 801 = 990 digits

94. Let the two consecutive numbers be x and x + 1
ATQ, 4 x – 3 (x + 1) = 10
x = 13
Sum of two numbers = 2 x + 1
= 2 × 13 + 1 = 27

95. Numbers are in the form 7k + 3.
Where k = 1, 2, 3, …… 13
1st number = 7 × 1 + 3 = 10
Last number = 13 × 7 + 3 = 94
Number of numbers = 13
Sum = $\frac{10+94}{2} \times 13 = 676$

96. 3 + 9 + p + 2 + 5 + 4 + 6 = 2 + p
2 + p = 9 p = 7

97. (sum of even place digit – sum of odd place digit) must be divisible by 11.
(8 + 6 + 2) – (2 + 9 + 0) = 16 – 11 = 5
5 is added to 6-digit number.

98. Option (a): $2^{96} + 1 = (2^{32})^3 + 1$
$a^n + 1$ is divisible by (a + 1), if n is odd.

99. 5P9 + 3R7 + 2Q8 = (500 + 10 × P + 9) + (300 + 10 ×R +7) + (200 + 10 × Q + 8) = 1114
1000 + (P + Q + R) × 10 + 24 = 1114
(P + Q + R) × 10 = 90
(P + Q + R) = 9
Maximum value of Q = 9 (P = R = 0)

100. Unit digit of any power of 1 is 1.
$(41)^n – 1 = 1 – 1 = 0$

101. $n^2 + n + 41 = n(n + 1) + 41$
Put n= 40, 40(40 + 1) + 41
40 × 41 + 41 = 41(40 + 1) = 41^2
For value of n for which expression $n^2 + n + 41$ is not a prime number i.e. square number.

102. $6^{10} \times 7^{17} \times 11^{27} = 2^{10} \times 3^{10} \times 7^{17} \times 11^{27}$
2, 3, 7 and 11 are prime numbers
Number of prime factors = Sum of power of the expression = 10 + 10 + 17 + 27 = 64

103. $2^m – 2^n = 960 = 64 \times 15$
$2^m – 2^n = 2^6 \times 15$
$2^{m-6} – 2^{n-6} = 15 = 2^4 – 2^0$
m – 6 = 4 and n – 6 = 0
m = 10 and n = 6

104. $10800 = 16 \times 27 \times 25 = 2^4 \times 3^3 \times 5^2$
Number of total factors = (4 + 1) (3 + 1) (2+ 1) = 60
Required number of ways = 60/2 = 30

105. Page 1 to 99: A digit appears 10 (tens place) + 10 (units place) = 20 times.
Page 100 to 199: A digit appears 100 (hundreds place) + 20 (units / tens place) = 120 times.
Page 1 to 199: 1 appears 20 + 120 = 140 times.
ATQ, 1 is used 136 times. So we count backward from page 199.
140 – 136 = 4 times
199 – 4 = 195 pages

A. LCM (Least Common Multiple)

Factors and Multiples

If a, b, c and x are three natural numbers and x = a × b × c, then:

1. a, b, and c are factors of x
2. x is divisible by a, b, and c
3. x is a multiple of a, b, and c

Example: 30 = 2 × 3 × 5

1. 2, 3, 5 are factors of 30.
2. 30 is divisible by 1, 2, 3, 5, 6, 10, 15, 30
3. 30 is a multiple of 1, 2, 3, 5, 6, 10, 15, 30

Definition: Lowest Common Multiple (LCM) of two or more numbers is the least number which is divisible by each of these numbers.

Standard Method to Find LCM

1. Factorize the numbers (prime factorization)
2. Identify the highest power of each prime factor
3. Multiply those highest powers

Example: Find the LCM of 432, 720, 384

$432 = 2^4 \times \underline{3^3}$ $720 = 2^4 \times 3^2 \times \underline{5}$

$384 = \underline{2^7} \times 3$

$LCM = 2^7 \times 3^3 \times 5 = 17{,}280$

LCM Model - 1

Find the smallest number which is exactly divisible by x, y and z = LCM of (x, y, z)

Example: Find the smallest number which is exactly divisible by 12, 15, 18 and 27.

Required number = LCM (12, 15, 18, 27)

LCM = 4 × 3 × 5 × 3 × 3 = 540

LCM Model - 2

Find the smallest number which when divided by x, y, z leaves remainder r in each case

Required number = LCM of (x, y, z) + r.

Example: Find the smallest number which when divided by 16, 24, 30, 36 leaves remainder 10 in each case.

Required number = LCM of (16, 24, 30, 36) + 10

= 16 × 3 × 5 × 3 = 720 + 10 = 730

LCM Model - 3

Find the smallest number which when divided by x, y, z leaves remainder a, b, c respectively.

Required number = LCM of (x, y, z) – k

Where x- a = y – b = z – c = k

Example: Find the smallest number which when divided by 3, 5, 7, 9 leaves remainders 1, 3, 5, 7 respectively.

Soln: 3−1 = 5−3 = 7−5 = 9−7 = 2

Required number = LCM (3, 5, 7, 9) − 2

= 315 − 2 = 313

LCM Model - 4

Neither remainder is constant nor Difference is Constant

Example: Find the smallest number which when divided by 11 leaves remainder 5 and when divided by 13 leaves remainder 11.

Soln: Required number = 11x + 5 = 13y + 11

$x = \frac{13y+6}{11}$,where x and y are quotients, x, y ∈ I

By hit and trial, we get y = 8 and x = 10

Required number = 11 × 10 + 5 = 13 × 8 + 11 = 115

B. HCF (Highest Common Factor)

Definition: HCF is the greatest factor of two or more numbers which can divide all of these numbers. It is also called GCD (Greatest Common Divisor).

Standard Method to Find HCF

1. Factorize the numbers (prime factorization)
2. Identify common prime factors
3. Multiply the common factors

Example: Find HCF of 432, 384, 720

Soln: $432 = 2^4 \times 3^3$ $384 = 2^7 \times 3$

$720 = 2^4 \times 3^2 \times 5$

$HCF = 2^4 \times 3 = 48$

Euclid's Algorithm

Repeatedly divide the larger number by the smaller until remainder becomes zero.

Example: HCF of 432, 384, 720

Soln: 384 < 432 < 720

720 = 432 × 1 + 288

432 = 288 × 1 + 144

384 = 144 × 2 + 96

144 = 96 × 1 + 48

96 = 48 × 2 + 0

Remainder is zero and the divisor is 48.

HCF of 384, 432 and 720 = 48

Let $n_1 = hx$ and $n_2 = hy$

HCF of (n_1, n_2) = h
$n_1 - n_2 = hx - hy = h(x - y)$
HCF is always either the difference of two numbers or factor of the difference of two numbers.

HCF Model - 1
Find the largest number which is exactly divisible by x, y, z.
Required number = HCF of (x, y, z)

Example: Find the maximum number by which after dividing 792, 936, and 1080 gives no remainder.
Required number = HCF of (792, 936, 1080)
1080 = 936 × 1 + 144
936 = 144 × 6 + 72
792 = 72 × 11 + 0
Remainder is zero and the divisor is 72.
Required number = 72

HCF Model - 2
Find the largest number which when divided by x, y, z leaves remainder r in each case.
Required number = HCF of [(x - r), (y - r), (z - r)]
Or HCF of [(x - y), (y - z), (z - x)]

Example: The largest number, which divides 25, 73, and 97 to leave the same remainder in each case is:
Soln: Required number = HCF of (73−25, 97−73, 97−25) = HCF(48, 24, 72) = 24

HCF Model - 3
Find the largest number which when divided by x, y, z leaves remainder a, b, c respectively.
Required number = HCF of [(x−a), (y−b), (z−c)]

Example: The greatest number that divides 411, 684, 821 and leaves 3, 4, and 5 as remainders respectively is:
Required number = HCF of [(411−3), (684−4), (821−5)]
=HCF of (408, 680, 816)
816 – 680 = 136 680 – 408 = 272
Required HCF = 272 – 136 = 136

Standard Formulae

- HCF × LCM = Product of two numbers
- HCF is always a factor of LCM
- LCM of fractions = LCM of numerators ÷ HCF of denominators
- HCF of fractions = HCF of numerators ÷ LCM of denominators
- If two numbers are relative prime, then HCF = 1 and LCM = product of numbers.
- Maximum LCM ⇒ Minimum HCF (and vice versa

Example: The LCM of two numbers is 1820 and their HCF is 26. If one number is 130, then the other number is:
Soln: Product of two numbers = HCF × LCM
130 × Other number = 1820 × 26
Other number = (1820 × 26) ÷ 130 = 364

Example: Product of two co-prime numbers is 117. Then their LCM is:
HCF × LCM = 117
LCM = 117 (∴HCF = 1)

If ratio of two numbers is x : y and HCF = h, then their LCM = x × y × h

Example: The ratio of two numbers is 3 : 4 and HCF is 5, then their LCM is:
Soln: LCM = 3 × 4 × 5 = 60

Example: Find the HCF of $\frac{12}{5}, \frac{14}{15}$ and $\frac{16}{17}$.

Soln: $\frac{HCF\ of\ (12,14,16)}{LCM\ of\ (5,15,17)} = \frac{2}{255}$

Example: Find the HCF of $\frac{1}{6}, \frac{5}{27}, \frac{4}{15}$ and $\frac{8}{3}$.

Soln: $\frac{LCM\ of\ (1,5,4,8)}{HCF\ of\ (6,27,15,3)} = \frac{40}{3}$

EXERCISE

1. The LCM of two prime numbers x and y is 161. If x > y, then the value of 15y - 7x is:
(a) -32 (b) -56 (c) 38 (d) 74
(OSSC CGL PRE 2023)

2. The product of two numbers is 4107. If the HCF of these numbers is 37, then the greater number is:
(a) 101 (b) 107 (c) 111 (d) 185
(OSSC CGL SPL PRE 2022)

3. Three numbers are in the ratio of 2 : 3 : 7 and their LCM is 8400. Their HCF is:
(a) 40 (b) 80 (c) 120 (d) 200
(OSSC CTSRE PRE 2022)

4. There are three numbers A, B and C. The Highest Common Factor of A and B, B and C, and C and A are 3, 15 and 3 respectively. If the common multiple of three numbers is 300 and their product is 13,500, then find the greatest possible number, which can divide them.

(a) 25 (b) 3 (c) 12 (d) none of these
(OSSC CTSRE PRE 2022)

5. If the sum and difference of two numbers are 128 and 64 respectively, then what is their HCF?
(a) 64 (b) 54 (c) 46 (d) 32
(OSSC CTSRE PRE 2023)

6. What will be the HCF of 459, 2241 and 833, 4067?
(a) 31, 53 (b) 29, 51 (c) 33, 55 (d) 27, 49
(OSSC BSSO 2022)

7. What will be the HCF of 592, 976 and 925, 1525?
(a) 18, 23 (b) 16, 25
(c) 19, 22 (d) 17, 24
(OSSC BSSO 2022)

8. Find the LCM of 38/39 and 39/40.
(a) 1282 (b) 1482 (c) 1582 (d) 1382
(OSSC BSSO 2022)

9. The LCM of two numbers is 280 and their HCF is 7. Find the product of two numbers.
(a) 1760 (b) 1960 (c) 2060 (d) 1860
(OSSC BSSO 2022)

10. Find the HCF of two numbers, if the LCM of two numbers is 434 and its product is 13454.
(a) 31 (b) 34 (c) 32 (d) 33
(OSSC BSSO 2022)

11. Two numbers are in the ratio of 81 : 82. If the HCF of the numbers is 49, find the smallest number.
(a) 3969 (b) 3769 (c) 3669 (d) 3869
(OSSC BSSO 2022)

12. The LCM of two numbers is 2244 and their ratio is 33 : 34. Find the two numbers.
(a) 66, 68 (b) 70, 72
(c) 68, 70 (d) 72, 74
(OSSC BSSO 2022)

13. What is the least possible number which when divided by 2, 3, 4, 5, 6 leaves the remainder 1, 2, 3, 4, 5 respectively?
(a) 60 (b) 61 (c) 59 (d) 69
(OSSC CGL PRE 2022)

14. Find the greatest number that will divide 43, 91, and 183 so as to leave the same remainder in each case.
(a) 4 (b) 7 (c) 9 (d) 13
(OSSC CGL SPL PRE 2023)

15. The least perfect square, which is divisible by each of 21, 36 and 66 is:
(a) 213444 (b) 214344
(c) 214434 (d) 231444
(OSSC CHSL PRE 2024)

16. The smallest five-digit number which is divisible by 12, 18 and 21 is:
(a) 30256 (b) 10080
(c) 10224 (d) 50321
(OSSC CHSL PRE 2024)

17. What is the least possible number which when divided by 18, 35 or 42, it leaves 2, 19 and 26 as the remainders respectively?
(a) 1244 (b) 614 (c) 1874 (d) None of these
(OSSC CTSRE PRE 2022)

18. What is the least number which leaves a remainder 5 when divided by 8, 12, 16 and 20?
(a) 235 (b) 240 (c) 245 (d) 265
(OSSC CTSRE PRE 2023)

19. The largest four-digit number exactly divisible by each of 12, 15, 18 and 27 is:
(a) 9930 (b) 9690 (c) 9720 (d) 9960
(OSSC CTSRE PRE 2024)

20. Find the smallest number which when reduced by 24, is divisible by 28, 26 and 65.
(a) 704 (b) 674 (c) 684 (d) 694
(OSSC BSSO 2022)

21. Find the greatest three-digit number which is divisible by 13, 39 and 52.
(a) 956 (b) 946 (c) 936 (d) 966
(OSSC BSSO 2022 & SCEW 2021)

22. A yellow light flashes 4 times per minute and a green light flashes 6 times in two minutes at regular intervals. If both lights start flashing at the same time, how many times do they flash together in each hour?
(a) 50 (b) 60 (c) 40 (d) 30
(OSSC CGL SPL PRE 2022)

23. Five bells ring at the intervals of 12, 15, 16, 20 and 25 min, respectively. If they ring together at midnight, then at what time next will they ring together?
(a) 7:00 PM (b) 7:30 PM (c) 8:00 PM (d) 8:30 PM
(OSSC CHSL PRE 2024)

24. The traffic lights at three different road crossings change after 48 seconds, 72 seconds and 108 seconds respectively. If they all change simultaneously at 8:20 hours, then at what time will they again change simultaneously?
(a) 8:27:12 hours (b) 8:27:48 hours
(c) 8:27:24 hours (d) 8:27:36 hours
(OSSC CTSRE 2024)

25. Find the largest scale size to measure accurately the three equilateral triangles with sides measuring 147 cm, 196 cm and 245 cm.
(a) 43 (b) 47 (c) 49 (d) 45
(OSSC BSSO 2022)

26. What is the greatest number that will divide 2400 and 1810 and leave remainders 6 and 4 respectively?
(a) 39 (b) 41 (c) 42 (d) 43
(OSSC CPGL PRE 2023)

27. The LCM of two numbers is 2079 and their HCF is 27. If one of the numbers is 189, find the other.
(a) 297 (b) 281 (c) 287 (d) 296
(OSSC CPGL PRE 2023)

28. In a school, 391 boys and 323 girls have been divided into the largest possible equal classes, so that each class of boys numbers the same as each class of girls. What is the number of classes?
(a) 14 (b) 19 (c) 17 (d) 21
(OSSC CGL Mains 2024-25 & CPGL PRE 2023)

29. Two natural numbers whose sum is 85 and the LCM is 102 is:
(a) 35 and 50 (b) 34 and 51
(c) 17 and 68 (d) 30 and 75
(OSSC Amin 2023)

30. A gardener wants to plant 66 apple trees, 88 banana trees and 110 mango trees in a row with equal number of trees with each row having only one kind of tree. The least number of rows required is:
(a) 6 (b) 8 (c) 10 (d) 12
(OSSC Amin 2023)

31. A sum of two numbers is 55. If the HCF and LCM of these numbers are 5 and 120, respectively, then the sum of the reciprocals of these two numbers is equal to:
(a) 55/601 (b) 601/55
(c) 120/11 (d) 11/120
(OSSC Statistical Asst. 2024)

32. How many such pair of numbers are there, whose product is 2028 and HCF is 13?
(a) 4 (b) 3 (c) 2 (d) 1
(OSSC ESI 2023)

33. The greatest possible length (in cm) which can be used to measure exactly the lengths 4 m, 2 m 85 cm, 11 m 85 cm is:
(a) 5 (b) 15 (c) 30 (d) 10
(OSSC VSA 2023)

34. Two numbers are in the ratio 5:13. If their HCF is 11, find the numbers respectively?
(a) 13 and 5 (b) 55 and 13
(c) 55 and 143 (d) 143 and 55
(OSSC VSA 2023)

35. Find the largest positive integer that will divide 398, 436 and 542 leaving remainders 7, 11 and 15 respectively.
(a) 15 (b) 17 (c) 18 (d) 21
(OSSC Steno 2022)

36. Five bells begin to toll together and toll respectively at intervals of 6, 5, 7, 10 and 12 seconds. How many times will they toll together in one hour excluding the one at start?
(a) 7 times (b) 8 times
(c) 9 times (d) 11 times
(OSSC Steno 2023 & CGL Mains 2022)

37. A man has a certain number of small gift to pack into parcels. If he packs 3, 4, 5 or 6 numbers of gifts in a parcel, he is left with one, if he parcels 7 gifts in a parcel, then he will left with none. Then what is the minimum number of total gifts, he may have to pack?
(a) 361 (b) 301 (c) 241 (d) 181
(OSSC CGL Mains 2022)

38. Which one of the following is the HCF of the numbers 1.08, 0.36 and 0.9?
(a) 0.3 (b) 0.18 (c) 0.12 (d) 0.03
(OSSC CGL Mains 2023)

39. Two numbers are in the ratio of 3 : 4. If their LCM is 240, then what is the smallest of these two numbers.
(a) 80 (b) 70 (c) 60 (d) 50
(OSSC CGL Mains 2023)

40. The LCM of the numbers 5.2 and 0.065 is:
(a) 5.2 (b) 0.52 (c) 0.052 (d) 52
(OSSC CGL Mains 2023)

41. What is the least multiple of 7 which when divided by 6, 9, 15 and 18, respectively, leaves 3 as the remainder in each case?
(a) 255 (b) 266 (c) 273 (d) 385
(OSSC ATO 2024)

42. What is the least number which when divided by 52, leaves 33 as the remainder and when divided by 78 leaves 59 and when divided by 117 leaves 98 as the respective remaindes?
(a) 429 (b) 436 (c) 449 (d) 446
(OSSC CGL Mains 2024-25)

43. What is the greatest number that will divide 38, 45 and 52 leave remainders as 2, 3 and 4 respectively?
(a) 4 (b) 6 (c) 8 (d) 3
(OSSC CGL Mains 2024-25)

44. The greatest number that will divide 55, 127 and 175 so as to leave the same remainder in each case is:
(a) 16 (b) 20 (c) 22 (d) 24
(OSSC CGL Mains 2024-25)

45. Find the smallest square number that is divisible by each of the numbers 12, 16 and 21.
(a) 7056 (b) 7256 (c) 7056 (d) 6956
(OSSC CGL 2021& SCEW 2021)

46. Find the smallest square number that is exactly divisible by each of the numbers 4, 7 and 9.
(a) 1784 (b) 1764 (c) 1754 (d) 1774
(OSSC CGL 2021 & SCEW 2021)

47. The least number divisible by all numbers from 1 to 10, both inclusive is:
(a) 5040 (b) 1504 (c) 252 (d) 2520
(OSSC Amin 2023)

48. The least number which should be added to 2497, so that the sum is exactly divisible by 5, 6, 4 and 3 is?
(a) 13 (b) 23 (c) 33 (d) 43
(OSSC Amin 2023)

ANSWER KEY

01. (b)	02. (c)	03. (d)	04. (b)	05. (d)	06. (d)
07. (b)	08. (b)	09. (b)	10. (a)	11. (a)	12. (c)
13. (c)	14. (a)	15. (a)	16. (b)	17. (b)	18. (c)
19. (c)	20. (b)	21. (c)	22. (b)	23. (c)	24. (a)
25. (c)	26. (c)	27. (a)	28. (c)	29. (b)	30. (d)
31. (d)	32. (c)	33. (a)	34. (c)	35. (b)	36. (b)
37. (b)	38. (b)	39. (c)	40. (a)	41. (c)	42. (c)
43. (b)	44. (d)	45. (a)	46. (b)	47. (d)	48. (b)

SOLUTION

1. $161 = 7 \times 23 = y \times x$
$\therefore 15y - 7x = 15 \times 7 - 7 \times 23 = -56$

2. Let the number be 37x and 37y
ATQ, $37x \times 37y = 4107$
$\Rightarrow xy = \frac{4107}{37 \times 37} = 3 = (1 \times 3)$
$\Rightarrow$ (x, y) = (1,3)
$\therefore$ Greater number = 37y = 37×3 = 111

3. Let the HCF of three numbers = h
The three numbers are 2h, 3h and 7h.
LCM of 2h, 3h, and 7h = 42h
ATQ, 42h = 8400
$\Rightarrow$ h = 200

4. HCF of A and B = 3
HCF of B and C = 15
HCF of C and A = 3
$\therefore$ HCF of A, B and C is 3.
HCF is the greatest number which can divide A, B and C.

5. Greater number = (128+64)/2 = 96
Smaller number = (128-64)/2 = 32
HCF of 96 and 32 = 32

6. HCF of 459 and 2241
= HCF of 27×17 and 27×83
= 27
Again HCF of 833 and 4067

= HCF of 49×17 and 49×83
= 49

7. HCF must be a factor of given number.
HCF of 925 & 1525 must be a multiple of 5.
Go through option, 23, 22 & 24 are not multiple of 5.
So option (b) 16, 25 is the correct answer.

8. LCM of $\frac{38}{39}$ and $\frac{39}{40}$

$= \frac{LCM\ of\ 38\ and\ 39}{HCF\ of\ 39\ and\ 40} = 1482$

9. Product of two numbers = HCF × LCM
= 280 × 7 = 1960

10. HCF = Product of two numbers / LCM of two number = 13454/434 = 31

11. Smallest number = 81 × 49 = 3969

12. Let the HCF of two numbers be h.
LCM = 33×34×h = 2249
H = $\frac{2244}{33\times34}$ = 2
Two numbers are 2 × 33 = 66 and 2 × 34 = 68

13. 2-1 = 3-2 4-3 5-4 6-5 = 1
Required number = LCM of (2,3,4,5,6) – 1
= 60 – 1 = 59

14. Greatest number = HCF of (91-43, 183 - 91)
= HCF of (48, 92) = 4

15. Least number = LCM of (21, 36, 66)
= 4 × 9 × 7 ×11
7 ×11 i.e. 77 must be multiplied to get perfect square.
Required number = 4 × 9 × 7 ×11 × 7 × 11 = 213444

16. LCM of (12, 18, 21) = 252
252k = 10000

k= $\frac{10000}{252} = \frac{2500}{63} = 39\frac{43}{63} < 40$

Required number = 252 × 40 = 10080

17. 18-2 = 35-19 = 42-26 = 16
Required number = LCM of (18, 35, 42) – 16
= 630 – 16 = 614

18. Required number = LCM of (8, 12, 16, 20) + 5
= 240 + 5 = 245

19. LCM of 12, 15, 18, 27 = 540
540k = 9999

K = $\frac{9999}{540} = \frac{1111}{60} = 18\frac{31}{60}$

Required number = 540 × 18 = 9720

20. Required number = LCM of (28, 26, 65) + 24
= 650 + 24 = 674

21. LCM of 13, 39, 52 = 156
156k = 999

K = $\frac{999}{156} = \frac{333}{52} = 6\frac{21}{52}$

Required number = 156 × 6 = 936

22. 4 times ---------- 60 sec
1 time ---------- 15 sec
Again, 6 times ---------- 120 sec
1 time ---------- 20 sec
LCM of (15, 20) = 60 sec
Both light start flashing together after 1 min
In 60 minutes, they will flash 60 times.

23. LCM of (12,15,16,20,25) = 1200 min
= 20 × 60 mins = 20 hours
They will ring together = 12.00 + 20 h = 8. P.m.

24. LCM of (48,72,108) = 12 × 36 sec
= 7 mins + 12 sec.
They will change simultaneously at 8 : 20 + 7 mins + 12 sec = 8 : 27 : 12 hours

25. HCF of (147, 196, 245) = 49

26. Greatest number = HCF (2400-6, 1810-4)
= HCF of (2394, 1806) = 2394 – 1806 = 588
= 42 × 14
HCF = 42
Note: HCF may be a factor of difference of numbers.

27. Product of two numbers = HCF × LCM
189x = 2079 × 27
x = $\frac{2079\times27}{189}$ = 297

28. The total number of class = HCF of 391, 323
= 391-323 = 68 = 4×17
17 which divide the given numbers.

29. Let the two natural numbers be X and Y.
HCF of two numbers be h.
X = ha and Y = hb
ATQ, ha + hb = 85
h(a+b) = 85 = 17 × 5 ……(1)
Again, hab = 102 = 17 × 6 ……. (2)

Comparing (1) & (2), we get h = 17,
a + b = 5 and ab = 6
a = 3 and b = 2
X = ha =17 × 3 = 51
Y = hb = 17 × 2 = 34

30. HCF of 66, 88, 110 = 22
Maximum number of trees in each row = 22
Apple row = 66/22 = 3
Banana row = 88/22 = 4
Mango row = 110/22 = 5
Total number of row = 3 + 4 + 5 = 12

31. Let the two numbers be a and b.
Sum of reciprocal = $\frac{1}{a}+\frac{1}{b}=\frac{a+b}{ab}$
$=\frac{55}{5\times120}=\frac{11}{120}$
Product of two numbers = HCF × LCM

32. Let the number be 13a and 13b.
ATQ, 13a × 13b = 2028
ab = 2028/169 = 12
Possible pairs are (1,12), (3,4)
Number of pairs = 2

33. Greatest possible length = HCF of (400, 285, 1185)
= 5

34. Numbers are 11 × 5 = 55 and 11 × 13 = 143

35. Largest integer = HCF of (398 - 7, 436 - 11, 542 - 15)
HCF of 391, 425, 527
= 425 – 391 = 34 and 527 – 425 = 102
Again, 102 – 34 = 68 = 17 × 4
HCF may be a factor of difference of numbers.
HCF = 17

36. LCM of (6,5,7,10,12) = 420 minutes
= 7 × 60 seconds = 7 minutes
They toll together in one hours excluding the one at the start = $\frac{60}{7}=8\frac{4}{7}$ = 8 times

37. Number of gift = LCM of (3, 4, 5, 6)k + 1
= 60k + 1 → divisible by 7.

$$\frac{60k+1}{7}=\frac{56k+4k+1}{7}\ \frac{4k+1}{7}$$

For k = 5, the value of 4k + 1 is divisible by 7.
Minimum number of gift = 60×5+1 = 301

38. HCF of 1.08, 0.36, 0.9
= HCF of $\frac{108}{100},\frac{36}{100},\frac{9}{10}$
= HCF of $\frac{27}{25},\frac{9}{25},\frac{9}{10}$
$=\frac{HCF\ of\ 27,9,9}{LCM\ of\ 25,25,10}=\frac{9}{25}$ = 0.18

39. Let the HCF of two number be h.
The numbers are 3h and 4h respectively.
ATQ, h × 3 × 4 = 240
h = 20
Smallest number = 3h = 3 × 20 = 60

40. LCM of $\frac{52}{10}\ and\ \frac{65}{100}$
LCM of $\frac{26}{5}\ and\ \frac{13}{20}$
$=\frac{LCM\ of\ 26\ and\ 13}{HCF\ of\ 5\ and\ 20}=\frac{26}{5}=5.2$

41. Number of gift = LCM of (6, 9, 15, 18)k + 3
= 90k + 3 → divisible by 7.

$$\frac{90k+3}{7}=\frac{84k+6k+3}{7}\ \frac{6k+3}{7}$$

For k = 3, the value of 6k + 3 is divisible by 7.
Required number = 90 × 3 + 3 = 273

42. Here 52 – 33 = 78 – 59 = 117 – 98 = 19
Required number = LCM (52, 78, 117) – 19
= 468 – 19 = 449

43. Greatest number = HCF of (38 – 2, 45 – 3, 52 – 4)
= HCF (36, 42, 48)) = 6

44. Required number = HCF of (127 – 55, 175 - 127) = HCF of (72, 48) = 24

45. Required number = LCM of (12, 16, 21) i.e. $4\times4\times3\times7$
∴ Required perfect square number
$=4\times4\times3\times7\times3\times7=7056$

46. Required number = LCM of (4, 7, 9) i.e. $2\times2\times3\times3\times7$
∴ Required perfect square number
$=2\times2\times3\times3\times7\times7=1764$

47. LCM of (1,2,3,4,5,6,7,8,9,10) = 2520

48. LCM of (5,6,4,3)k – 2497
= 60k – 2497
Put k = 42, $60\times42-2497$
= 2520 – 2497 = 23

A. RECURRING DECIMAL

Decimal numbers are of three types:

1. Terminating Decimal
e.g- 0.63 = 63/100 0.992 = 124/125

2. Non-terminating Repeating Decimal
e.g- 0.333… = 1/3 0.585858… = 58/99

3. Non-terminating Non-repeating Decimal
e.g- √5 = 2.236067… , π = 3.14159…

Note:

- Terminating decimals and non-terminating repeating decimals are **rational numbers**, so they can be written as fractions.
- Non-terminating non-repeating decimals are **irrational numbers**, so they cannot be written as fractions.

Decimal into Fraction

(i) Terminating Decimal
Divide 1 for decimal and put 0 for each digit after the decimal point.
e.g- 0.51 = 51/100 1.57 = 157/100

(ii) Non-terminating Repeating Decimal
Rule:

- $0.\overline{abc} = 0.abc = \frac{abc}{999}$

$$= \frac{Repeated\ term}{no.of\ 9's for\ the\ repeated\ term}$$

- $0.a\overline{bc} = \frac{abc-a}{990}$

$$\frac{Total\ numbers - nonrepeating\ numbers}{9\ for\ repeating\ \&\ 0\ for\ nonrepeating\ term}$$

e.g- $0.1\overline{23} = \frac{123-1}{990} = \frac{122}{990}$

$1.5\overline{69} = \frac{1569-15}{990} = \frac{1554}{990}$

B. DIGITAL ROOT

Digital root is the final single-digit value you get after repeatedly adding the digits of a number until only one digit is left.

e.g- DR of 7546857
= 7 + 5 + 4 + 6 + 8 + 5 + 7 = 42
= 4 + 2 = 6
Digital root is the remainder when a number is divided by 9.
DR of 872 = remainder of (872 ÷ 9) = 8
Digital root of any multiple of 9 is **9**
9 × 4 = 36 → 3 + 6 = 9
9 × 7 = 63 → 6 + 3 = 9
9 × 13 = 117 → 1 + 1 + 7 = 9

Example: Without doing actual division, find the remainder when 28735429 is divided by 9

Soln: Sum of digits = 2 + 8 + 7 + 3 + 5 + 4 + 2 + 9 = 40 = 4 + 0 = 4

Digital root cannot be negative but we take negative DR for easier calculation.

If DR is negative, add 9 to make it positive

Convert Digital Root of Denominator to 1

DR	Multiply	Result
2	5	2 × 5 = 10 = 1
4	7	7 × 4 = 28 = 1
5	2	5 × 2 = 10 = 1
7	4	4 × 7 = 28 = 1
8	8	8 × 8 = 64 = 1

Limitations:

1. It is not valid for approximation
2. Not applicable if denominator DR is 3, 6, or 9

Example: 78 × 16 + 285 + 648 − 17 × 25 = ?

(a) 1760 (b) 1756 (c) 1744 (d) 1749

Solution: (DR method):

DR of 78 × DR of 16 + DR of 285 + DR of 648 − DR of 17 × DR of 25 = 6×7 + 6 + 0 − 8×7
= 42 + 6 – 56 = DR = 1

Correct option: (B) 1756 DR of 1756 = 1

Example: $\frac{8(3.75)^3+1}{7.5^2-6.5}$ is equal to:

(a) 2.75 (b) 1.8 (c) 4.75 (d) 8.5

Soln: $\frac{8(3.75)^3+1}{7.5^2-6.5} = \frac{(-1)\times 6^3+1}{3^2-2} = \frac{1}{7} = \frac{4}{28} = 4$

Correct option: (d) 8.5
DR of 8.5 = 4

C. RULE OF CALCULATION (BODMAS)

Numerical Expression: Combination of numbers and operators (like +, −, ×, ÷)

e.g- $133 \div [6 + 3 \times (4 + 2) - 5]$

BODMAS Rule:

BODMAS rule helps us determine the correct order in which mathematical operations must be performed.

Brackets → Of → Division → Multiplication → Addition → Subtraction

Bracket Priority Order

$\overline{line\ bracket}$ > (common bracket) > {curly bracket} > [rectangular bracket]

Example: Find the value of

$364 - [142 - \{75 + (38 - \overline{\frac{5}{4} + \frac{14}{8}})\}]$

Solution: $364 - [142 - \{75 + (38 - 3)\}]$
= 364 − [142 − (75 + 35)]
= 364 − [142 − 110] = 364 − 32
= 332

D. SQUARING

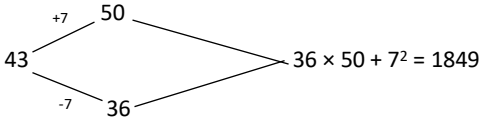
Square means a number multiplied by itself.

$A^2 = (A + d)(A - d) + d^2$

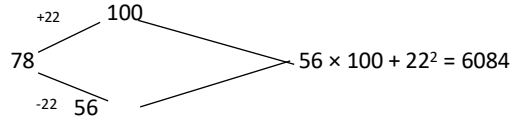
Where A is the number whose square is to be calculated. d is the difference between the number and the nearest multiple of 10 like 10, 50, 100 etc.

Examples

- $43^2 = (43 + 7)(43 - 7) + 7^2$
  = 50 × 36 + 49 = 1849



- $78^2 = (78 + 22)(78 - 22) + 22^2$
  = 100 × 56 + 484 = 6084



- $112^2 = (112 + 12)(112 - 12) + 12^2$
  = 124 × 100 + 144 = 12544

- $186^2 = (186 + 14)(186 - 14) + 14^2$
  = 200 × 172 + 196 = 34596

Properties of Squares

1. If a number has n digits, its square has (2n − 1) or 2n digits.

114^2 = 12996 (5 digits) &856^2 = 732736 (6 digits)

2. The last digit of a square is always: **0, 1, 4, 5, 6, or 9.**

3. The last two digits of a perfect square must be last two digits from the squares 1 to 24 i.e. 00, 01, 04, 09, 16, 21, 24, 25, 29, 36, 41, 44, 49, 56, 61, 64, 69, 76, 81, 84, 89 and 96.

4. The last two digits of x^2 and $(50k \pm x)^2$ will be same.

Put x = 13	Number	Square
x	13	169
50 - x	37	1369
50 + x	63	3969
100 – x	87	7569
100 + x	113	12769
150 -x	163	26569

Last two digit = 69.

5. The digital root of any perfect square can only be: 1, 4, 7, or 9

6. If 'n' is an even number, its square is always divisible by 4
n = 2k $n^2 = 4k^2$ → multiple of 4

7. If 'n' is an odd number, then its square always leaves remainder 1 when divided by 4
$n = 2k \pm 1$ $n^2 = 4k^2 \pm 4k + 1 = 4(k^2 \pm k) + 1$

Example: Which smallest number should be added to 2203 to get a perfect square?
(a) 1 (b) 3 (c) 6 (d) 8

Solution: Option (a): 2203 + 1 → DR = 8.
DR of any perfect square can't be 8.
Option (b): 2203 + 3 = 2206.
The last two digit of any perfect square can't be 06.
Option (c): 2203 + 6 = 2209 = 47^2
Option (c) is the correct answer.
Option (d): 2203 + 8→ DR = 6.
DR of any perfect square can't be 6.

Example: Which of the following cannot be the square of a natural number?
(a) 30976 (b) 75625 (c) 28561 (d) 143642
Correct answer: (d) 143642
The last digit of a perfect square cannot be 2.

Square Root of a Perfect Square

Square ends with	Number ends with
0, 5	Same digit
1	1 or 9
4	2 or 8
6	4 or 6
9	3 or 7

Step 1: Start from the right and make pairs
Example: 3844 → 38 | 44

Step 2: Nearest square ≤ first pair
$6^2 = 36 < 38$

Step 3: Since square ends with 4 → last digit is **2 or 8**

Step 4: Possible numbers: 62 or 68
6 × 7 = 42 > 38
Smaller number is the answer → **62**

Example: Find the square root of 76729
Solution: 767 | 29
Last digit → 3 or 7
$27^2 = 729 < 767$

Possible numbers: 273 or 277
27 × 28 = 756
$27^2 + 27 = 729 + 27 = 756 < 767$

Greater number is the answer → **277**

Square Root of a Non-Perfect Square (Approximation)

- Square root of a non-perfect square cannot be an integer.
- Square root of non-perfect square is always an irrational number.

Let N = $a^2 \pm b$, then $\sqrt{N} = a \pm \frac{b}{2a}$

Example:- $\sqrt{189}$
Check nearest Perfect Square
i.e. 13^2 = 169 and 14^2 = 196
189 is very close to 196

$$\sqrt{189} = \sqrt{14^2 - 7}$$

$= 14 - \frac{7}{2\times14} = 14 - 0.25 \approx 13.75$

E. CUBE

Cube: Cube means a number multiplied by itself two times.

Cube of a 2-digit number: $(ab)^3$

1. Write: a^3, a^2b, ab^2, b^3
2. Double the middle term and write below them.
3. Add each column (Carry if needed)

a^3	a^2b	ab^2	b^3
	$+2a^2b$	$+2ab^2$	
a^3	$3a^2b$	$3ab^2$	b^3

Example:- $(32)^3$

3^3	$3^2.2$	3.2^2	2^3
27	18	12	8
	+36	+24	
32	57	36	8

$(32)^3 = 32768$

Cube Root of a perfect cube

Find the cube root of 262144.

Soln: Step 1: Identify the last digit.
$4^3 = 64$ -> last digit 4

Step 2: Start from the right and make pairs
Example: 3844 → 262 | 144

Step 3: find the nearest smaller perfect cube.
$6^3 = 216 < 262$

So the cube root of 262144 = 64

F. INDICES & SURDS

Indices: Power is greater than 1.

Surds: Power is less than 1

e.g. - $7^{\frac{5}{3}}$, here 5 is indices and $\frac{1}{3}$ is surds.

It can be written as $\sqrt[3]{7^5}$

Laws of Indices

1. $a^m \times a^n = a^{m+n}$
2. $a^m \div a^n = a^{m-n}$
3. $(a^m)^n = (a^n)^m = a^{mn}$
4. $(ab)^n = a^n \times b^n$
5. $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$
6. $\frac{1}{a^n} = a^{-n}$
7. $\frac{a^{-n}}{b^{-m}} = \frac{a^m}{b^n}$
8. $\sqrt[m]{a} = a^{\frac{1}{m}}$
9. $a^{\frac{m}{n}} = \sqrt[n]{a^m}$
10. $\sqrt[mn]{a} = \sqrt[m]{\sqrt[n]{a}}$
11. $a^0 = 1$
12. $a^x = a^y \Rightarrow x = y$
13. $a^x = b^x \Rightarrow a = b$

Fraction Comparison

The smallest of the fractions 3/4, 5/6, 7/12, 2/3 is:

$\frac{3}{4}$ ✕ $\frac{5}{6}$ => 18 < 20

$\frac{3}{4}$ ✕ $\frac{7}{12}$ => 36 > 28

$\frac{7}{12}$ ✕ $\frac{2}{3}$ => 21 < 24

$\frac{7}{12}$ is the smallest fraction.

EXERCISE

What will come in place of question mark (?) in the following equation?

1. 1171.58 - 499.31 = 1076.84 - ?
   (a) 408.57 (b) 404.57 (c) 406.57 (d) 402.57
   (OSSC CGL 2021)

2. $0.5\overline{27} - 0.3\overline{25} + 0.2\overline{24}$ = ?
   (a) 432/990 (b) 422/990
   (c) 402/990 (d) 412/990
   (OSSC CGL 2021)

3. 1290.58 - 590.31 = 1182.84 - ?
   (a) 486.57 (b) 484.57 (c) 482.57 (d) 488.57
   (OSSC CGL 2021)

4. $\frac{652}{900} - \frac{552}{900} + \frac{452}{900}$ = ?
   (a) 0.5133333 (b) 0.7133333
   (c) 0.4133333 (d) 0.6133333
   (OSSC CGL 2021)

5. 54.(?) + 567 + 5.67 = 627.26
   (a) 9 (b) 5 (c) 3 (d) 7

6. (0.008 ÷?) + (0.005 ÷ 0.05) + (0.09 ÷ 0.9) = 0.3
   (a) 0.001 (b) 0.008 (c) 0.8 (d) 0.08

7. 13, 14, 30, 93, 376, 1885, ?
   (a) 10818 (b) 10316 (c) 11316 (d) 11318

8. 27, 28, 36, 89, 45, ?
   (a) 78 (b) 79 (c) 80 (d) 81

9. $\{(476 + 424)^2 - 4 \times 476 \times 424\}$ = ?
   (a) 2906 (b) 3116 (c) 2704 (d) 2904
   (OSSC CGL SPL PRE 2023)

10. $(41.99^2 - 18.04^2 - ? = 13.11^2 - 138.99)$
    (a) 4004 (b) 1720 (c) 1410 (d) 8432
    (OSSC CGL SPL PRE 2023)

11. $112 \times 5^4 = ?$
    (a) 67000 (b) 70000 (c) 76500 (d) 77200
    (OSSC CHSL PRE 2023)

12. $(25.732)^2 - (15.732)^2 = ?$
    (a) 414.64 (b) 414.52 (c) 414.256 (d) 414.128
    (OSSC CHSL SPL PRE 2023)

13. 171.015 + 355.343 – 155.503 = 137.1 + ?
    (a) 235.755 (b) 231.755
    (c) 237.755 (d) 233.755

14. $3.2 \times (32 \times 19 \times 189) \div 102.4 = ?$
    (a) 3591 (b) 3291 (c) 3491 (d) 3391

15. $(1952 + 330 - 598 + 527) \div (71 + 28 - 45 + 13) = ?$
    (a) 27 (b) 24 (c) 33 (d) 30

16. $147\frac{4}{3}+58\frac{3}{2}-156\frac{3}{4}=?-140\frac{2}{5}$
(a) 202 (b) 192 (c) 212 (d) 222

17. $\frac{657}{900}-\frac{557}{900}+\frac{457}{900}$ = ?
(a) 0.518888 (b) 0.718888
(c) 0.418888 (d) 0.618888
(OSSC CGL 2021)

18. $\frac{888\times888\times888-222\times222\times222}{888\times888+888\times222+222\times222}$ = ?
(a) 1110 (b) 666 (c) 4 (d) 6
(OSSC CGL PRE 2022)

19. The value of $\frac{978.1375\times0.497\times1.956}{0.0866\times92.781+99.739}$ is closest to:
(a) 0.117 (b) 1.17 (c)11.7 (d) 117
(OSSC CTSRE PRE 2023)

20. What is the value of 'X' in the expression:
$$\frac{36}{11}\times\frac{36}{11}-\frac{X}{11}\times\frac{12}{11}+\frac{25}{11}\times\frac{25}{11}=1$$
(a) 150 (b) 125 (c) 100 (d) 50
(OSSC CTSRE PRE 2024)

21. The value of $\frac{4}{9}+\frac{1}{9}+\frac{4}{18}+\frac{3}{9}-1$ is:
(a) 1/9 (b) -5/18 (c) 4/18 (d) -4/18
(OSSC JEO & JA 2024)

22. After simplification, what is the value of the following expression:
$$\left(1-\frac{1}{2}\right)\left(1-\frac{1}{3}\right)\left(1-\frac{1}{4}\right)\ldots\ldots\ldots\left(1-\frac{1}{100}\right)$$
(a) 0.001 (b) 0.01 (c) 0.1 (d) 1
(OSSC CTSRE PRE 2024)

23. 13.6895 divided by 0.131 gives
(a) 108.5 (b) 102.5 (c) 106.5 (d) 104.5
(OSSC CGL 2021)

24. If $\frac{13930}{1.75}$ = 7960, what is the value of $\frac{27860}{17.5}$?
(a) 1692 (b) 1792 (c) 1592 (d) 1892
(OSSC CGL 2021)

25. Find the fraction of 0.426262626.....
(a) 442/990 (b) 452/990
(c) 422/990 (d) 432/990
(OSSC CGL 2021)

26. Find the fraction of 0.5055555.....
(a) 455/900 (b) 453/900
(c) 457/900 (d) 555/900
(OSSC CGL 2021)

27. 0.169 × 0.0267 is equal to:
(a) 0.0045023 (b) 0.0045123
(c) 0.00452223 (d) 0.0045323
(OSSC CGL 2021)

28. 85/2 divided by 2 is:
(a) 5.3125 (b) 5.5125
(c) 5.4125 (d) 5.2125
(OSSC CGL 2021)

29. When 1.98 is written in the simplest form, the sum of the numerator and denominator is:
(a) 145 (b) 193 (c) 147 (d) 149

30. $\frac{5}{6}$ of a number is 635, find $\frac{9}{20}$ of the same number.
(a) 340.9 (b) 342.9 (c) 338.9 (d) 344.9

31. Which one is the highest among the following fraction: 1/2, 2/5, 2/3, 4/7?
(a) 1/2 (b) 2/5 (c) 2/3 (d) 4/7
(OSSC CGL PRE 2022)

32. What is the value of the following expression:
$[26+\{42\times(23-20)+2-(2\times(5\times80-100))+16-4\}]$
(a) -434 (b) 434 (c) -443 (d) -453
(OSSC CGL PRE 2022)

33. What is the value of the expression:
12.8 – 0.4 of (7.2 – 3.7) + 2.4 × 3.02?
(a) 18.648 (b) 18.849 (c) 17.648 (d) 16.848
(OSSC CTSRE PRE 2024)

34. The approximate value of 0.4 × 0.4 + 0.04 × 0.04 + 0.04 is:
(a) 0.16 (b) 0.20 (c) 0.38 (d) 0.46

35. Simplify: 5×0.5×0.05×0.005×5000
(a) 31.25 (b) 0.3125 (c) 3.125 (d) 0.03125
(OSSC CHSL SCEW PRE 2025)

36. Simplify: $17\times(6\times5^2)\div2+1-45$
(a) 1227 (b) 1239 (c) 1234 (d) 1231
(OSSC JEO & JA 2024)

37. What is the value of the expression:
$1000[(0.01)^2+(0.22)^2+2\times0.01\times0.22]$
(a) 576 (b) 625 (c) 529 (d) 484

38. Evaluate: $806^2 - 194^2$
(a) 610000 (b) 611000
(c) 613000 (d) 612000
(OSSC JEO & JA 2024)

39. $55\times55\div11\times9\div9\div\frac{495}{11}$ = ?
(a) 45/8 (b) 65/11 (c) 53/9 (d) 55/9

40. $\frac{2}{7}\div\frac{4}{5}\times\frac{7}{9}\times9\div5$ = ?
(a) 1.5 (b) 1 (c) 0.5 (d) 0.4

41. Cube root of 0.000216 is:
(a) 0.6 (b) 0.06 (c) 0.66 (d) 0.006
(OSSC CHSL PRE 2023)

42. Find the value of y, satisfying $25\times7\times931\div\sqrt{2401}=y+716$
(a) 2605 (b) 2609 (c) 2612 (d) 2606
(OSSC JEO & JA 2024)

43. What number divides $\sqrt{0.000441}$ to give the result as 10.5?
(a) 0.002 (b) 0.006 (c) 0.008 (d) 0.004

44. Find the value of $\sqrt{17.64}+\sqrt{0.1764}+\sqrt{0.001764}$.
(a) 7.662 (b) 6.662 (c) 4.662 (d) 5.662

45. Find the value of Z: $\sqrt{0.2116}\times Z=4.6$
(a) 18 (b) 14 (c) 16 (d) 10

46. If the operation * is defined by x*y=x+y+xy, then what is the value of 3*4 – 2*3?
(a) 6 (b) 8 (c) 10 (d) 1
(OSSC ATO 2024)

47. $\left(\sqrt{21.16}\div\sqrt{5.29}\right)\times\left(\sqrt{47.61}\div\sqrt{5.29}\right)+\left(\sqrt{21.16}\div\sqrt{5.29}\right)\times\left(\sqrt{47.61}\times\sqrt{5.29}\right)$
(a) 12 (b) 19 (c) 15 (d) 17

48. The value of $\sqrt{225}+\sqrt{0.0256}-\sqrt{4.84}$ is:
(a) 1.78 (b) 15.39 (c) 13.88 (d) 12.96
(OSSC JEO & JA 2024)

49. Simplify: $\sqrt{1183}+\sqrt{576}+\sqrt{252}-\sqrt{1183}$
(a) $14\sqrt{7}$ (b) $15\sqrt{7}$ (c) $17\sqrt{7}$ (d) $12\sqrt{7}$
(OSSC JEO & JA 2024)

50. In the below given expression, what is the value of '?' $17^{3.5}\times17^{?}=17^{8}$
(a) 2.29 (b) 2.75 (c) 4.25 (d) 4.5
(OSSC CGL PRE 2022)

51. If $\left(\sqrt{3}\right)^{5}\times9^{2}=3^{x}\times3\sqrt{3}$, then x is equal to:
(a) 3 (b) 4 (c) 5 (d) 6

52. $25^{7.5}\times5^{2.5}\div125^{1.5}=5^{x}$, then the value of x is:
(a) 13 (b) 15 (c) 17 (d) 18
(OSSC ATO 2024)

53. Simplify the given expression:
$$\left(\frac{125}{343}\right)^{\frac{2}{3}}\times\left(\frac{216}{512}\right)^{-\frac{2}{3}}\div\left(\frac{9}{2}\right)^{-2}$$
(a) 903/48 (b) 901/50
(c) 899/52 (d) 900/49
(OSSC JEO & JA 2024)

54. Simplify the given expression:
$$\left(\frac{64}{343}\right)^{\frac{2}{3}}\times\left(\frac{125}{216}\right)^{-\frac{2}{3}}\div\left(\frac{8}{5}\right)^{-2}$$
(a) 36865/30626 (b) 36863/30628
(c) 36864/30625 (d) 36867/30624
(OSSC JEO & JA 2024)

55. Find the value of 'm', satisfying equation:
$$\left(\frac{16}{7}\right)^{14}\times\left(\frac{7}{16}\right)^{18}\times\left(\frac{16}{7}\right)^{9}=\left(\frac{7}{16}\right)^{8m+10}$$
(a) -20/8 (b) -34/8 (c) -25/8 (d) -22/8
(OSSC JEO & JA 2024)

56. Which of the following sets of fraction is in ascending order?
(a) 5/3, 4/5, 7/8 (b) 5/3, 7/8, 4/5
(c) 7/8, 5/3, 4/5 (d) 4/5, 7/8, 5/3
(OSSC VSA 2023)

57. The difference between the smallest and the largest fractions among $\frac{6}{9},\frac{3}{8},\frac{10}{34},\frac{31}{37}$ is:
(a) $\frac{342}{624}$ (b) $\frac{342}{629}$ (c) $\frac{342}{631}$ (d) $\frac{342}{630}$
(OSSC JEO & JA 2024)

58. The difference between the smallest and the largest fractions among $\frac{4}{7},\frac{5}{5},\frac{18}{27},\frac{12}{19}$ is:
(a) $\frac{3}{12}$ (b) $\frac{3}{7}$ (c) $\frac{3}{9}$ (d) $\frac{3}{3}$
(OSSC JEO & JA 2024)

59. Which one of the following can't be the square of a natural number?
(a) 30976 (b) 175625 (c) 28561 (d) 143642
(OSSC Steno 2022)

60. Find the least number by which 19404 must be multiplied or divided so as to make it a perfect square.

(a) 9 (b) 11 (c) 13 (d) 15
(OSSC CPGL PRE 2023)

61. Find the least number with which you would divide 7350, to get a perfect square.
(a) 4 (b) 6 (c) 2 (d) 8
(OSSC SCEW 2021)

62. Find the smallest number by which 3528 must be multiplied to obtain a perfect cube.
(a) 23 (b) 25 (c) 21 (d) 19
(OSSC SCEW 2021)

63. Find the smallest number by which 10368 must be divided to obtain a perfect cube.
(a) 6 (b) 9 (c) 10 (d) 8
(OSSC SCEW 2021)

64. Find the cube root of 46656 by prime factorisation method.
(a) 40 (b) 36 (c) 38 (d) 42
(OSSC SCEW 2021)

65. Which of the following is a perfect cube?
(a) 4813 (b) 4913 (c) 4713 (d) 4613
(OSSC SCEW 2021)

66. What least number must be added to 5607 to make the sum a perfect square?
(a) 17 (b) 20 (c) 18 (d) 28
(OSSC Steno 2022)

67. Pick out the least number from the options given below.
(A) 0.2 (B) $\frac{1}{0.2}$ (C) $0.\bar{2}$ (D) $(0.2)^2$
(OSSC CGL Mains 2023)

68. Which one of the following is the value of $3.\overline{87} - 2.\overline{59}$?
(A) 1.28 (B) 1.37 (C) 1.49 (D) 1.58
(OSSC CGL Mains 2023)

69. If $m^n = 32$, where m and n are positive integers, then value of n^{mn} is:
(A) 5^{25} (B) 5^{10} (C) 5^2 (D) 2^5
(OSSC CGL Mains 2023)

70. Find the value of :
$\left(1-\frac{1}{3}\right)\left(1-\frac{1}{4}\right)\left(1-\frac{1}{5}\right)\ldots\ldots\ldots\left(1-\frac{1}{n}\right)$
(A) $\frac{n}{9}$ (B) $\frac{2}{n}$ (C) $\frac{5}{n}$ (C) $\frac{n}{55}$
(OSSC CGL Mains 2022)

71. If $\frac{144}{0.144} = \frac{14.4}{x}$, then what is the value of x?
(A) 0.0144 (B) 0.144 (C) 1.44 (D) 14.4
(OSSC CGL Mains 2023)

72. If x = 0.5 and y = 0.2, then the value of $\sqrt{0.6} \times (3y)^x$ is equal to:
(A) 0.6 (B) 0.9 (C) 1.2 (D) 1.5
(OSSC CGL Mains 2023)

ANSWER KEY

01. (b)	02. (b)	03. (c)	04. (d)	05. (b)	06. (d)
07. (c)	08. (c)	09. (c)	10. (c)	11. (b)	12. (a)
13. (d)	14. (a)	15. (c)	16. (b)	17. (d)	18. (b)
19. (a)	20. (a)	21. (a)	22. (b)	23. (d)	24. (c)
25. (c)	26. (a)	27. (b)	28. (a)	29. (d)	30. (b)
31. (c)	32. (a)	33. (a)	34. (b)	35. (c)	36. (d)
37. (c)	38. (d)	39. (d)	40. (c)	41. (b)	42. (b)
43. (a)	44. (c)	45. (d)	46. (b)	47. (a)	48. (d)
49. (b)	50. (d)	51. (a)	52. (a)	53. (d)	54. (c)
55. (c)	56. (d)	57. (b)	58. (b)	59. (d)	60. (b)
61. (b)	62. (c)	63. (a)	64. (b)	65. (b)	66. (c)
67. (d)	68. (a)	69. (b)	70. (b)	71. (a)	72. (a)

SOLUTION

1. DR of 1171.58 – DR of 499.31 = DR of 1076.84 - ?
5 – 8 = 8 - ?
? = 2
Option (b):DR of 404.57 = 2

2. $0.5\overline{27} - 0.3\overline{25} + 0.2\overline{24}$
$= \frac{527-5}{990} + \frac{325-3}{990} + \frac{224-2}{990}$
$= \frac{522}{990} - \frac{322}{990} + \frac{222}{990} = \frac{422}{990}$

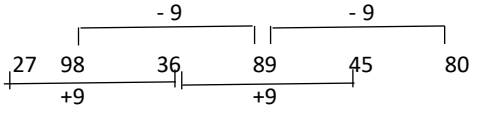
3. DR of 1290.58 – DR of 590.31 - DR of 1182.84 - ?
7 – 9 = 6 - ? ? = 8
Option (b):DR of 482.57 = 8

4. $\frac{652}{900} - \frac{552}{900} + \frac{452}{900} = \frac{552}{900}$
   $\frac{613-61}{900} = 0.61\bar{3} = 0.613333333.....$

5. DR of 54.(?) + DR of 567 + DR of 5.67 = DR of 627.26
   = 9.? + 0 + 0 = 5 ? = 5

6. (0.008 ÷ ?) + (0.005 ÷ 0.05) + (0.09 ÷ 0.9) = 0.3
   $\left(\frac{8}{1000} \div ?\right) + \left(\frac{5}{1000} \times \frac{100}{5}\right) + \left(\frac{9}{100} \times \frac{10}{9}\right) = \frac{3}{10}$
   $\left(\frac{8}{1000} \div ?\right) + \frac{1}{10} + \frac{1}{10} = \frac{3}{10}$
   $\left(\frac{8}{1000} \div \frac{1}{?}\right) = \frac{1}{10}$
   ? = $\frac{8\times10}{1000}$ = 0.08

7. 13 × 1 + 1 = 14 14 × 2 + 2 = 30
   30 × 3 + 3 = 93 93 × 4 + 4 = 376
   376 × 5 + 5 = 1885 1885 × 6 + 6 = 11316

8. 

9. $(476 + 424)^2 - 4 \times 476 \times 424$
   $= (476 - 424)^2 = (52)^2 = 2704$

10. $(41.99^2 - 18.04^2)$ - ? = 13.11^2 – 138.99
    ? = $(42^2 - 18^2)$ - 13^2 + 139
    = 60 × 24 – 169 + 139 = 1440 – 30 = 1410

11. $112 \times 5^4 = \frac{112\times5^4\times2^4}{2^4}$
    $= \frac{112\times10^4}{16}$ = 70000

12. $(25.732)^2$ - $(15.732)^2$
    = (25.732 + 15.732) (25.732 - 15.732)
    = 41.464 × 10 = 414.64

13. 171.015 + 355.343 – 155.503 = 137.1 + ?
    DR of 171.015 + DR of 355.343 - DR of 155.503 = DR of 137.1 + ?
    6 + 5 – 1 = 3 + ? ? = 7
    Option (d) DR of 233.755 = 7

14. 3.2 × (32 × 19 × 189) ÷ 102.4
    $= \frac{32\times32\times19\times189}{1024}$ = 19 × 189 = 3591

15. $\frac{1952+330\pm598+527}{71+28-45+13} = \frac{2211}{67}$ = 33

16. ? = $147\frac{4}{3} + 140\frac{2}{5} + 58\frac{3}{2}$ - $156\frac{3}{4}$
    = 148.33 + 140.40 + 59.5 – 156.75
    = 191.48 = 192 (Approx)

17. $\frac{657}{900} - \frac{557}{900} + \frac{457}{900} = \frac{557}{900}$
    $\frac{618-61}{900} = 0.61\bar{3} = 0.61888888.....$

18. $\frac{(888)^3-(222)^3}{(888)^2\times888\times222+(222)^2}$ = 888 – 222 = 666

19. $\frac{978.1375\times0.0497\times1.956}{0.0866\times92.781\times99.739}$
    $= \frac{978\times0.05\times2}{0.09\times93\times100} = \frac{97.8}{9\times93}$ = 0.117 (approx.)

20. $\frac{36}{11} \times \frac{36}{11} - \frac{12}{11} \times \frac{x}{11} + \frac{25}{11} \times \frac{25}{11} = 1$
    $(36)^2 + (25)^2 - 12x = (11)^2$
    $(36)^2 - (11)^2 + (25)^2 = 12x$
    $x = \frac{47\times25+(25)^2}{12} = \frac{25(47+25)}{12}$ = 25 × 6 = 150

21. $\frac{4}{9} + \frac{1}{9} + \frac{4}{18} + \frac{3}{9} - 1$
    $= \frac{8\times2}{9\times2} + \frac{4}{18} - 1 = \frac{20}{18} - 1 = \frac{1}{9}$

22. $\left(1 - \frac{1}{2}\right)\left(1 - \frac{1}{3}\right)\left(1 - \frac{1}{4}\right) \ldots\ldots\ldots\ldots \left(1 - \frac{1}{100}\right)$
    $= \frac{1}{2} \times \frac{2}{3} \times \frac{3}{4} \times \ldots\ldots\ldots \times \frac{99}{100} = \frac{1}{100}$ = 0.01

23. $\frac{DR\ of\ (13.6895)}{DR\ of\ (0.131)} = \frac{5}{5}$ = 1
    Option – (d) DR of 104.5 = 1

24. $\frac{13930}{1.75}$ = 7960
    $\frac{27860}{17.5} = \frac{2}{10} \times \frac{13930}{1.75} = \frac{2}{10} \times 7960$ = 1592

25. 0.4262626..... = $0.4\overline{26}$
    $\frac{426-4}{990} = \frac{422}{990}$

26. 0.5055555..... = $0.50\bar{5}$
    $\frac{505-50}{900} = \frac{455}{900}$

27. DR of (0.169) × DR of (0.267)
    = 7 × 6 = 42 = 6
    Option (b) DR of (0.0045123) = 6

28. $\frac{85}{8} \div 2 = \frac{85}{16}$ = 5.3125

29. 1.98 = $\frac{198}{100} = \frac{99}{50}$
    Sum of numerator and denominator
    = 99 + 50 = 149

30. $\frac{5}{6}x$ = 635
$x = \frac{6}{5} \times 635 = 762$
$\frac{9}{20} \times 762 = 342.9$

31. $\frac{1}{2}$ = 0.5 $\frac{2}{3}$ = 0.666.....
$\frac{2}{5}$ = 0.4 $\frac{4}{7}$ = 0.57
Option (c) is the highest among fraction.

32. $[26 + \{42 \times (23 - 20) + 2 - (2 \times (5 \times 80 - 100)) + 16 - 4\}]$
$= [26 + \{42 \times 3 + 2 - 2 \times 300 + 12\}]$
$= [26 + 128 - 588] = -434$

33. 12.8 – 0.4 of (7.2 – 3.7) + 2.4 × 3.02
12.8 – 0.4 of 3.5 + 7.248
12.8 – 1.4 + 7.248 = 18.648

34. 0.4 × 0.4 + 0.04 × 0.04 + 0.04
0.16 + 0.0016 + 0.04 = 0.2016

35. 5 × 0.5 × 0.05 × 0.005 × 5000
$5 \times \frac{5}{10} \times \frac{5}{100} \times \frac{5}{1000} \times 5000 = 3.125$

36. 17 × (6 × 5^2) ÷ 2 + 1 – 45
17 × 150 ÷ 2 + 44
17 × 75 – 44 = 1231

37. $10000[(0.01)^2 + (0.22)^2 + 2(0.01)(0.22)]$
$= 10000(0.01 + 0.22)^2$
$= 10000 \times \frac{23}{100} \times \frac{23}{100} = 529$

38. $806^2 - 194^2$
= (806 + 194)(806 - 194)
= 1000 × 612 = 612000

39. 55 × 55 ÷ 11 × 9 ÷ 9 ÷ $\frac{495}{11}$
= 55 × 5 × $\frac{11}{495} = \frac{55}{9}$

40. $\frac{2}{7} \div \frac{4}{5} \times \frac{7}{9} \times 9 \div 5$
$= \frac{2}{7} \times \frac{5}{4} \times \frac{7}{9} \times \frac{9}{5}$ = 0.5

41. $\sqrt[3]{0.000216}$
6^3 = 216 -> last digit 6
000216 → 000 | 216
So the cube root of 0.000216 = 0.06

42. 25 × 7 × 931 ÷ $\sqrt{2401}$ = y + 716
$\frac{25 \times 7 \times 931}{49}$ = y + 716
25 × 133 = y + 716
y = 3325 – 716 = 2609

43. $\frac{\sqrt{0.000441}}{10.5} = \frac{\sqrt{0.021^2}}{10.5} = \frac{0.042}{21}$ = 0.002

44. $\sqrt{17.64} + \sqrt{0.1764} + \sqrt{0.001764}$
$= \sqrt{\frac{1764}{100}} + \sqrt{\frac{1764}{10000}} + \sqrt{\frac{1764}{1000000}}$
$= \frac{42}{10} + \frac{42}{100} + \frac{42}{1000}$ = 4.2 + 0.42 + 0.042 =4.662

45. $\sqrt{(0.46)^2}$ × z = 4.6
Z = $\frac{4.6}{0.46}$ = 10

46. 3*4 – 2*3 = 3 + 4 + 3 × 4 – (2 + 3 + 2 × 3)
= 19 – 11 = 8

47. $\frac{\sqrt{21.16}}{\sqrt{5.29}} \times \frac{\sqrt{47.61}}{\sqrt{5.29}} + \frac{\sqrt{21.16}}{\sqrt{5.29}} \times \frac{\sqrt{47.61}}{\sqrt{5.29}}$
$= 2 \times \frac{\sqrt{(4.6)^2}}{\sqrt{(2.3)^2}} \times \frac{\sqrt{(6.9)^2}}{\sqrt{(2.3)^2}}$
$= 2 \times \frac{4.6}{2.3} \times \frac{6.9}{2.3} = 2 \times 2 \times 3 = 12$

48. $\sqrt{225} + \sqrt{0.0256} - \sqrt{4.84}$
= 15 + 0.16 – 2.2 = 12.96

49. $\sqrt{1183} + \sqrt{567} + \sqrt{252} - \sqrt{1183}$
$= \sqrt{567} + \sqrt{252} = \sqrt{9 \times 9 \times 7} + \sqrt{4 \times 9 \times 7}$
= 9√7 + 6√7 = 15√7

50. $(17)^{3.5} \times (17)^{?} = (17)^8$
$(17)^{3.5+?} = (17)^8$
3.5 + ? = 8
? = 8 – 3.5 = 4.5

51. $(\sqrt{3})^5 \times 9^2 = 3^x \times 3\sqrt{3}$
$(\sqrt{3})^5 \times (\sqrt{3})^4 = (\sqrt{3})^{2x} \times (\sqrt{3})^3$
$(\sqrt{3})^9 = (\sqrt{3})^{2x+3}$
$9 = 2x + 3$
$x = 3$

52. $25^{7.5} \times 5^{2.5} \div 125^{1.5} = 5^x$
$(5^2)^{7.5} \times 5^{2.5} \div (5^3)^{1.5} = 5^x$
$5^{15} \times 5^{2.5} \div 5^{4.5} = 5^x$
$5^{15+2.5-4.5} = 5^x$
x = 15 + 2.5 – 4.5 = 13

53. $\left(\frac{125}{343}\right)^{\frac{2}{3}} \times \left(\frac{216}{512}\right)^{-\frac{2}{3}} \div \left(\frac{9}{2}\right)^{-2}$

$= \left(\frac{5^3}{7^3}\right)^{\frac{2}{3}} \times \left(\frac{8^3}{6^3}\right)^{\frac{2}{3}} \times \left(\frac{9}{2}\right)^2$

$= \left(\frac{5\times8\times9}{7\times6\times2}\right)^2 = \left(\frac{30}{7}\right)^2 = \frac{900}{49}$

54. $\left(\frac{64}{343}\right)^{\frac{2}{3}} \times \left(\frac{125}{216}\right)^{-\frac{2}{3}} \div \left(\frac{8}{5}\right)^{-2}$

$= \left(\frac{4^3}{7^3}\right)^{\frac{2}{3}} \times \left(\frac{6^3}{5}\right)^{\frac{2}{3}} \times \left(\frac{8}{5}\right)^2$

$= \left(\frac{4\times6\times8}{7\times5\times5}\right)^2 = \left(\frac{192}{175}\right)^2 = \frac{36864}{30625}$

55. $\left(\frac{16}{7}\right)^{14} \times \left(\frac{7}{16}\right)^{18} \times \left(\frac{16}{7}\right)^{9} = \left(\frac{7}{16}\right)^{8m+10}$

$\left(\frac{7}{16}\right)^{-14} \times \left(\frac{7}{16}\right)^{18} \times \left(\frac{7}{16}\right)^{-9} = \left(\frac{7}{16}\right)^{8m+10}$

$\left(\frac{7}{16}\right)^{-14+18-9} = \left(\frac{7}{16}\right)^{8m+20}$

-5 = 8m + 20

$m = -\frac{25}{8}$

56. $\frac{5}{3}$ ✕ $\frac{4}{5}$ => 25 > 12

$\frac{4}{5}$ ✕ $\frac{7}{8}$ => 32 < 35

Correct ascending order: $\frac{4}{5} < \frac{7}{8} < \frac{5}{3}$

57. $\frac{6}{9} \rightarrow 6 \times \underline{1.5} = 9$ $\frac{3}{8} \rightarrow 3 \times \underline{2.6} \approx 8$

$\frac{10}{34} \rightarrow 10 \times \underline{3.4} = 34$ $\frac{31}{37} \rightarrow 31 \times \underline{1.2} \approx 37$

3.4 < 2.6 < 1.5 < 1.2

$\frac{10}{34} < \frac{3}{8} < \frac{6}{9} < \frac{31}{37}$

Largest – Smallest = $\frac{31}{37} - \frac{10}{34} = \frac{1054-37}{1258}$

$= \frac{684}{1258} = \frac{342}{629}$

58. $\frac{4}{7} \rightarrow$ less than two times

$\frac{5}{5} \rightarrow$ 1 times

$\frac{18}{27} \rightarrow$ 1.5 times

$\frac{12}{19} \rightarrow$ more than 1.5 times

3.4 < 2.6 < 1.5 < 1.2

$\frac{4}{7} < \frac{12}{19} < \frac{18}{27} < \frac{5}{5}$

Largest – Smallest = $\frac{5}{5} - \frac{4}{7} = \frac{3}{7}$

59. Last digit of square of a natural numbers are 0, 1, 4, 5, 6 and 9
So option (c) 143642 can't be a square.

60. $19404 = 2 \times 2 \times 3 \times 3 \times 7 \times 7 \times 11$
∴ 11 must be divided to make the number a perfect square.

61. $7350 = 2 \times 3 \times 5 \times 5 \times 7 \times 7$
$= 6 \times 5^2 \times 7^2$
∴ Least number multiplied to get a perfect square = 6

62. $3528 = 8 \times 441 = 2^3 \times 21^2$
∴ 21 would be multiplied to get a perfect cube.

63. $10368 = 4^2 \times 3^3 \times 6$
∴ 6 would be divided to get a perfect cube.

64. $46656 = 4^3 \times 9^3$
∴ Cube root of 46656 = 4 × 9 = 36

65. From option, Unit digit must be 7
Decimal place digit = $1^3 < 4$
∴ Required number is $(17)^3 = 4913$

66. DR of 5607 = 0 DR of 17 = 8 DR of 20 = 2
Digital root of a perfect square is always 1, 4, 7 and 9.
Option (a) and (b) are not correct.
Option (c): 5607 + 18 =5625 = 75^2
Option (d): 5607 + 28 =5635
35 is not last two digit of perfect square.

67. Option (a): 0.2
Option (b): $\frac{1}{0.2} = 5$
Option (c): $0.\overline{2} = 0.2222\ldots\ldots$
Option (d): $(0.2)^2 = 0.04$
Least number = 0.04

68. $3.\overline{87} - 2.\overline{59} = 3.878787\ldots\ldots - 2.595959\ldots\ldots$
$= 1.282828\ldots\ldots = 1.\overline{28}$

69. $m^n = 2^5 = 32$
m= 2 and n = 5
∴ $n^{mn} = 5^{2\times5} = 5^{10}$

70. $\left(1-\frac{1}{3}\right)\left(1-\frac{1}{4}\right)\left(1-\frac{1}{5}\right)\ldots\ldots\ldots\left(1-\frac{1}{n}\right)$
$= \frac{2}{3} \times \frac{3}{4} \times \frac{4}{5} \times \ldots\ldots \frac{n-1}{n} = \frac{2}{n}$

71. $\frac{144}{0.144} = \frac{14.4}{x}$
$x = \frac{14.4\times0.144}{144} = \frac{144\times144}{144\times10\times1000} = 0.0144$

72. $\sqrt{0.6} \times (3y)^x = \sqrt{0.6} \times (3 \times 0.2)^{0.5}$
$= 0.6^{0.5} \times 0.6^{0.5} = 0.6^{0.5+0.5} = 0.6$