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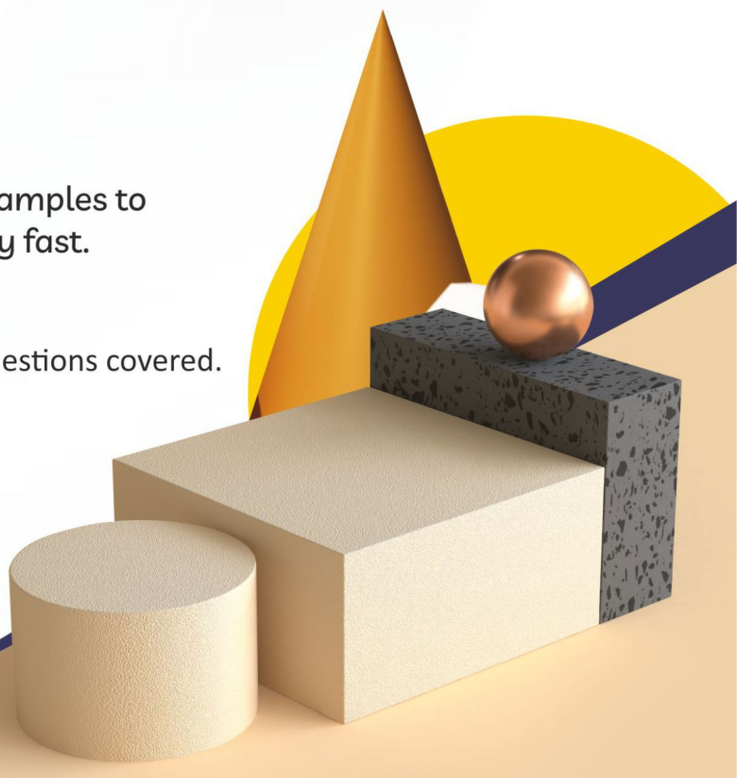

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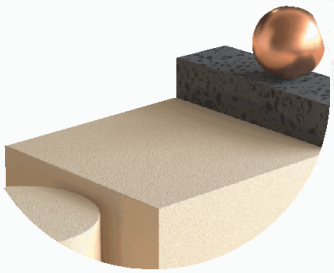


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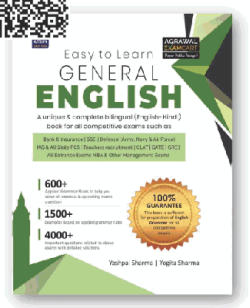


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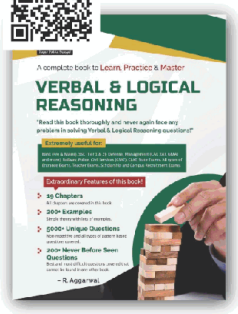


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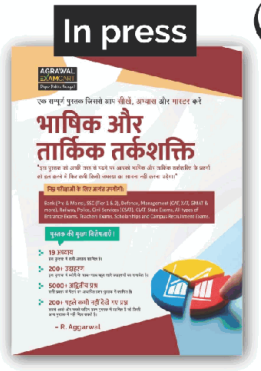


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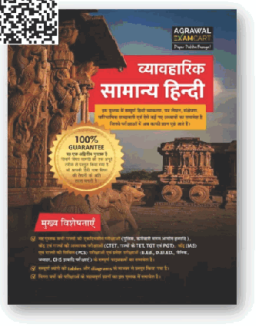


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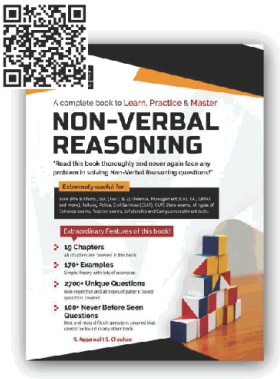



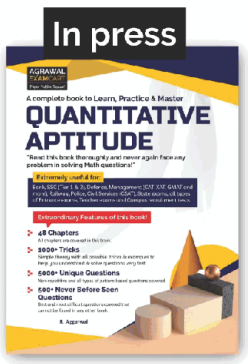

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# Chapter 1

# Number System

The study of numbers formed by different digits, properties of different groups of numbers is called 'Number System'.

## 1.1 Number System

The number system is categorized in mainly two parts—

**I. Decimal Number System :** In this system, different numbers are formed using the digits 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9. For example, 786, 1250, 2018, 15 etc. are numbers formed by digits 0 to 9.

The following two systems are used to read these numbers—

**(i) Indian Number System—** In this system, numbers are read according to their following place values—

| Crore | | Lakh | | Thousand | | Unit | | |
|---|---|---|---|---|---|---|---|---|
| **Ten Crores** | **Crores** | **Ten Lakhs** | **Lakhs** | **Ten thousands** | **Thousands** | **Hundreds** | **Tens** | **Ones** |
| 10,00,00,000 | 1,00,00,000 | 10,00,000 | 1,00,000 | 10,000 | 1,000 | 100 | 10 | 1 |
| $10^8$ | $10^7$ | $10^6$ | $10^5$ | $10^4$ | $10^3$ | $10^2$ | $10^1$ | $10^0$ |

**Example :** Number 45, 23, 16, 786 is read as Forty-five crores twenty-three lakhs sixteen thousands seven hundred eighty-six. Commas are put according to place values, as represented in the above table.

**(ii) International Number System—**

| Million | | | Thousand | | | Unit | | |
|---|---|---|---|---|---|---|---|---|
| **Hundred Millions** | **Ten Millions** | **Millions** | **Hundred Thousands** | **Ten Thousands** | **Thousands** | **Hundreds** | **Tens** | **Ones** |
| 100,000,000 | 10,000,000 | 1,000,000 | 100,000 | 10,000 | 1,000 | 100 | 10 | 1 |
| $10^8$ | $10^7$ | $10^6$ | $10^5$ | $10^4$ | $10^3$ | $10^2$ | $10^1$ | $10^0$ |

**Example :** Number 452, 316, 786 is read as Four hundred fifty-two million three hundred sixteen thousands seven hundred eighty-six. Commas are put according to place values, as represented in the above table.

**II. Roman Number System :** In this system, numbers are represented by the combination of Latin alphabets. The Roman numerals using in present, are based on seven symbols.

| **Symbol** | I | V | X | L | C | D | M |
|---|---|---|---|---|---|---|---|
| **Value** | 1 | 5 | 10 | 50 | 100 | 500 | 1000 |

The following Roman numerals are used for first ten numbers from 1 to 10 – I, II, III, IV, V, VI, VII, VIII, IX, X.

The following Roman numerals are used for numbers 10, 20, 30, .....100 —

X, XX, XXX, XL, L, LX, LXX, LXXX, XC, C

Similarly, following is the order for numbers 100, 200, 300, .....1000 —

C, CC, CCC, CD, D, DC, DCC, DCCC, CM, M

**Example :** 25 is written as XXV and 1990 is written as MCMXC.

## 1.2 Place Value and Face Value

**I. Place Value :** In the given number, the value of a digit is obtained by the product of its place value and the digit itself. Ex. : The place value of 6 in 4,89,765 will be $6 \times 10 = 60$, where 6 is multiplied by its place value or tens place (10). Similarly, the place value of 8 in the above number is 80,000 and place value of 4 is 4,00,000.

**II. Face Value :** The face value of a digit in a number is the digit itself. Ex : Face value of 9 in 59,438 is 9.

**Note :** If $10x + y$ is a number formed by two digits $x$ and $y$, then $x$ is the tens digits and $y$ is the unit digit.

## 1.3 Comparison of Numbers

- **When both numbers have unequal number of digits**

  The number having more digits is greater. It means

  ..... 5-digit number > 4-digit number > 3-digit number .....

  **Example :** Find out which is greater 5429683 or 65245893 ?

  **Solution :** Since, the first number 5429683 is of 7-digit number whether the second number 65245893 is of 8-digit. Therefore, the second number is greater than the first number.

- **When both numbers have equal number of digits**

  In case of the equal number of digits, we have to check the place value of the left-most digit of both numbers. If the digits of both numbers are also equal, then we move to its next digit placed on the right side and repeat the process until we get the desired result.

  **Example :** Arrange the following numbers in ascending order :

  5403100, 5460860, 5458087, 5420378

  **Solution :** At first, we check the place value of the leftmost digit of each number. Then repeat the same process until we get the answer. Here, in each number, two leftmost digits are equal. After that, we check ten thousand place values and then arrange the digits in ascending order. Hence, we get

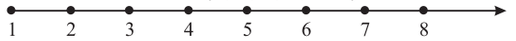
  $5403100 < 5420378 < 5458087 < 5460860$

## 1.4 Classification of Numbers

In decimal number system, numbers are represented using the digits 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9. Numbers are classified into different groups according to their properties.

- **Natural Numbers—**These numbers start from 1 and go to infinity. Their group is represented by N.

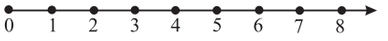
$$N = \{1, 2, 3, 4, 5....\}$$




This line increases indefinitely from right side of 1.

- **Whole Numbers**— When 0 is included in natural numbers, then they become whole numbers.

$$W = \{0, 1, 2, 3, 4....\}$$




This line increases indefinitely from right side of 0.

- **Even Numbers—** Numbers, which are divisible by 2, are called even numbers.

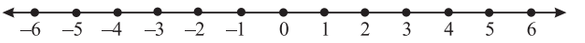
$$E = \{2, 4, 6, 8, .....\}$$

- **Odd Numbers—** Numbers, which are not divisible by 2, are called odd numbers.

$$O = \{1, 3, 5, 7, .....\}$$

- **Integers—** Positive and negative counting numbers as well as zero are called integers.

$$Z = \{... -3, -2, -1, 0, 1, 2, 3...\}$$




This line increases indefinitely from both side of zero.

- **Prime Numbers—** A natural number with exactly two positive divisors; itself and 1 is called prime number. '2' is the only number which is even and also prime.

$$P = \{2, 3, 5, 7, 11, .....\}$$

**Note :** How to identify a prime number ?

First of all, find the square root of the square number immediately after the given numbers. Divide the original number by prime numbers smaller than the square root number obtained. If the original number is perfectly divisible by those prime numbers, then that number is called the composite number and if it is not divisible, then that number is called a prime number.

**Ex. :** 541 is a composite number or prime number ?

**Solution :** Perfect square number just after

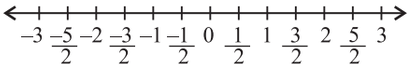
$$541 = 576$$

$$\therefore \quad \sqrt{576} = 24$$

So, we find the divisibility of all prime numbers less than 24 *i.e.*, (23, 19, 17, 13, 11, 7, 5, 3, 2). Since, 541 is not divisible by only of these numbers. So, 541 is a prime number.

- **Rational Numbers—** The numbers which can be written in the form of $p/q$, where $p$ and $q$ are co-prime numbers and $q \neq 0$.

$$Q \text{ or } R = \left\{.....\frac{2}{5}, \frac{1}{5}, -4, 0, 4, \frac{7}{5}\right\}$$




This line increases indefinitely from both sides, but there are numbers between –1 and 0, 0 and 1 represented on number line. To find a rational number between two rational numbers, we can use the concept of mean. There are infinite numbers between two rational numbers.

- **Irrational Numbers—**The numbers, which cannot be written in the form of $p/q$ are called irrational numbers. Here, $p$ and $q$ are co-prime numbers and $q \neq 0$.

$$I = \{.....\sqrt{2}, \sqrt{3}, \sqrt{7}.....\}$$

- **Co-Prime Numbers—**The two numbers whose H.C.F. is 1, are called co-prime numbers.

**Ex. :** (2, 3), (5, 7), (9, 11).....etc. are co-prime numbers.

- **Real Numbers—**The numbers whose square root give positive numbers, are called real numbers. Generallly, it is represented by symbol R *i.e.*,

  $R = \left\{\infty, ..... -2, -1, -\frac{1}{2}, 0, \frac{1}{2}, 1, \frac{3}{2} .....\infty\right\}$

  or combinations of rational and irrational numbers are called real numbers.

- **Imaginary Numbers**—Square roots of negative numbers are called imaginary numbers.

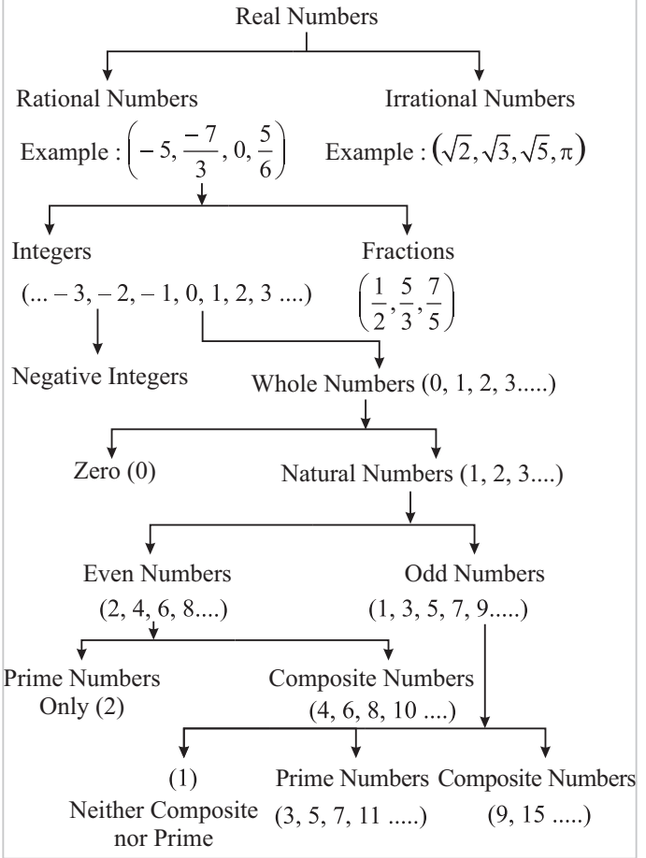
  **Ex. :** $\sqrt{-3}, \sqrt{-5}, \sqrt{-7}, .....$ etc.

- **Complex Numbers—**Combination of real and imaginary numbers are called complex numbers. It is represented by symbol *c*. Its standard form is as follow :

  $c = a + \sqrt{-b}$, where *a* and *b* are real numbers.

  **Ex. :** $2 + \sqrt{-3.3} + \sqrt{-5}$ etc.

**Graph : Types of Numbers**




## 1.5 Approximate Values of Numbers

Place values are considered to be the base to find approximation values in numbers. Approximation value of few place values is determined by the following methods :

- **Approximate value nearest tens place–**If the number at units place is less than 5 then it is rounded of zero otherwise add 1 to the tens place and keeps unit place as zero.

  **Example :** 73 can be rounded off to 70, 156 can be rounded off to 160 and 4265 can be rounded off to 4270.

- **Approximate value nearest hundred place–**If the number at tens place is less than 5 then it is rounded of zero otherwise add 1 to the hundred place and keeps tens place and unit place as zero.

  **Example :** 510 can be rounded off to 500, 9573 can be rounded off to 9600 and 53650 can be rounded off to 53700.

- **Approximate value nearest thousand place–**If the number at hundred place is less than 5 then it is rounded of zero otherwise add 1 to the thousand place and keeps hundred place, tens place and unit place as zero.

  **Example :** 6240 can be rounded off to 6000, 17573 can be rounded off to 18000 and 553650 can be rounded off to 554000.

## 1.6 Whole Numbers

We start counting from the number 1. Hence, 1 is the first natural number and the next natural number is 2 which is obtained by adding 1 to the first number. Hence, numbers are represented in two ways according to their orderliness :

- **Antecedent Number**—The natural number immediately preceding a natural number is its predecessor.

  **Example :** Predecessor number of 65 = 65 – 1 = 64
  Predecessor number of 127 = 127 – 1 = 126

- **Subsequent Number**—The natural number immediately next to any natural number is its successor.

  **Example :** Successor number of 785 = 785 + 1 = 786
  Successor number of 109 = 109 + 1 = 110

- **Whole Numbers**—Natural numbers combine with zeroes to form whole numbers. When operations (addition, subtraction, multiplication, division) are used on whole numbers, many properties are revealed.

**I. Characteristics of Whole Numbers**

- All properties of natural numbers are true for the whole numbers.
- The smallest whole number is '0' (zero).

**II. Properties of Whole Numbers**

**(i) Closure property —** If *a* and *b* be two whole numbers, then $a + b$ and $a * b$ will also be whole numbers.

**Example :**

- $4 + 5 = 9$, a whole number
- $4 \times 5 = 20$, a whole number
- $4 - 5 = -1$, not a whole number
- $4 \div 5 = 0.8$, not a whole number

Hence, whole numbers don't follow the subtraction and division operations for closure property.

**(ii) Communicative property**—Addition and multiplication operations are both communicative for whole numbers.

**Example :**

- $4 + 5 = 9 = 5 + 4$, a whole number
- $4 \times 5 = 20 = 5 \times 4$, a whole number
- $4 - 5 = -1 \neq 5 - 4 = 1$, not a whole number
- $4 \div 5 = 0.8 \neq 5 \div 4 = 1.25$, not a whole number

Hence, whole numbers don't follow the subtraction and division operations for communicative property.

**(iii) Associative property**—Addition and multiplication operations are both associative for whole numbers.

**Example :** $4 + (5 + 6) = 4 + 11 = 15$

$(4 + 5) + 6 = 9 + 6 = 15$

$\therefore \quad 4 + (5 + 6) = (4 + 5) + 6$

**(iv) Distributive property**—

$$a \times (b + c) = a \times b + a \times c$$

**or** $(a + b) \times c = a \times c + b \times c$

**Example :** $4 \times (5 + 8) = 4 \times 5 + 4 \times 8$

$4 \times 13 = 20 + 32$

$52 = 52$

It is clear from the example that it is called distribution property of multiplication on addition operation.

**(v) Identity element**—

- **Additive identity**—'0' is called additive identity because it is only the element its addition with any number gives the same number.

  **Example :** $5 + 0 = 5$, and $7 + 0 = 7$ etc.

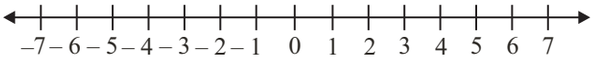
- **Multiplicative identity**—'1' is called multiplicative identity because it is only the element its multiplication with any number gives the same number.

  **Example :** $6 \times 1 = 6$, and $7 \times 1 = 7$ etc.

## 1.7 Integers

The set of all negative counting numbers, positive counting numbers and zero is called Integers.

**Ex. :** – 5, – 4, – 3, – 2, – 1, 0, 1, 2, 3, 4 and 5 all are the integers. On the numbers line, integers are represented as follows :




**I. Properties of Integers :**

**(i) Closure Property (For addition, subtraction and multiplication)—**The sum of any two integers is always an integer and we say that integers are close for addition.

If $a$ and $b$ are two integers, then $(a + b)$, $(a - b)$ and $(a \times b)$ will also be integers.

**Ex. :**

| | |
|---|---|
| $4 + 5 = 9$ | Integer |
| $4 \times 5 = 20$ | Integer |
| $4 - 5 = -1$ | Integer |
| $4 \div 5 = \frac{4}{5}$ | Not Integer |

It is clear that division of integers does not follow the closure law.

**(ii) Commutative Property (For addition and multiplication)—**If $a$ and $b$ are two integers, then

- $(a + b) = b + a$
- $a * b = b * a$

**Ex. :** $4 + 5 = 9 = 5 + 4$

$4 \times 5 = 20 = 5 \times 4$

$4 - 5 = -1 \neq 5 - 4$

$4 \div 5 = \frac{4}{5} \neq 5 \div 4$

It is clear that subtraction and division of integers do not follow the commutative property.

**(iii) Associative Property (For Addition and Multiplication)—**If $a$, $b$ and $c$ are three integers, then

- $(a + b) + c = a + (b + c)$
- $(a * b) * c = a * (b * c)$

**Ex. :** $4 + (5 + 6) = 15 = (4 + 5) + 6$

$4 * (5 * 6) = 120 = (4 * 5) * 6$

**(iv) Distributive Property (For addition and multiplication)—**If $a$, $b$ and $c$ are three integers, then $(a + b) * c = (a * c) + (b * c)$

**Ex. :** $(4 + 5) * 6 = (4 * 6) + (5 * 6)$

$9 * 6 = 24 + 30$

$54 = 54$

**(v) Identity Element (For addition and multiplication)—**

- **Additive Identity—** '0' (zero) is called the additive identity for integers, because we get the same number on adding zero to the number.

  **Ex. :** $4 + 0 = 4$, Integer

  $5 + 0 = 5$, Integer

- **Multiplicative Identity—**'1' is called the multiplicative identity.

  **Ex. :** $4 \times 1 = 4$, Integer

  $5 \times 1 = 5$, Integer

**II. Multiplication Operation of Integers :**

**(i) Product of (+) integer and (–) integer**

$$a * (-b) = -ab$$

**Ex. :** $3 * (-4) = (-4) + (-4) + (-4) = -12$

By using this method, we can say that we get a negative integer on multiplying a positive integer and a negative integer.

$\therefore \quad (-4) \times 3 = -12$ (Also, in reverse order)

**(ii) Product of (–) integers :**

$$(-a) * (-b) = (-b) * (-a) = ab$$

**Ex. :** $(-15) * (-4) = 60$

$(-4) * (-15) = 60$

**(iii)** $a * 0 = 0 * a = 0$ (For all integers.)

## 1.8 Divisibility Rule of Numbers

- **Divisibility by 2 :**

  If the unit digit of a number is any of 0, 2, 4, 6, 8, then the given number is divisible by 2.

  **Example :** 84, 786, 282, 1008, 5000….., etc. are divisible by 2.

- **Divisibility by 3 :**

  A number is divisible by 3, if the sum of all digits of the number is divisible by 3.

  **Example :** 786, here 7 + 8 + 6 = 21 (completely divisible by 3)

  So, the number 786 will be divisible by 3.

- **Divisibility by 4 :**

  A number is divisible by 4, if the last two-digits of the number is divisible by 4.

  **Example :** 3464, here 64 is the last two-digit number which is divisible by 4.

  So, the number 3464 will be divisible by 4.

- **Divisibility by 5 :**

  A number is divisible by 5, if the unit digit of the number is either 0 or 5.

  **Example :** 3125, 2010, 2015, 6580……, etc. are divisible by 5.

- **Divisibility by 6 :**

  A number is divisible by 6, if the number is divisible by the numbers 2 and 3.

  **Example :** Test whether number 8202 is divisible by 6.

  **Solution :** (i) the unit digit of the number is 2 which is divisible by 2.

  (ii) the sum of digits of the number = 8 + 2 + 0 + 2 = 12 (divisible by 3)

  Since, it is clear from (i) and (ii) that the number 8202 is divisible by both 2 and 3. So, the number will be divisible by 6.

- **Divisibility by 7 :**

  Take the last digit of the given number and double it. Subtract this number from the rest of the digits in the original number. If this new number is either 0 or if it is a number that is divisible by 7, then the given number is also divisible by 7.

  **Example :** Test whether number 2492 is divisible by 7.

  **Solution :** Here, the unit digit of the number = 2

  $249 - 2 \times 2 = 245$ (divisible by 7). So, the number will be divisible by 7.

- **Divisibility by 8 :**

  A number is divisible by 8, if the last three-digits of the number is divisible by 8.

  **Example :** Test whether number 6288 is divisible by 8.

  **Solution :** Here, in the given number, 288 is the last three-digit number which is completely divisible by 8.

  So, the number 6288 will be divisible by 8.

- **Divisibility by 9 :**

  A number is divisible by 9, if the sum of its digits is divisible by 9.

  **Example :** Test whether number 7074 is divisible by 9.

  **Solution :** Sum of all digits of the number = 7 + 0 + 7 + 4 = 18 (divisible by 9).

  So, the number 7074 will be divisible by 9.

- **Divisibility by 11 :**

  A number is divisible by 11, if difference between the sum of digits at odd places and the sum of digits at even places, is divisible by 11.

  **Example :** Test whether number 86460 is divisible by 11.

  **Solution :** Sum of the all digits at even places in the number = 6 + 6 = 12

  Sum of the all digits at odd places in the number = 8 + 4 + 0 = 12

  Their difference = 12 – 12 = 0. So, the number 86460 will be divisible by 11.

- **Divisibility by 13 :**

  Take the last digit of the given number and multiply by 4. Add this product to the rest of the digit. If the sum is either 0 or divisible by 13, then the given number is also divisible by 13. If the sum is still the greater number, then repeat the pattern until you get the smaller number.

  **Example :** Test whether the given number 5304 is divisible by 13.

  **Solution :** The unit digit of 5304 is 4

  $530 + 4 \times 4 = 546$ (This is still the larger number)

  Again, the unit digit of 546 is 6

  $54 + 4 \times 6 = 78$ (Which is divisible by 13)

  Hence, the number 5304 is completely divisible by 13.

- **Divisibility by 17 :**

  Take the last digit of the given number and multiply by 12. Add this product to the rest of the digit. If the sum is either 0 or divisible by 17, then the given number is also divisible by 17. If the sum is still the greater number, then repeat the pattern until you get the smaller number.

**Example :** Test whether the given number 11118 is divisible by 17.

**Solution :** The unit digit of 11118 is 8

$1111 + 12 \times 8 = 1207$ (This is still the larger number)

Again, the unit digit of 1207 is 7

$120 + 12 \times 7 = 204$ (This is still the larger number)

Again, the unit digit of 204 is 4

$20 + 12 \times 4 = 68$ (Which is divisible by 17)

Hence, the number 11118 is completely divisible by 17.

- **Divisibility by 19 :**

Take the last digit of the given number and multiply by 2. Add this product to the rest of the digit. If the sum is either 0 or divisible by 19, then the given number is also divisible by 19. If the sum is still the greater number, then repeat the pattern until you get the smaller number.

**Example :** Test whether the given number 46683 is divisible by 19.

**Solution :** The unit digit of 46683 is 3

$4668 + 2 \times 3 = 4674$ (This is still the larger number)

Again, the unit digit of 4674 is 4

$467 + 2 \times 4 = 475$ (This is still the larger number)

Again, the unit digit of 475 is 5

$47 + 2 \times 5 = 57$ (Which is divisible by 19)

Hence, the number 46683 is completely divisible by 19.

## 1.9 Euclid's Division Theorem

Euclid was greek mathematician. He is known for the work done on geometry and number system. He derived the quotient related principles of real numbers. In arithmetic, Euclid's Division Algorithm is based on division lemma derived by him.

Let $a$ be any non-zero integer ($a \neq 0$) and $b$ and $c$ are two integers defined as $b/a = c$

Then, number $b$ is called dividend number, $a$ is called divisor and number $c$ is called quotient.

For divisibility, following properties should be kept in mind, that —

(i) any non-zero integer can be divided by ± 1.

(ii) 0 can be divided by any number.

(iii) any number cannot be divided by 0.

(iv) If $a$ and $b$ are non-zero then division operation can be applied to them.

(v) If $a$ and $b$ are non-zero integers and $q$ and $r$ are other integers such that $a = bq + r$, where $a \rightarrow$ dividend $b \rightarrow$ divisor $q \rightarrow$ quotient and $r \rightarrow$ remainder.

We consider the following pairs of integers—

(i) 56, 16 (ii) 10, 2 (iii) 5, 7

We can write the relation for these pairs of the following—

(i) $56 = 16 \times 3 + 8$ (when we divide 56 by 16, the quotient is 3 and remainder is 8)

(ii) $10 = 5 \times 2 + 0$ (when we divide 10 by 2 the quotient is 5 and remainder is 0)

(iii) $5 = 7 \times 0 + 5$ (Here, quotient = 0 and remainder = 5)

It is clear from above examples that for each pair of two positive integers $a$ and $b$, when $a$ is divided by $b$, leaves the remainder $r$ and the remainder $r$ is either 0 or less that divisor $b$, *i.e.*,

$$a = bq + r$$

where, $0 \leq r < b$

This result is known as Euclid's lemma in arithmetic.

**Theorem—(Euclid's Division Lemma)**

If $a$ and $b$ are two positive integers, then there exists two unique integers $q$ and $r$ such that $a = bq + r$, where $0 \leq r < b$

**Note :** The above lemma can be applied to all integers (Excluding zero and remember that $q$ or $r$ can also be zero.

**Ex. 1 :** Show that any positive integer can be written in the form of $3q$ or $3q + 1$ or $3q + 2$, where $q$ is any integer.

**Sol. :** Let $a$ be any integer and $b = 3$ apply division lemma for $a$ and $b$, $a = 3q + r$ where $0 \leq r < 3$ and $q$ is any integer.

put $r = 0$, 1 and 2

$a = 3q + 0$ where $a = 3q + 1$ or $a = 3q + 2$

So $a = 3q$ or $a = 3q + 1$ or $a = 3q + 2$

So, any positive integer can be written in the form of $3q$, $3q + 1$, $3q + 2$

**Ex. 2 :** Show that every positive even integer is in the form of $2q$ and every odd integer is in the form of $2q + 1$, where $q$ is any integer.

**Sol. :** Let $a$ be any positive integer, and $b = 2$

Apply Division Lemma to $a$ and $b$,

$a = 2q + r$, where $0 \leq r < 2$ and $q$ is any integer.

Put $r = 0$, 1

$a = 2q + 0$ or $a = 2q + 1$ ($\because$ $r$ is an integer)

$a = 2q$ or $a = 2q + 1$

$\because$ $q$ is an integer and $a = 2q$ then $a$ is an even integer.

We know that an integer can be even or odd. So, if $a$ is an even integer then $a + 1$ *i.e.*, $2q + 1$ will be an odd integer.

**Ex. 3 :** Using Euclid's Division Lemma, show that the square of any positive integer is of the form of $3m$ or $3m + 1$, where $m$ is any integer.

**Sol. :** Let $a$ is any positive integer. We know that this positive integer will be form of $a = 3q$ or $a = 3q + 1$ or $a = 3q + 2$.

(i) If $a = 3q$ then, $a^2 = (3q)^2 = 9q^2 = 3\,(3q^2) = 3m$ where, $m = 3q^2$

(ii) If $a = 3q + 1$ then,

$$a^2 = (3q + 1)^2$$
$$= 9q^2 + 6q + 1$$
$$= 3q\,(3q + 2) + 1$$
$$= 3m + 1$$

where, $m = q(3q + 2)$

(iii) If $a = 3q + 2$, then

$$a^2 = (3q + 2)^2 = 9q^2 + 12q + 4$$
$$= 9q^2 + 12q + 3 + 1$$
$$= 3(3q^2 + 4q + 1) + 1$$
$$= 3m + 1$$

where $m = (3q^2 + 4q + 1)$

So, it is clear from (i), (ii) and (iii) that square of integer $a$ is of the form $3m$ or $3m + 1$.

### 1.9.1 Division Operations in Numbers

- Dividend = Divisor × Quotient + Remainder, where 0 ≤ Quotient < Divisor

$$\text{Divisor})\overline{\text{Dividend}}(\text{Quotient}$$
$$\overline{\text{Remainder}}$$

- Remainder = Dividend – Divisor × Quotient
- Divisor = (Dividend – Remainder)/Quotient
- Quotient = (Dividend – Remainder)/Divisor

**Example :** On dividing a number by 808, we get 15 as a quotient and 13 as a remainder. Find the divisor.

**Solution :** $\text{Divisor} = \dfrac{\text{Dividend} - \text{Remainder}}{\text{Quotient}} = \dfrac{808 - 13}{15}$

$$= \frac{795}{13} = 53$$

### 1.10 To Find Unit's Digit

Following is the method to find the unit digit in product of numbers and in power form of number :

**I. In product of numbers**–We find the product of unit digits of all numbers to find the unit digit in the product of numbers. The unit digit of obtained product is equal to the unit digit in product of given numbers.

**Ex. :** Find the unit digit in product of 786 × 78 × 687

(A) 4 (B) 5 (C) 6 (D) 2

**Sol.** (C) : Here, we multiply the unit digits of all numbers in 786 × 78 × 687.

= Unit digit in 6 × 8 × 7

= Unit digit in 336 = 6

So, 6 will be the unit digit in the given product.

**II. In Exponential number :**

**(i) For odd numbers :** When unit digit is an odd number excluding 5, then

$(\times\times\times\ 1)^n = (\times\times\times\ 1)$

$(\times\times\times\ 3)^{4n} = (\times\times\times\ 1)$

$(\times\times\times\ 7)^{4n} = (\times\times\times\ 1)$

$(\times\times\times\ 9)^n = (\times\times\times\ 1)$, if $n$ is an even number

$= (\times\times\times\ 9)$, if $n$ is an odd number.

**Ex. :** Find the unit digit in $(27)^{43}$

(A) 3 (B) 4 (C) 5 (D) 6

**Sol.** (A) : Unit digit in $(27)^{43}$

= Unit digit in $(7)^{43}$

= Unit digit in $(7)^{4 \times 10 + 3}$

= Unit digit in $(7)^3$

= 3

**(ii) For Even numbers :**

$(\times\times\times\ 2)^{4n} = (\times\times\times\ 6)$

$(\times\times\times\ 4)^{2n} = (\times\times\times\ 6)$

$(\times\times\times\ 6)^n = (\times\times\times\ 6)$

$(\times\times\times\ 8)^{4n} = (\times\times\times\ 6)$

**Ex. :** Find the unit digit in $(44)^{69}$

(A) 5 (B) 4 (C) 6 (D) 2

**Sol.** (B) : Unit digit in $(44)^{69}$

= Unit digit in $(4)^{69}$

= Unit digit in $(4)^{2 \times 34 + 1}$

= Unit digit in $(6 \times 4) = 4$

**Note :** If unit digits of a number is 0, 1, 5 and 6, then the unit digit in exponent of that number will also be 0, 1, 5 and 6 respectively.

### 1.11 Factorial of a Number

Factorial of a non-negative number $n$, is the number which is equal to the product of the number $n$ and all positive integers less than $n$. It is represented by $n!$

$$n! = n(n - 1)\,(n - 2)\,(n - 3) \ldots\ldots\ldots 3.2.1$$

**Ex. :** $5! = 5 \times 4 \times 3 \times 2 \times 1 = 120$

**Note :** $0! = 1$

### 1.12 Modulus of a Number

$$|x| = \begin{cases} x, \text{ When } x \geq 0 \\ -x, \text{ When } x < 0 \end{cases}$$

**Ex. :** $|-5| = 5$

$|4| = 4$

$|-1| = 1$ etc.

## 1.13 Greatest Integer Value

The greatest integer value of $x$ is defined as the greatest integer which is not greater than $x$. It is represented by $[x]$.

**Ex. :** $[1.135] = 1$

$\left[\frac{11}{4}\right] = \left[2\frac{3}{4}\right] = 2$ etc.

## 1.14 Some Special Formulae

(i) $(a+b)^2 = (a^2 + b^2 + 2ab)$

(ii) $(a-b)^2 = (a^2 + b^2 - 2ab)$

(iii) $(a+b)^2 + (a-b)^2 = 2(a^2 + b^2)$

(iv) $(a+b)^2 - (a-b)^2 = 4ab$

(v) $(a^2 - b^2) = (a+b)(a-b)$

(vi) $(a+b)^3 = a^3 + b^3 + 3ab(a+b)$

(vii) $(a-b)^3 = a^3 - b^3 - 3ab(a-b)$

(viii) $(a^3 + b^3) = (a+b)(a^2 - ab + b^2)$

(ix) $(a^3 - b^3) = (a-b)(a^2 + ab + b^2)$

## 1.15 Short-Tricks

- **Type 1 :** When a number formed by the repetition of a digit 6 times, 12 times, 18 times, .... (in multiple of 6) then the number will exactly divisible by 3, 7, 11, 13 and 37.

**Ex. :** Examine the divisibility of 66666 by 7.

**Sol. :** $66666 - 2 \times 6 = 66666 - 12 = 66654$
(which is exactly divisible by 7)
so, number 66666 will be exactly divisible by 7.

- **Type 2 :** The sum of a two-digit number and the number formed by reversing its digit will always be divisible by 11. Then, sum of digits of number $= \frac{\text{Sum of numbers}}{11}$

**Ex. :** The sum of a two-digit number and the number formed by reversing its digit is 88, then find the sum of digits of the number.

**Sol. :** Sum of digits of the number

$$= \frac{\text{Sum of numbers}}{11}$$

$$= \frac{88}{11} = 8$$

- **Type 3 :** The difference between a two-digit number and the number formed by reversing its digit is always divisible by 9. Then, the difference between the digits of number

$$= \frac{\text{Difference in numbers}}{9}$$

**Ex. :** The difference between a two-digit number and the number formed by reversing its digit is 54, then find the difference between the digits of the number.

**Sol. :** **Difference between the digits of number** $= \frac{54}{9} = 6$

- **Type 4 :** If the unit digit of a number in the form of exponent is 0, 1, 5 or 6, the unit digit of its solution remains same.

**Ex. :** Find the unit digit in $(240)^5$

**Sol. :** Here, the unit digit in 240 is 0
So, The unit digit of solution of $(240)^5$ will also be 0 (zero).

- **Type 5 :** Sum of natural number from 1 to $n = \frac{n(n+1)}{2}$

**Ex. :** Find the sum of first 25 natural numbers.

**Sol. :** Required sum $= \frac{n(n+1)}{2}$

$$= \frac{25(25+1)}{2} \qquad (\because n = 25)$$

$$= 25 \times 13 = 325$$

- **Type 6 :** Sum of even numbers from first $n$ consecutive natural numbers $(s) = \frac{n}{2}\left(\frac{n}{2} + 1\right)$; where $n$ is even number.

**Ex. :** Find the sum of even numbers from first 10 natural numbers.

**Sol. :** Required sum $= \frac{n}{2}\left[\frac{n}{2} + 1\right]$; [$n$ = even number]

$$= \frac{10}{2}\left[\frac{10}{2} + 1\right]$$

$$= 5 \times 6 = 30$$

- **Type 7 :** The sum of odd numbers from first $n$ natural numbers $(s) = \left(\frac{n+1}{2}\right)^2$; where $n$ is an odd number.

**Ex. :** Find the sum of odd numbers from first 25 natural numbers.

**Sol. :** Required sum $= \left[\frac{n+1}{2}\right]^2$; ($n$ = odd number)

$$= \left[\frac{25+1}{2}\right]^2$$

$$= (13)^2 = 169$$

- **Type 8 :** Sum of first $n$ even numbers $= n(n+1)$

**Ex. :** Find the sum of first 10 even numbers.

**Sol. :** Required sum $= n(n+1)$

$$= 10(10+1)$$

$$= 10 \times 11 = 110$$

- **Type 9 :** The sum of first $n$ odd numbers = $n^2$

**Ex. :** Find the sum of first 7 odd numbers.

**Sol. :** Required sum = $n^2$

$= (7)^2 = 49$

- **Type 10 :** Sum of squares of first $n$ natural numbers

$$(s) = \frac{n(n+1)(2n+1)}{6}$$

**Ex. :** What will be the sum of squares of first 12 natural numbers ?

**Sol. :** Required sum $= \frac{n(n+1)(2n+1)}{6}$

$= \frac{12(12+1)(2\times12+1)}{6}$

$= 2 \times 13 \times 25 = 650$

- **Type 11 :** Sum of squares of even numbers from 1 to $n$

$$= \frac{n(n+1)(n+2)}{6}$$

**Ex. :** What will be the value of $2^2 + 4^2 + 6^2 + ..... + 18^2 + 20^2$ ?

**Sol. :** $n = 20$

Required Sum $= \frac{20(20+1)(20+2)}{6}$

$= \frac{20\times21\times22}{6} = 1540$

- **Type 12 :** Sum of squares of odd numbers from 1 to $n$.

$$= \frac{n(n+1)(n+2)}{6}$$

**Ex. :** What will be the value of $1^2 + 3^2 + 5^2 + ..... + 19^2 + 21^2$.

**Sol. :** $n = 21$

Required sum $= \frac{n(n+1)(n+2)}{6}$

$= \frac{21\times22\times23}{6} = 1771$

- **Type 13 :** Sum of cubes of first $n$ natural numbers

$$(s) = \left[\frac{n(n+1)}{2}\right]^2$$

**Ex. :** What will be the sum of cubes of first 5 natural numbers ?

**Sol. :** Required sum $= \left[\frac{n(n+1)}{2}\right]^2$

$= \left[\frac{5\times(5+1)}{2}\right]^2$

$= (5 \times 3)^2 = (15)^2 = 225$

- **Type 14 :** Total No. of $n$ digit = $9 \times 10^{n-1}$

**Ex. :** Find the total number of two digit number between 1 to 100.

**Sol. :** Required numbers = $9 \times 10^{n-1}$

$\because$ Here $n = 2$,

$\therefore$ Numbers = $9 \times 10^{(2-1)}$

$= 9 \times 10 = 90$

- **Type 15 :** $n$ being even or odd $(x^n - 1)$ is always divisible by $(x - 1)$.

**Ex. :** Find that, Is number $(26^5 - 1)$ completely divisible by 25 ?

**Sol. :** $\frac{26^5 - 1}{25} = \frac{(26^5 - 1)}{(26 - 1)}$

So, it is clear that $(26^5 - 1)$ will be divisible by 25.

- **Type 16 :** If $n$ is odd then $(x^n + 1)$ will be always divisible by $(x + 1)$.

**Ex. :** Find that, Is number $(32^7 + 1)$ is completely divisible by 33 ?

**Sol. :** $\frac{32^7 + 1}{33} = \frac{32^7 + 1}{32 + 1}$; Here $n = 7$ (odd)

So, given number will be exactly divisible by 33.

- **Type 17 :** If sum of three consecutive numbers is X, then

$$\text{Middle number} = \frac{X}{3}$$

**Ex. :** If the sum of three consecutive numbers is 18, then what will be the middle number ?

**Sol. :** Let, three consecutive numbers are $x - 1$, $x$ and $x + 1$ and sum (X) = 18

then, Middle number $= \frac{X}{3} = \frac{18}{3} = 6$

- **Type 18 :** (i) $(x^n - a^n)$ will be divisible by $(x - a)$, where $n \in N$
(ii) $(x^n - a^n)$ will be divisible by $x + a$, where $n$ is an even natural number.

- **Type 19 :** (i) Dividend = Divisor × Quotient + Remainder
(ii) Remainder = 1st remainder + 2nd Remainder × 1st Divisor + 3rd Remainder × 1st Divisor × 2nd Divisor + .....

**Ex. :** $\frac{7856745}{9\times8\times6\times5} = ?$

**Sol. :**

| | | | | |
|---|---|---|---|---|
| 1st Divisor | 9 | 7856745 | Remainder | |
| 2nd Divisor | 8 | 872971 → | 6 | 1st |
| 3rd Divisor | 6 | 109121 → | 3 | 2nd |
| 4th Divisor | 5 | 18186 → | 5 | 3rd |
| | | 3637 → | 1 | 4th |

Quotient = 3637

Required remainder = $R_1 + R_2 \times D_1 + R_3 \times D_1 \times D_2 + R_4 \times D_1 \times D_2 \times D_3$

$= 6 + 3 \times 9 + 5 \times 9 \times 8 + 1 \times 8 \times 6 \times 9$

$= 6 + 27 + 360 + 432$

$= 825$

- **Type 20 :** If, there are $n$ persons in a group and each person gives gifts to the remaining persons, then total number of gifts = $n(n-1)$

**Ex. :** On the occasion of new year, 12 people of a community gave gifts to each other. Then find, how many gifts were distributed ?

**Sol. :** Number of gifts = $12\ (12-1)$

$= 12 \times 11 = 132$

- **Type 21 :** Question based on animals and birds.

**Important facts :**

Total number of heads of Birds = No. of Birds

Total number of legs of Birds = 2 × No. of Birds

Number of heads of Animals = No. of Animals

Number of legs of Animals = 4 × No. of Animals

Number of heads of Humans = No. of humans

Number of legs of Humans = 2 × No. of humans

**Ex. :** A Zoo has some rabbits and pigeons. If total number of heads is 90 and total number of legs is 224, then find the total number of pigeons.

**Sol. :** Let, Number of rabbits = $x$

and Number of pigeons = $y$

ATQ,

$x + y = 90$ ...(1) × 2

and $4x + 2y = 224$ ...(2)

$2x + 2y = 180$

$4x + 2y = 224$

$- \quad - \quad -$

$-2x = -44$

$x = 22$

So, Total number of rabbits = 22

andTotal Number of Pigeons = 90 – 22

= 68

**Note :** Here, the means of animals is generally animals with four feet.

- **Type 22 :** Find the number of prime factors and total number of factor in number $N = a^p \times b^q \times c^r$, where $a, b, c$ are prime factors of number N, then

(i) Total number of factors = $(p+1)(q+1)(r+1)$

(ii) Number of unique factors = 3

(iii) Number of prime factors = $p + q + r$

(iv) Sum of factor = $(a^0 + a^1 + a^2 + \ldots a^p)(b^0 + b^1 + \ldots b^q)$ $(c^0 + c^1 + \ldots . c^r)$

(v) Product of factors = $(N)^{(\text{number of factors}/2)}$

**Ex. :** Find the number of prime factors in $(4)^{11} \times (7)^5 \times (11)$

**Sol. :** According to the question,

$(4)^{11} \times (7)^5 \times (11)^1 = (2)^{22} \times (7)^5 \times (11)^1$

$\therefore$ Total number of prime factors = 22 + 5 + 1

= 28

## Important Examples

**1.** What is the difference between place value and face value of 7 in 867943 ?

**[SSC MTS Exam, 2010]**

(A) 943 (B) 7936

(C) 6993 (D) None of these

**1.** (C) Place value of 7 in 867943 =7000

Face value of 7 in 867943 = 7

$\therefore$ Required difference

$7000 - 7 = 6993$

**2.** What will be the remainder, if $(67^{67} + 67)$ is divided by 68 ?

**[SSC Exam, 2010]**

(A) 1 (B) 67

(C) 63 (D) 66

**2.** (D) $(67^{67} + 67) \div 68$

$= \dfrac{(67^{67}+1)+66}{68}$

Here, $n = 67$ which is odd

So, $(67^{67} + 1)$ will be exactly divisible by $(67 + 1) = 68$

So, Remainder = 66

**3.** A number exceeds its $\frac{2}{5}$ by 75. The number is : **[Rly Group-D Exam., 2013]**

(A) 125 (B) 100

(C) 112 (D) 150

**3.** (A) Let the required number be $x$. Then,

According to the question,

$x - \frac{2}{5}x = 75$

$\Rightarrow \quad \frac{3}{5}x = 75$

$\Rightarrow \quad x = 125$

**4.** The unit digit in the product $3 \times 38 \times 537 \times 1256$ is :

**[U.P. Teacher Eligibility Exam, 2012]**

(A) 4 (B) 2

(C) 6 (D) 8

**4.** (D) On multiplying the unit digits of all numbers,

$3 \times 8 = 2$ ④

↓

$4 \times 7 = 2$ ⑧

↓

$8 \times 6 = 4$⑧

So, the unit digit in product of the given numbers will be 8.

**5.** The sum of all prime numbers which is not greater than 17 is :

**[SSC CPO (Re) Exam, 2016]**

(A) 59 (B) 58

(C) 41 (D) 42

**5.** (B) Required sum

$= 2 + 3 + 5 + 7 + 11 + 13 + 17$

$= 58$

**6.** If a seven-digit number $56x34y4$ is exactly divisible by 72 then what is the least value of $(x + y)$ ?

**[SSC CAPFs, 2019]**

(A) 8 (B) 12

(C) 5 (D) 14

**6.** (C) $\because$ A number will be divisible by 72 if it is divisible by 8 and 9

So, the given number will be divisible by 8, if $4y4$ is divisible by 8.

So, here the minimum value of $y$ will be 2

Now, the sum of all digit should be divisible by 9

So,

$56x34y4 = 5 + 6 + x + 3 + 4 + 2 + 4$ $(\because\ y = 2)$

$= 24 + x$

The above sum will be divisible by 9, if $x = 3$,

So, the minimum value of $x + y = 3 + 2 = 5$

**7.** If a nine-digit number $985x3678y$ is divisible by 72, then the value of $(4x - 3y)$ will be :

**[SSC CGL, 2019]**

(A) 5 (B) 4

(C) 6 (D) 3

**7.** (B) As, it is shown in previous solution that a number will be divisible by 8 if $78y$ will be divisible by 8.

Here, the minimum value of $y$ will be 4.

Now, to divisible by 9, the sum of all digits should also be divisible by 9.

So,

$985x3678y = 9 + 8 + 5 + x + 3 + 6 + 7 + 8 + 4$ $(\because\ y = 4)$

$= 50 + x$

The above sum will divisible by 9, if $x = 4$

So, $4x - 3y = 4 \times 4 - 3 \times 4$

$= 4 \times (4 - 3)$

$= 4 \times 1 = 4$

**8.** Find the sum of first 5 multiples of 3.

(A) 44 (B) 45

(C) 48 (D) 50

**8.** (B) First five multiples of 3 = 3, 6, 9, 12, 15

Required sum = $3 + 6 + 9 + 12 + 15$

$= 3(1 + 2 + 3 + 4 + 5)$

$= \frac{3 \times 5 \times (5+1)}{2}$

$\left[\because 1 + 2 + 3 + ..... + n = n\left(\frac{n+1}{2}\right)\right]$

$= \frac{15 \times 6}{2} = 45$

**9.** If the sum of squares of three consecutive odd numbers is 83, then find the middle number.

(A) 5 (B) 7

(C) 8 (D) 9

**9.** (A) Let three consecutive odd numbers are $2x$, $2x + 2$ and $2x + 4$ respectively.

ATQ,

$(2x)^2 + (2x + 2)^2 + (2x + 4)^2 = 83$

$x^2 + 4x^2 + 4 + 8x + 4x^2 + 16 + 16x = 83$

$12x^2 + 24x + 20 = 83$

$2x^2 + 24x - 63 = 0$

$3(4x^2 + 8x - 21) = 0$

$4x^2 + 8x - 21 = 0$

$4x^2 + 14x - 6x - 21 = 0$

$2x(2x + 7) - 3(2x + 7) = 0$

$(2x - 3)(2x + 7) = 0$

When $2x - 3 = 0$

Then $x = \frac{3}{2}$

When $2x + 7 = 0$

Then $x = -\frac{7}{2}$ (Impossible)

$\therefore$ Middle of Number $= 2x + 2$

$= 2 \times \frac{3}{2} + 2 = 5$

**10.** If sum of squares of four consecutive even numbers is 216, then find the numbers.

(A) 4, 6, 8, 10 (B) 12, 14, 16, 18

(C) 2, 4, 10, 12 (D) 8, 10, 12, 14

**10.** (A) Let four consecutive positive even numbers are $x$, $x + 2$, $x + 4$, $x + 6$ respectively.

Then, ATQ

$x^2 + (x + 2)^2 + (x + 4)^2 + (x + 6)^2 = 216$

$x^2 + x^2 + 4 + 4x + x^2 + 16 + 8x + x^2 + 36 + 12x = 216$

$4x^2 + 24x + 56 - 216 = 0$

$4x^2 + 24x - 160 = 0$

$x^2 + 6x - 40 = 0$

$(x + 10)(x - 4) = 0$

$\therefore\ x = 4$ or $(-10)$ (Impossible)

So, Numbers = 4, 6, 8 and 10

**11.** If sum of squares of 5 consecutive odd numbers is 285, then find the value of middle number.

(A) 3, 5, 7, 9, 11

(B) 5, 7, 11, 13, 15

(C) 9, 13, 17, 19, 21

(D) 1, 3, 5, 7, 9

**11.** (A) Let five consecutive positive odd numbers are $x$, $x + 2$, $x + 4$, $x + 6$, $x + 8$ respectively.

Then, according to the question,

$x^2 + (x + 2)^2 + (x + 4)^2 + (x + 6)^2 + (x + 8)^2 = 285$

$\Rightarrow x^2 + x^2 + 4 + 4x + x^2 + 16 + 8x + x^2 + 36 + 12x + x^2 + 64 + 16x = 285$

$\Rightarrow 5x^2 + 40x + 120 - 285 = 0$

$\Rightarrow 5x^2 + 40x - 165 = 0$

$\Rightarrow x^2 + 8x - 33 = 0$

$\Rightarrow (x + 11)(x - 3) = 0$

$\therefore\ x = 3, -11$ (Impossible)

So, Numbers are 3, 5, 7, 9, 11.

**12.** If the sum of squares of three consecutive numbers is 14, then find the numbers.

(A) 2, 3, 5 (B) 1, 2, 3

(C) 5, 7, 9 (D) 9, 11, 13

**12.** (B) Let three consecutive numbers are $x$, $x + 1$ and $(x + 2)$ respectively.

ATQ,

$x^2 + (x + 1)^2 + (x + 2)^2 = 14$

$x^2 + x^2 + 1 + 2x + x^2 + 4 + 4x = 14$

$3x^2 + 6x - 9 = 0$

$x^2 + 2x - 3 = 0$

$x^2 + 3x - x - 3 = 0$

$x(x + 3) - 1(x + 3) = 0$

$(x + 3)(x - 1) = 0$

So, $x = 1$

So, Numbers will be 1, 2 and 3.

**13.** $425 \times 5^4 = ?$

(A) 265626 (B) 265625

(C) 262556 (D) 262765

**13.** (B) $425 \times 5^4 = \frac{425 \times 5^4 \times 2^4}{2^4}$

$= \frac{425 \times (5 \times 2)^4}{2^4}$

$= \frac{425 \times 10^4}{16}$

$= \frac{4250000}{16}$

$= 265625$

# Important Questions
# Exercise–1 (A)

## Remainder Theorem

**1.** When a number is divided by 221, the remainder is 64. If the same number is divided by 13, what will be the remainder ?

(A) 0 (B) 1

(C) 2 (D) 12

**2.** When an integer K is divided by 3, the remainder is 1 and when (K + 1) is divided by 5, the remainder is 0. What will be the possible value of K ?

(A) 62 (B) 63

(C) 64 (D) 65

**3.** If two numbers are divided by the same divisor, then the remainders are 3 and 4 respectively. If the sum of numbers are divided by the same divisor, the remainder is 2, then find the divisor.

(A) 9 (B) 7

(C) 5 (D) 3

**4.** On dividing a number by 38, we get 90 as a quotient and 19 as a remainder. What is the number ? **[SSC CHSL, 2017]**

(A) 3401 (B) 3382

(C) 3458 (D) 3439

**5.** What will be the remainder on dividing 141 × 142 × 143 by 6 ?

**[SSC CAPFs, 2017]**

(A) 0 (B) 2

(C) 4 (D) 5

**6.** M is the largest number of three digit which when divided by 6 and 5 leaves remainders 5 and 3 respectively. What will be the remainder when M is dividied by 11 ? **[SSC CGL, 2018]**

(A) 1 (B) 2

(C) 3 (D) 4

**7.** How many natural numbers are there between 1000 and 2000, which divided by 341, leaves remainder 5 ?

**[SSC CGL, 2018]**

(A) 3 (B) 2

(C) 4 (D) 1

## Divisibility Rules

**8.** Number 222333444 will be divisible by :

**[R.R.C. Group-D Exam., 2014]**

(A) 3 (B) 37

(C) 11 (D) 3 and 37

**9.** The number $142^2 - 1$ is divisible by :

**[Rly (Delhi), Group-D Exam., 2014]**

(A) 19 (B) 7

(C) 9 (D) 13

**10.** Fill the smallest digit that will make 93856 ? 294 divisible by 9.

**[SSC Exam., 2013]**

(A) 0 (B) 4

(C) 5 (D) 8

**11.** What is the smallest five-digit number divisible by 123 ?

**[SSC CGL Exam., 2013]**

(A) 10037 (B) 10086

(C) 10081 (D) 10063

**12.** If $n$ is an integer, then by what number $(n^3 - n)$ will be divisible ? **[CTET, 2011]**

(A) 4 (B) 5

(C) 6 (D) 7

**13.** How many integers are there between 100 and 600, which are divisible by both 4 and 6 ? **[CTET, 2011]**

(A) 40 (B) 42

(C) 41 (D) 50

**14.** Which number will always divide a 6 digit number of the form *xyxyxy* ?

(where $1 \le x \le 9$, $1 \le y \le 9$)

**[UPTET, 2013]**

(A) 1010 (B) 10101

(C) 11011 (D) 11010

**15.** The smallest number which should be added to 756896 so as to obtain a multiple of 11, is :

**[SSC CGL (Mains) Exam., 2016]**

(A) 1 (B) 2

(C) 3 (D) 4

**16.** A number when divided by the sum of 555 and 445 gives two times their difference as quotient and 30 as the remainder. Find the number.

**[SSC CGL (Mains) Exam., 2016]**

(A) 220030 (B) 22030

(C) 122030 (D) 12500

**17.** The smallest number which added to 756896, the resulting number is multiple of 11, is : **[SSC CGL, 2017]**

(A) 1 (B) 2

(C) 3 (D) 5

**18.** If a six-digit number $4x4y96$ is exactly divisible by 88, then what will be the value of $x + 2y$ ?

**[SSC CAPFs, 2019]**

(A) 13 (B) 10

(C) 12 (D) 11

**19.** If the number 583 – 437 is completely divisible by 9, then find the minimum integer in the blank space ?

(A) 4 (B) 5

(C) 3 (D) 6

**20.** If a number 657423547 $x$ 46 is divisible by 11, then find the value of $x$.

**[SSC CHSL, 2018]**

(A) 7 (B) 9

(C) 8 (D) 6

## Finding Unit Digit

**21.** The last digit of $3^{40}$ is :

**[M.P. Police Constable Exam., 2013]**

(A) 1 (B) 3

(C) 7 (D) 9

**22.** The digit at hundreds place in 17 ! is :

**[U.P. Rajasva Lekhpal Exam., 2015]**

(A) 1 (B) 0

(C) 2 (D) 3

**23.** What is the unit digit in the product $(2467)^{153} \times (341)^{72}$? **[SSC Exam., 2013]**

(A) 1 (B) 3

(C) 7 (D) 9

**24.** If the unit digit of 433 × 456 × 43N is (N + 2), then what is the value of N ?

**[SSC CGL, 2018]**

(A) 1 (B) 8

(C) 3 (D) 6

**25.** The unit digit of 246! is

(A) 0 (B) 6

(C) 4 (D) 2

**26.** The unit digit of $(1!)^1 + (2!)^2 + (3!)^3 + (4!)^4 + ..... + (100!)^{100}$ is

(A) 1 (B) 5

(C) 0 (D) 7

**27.** The unit digit of $(6374)^{1793} \times (625)^{317} \times (34)^{49}$ is

(A) 5 (B) 0

(C) 1 (D) 4

**28.** The unit digit of $(4152)^{51} \times (3268)^{67} \times (5913)^{83} \times (6217)^{103}$ is

(A) 3 (B) 7

(C) 8 (D) 6

## Finding Last two digits

**29.** The last 2 digits of a 200 digit number 12301230012300012300000.....are :
(A) 00 (B) 01
(C) 12 (D) 23

**30.** The last two digit of the product 2345 × 6789 is :
(A) 35 (B) 15
(C) 05 (D) 25

**31.** The last two digit of $(99)^{45}$ is :
(A) 49 (B) 79
(C) 99 (D) 89

**32.** The last two digit of $(49)^{158}$ is :
(A) 51 (B) 01
(C) 49 (D) 59

## Total number of digits

**33.** How many digits are required to write numbers from 1 to 50 ?
**[SSC MTS Exam., 2014]**
(A) 100 (B) 92
(C) 91 (D) 50

**34.** Find the numbers of digits required to write down the numbers of 1 to 300.
(A) 791 (B) 800
(C) 792 (D) 798

**35.** How many digits are required to write the number from 100 to 1000 ?
(A) 2700 (B) 3204
(C) 2704 (D) 3208

## Number of Trailing Zeroes

**36.** A man engaged a servant on the condition that he would pay him ₹ 90 and a turban after a service of one year. He served only for nine months and received the turban and ₹ 65. The price of turban is :
**[UPTET, 2013]**
(A) 25 (B) 18.75
(C) 10 (D) 2.50

**37.** 2, 4, 6, 8, 10 ..... 196, 198, 200 are multiplied together, then how many zeroes will be their at the end of the product ? **[DSSSB, LDC Exam., 2014]**
(A) 21 (B) 22
(C) 24 (D) 25

**38.** Find the Number of zero in the right had of 625 × 101 × 2 × 155 :
(A) 0 (B) 1
(C) 28 (D) 25

**39.** Find the Number of zero in the right hand of 257! :
(A) 60 (B) 62
(C) 61 (D) 63

**40.** Find the Number of zero in the right hand of (3 × 6 × 9 × 12 ..... × 375) :
(A) 40 (B) 31
(C) 45 (D) 50

**41.** Find the Number of zero in the right hand of (10 × 20 × 30 × 40 ..... × 1000) :
(A) 125 (B) 124
(C) 100 (D) 1000

## Language Based problems (2 Digit No. & 3 digit No.)

**42.** The sum and the difference of two numbers are 45 and 15 respectively, then find the smaller number.
(A) 13 (B) 14
(C) 17 (D) 15

**43.** The sum and the difference of two numbers are 5 and 3 respectively, then find the product of these numbers.
(A) 15 (B) 2
(C) 4 (D) 30

**44.** Two positive integers are such that the sum of first number and twice the second number is 8 and their difference is 2. Find the numbers.
**[KVS LDC Exam., 2015]**
(A) 7, 5 (B) 3, 5
(C) 6, 4 (D) 4, 2

**45.** In an exam, the sum of the scores of A and B is 120, that of B and C is 130 and that of C and A is 140. What is the score of C ?
**[KVS LDC Exam., 2015]**
(A) 70 (B) 75
(C) 60 (D) 65

**46.** The sum of three numbers is 2. First number is $\frac{1}{2}$ times of second number and third number is $\frac{1}{4}$ times the second number. What will be the second number ?
**[SSC CGL (Mains) Exam., 2016]**
(A) $\frac{7}{6}$ (B) $\frac{8}{7}$
(C) $\frac{9}{8}$ (D) $\frac{10}{9}$

**47.** The sum of the squares of the three numbers is 323. If the sum of the squares of the two numbers is twice the third number, then find their product.
**[SSC CGL (Mains) Exam., 2016]**
(A) 255 (B) 260
(C) 265 (D) 270

**48.** If the arithmetic mean of $3a$ and $4b$ is greater than 50 and $a$ is twice of $b$, then what will be the smallest possible integer value of $a$ ?
**[SSC CGL (Mains) Exam., 2015]**
(A) 18 (B) 19
(C) 20 (D) 21

**49.** Each member of a club contributes as much rupees and as much paise as the number of members of a club. If the total contribution is ₹ 2525, then the number of members of the club is :
**[SSC CGL (Mains) Exam., 2016]**
(A) 60 (B) 45
(C) 55 (D) 50

**50.** There are two teams A and B. If 3 people move from A team to B team, then the number of members in B team is 3 times than A team. If 2 people are brought from team B to team A then team B has twice as many members as team A. How many members were originally in team B ?
**[SSC CPO (Re) Exam., 2016]**
(A) 15 (B) 18
(C) 42 (D) 45

**51.** In an examination, a student scores 4 marks for every correct answer and loses 1 mark for every wrong answer. If he attempts all 200 questions and secures 200 marks. What is the number of questions he attempted correctly ?
(A) 82 (B) 80
(C) 68 (D) 60

**52.** The product of two numbers is 48. If one number equals "the number of wings of a bird plus 2 times the number of fingers on your hand divided by the number of wheels of a tricycle" then the other number is :
**[SSC CGL (Mains) Exam., 2016]**
(A) 9 (B) 10
(C) 12 (D) 18

**53.** There are 50 boxes and 50 persons. First person keeps 1 marble in every box, second person keeps 2 marbles in every 2nd box, third person keeps 3 marbles in every third box. The process goes on till $50^{th}$ person keeps 50 marbles in $50^{th}$ box. Find the total number of marbles kept in the $50^{th}$ box. **[CTET, 2015]**
(A) 43 (B) 78
(C) 6 (D) 93

**54.** The weight of a container completely filled with water is 2.25 kg. The container

weights 0.77 kg when its 0.2 part is filled with water. The weight (in kg) of the container when 0.4 part of its is filled with water is : **[LDC Exam., 2015]**

(A) 0.40 (B) 1.14

(C) 0.74 (D) 1.88

**55.** While solving a problem, by mistake, Anita squared a number and then subtracted 25 from it rather than first subtracting 25 from the number and the squarring it. But she got the right answer. What was the given number ?

**[SSC CGL (Mains) Exam., 2015]**

(A) 48

(B) cannot be determined

(C) 13

(D) 38

**56.** In a farm there are cows and hens, if heads are counted there are 180, if legs are counted there are 420. Find the number of cows in farm.

**[SSC CGL (Mains) Exam., 2015]**

(A) 130 (B) 50

(C) 150 (D) 30

**57.** A school group charters three identical buses and occupies $\frac{4}{5}$ of the seats. After $\frac{1}{4}$ of the passengers leave, the remaining passengers use only two of the buses. What is the fraction of the seats on the two buses that are now occupied ?

**[SSC CGL (Mains) Exam., 2015]**

(A) $\frac{8}{9}$ (B) $\frac{7}{9}$

(C) $\frac{7}{10}$ (D) $\frac{9}{10}$

**58.** If the digits in the unit and tens place of a two-digit number are interchanged, then the new number is 63 more than the original number. Suppose the digit in the unit plce of the original number be $x$ then all the possible values of $x$ will be :

**[U.P. Chakbandi Lekhpal Exam., 2015]**

(A) 7, 8, 9 (B) 2, 7, 9

(C) 0, 1, 2 (D) 1, 2, 8

**59.** The sum of a two-digit number and the number formed by reversing its digits is a perfect square number, then how many of such number exists ?

**[U.P. Rajasva Lekhpal Exam., 2015]**

(A) 5 (B) 6

(C) 7 (D) 8

**60.** The height of a tree increases every year $\frac{1}{8}$ of its height. If the present height of tree is 64 cm, then what will be its height after 2 years ?

**[UP Rajasva Lekhpal Exam., 2015]**

(A) 72 cm (B) 74 cm

(C) 75 cm (D) 81 cm

**61.** 64329 is divided by a certain number, then, 175, 114 and 213 appear as three successive remainders, then what is the divisor ?

**[JSSC CGL (Pre) Exam., 2016]**

(A) 184 (B) 224

(C) 234 (D) 296

**62.** 380 mangoes are distributed among some boys and girls who are 85 in numbers. Each boy gets 4 mangoes and each girl gets 5 mangoes, then find the number of boys. **[IP Postman Exam., 2016]**

(A) 15 (B) 38

(C) 40 (D) 45

**63.** Doubling a number and adding 20 to the result gives the same answer as multiplying the number by 8 and taking away 4 from the product. Find the number.

**[Patna High Court Assistant Exam., 2016]**

(A) 2 (B) 3

(C) 4 (D) 6

**64.** In competitions of race, there is a run of 100 yards as well as 100 metres. How many metres is 100 metres more than 100 yards ? **[UPSC (CSAT), 2015]**

(A) 0.856 metre (B) 8.56 metres

(C) 0.0856 metre (D) 1.06 metres

**65.** A student missed a number while adding first some positive integers and writes the answer 177, what will be the missed number ? **[UPSC (CSAT), 2009]**

(A) 11 (B) 12

(C) 13 (D) 14

**66.** How many numbers from 0 to 999 are neither divisible by 5 nor by 7 ?

**[UPSC (CSAT), 2010]**

(A) 313 (B) 341

(C) 686 (D) 786

**67.** In a parking area, the total number of wheels of all the cars and bikes is 100 more than twice the number of parked vehicles. Find the number of parked cars :

(A) 35 (B) 45

(C) 50 (D) 55

**68.** The product of digits of a two-digit number is 24. If we add 45 to the number, then the new number obtained is the number in which the digits are interchanged. What is the original number ?

**[SSC CHSL, 2017]**

(A) 54 (B) 83

(C) 38 (D) 45

**69.** 1800 chocolates were distributed among students in a class. Each student gets the chocolates twice the number of students in the class. Find the number of students in the class. **[SSC CHSL, 2018]**

(A) 30 (B) 40

(C) 60 (D) 90

**70.** The sum of three numbers is 252. If first number is thrice the second number and third number is two-third of first number then what will be the second number ?

**[SSC CHSL, 2016]**

(A) 41 (B) 21

(C) 42 (D) 84

**71.** In a two-digit number, the digit at units place is twice the digit at tens place and if 2 is subtracted from the sum of both digits, then the difference is equal to the $\frac{1}{6}$ times of the number. What is the number ? **[SSC CGL, 2015]**

(A) 26 (B) 25

(C) 24 (D) 23

**72.** The sum of three consecutive even numbers is always divisible by.....

**[Delhi Police SI Exam., 2017]**

(A) 12 (B) 6

(C) 18 (D) 24

**73.** The tens digit of a two-digit number is greater than unit digit by 7. If we subtract 63 from the number the new number formed by interchanging of digits. Find the number. **[SSC CGL, 2017]**

(A) 81 (B) 18

(C) 62 (D) 26

## Miscellaneous

**74.** How many $\frac{1}{6}$ together make $41\frac{2}{3}$ ?

**[UP Chakbandi Lekhpal Exam., 2015]**

(A) 125 (B) 150

(C) 250 (D) 350

**75.** What is two-thirds of three quarters ?

**[Patna High Court Assistant Exam., 2016]**

(A) Half of numbers

(B) One-third of numbers

(C) $\frac{8}{9}$ of numbers

(D) $\frac{17}{12}$ of numbers

**76.** What is the maximum value of F in the given equation ?

5E9 + 2F8 + 3G7 = 1114, where each of E, F and G shows a number.

**[SSC, CPO Exam., 2015]**

(A) 8 (B) 5

(C) 9 (D) 7

**77.** The product of all prime numbers between 80 and 90 will be :

**[KVS LDC Exam., 2015]**

(A) 83 (B) 89

(C) 7387 (D) 598347

**78.** Find the maximum number of trees which can be planted 20 metres apart, on two sides of a straight road 1760 metres ?

**[SSC CGL (Pre) Exam., 2016]**

(A) 180 (B) 178

(C) 174 (D) 176

**79.** Which of the following statements is not correct ? **[LDC Exam., 2015]**

(A) Every natural number is a real number

(B) Every real number is a rational number

(C) Every integer is a rational number

(D) Every natural number is an integer.

**80.** How many composite numbers are there between 67 and 101 ?

**[Delhi Rly. Group-D, 2014]**

(A) 27 (B) 26

(C) 24 (D) 23

**81.** The sum of cubes of first 9 odd numbers is :

(A) 17730 (B) 17301

(C) 13041 (D) 77301

**82.** An owner of motorcar reduced his monthly usage of C.N.G. on increasing the price of C.N.G. Price-usage relation is following :

| Price (₹/Litre) | C.N.G. (in litres) |
|---|---|
| 40 | 60 |
| 50 | 48 |
| 60 | 40 |
| 75 | 32 |
| 80 | ? |

Then find the value of :

(A) 30 (B) 28

(C) 26 (D) 24

**83.** A and B are positive integers. If A + B + AB = 65, then what is the difference between A and B (A, B ≤ 15) ?

**[SSC CGL, 2018]**

(A) 3 (B) 4

(C) 5 (D) 6

**84.** If the sum of digits of any integer lying between 100 and 1000 is subtracted from the same integer, the resulting number is always divisible by which of the following number ? **[SSC CGL, 2016]**

(A) 2 (B) 5

(C) 6 (D) 9

**85.** If * is a operation so that $a * b = a + b$ when, $a > 0, b > 0$ $a * b = \sqrt{a^2 + b^2}$, for other values of $a$ and $b$ then the value of $\frac{8*(7-13)-(3*1)}{(3-6)*(9-5)}$ will be :

**[SSC CPO, 2008]**

(A) $\frac{1}{5}$ (B) $\frac{4}{5}$

(C) $\frac{6}{5}$ (D) $\frac{2}{5}$

# Explanatory Solutions

## Remainder Theorem

**1.** (D) **By Logical Method,**

∵ 13 is a factor of 221

∴ Remainder obtained on dividing, the remainder 64 again by 13 = 12

**2.** (C) On solving by options,

$64 = 21 \times 3 + 1$

and $64 + 1 = 65$

$= 13 \times 5 + 0$

So, possible value of K = 64

**3.** (C) **By Remainder Theorem,**

When two numbers are divided by the same number leaving remainders $r_1$ and $r_2$ respectively and the sum of these numbers are also divided by the same divisor leaving the remainder $r_3$

then, divisor = $r_1 + r_2 - r_3$

∴ Required divisor = 3 + 4 – 2 = 5

**4.** (D) **By Remainder Theorem,**

Dividend = Divisor × Quotient + Remainder

$= 38 \times 90 + 19$

$= 3420 + 19$

$= 3439$

**5.** (A) 141 = 3 × 47 and 142 = 2 × 71

$\therefore \frac{141 \times 142 \times 143}{6}$

$= \frac{3 \times 47 \times 2 \times 71 \times 143}{6}$

which is exactly divisible by 6, so remainder = 0

**6.** (D) By formula,

Dividend = Divisor × Quotient + Remainder

According to the question,

$M = 6x + 5$ ...(i)

and $M = 5y + 3$ ...(ii)

From equations (i) and (ii),

$6x + 5 = 5y + 3$

$6x = 5y - 2$ ...(iii)

Equation (iii) satisfies on $x = 3$ and $y = 4$

So, two-digit number formed by $x$ and $y$ = 18 + 5 or 20 + 3

= 23

Now, L.C.M. of divisors 6 and 5 = 30

∴ Required three-digit number

$M = 30n + 23$

So, the maximum value of $n$ will be 32 to find the greatest three-digit number.

∴ M = 30 × 32 + 23 = 983

Now, by the divisibility rule of 11,

(9 + 3) – 8 = 12 – 8 = 4

So, obtained remainder on dividing 983 by 11 = 4

**7.** (A) According to the question,

First number = 341 × 3 + 5

= 1023 + 5 = 1028

Second number = 341 × 4 + 5

= 1364 + 5 = 1369

Third number = 341 × 5 + 5

= 1705 + 5 = 1710

Fourth number = 341 × 6 + 5

= 2046 + 5

= 2051

which is greater than 2000

So, required natural numbers between 1000 and 2000 = 3

## Divisibility Rules

**8.** (D) Digits 2, 3 and 4 appear three times in number 222333444. So, this number will exactly divisible by 3 and 37

**Second Method :**

222, 333, 444

222 + 333 + 444 = 999

999 – 333 = 666

666 is a multiple of 37

222333444 will be divisible by 37

**Divisibility by 3**

2 + 2 + 2 + 3 + 3 + 3 + 4 + 4 + 4 = 27

27 is divisible by 3

So, 222333444 is divisible by both 3 and 37

**9.** (D) $142^2 - 1^2 = (142 + 1)(142 - 1)$

$= 143 \times 141$

$= 11 \times 13 \times 141$

$\therefore$ The given number is divisible by 13

**10.** (D) By the divisibility rule of 9, if the sum of all digits of the given number is divisible by 9, then the number will also be divisible by 9

So, $(9 + 3 + 8 + 5 + 6 + ? + 2 + 9 + 4) / 9$

$\Rightarrow \frac{46 + ?}{9}$

$\therefore$ On putting minimum value 8 in place of ?, the number will divisible by 9.

**11.** (B) $\because$ Smallest number of 5 digits $= 10000$

$\therefore \quad 10000 = 123 \times 81 + 37$

So, required number

$= 10000 - 37 + 123$

$= 10086$

**12.** (C) In $n^3 - n$

put $n = 2$, $8 - 2 = 6$

put $n = 3$, $27 - 3 = 24$

put $n = 4$, $64 - 4 = 60$

put $n = 5$, $125 - 5 = 120$

$\therefore$ Answer will be in the multiple of 6 for each value of $n$

$\therefore$ Required number = 6

**13.** (C) If a number is divisible by both 4 and 6, then it will also be divisible by their L.C.M. *i.e.*, 12

$\therefore$ Integers between 100 and 600 which are divisible by 12, will be :

108, 120, ....., 588

So, Total number of integers.

$= \frac{588 - 108}{12} + 1 = 41$

**14.** (B) Writing the given number in the form of place values of $xy$

$xyxyxy$

$= xy \times 10000 + xy \times 100 + xy \times 1$

$= xy(10000 + 100 + 1)$

$= xy(10101)$

So, the number will be exactly divisible by 10101.

**15.** (C) For divisibility by 11, the difference between sum of digits at even places and sum of digits at odd places should be zero or divisible by 11

$\therefore (7 + 6 + 9) \sim (5 + 8 + 6) = 3$

**16.** (A) **By Logical Method,**

Number = divisor × quotient + remainder

$= (555 + 445) \times 2 (555 - 445) + 30$

$= 1000 \times 220 + 30$

$= 220000 + 30 = 220030$

**17.** (C) By divisibility rule of 11

Sum of digits at even place (E)

$= 5 + 8 + 6 = 19$

Sum of digits at odd place

$= 7 + 6 + 9 = 22$

$\therefore$ By rule,

$O - E = 22 - 19 = 3$

So, we have to add 3 in the above number to be divisible by 11.

**18.** (A) $\because$ We know that a number will be divisible by 88, when it is divisible by 11 and 8

$\therefore$ The given number will be divisible by 8 when $y96$ is divisible by 8

So, here $y = 0$ or $y = 2$

Now, for divisibility by 11

$(x + y + 6) - (4 + 4 + 9) = 0$

$\Rightarrow \quad x + y = 11$

$\because \ y \neq 0 \ \Rightarrow$ put $y = 2$

$\Rightarrow \quad x = 11 - 2 = 9$

So, $x + 2y = 9 + 2 \times 2 = 13$

**19.** (D) Given : The number 583 – 437 is completely divisible by 9.

$\therefore 5 + 8 + 3 + \underline{x} + 4 + 3 + 7 = 30 + x$

Therefore, If 6 is filled the blank space, then only the number is completely divisible by 9.

$30 + 6 = 36 \div 9 = 4$

Hence, Required number = 6.

**20.** (B) $6 + 7 + 2 + 5 + 7 + 4 = 31$

(Sum of odd digits)

and $5 + 4 + 3 + 4 + x + 6 = x + 22$

(Sum of even digits)

By divisibility rule of 11

$x + 22 - 31 = 0$

$x - 9 = 0$ or $x = 9$

## Finding Unit Digit

**21.** (A) $3^{40} = 3^{4 \times 10} = (3^4)^{10}$

$= (81)^{10}$

$\therefore$ The last digit in $3^{40}$ will be 1.

**22.** (B) $\because$ On solving 17 !, the numbers 2, 4, 5, 10, 15 will come out.

$\because \ 2 \times 4 \times 5 \times 10 \times 15 = 6000$

So, it is clear that 0 will be on the hundred$^{th}$ place of 17 !

**23.** (C) $\because \quad 7^4 = 2401$

$\therefore$ The unit digit in $(2467)^{153}$

$= (2467)^{4 \times 38 + 1}$ will be :

$(2467)^{153} = 1 \times 7$

$= 7$

and unit digit in $(341)^{72} = 1$

$\therefore$ The unit digit in the required product $= 7 \times 1 = 7$

**24.** (D) From question,

Unit digit of $433 \times 456 \times 43N$

$= N + 2$

$\Rightarrow$ Unit digit of $8 \times 43N = N + 2$

So, $8 = N + 2$

or $N = 8 - 2 = 6$

(Here, on putting N = 6, 8 will come at units place)

**25.** (A) $246! = 246 \times 245 \times 244 \times 243 .... 1$

$\Rightarrow$ Zero will be formed by 2 and 5.

So, The unit digit of 246! will be 0.

**26.** (D) $(1!)^1 + (2!)^2 + (3!)^3 + (4!)^4 + ..... + (100!)^{100}$

Unit digit of $(1!)^1 = 1$

Unit digit of $(2!)^2 = 4$

Unit digit of $(3!)^3 = 6$

Unit digit of $(4!)^4 = 6$

.....

.....

Unit digit of $(100!)^{100} = 0$

Sum of unit digit

$= 1 + 4 + 6 + 6 + 0 + 0 ..... + 0 = 17$

So, unit digit = 7

**27.** (B) $(6374)^{1793} \times (625)^{317} \times (34)^{49}$

Unit digit of $(6374)^{1793} \Rightarrow (...4)^1 = 4$

Unit digit of $(625)^{317} \Rightarrow (....5)^1 = 5$

Unit digit of $(34)^{99} \Rightarrow (....4)^3 = 4$

So,

Unit digit = $4 \times 5 \times 4 = 8$ $\boxed{0}$

So, unit digit will be 0.

**28.** (D) $(4152)^{51} \times (3268)^{67} \times (5913)^{83} \times (6217)^{103}$

Unit digit of $(4152)^{51} \Rightarrow (....2)^3 = 8$

Unit digit of $(3268)^{67} \Rightarrow (....8)^3 = 2$

Unit digit of $(5913)^{83} \Rightarrow (....3)^3 = 7$

Unit digit of $(6217)^{103} \Rightarrow (...7)^3 = 3$

So, unit digit of $(4152)^{51} \times (3268)^{67} \times (5913)^{83} \times (6217)^{103}$

$= 8 \times 2 \times 7 \times 3 = 33$ $\boxed{6}$

Hence, unit digit is 6.

## Finding Last two digits

**29.** (A) By general understanding,

In the given 200 digit number, zero are increasing after 123 digits. So it is clear that last digit will also be 100 of the above number.

**30.** (C) To find the last two digits of the product *ab*, we have to find the remainder when *ab* is divided by 100

$(2345 \times 6789) \bmod 100$

$= [2345 \bmod 100 \times 6789 \bmod 100] \bmod 100$

$= [45 \times 89] \bmod 100$

$= 4005 \bmod 100 = 05$

**31.** (C) To find the last two digits of $99^{45}$, we have to find the remainder when $99^{45}$ is divided by 100.

$(99)^{45} \bmod 100$

$= (-1)^{45} \bmod 100$

$= 100 - 1 = 99$

**32.** (B) To find the last two digits of $(49)^{158}$, we have to find the remainder when $(49)^{158}$ is divided by 100.

$= (49)^{158} \bmod 100$

$= (49^2)^{79} \bmod 100$

$= (2401)^{79} \bmod 100$

$= (01)^{79} = 01$

## Total number of digits

**33.** (C) Number of digits

| | | |
|---|---|---|
| 1 to 9 | $-1 \times 9 =$ | 9 |
| 10 to 19 | $-2 \times 10 =$ | 20 |
| 20 to 29 | $-2 \times 10 =$ | 20 |
| 30 to 39 | $-2 \times 10 =$ | 20 |
| 40 to 49 | $-2 \times 10 =$ | 20 |
| 50 | $-2 \times 1 =$ | 2 |
| | Total digits = | 91 |

**34.** (C) 1 – 9 (9 digits)

10 – 99 (90 numbers, 2 digits each = 180 digits

100 – 300 (300 – 100 + 1 = 201 numbers, 3 digits each = 603)

adding all the numbers of digits, we have = 9 + 180 + 603 = 612 + 180

= 792

**35.** (C) Total three digit number from 100 to 1000 = 900

$\Rightarrow$ Total digits = $900 \times 3 = 2700$

& 1 four digit number = 1000

total digit = 4

So, sum of total digits = 2700 + 4

= 2704

## Number of Trailing Zeroes

**36.** (C) **By Logical Method,**

| Months | Rupees + Turban |
|---|---|
| 12 | ₹ 90 + Turban ...(i) |
| 9 | ₹ 65 + Turban ...(ii) |
| 3 | ₹ 25 |

If ₹ 25, is received for 3 months then money will receive for 9 months

$= 3 \times 25 =$ ₹ 75

But from equation (ii),

₹ 65 + Turban = ₹ 75

$\Rightarrow$ Turban = ₹ 75 – ₹ 65

= ₹ 10

**37.** (C) $\because$ Number of zeroes in the product of natural numbers from 1 to 100 = 24

$\therefore 2 \times 4 \times 6 \times 8 \times ..... \times 198 \times 200$

$= 2 (1 \times 2 \times 3 \times 4 \times ..... \times 99 \times 100)$

So, number of zeroes = 24

**38.** (B) $625 \times 101 \times 2 \times 155$

Zero will be formed by 2 and 5.

So, $625 = 5 \times 5 \times 5 \times 5 \times 1$

$101 = 101 \times 1$

$2 = 2 \times 1$

$155 = 5 \times 23 \times 1$

So, no. of 2's = 1

4 no. of 5's = 5

$\Rightarrow$ no. of zeroes = 1

**39.** (D) Number of zeroes in 257! is

$\left[\frac{257}{5}\right] + \left[\frac{257}{5^2}\right] + \left[\frac{257}{5^3}\right]$

$= 51 + 10 + 2$

$= 63$

**40.** (B) $3 \times 6 \times 9 \times 12 \times ..... \times 375$

$= 3^{125} (1 \times 2 \times 3 \times ..... \times 125)$

$= 3^{125} \times (125!)$

Number of zeroes in $3^{125} \times (125!)$ is

$\left[\frac{125}{5}\right] + \left[\frac{125}{5^2}\right] + \left[\frac{125}{5^3}\right]$

$= 25 + 5 + 1$

$= 31$

**41.** (B) $(10 \times 20 \times 30 \times 40 \times ..... \times 1000)$

$= 10^{100} [1 \times 2 \times 3 \times ..... \times 100]$

$= 10^{100} \times (100!)$

Number of zeroes in (100!) is

$\left[\frac{100}{5}\right] + \left[\frac{100}{5^2}\right]$

$= 20 + 4 = 24$

Number of zeroes in $10^{100} \times (100!)$

$= 100 + 24 = 124$

## Language Based problems ( 2 Digit No. & 3 digit No.)

**42.** (D) **By Mean Method,**

Mean of numbers = $\frac{\text{Sum}}{2}$

$= \frac{45}{2} = 22.5$

Mean of difference = $\frac{15}{2} = 7.5$

So, larger number = 22.5 + 7.5 = 30

and smaller number = 22.5 – 7.5

= 15

**43.** (C) **By Formula method,**

Product

$= \frac{(\text{sum} + \text{difference})(\text{sum} - \text{difference})}{4}$

$= \frac{(5+3)(5-3)}{4}$

$= \frac{8 \times 2}{4} = 4$

**44.** (D) According to the question,

$x + 2y = 8$ ....(i)

$x - y = 2$ ....(ii)

On solving equations (i) and (ii),

$y = 2$

and $x = 4$

So, positive integer = 4, 2

**45.** (B) According to question,

$A + B = 120$ ....(i)

$B + C = 130$ ....(ii)

$C + A = 140$ ....(iii)

On adding eqns. (i), (ii) and (iii)

$2 (A + B + C) = 390$

$A + B + C = 195$ ....(iv)

On subtracting eq. (i) from eq. (iv),

$C = 195 - 120 = 75$

**46.** (B) Let,

Third number = $x$

$\therefore$ Second number = $4x$

$\therefore$ First number = $2x$

Now, $2x + 4x + x = 2$

$\Rightarrow x = \frac{2}{7}$

$\therefore$ Second number = $4 \times \frac{2}{7} = \frac{8}{7}$

**47.** (A) Let three positive integers be $x$, $y$ and $z$.

According to the question,

$$x^2 + y^2 + z^2 = 323 \quad ...(i)$$

$$x^2 + y^2 = 2z \quad ...(ii)$$

From equations (i) and (ii),

$$z^2 + 2z = 323$$

$$\Rightarrow \quad z^2 + 2z - 323 = 0$$

$$z^2 + 19z - 17z - 323 = 0$$

$$z(z + 19) - 17(z + 19) = 0$$

$$\Rightarrow \quad (z + 19)(z - 17) = 0$$

$$\Rightarrow \quad z = 17$$

$\therefore$ By eq. (ii), $x^2 + y^2 = 34$

It is clear from the above equation that values of $x$ and $y$ will be less than 6

So, on choosing the required values,

$$3^2 + 5^2 = 34$$

$$\Rightarrow \quad 9 + 25 = 34$$

$$\Rightarrow \quad 34 = 34$$

$$\therefore \quad x = 3, y = 5$$

and $z = 17$

So, product $= 3 \times 5 \times 17 = 255$

**48.** (D) $a = 2b$ and

$$\frac{3a + 4b}{2} > 50$$

$$\Rightarrow \quad 3a + 2a > 100$$

$$\Rightarrow \quad 5a > 100$$

$$\Rightarrow \quad a > 20$$

So, Required value $= 21$

**49.** (D) Let number of members of club be $x$

According to the question,

Contribution of rupees $= x \times x = x^2$

$$\text{Contribution of paise} = \frac{x \times x}{100} = \frac{x^2}{100}$$

So, $$x^2 + \frac{x^2}{100} = 2525$$

$$\Rightarrow \quad \frac{101}{100}x^2 = 2525$$

$$\Rightarrow \quad x^2 = \frac{2525 \times 100}{101}$$

$$= 2500$$

$$\Rightarrow \quad x = \sqrt{2500} = 50$$

**50.** (C) According to the question,

$$\frac{A - 3}{B + 3} = \frac{1}{3} \text{ and } \frac{A + 2}{B - 2} = \frac{1}{2}$$

$\Rightarrow$ $3A - B = 12$ and $2A - B = -6$

On solving the above equations,

$$B = 42$$

**51.** (B) Let number of correct answers $= x$

$\therefore$ Number of incorrect answers

$$= 200 - x$$

According to the question,

$$4x - (200 - x) \times 1 = 200$$

$$4x - 200 + x = 200$$

$$5x = 400$$

$$x = 80$$

**52.** (C) Let two numbers be $x$ and $y$.

According to the question,

$$xy = 48$$

and $$x = \frac{2 + 5 \times 2}{3}$$

$$x = \frac{12}{3} = 4$$

then, $$y = \frac{48}{4} = 12$$

**53.** (D) According to the question, only the factors of 50 *i.e.*, 1, 2, 5, 10, 25 and $50^{th}$ person will keep the marble in $50^{th}$ box. So total number of marbles in $50^{th}$ box

$$= 1 + 2 + 5 + 10 + 25 + 50$$

$$= 93$$

**54.** (B) Let, Weight of water $= x$ kg.

and, Weight of container $= y$ kg.

According to the question,

$$x + y = 2.25 \quad ....(i)$$

$\because$ 0.2 part of container is filled with water.

$$\therefore \quad 0.2x + y = 0.77 \quad ....(ii)$$

On solving equations (i) and (ii),

$$0.8x = 1.48$$

$$\Rightarrow \quad x = 1.85 \text{ kg}$$

So, $$y = 2.25 - 1.85$$

$$y = 0.40 \text{ kg}$$

Since, now water is filled in 0.4 part of vessel. Then, total weight of vessel will be :

$$= 0.4x + y$$

$$= 0.4 \times 1.85 + 0.40$$

$$= 1.14 \text{ kg}$$

**55.** (C) Let the number be $x$.

According to the question,

$$x^2 - 25 = (x - 25)^2$$

$$\Rightarrow \quad x^2 - 25 = x^2 - 50x + 625$$

$$\Rightarrow \quad 50x = 650$$

$$\Rightarrow \quad x = 13$$

$\therefore$ The number is 13.

**56.** (D) Let the number of cows be G and number of hens be M. Then,

According to the question,

$$G + M = 180 \quad ...(i)$$

(Number of heads)

and $$4G + 2M = 420$$

(Number of legs)

$$\Rightarrow \quad 2G + M = 210 \quad ...(ii)$$

On subtracting equation (ii) from equation (i),

$$G = 30$$

So, Number of cows $= 30$

**57.** (D) Let, number of seats in each bus $= x$

So, Total seats in three buses $= 3x$

According to the question,

$$\text{No. of passengers} = \frac{4}{5} \times 3x = \frac{12x}{5}$$

$\because$ $\frac{1}{4}$ passengers leaves the journey

$\therefore$ Number of remaining passengers

$$= \frac{12x}{5} - \frac{12x}{5} \times \frac{1}{4}$$

$$= \frac{12x}{5} - \frac{3x}{5}$$

$$= \frac{9x}{5}$$

$\therefore$ Number of occupied seats by remaining passengers in two buses

$$= \frac{\frac{9x}{5}}{2x} = \frac{9}{10}$$

**58.** (A) Let, two-digit number $= 10y + x$

According to the question,

$$10x + y - (10y + x) = 63$$

$$9x - 9y = 63$$

$$x - y = 7$$

So, it is clear that, we will get

$y = 0, 1, 2$ for $x = 7, 8, 9$

**59.** (D) Let, two-digit number $= 10x + y$

According to the question,

$10x + y + 10y + x =$ perfect square number

$\Rightarrow$ $11(x + y) =$ perfect square number

So, the value of $x + y$ must be 11 to be a perfect square number.

$\therefore$ Possible pairs—(2, 9), (9, 2), (3, 8), (8, 3), (4, 7), (7, 4), (5, 6) and (6, 5)

$\Rightarrow$ Total numbers $= 8$

**60.** (D) Present height $= 64$ cm

Height of tree after first year

$$= 64 + \frac{1}{8} \times 64 = 72 \text{ cm}$$

Height of tree after second year

$$= 72 + \frac{1}{8} \times 72 = 81 \text{ cm}$$

**61.** (C) 64329

1752 remainder I

1149 remainder II

213 remainder III

First stage = 643 – 175 = 468

Second stage = 1752 – 114 = 1638

Third stage = 1149 – 213 = 936

∴ Divisor = HCF of 468, 1638 and 936

= 234

**62.** (D) Let, number of boys = $x$

and number of girls = $y$

So, $x + y = 85$ ...(i)

∵ Number of mangoes, each boy got = 4

Number of mangoes, each girl got = 5

Now, according to the question,

∴ $4x + 5y = 380$ ...(ii)

On solving equations (i) and (ii)

$x = 45$

**63.** (C) Let the number be $x$.

According to the question,

$2x + 20 = 8x - 4$

$\Rightarrow 6x = 24$

$\Rightarrow x = 4$

So, the number is 4.

**64.** (B) ∵ 1 yard = 36 inch

and 1 inch = 2.54 cm

∴ 1 yard = 36 × 2.54 cm

∴ 100 yard = $\frac{36 \times 2.54}{100}$ 100 metre

= 91.44 m

So, 100 – 91.44 = 8.56 m

**65.** (C) Let the missed number in the sum of $n$ natural numbers is $x$

So, according to the question,

$$\frac{n(n+1)}{2} - x = 177$$

$n(n + 1) = 354 + 2x$

Let, $x = 13$

$n(n + 1) = 354 + 26$

$= 380$

$n(n + 1) = 19(19 + 1)$

So, required number = 13

**66.** (C) Number divisible by 7 from 0 to 999 are :

$$= \frac{999}{7} = 142\frac{5}{7} \approx 142$$

∵ The number which are divisible by both 5 and 7

= 142 + 199 – 28

= 313

∴ Numbers divisible by 5 or 7

= 999 – 313

= 686

**67.** (C) Let the number of cars be $x$ and number of scooters be $y$

According to the question,

$4x + 2y = 2(x + y) + 100$

$\Rightarrow 4x + 2y = 2x + 2y + 100$

$\Rightarrow 2x = 100$

$\Rightarrow x = 50$

**68.** (C) Let, number = $10x + y$

From question,

$xy = 24$ ...(i)

and $(10x + y) + 45 = 10y + x$

or $9(y - x) = 45$

or $y - x = 5$ ...(ii)

By formula,

$(y + x)^2 = (y - x)^2 + 4yx$

$= (5)^2 + 4 \times 24$

$= 25 + 96$

∴ $(y + x) = \sqrt{121}$

$\Rightarrow y + x = 11$ ...(iii)

On solving equations (ii) and (iii)

$y = 8$ and $x = 3$

So, required two digit number

$= 10 \times 3 + 8 = 38$

**69.** (A) Let, total number of students = $m$

From question,

$m \times 2m = 1800$

$\Rightarrow 2m^2 = 1800$

$\Rightarrow m = \sqrt{900} = 30$

So, total number of students = 30

**70.** (C) Let, Second number is $x$, then

First number will be $3x$

∴ Third number $= 3x \times \frac{2}{3} = 2x$

From question,

$3x + x + 2x = 252$

$\Rightarrow 6x = 252$

$\Rightarrow x = 42$

**71.** (C) Let the tens digit of required number = $x$

then, Unit digit = $2x$

∴ Number = $10x + y$

$= 10x + 2x = 12x$

From question,

$$3x - 2 = \frac{1}{6} \times 12x$$

$3x - 2 = 2x$

$x = 2$

∴ Required number = 12 × 2 = 24

**72.** (B) Let, three consecutive even numbers are $2x$, $2x + 2$ and $2x + 4$. Then from question,

Sum = $2x + 2x + 2 + 2x + 4$

= $6x + 6$ or $6(x + 1)$

So, the sum will always be divisible by 6.

**73.** (A) From the given options, only option (A) *i.e.*, 81 is such a number whose tens digit is 7 more than its ones digit and 81 – 63 = 18 (Required new number)

## Miscellaneous

**74.** (C) Required number = $41\frac{2}{3} \div \frac{1}{6}$

$$= \frac{125}{3} \times 6 = 250$$

**75.** (A) **By Logical Method,**

Required option = $\frac{3}{4} \times \frac{2}{3}$

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

**76.** (C)
$$\begin{array}{r} 5E9 \\ 2F8 \\ 3G7 \\ \hline 1114 \end{array}$$

Here, 2 + E + F + G will be 11

$\Rightarrow$ E + F + G = 11 – 2 = 9

So, the values of E and G will be zero, for the maximum value of F.

then, F = 9

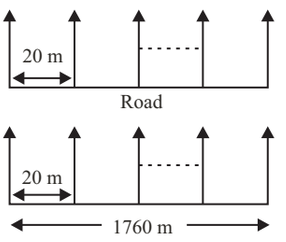
**77.** (C) Prime numbers between 80 and 90

= 83, 89

So, Product = 83 × 89

= 7387

**78.** (B) **By Logical Method,**



∵ Distance between two consecutive trees = 20 m

Number of trees on one side of road

$$= \frac{1760}{20} + 1 = 89$$

So, number of trees on both sides of road = 2 × 89 = 178

**79.** (D) Every natural number is not an integer.

**80.** (A) (68, 69, 70, 72, 74, 75 .... 100)

Numbers greater than 1, which are not prime, are called "composite number".

So, Numbers = 27

**81.** (C) **By Formula Method,**

Sum of cubes of first $n$ odd natural numbers,

$$= n^2 (2n^2 - 1)$$

here $n = 9$

$$\therefore \quad \text{Sum} = 9^2 (2 \times 9^2 - 1)$$

$$= 81 \times 161$$

$$= 13041$$

**82.** (A) ∵ Here monthly cost of C.N.G. in each condition = ₹ 2400

∴ When price is ₹ 80, then monthly usage of C.N.G.

$$= \frac{2400}{80} = 30 \text{ litres}$$

**83.** (C) A + B + AB = 65 where (A, B ≤ 15)

A + B + AB = 10 + 5 + 10 × 5

(On dividing 65)

On comparing both sides,

A = 10 and B = 5

So, A – B = 10 – 5 = 5

**84.** (D) Let the integer between 100 and 1000

$$= 100x + 10y + z$$

From question,

$$(100x + 10y + z) - (x + y + z)$$

$$= (100x - x) + (10y - y)$$

$$= 99x + 9y$$

$$= 9(11x + y)$$

So, the above number will divisible by 9.

**85.** (C) Given, $a * b = a + b$, $a > 0$, $b > 0$ and $a * b = \sqrt{a^2 + b^2}$, for other values of $a$, $b$

Now,

$$\frac{8*(7-13)-(3*1)}{(3-6)*(9-5)}$$

$$= \frac{8*(-6)-(3+1)}{(-3)*(4)}$$

$$= \frac{\sqrt{(8)^2 + (-6)^2} - 4}{\sqrt{(-3)^2 + (4)^2}}$$

$$= \frac{10-4}{5} = \frac{6}{5}$$

# Exercise–1 (B)

## Remainder Theorem

**1.** S is the set of positive integers such that when divided by 2, 3, 4, 5, 6 leaves the remainders 1, 2, 3, 4, 5 respectively. Find that how many numbers between 0 and 100 will belong to Set S ?

(A) 0 (B) 1

(C) 2 (D) 3

**2.** A number is formed by writing together first 32 natural numbers in the form of 1 2 3 4 5 6 7 8 9 10 11 12 .....Find the value of remainder obtained by dividing this formed number by 8.

(A) 0 (B) 1

(C) 2 (D) 4

**3.** Three students divide a number by 385 using factorization method. They write the numbers obtained in factorization in series of 11, 7, 5; 5, 7, 11 and 7, 5, 11 respectively. If the first student has obtained 3, 2 and 1 respectively as remainder, then find the remainders obtained by other two.

(A) (2,6,2) ; (4,4,2)

(B) (2,2,6) ; (2,4,4)

(C) (2,6,6) ; (4,2,4)

(D) (2,2,6) ; (4,4,4)

**4.** If number 99999111 is divided by number 9999, then the value of remainder will be :

(A) 1119 (B) 9111

(C) 9991 (D) 9911

**5.** On dividing numbers 2272 and 875 by a three-digit number, we get the same remainder. Find the sum of the digits of the number.

(A) 13 (B) 12

(C) 11 (D) 10

**6.** If the square of any odd number, which is greater than 1 is divided by 8 then the remainder will be :

(A) 1 (B) 6

(C) 8 (D) 5

**7.** What will be the remainder on dividing the number $2^{1000}$ by 3 ?

**[CAT]**

(A) 1 (B) 2

(C) 4 (D) 6

**8.** When the number $9^{1000}$ is divided by 8, find the remainder. **[CAT]**

(A) 1 (B) 5

(C) 8 (D) 0

**9.** If $n$ is divided by 7, then the remainder is 4. If $3n + 1$ is divided by 7, then the remainder will be :

**[UPPSC, 2014]**

(A) 0 (B) 3

(C) 5 (D) 6

**10.** What is the least positive integer, which divided by 4, 5, 6 and 8 leaves a remainder 3, but when divided by 9 leaves no remainder ? **[UPPSC, 2013]**

(A) 729 (B) 363

(C) 123 (D) 243

**11.** On dividing a certain number by 342, we get 47 as remainder. If the same number is divisible by 19, then what will be the remainder ?

**[BPSC, 2018]**

(A) 0 (B) 9

(C) 18 (D) 8

(E) None of the above/More than one of the above

**12.** The product of three consecutive positive numbers when divided by each number turn by turn the sum of three quotients is 74. What will be sum of three numbers ? **[RAS/RPSC, 2018]**

(A) 17 (B) 12

(C) 19 (D) 15

**13.** Find the smallest number which divided by 5, 6, 7, 8 leaving remainder 3 and the number is also a multiple of 9.

**[RRB Exam., 2019]**

(A) 1983 (B) 1677

(C) 1683 (D) 843

**14.** Find the remainder on dividing $(12^{13} + 12)$ by 13. **[RRB Exam., 2019]**

(A) 11 (B) 2

(C) 12 (D) 1

**15.** A number when divided by 10, 9 and 8 individually leaves the remainders 9, 8 and 7 respectively. Find the smallest number. **[RRB Exam., 2019]**

(A) 359 (B) 719

(C) 353 (D) 1359

**16.** Two numbers are $x$ and $y$. $x$ is the least number that, when divided by 3 and 7, leaves the remainder 2 each time $y$ is the least number that, when divided by 5 and 11, leaves remainder 4 each time, then what will be the value of $x + y$ ?

**[UPSSSC Nalkoop Chalak (Tubewell Operator) Exam., 2018]**

(A) 88 (B) 82

(C) 79 (D) 73

**17.** Each of the digits 1, 2, 3, 4, 5 and 6 are used exactly once to form a six digit number abcdef. Such that three digit number abc is divisibly by 4, bcd is divisible by 5, cde is divisible by 3 and def is divisible by 11. The number is :

**[UPSSSC Vikas Dal Adhikari (General Selection) Exam., 2018]**

(A) 325461 (B) 324651

(C) 324561 (D) 326451

**18.** A number when divided by 52 leaves a remainder 44. What will be the remainder if the same number is divided by 13 ?

(A) 2 (B) 3

(C) 4 (D) 5

**19.** A number when divided by 6, then leaves remainder 5. When divided by 5, then leaves remainder 4. When divided by 4, then leaves remainder 3. When divided by 3, then leaves remainder 2. When divided by 2, then leaves remainder 1. The number is :

**[UPSSSC Cane Supervisor Exam., 2016]**

(A) 59 (B) 49

(C) 29 (D) 19

**20.** When the remainder obtained on dividing 80808 by 108 is divided by the remainder obtained on dividing 90909 by 109, then the quotient is :

**[CTET, 2016]**

(A) 6 (B) 8

(C) 12 (D) 3

**21.** The product of remainders obtained by $19009 \div 11$ and $9090 \div 11$

**[CTET, 2014]**

(A) 5 (B) 8

(C) 12 (D) 4

**22.** Find the remainder, when $[(2222)^{5555} + (5555)^{2222}]$ is divided by 7 :

(A) 0 (B) 2

(C) 5 (D) 7

**23.** What is the remainder when ($127^{97}$ + $97^{97}$) is divided by 32 ?

(A) 2 (B) 4

(C) 0 (D) 7

**24.** When 7897, 8110 and 8536 are divided by the greatest number $x$, then the remainder, in each case is the same. The sum of the digits of $x$ is :

**[SSC CGL. TIER-II, 11-09-2019]**

(A) 14 (B) 5

(C) 9 (D) 6

**25.** Two positive numbers differ by 2001. When the larger number is divided by the smaller number, the quotient is 9 and the remainder is 41. The sum of the digits of the larger number is :

**[SSC CGL. TIER-II, 13-09-2019]**

(A) 15 (B) 11

(C) 10 (D) 14

**26.** If $x$ is the remainder when $3^{61284}$ is divided by 5 and $y$ is the remainder when $4^{96}$ is divided by 6, then what is the value of $(2x - y)$ ?

**[SSC CGL. TIER-II, 13-09-2019]**

(A) – 4 (B) 4

(C) – 2 (D) 2

**27.** N is the largest two digit number, which when divided by 3, 4 and 6 leaves the remainder 1, 2 and 4 respectively. What is the remainder when N is divided by 5 ?

**[SSC CGL TIER-II, 17-02-2018]**

(A) 4 (B) 2

(C) 0 (D) 1

## Divisibility Rules

**28.** Let $k$ be a positive integer such that $(k + 4)$ is divisible by 7. Then, the smallest positive integer $n$ $(n > 2)$, such that $(k + 2n)$ is divisible by 7, equals :

**[CAT, 2006]**

(A) 9 (B) 7

(C) 5 (D) 3

**29.** If $x$ is a positive integer such that $(2x + 12)$ is exactly divisible by $x$, then the number of all possible values of $x$ will be :

**[CAT, 2006]**

(A) 2 (B) 5

(C) 6 (D) 12

**30.** How many 5 digit numbers can be formed using the digits 2, 3, 5, 7, 8 exactly once, such that these numbers are divisible by 125 ? **[CAT, 2008]**

(A) 0 (B) 1

(C) 4 (D) 3

**31.** How many even numbers, where $100 \le n \le 200$, are divisible neither by 7 nor by 9 ?

**[CAT, 2003 (L)]**

(A) 40 (B) 37

(C) 39 (D) 38

**32.** Let $b$ be a positive integer and $a = b^2 - b$ If $b \ge 4$, then $a^2 - 2a$ will be divisible :

**[CAT, 2001]**

(A) By 15

(B) By 20

(C) By 24

(D) All of the above

**33.** If all the two-digit multiples of 8 are reversed, then how many numbers from obtained results are there, which are divisible by 4 but not from 8 ?

**[CAT, 2009]**

(A) 3 (B) 4

(C) 2 (D) 1

**34.** Find the number $n$ of all such positive integers between 12 and 40, when $\underline{|n-1}$ is not divisible by number $n$.

(A) 5 (B) 7

(C) 13 (D) 14

**35.** Which of the following given numbers, exactly divides ($106^{90} - 49^{90}$) ?

**[CAT, 2015]**

(A) 589 (B) 186

(C) 124 (D) None of these

**36.** Consider a four digit number for which the first two digits are equal and the last two digits are also equal. Find all such numbers which are perfect squares.

(A) 3 (B) 4

(C) 2 (D) 1

**37.** If X and Y are two digits of a number 347XY, such that the number becomes exactly divisible by 80, then what is the value of X + Y ?

**[SSC CGL, 2017]**

(A) 2 (B) 4

(C) 6 (D) 8

**38.** Let $x$ be a natural number such that $\frac{1}{x}+\frac{1}{7}+\frac{1}{3}+\frac{1}{2}$ is also a natural number. Which of the following statement is false ?

(A) $x > 84$ (B) 7 divides $x$

(C) 3 divides $x$ (D) 2 divides $x$

**39.** Find the values of $x$ and $y$ in the number $422213xy$ if this number is exactly divisible by 99.

(A) 3, 7 (B) 5, 5

(C) 4, 6 (D) 1, 9

**40.** The highest power of 7 that exactly divides 80 !, is : **[CAT]**

(A) 15 (B) 14

(C) 13 (D) 12

**41.** The highest power of 12 that exactly divides 122 ! :

**[CAT]**

(A) 56 (B) 58

(C) 60 (D) 62

**42.** Number X! is exactly divisible by $11^{51}$ but not by $11^{52}$. What will be the sum of digits of such greatest number X ?

**[CAT]**

(A) 13 (B) 14

(C) 15 (D) 16

**43.** If 54321A is divisible by 9, then find the value of 'A'. **[RRB Exam., 2019]**

(A) 0 (B) 2

(C) 4 (D) 3

**44.** Find the value of Z, if the number 417Z8 is divisible by 8. **[UPTET, 2020]**

(A) 7 (B) 9

(C) 3 (D) 6

**45.** Each digit of a natural number is either 3 or 4. The number is divisible by both 3 and 4. What is the smallest such number ?

**[UPTET, 2017]**

(A) 333 (B) 444

(C) 44 (D) 4444

**46.** The least perfect square number which is divisible by 3, 4, 5, 6, 8 is :

**[HTET, 2017]**

(A) 4900 (B) 1600

(C) 2500 (D) 3600

**47.** $2^{10} - 1$ is divisible by : **[HTET, 2018]**

(A) 2 (B) 3

(C) 4 (D) 10

**48.** What power of 15, completely divides 87! ?

(A) 21 (B) 29

(C) 20 (D) 24

**49.** Find the least perfect square, which is divisible by 7! **[IIFT, 2010]**

(A) 44100 (B) 176400

(C) 705600 (D) 19600

**50.** For two positive integers $a$ and $b$, $(a + b)^{a+b}$ is divisible by 500, then what will be the minimum possible value of $ab$?

**[XAT, 2016]**

(A) 8 (B) 9

(C) 10 (D) 12

## Finding Unit Digit

**51.** If $n$ is a natural number, then which of the following will have zero at its unit place ?

**[Bihar Police Constable Exam., 2014]**

(A) $(3 \times 2)^n$ (B) $(3 \times 5)^n$

(C) $(2 \times 5)^n$ (D) $(6 \times 2)^n$

**52.** The digit at units place of number $3^{99} - 3^{50}$ is : **[UPTET, 2016]**

(A) 0 (B) 4
(C) 6 (D) 8

**53.** If the unit digit of (433 × 456 × 43N) is (N + 2), then what is the value of N ?
**[SSC CGL. TIER-II, 09-03-2018]**

(A) 1 (B) 8
(C) 3 (D) 6

**54.** Let $x = (633)^{24} - (277)^{38} + (266)^{54}$. What is the unit's digit of $x$ ?
**[SSC CGL. TIER-II, 11-09-2019]**

(A) 7 (B) 6
(C) 4 (D) 8

**55.** If $x = (164)^{169} + (333)^{337} - (727)^{726}$, then what is the unit's digit of $x$ ?
**[SSC CGL. TIER-II, 12-09-2019]**

(A) 5 (B) 7
(C) 8 (D) 9

## Finding Last two digits

**56.** The last two digits of a 200 digit number 123012300123000123000 .....is :
**[RAS/RPSC, 2013]**

(A) 00 (B) 01
(C) 12 (D) 23

## Total number of digits

**57.** Z is the product of first 31 natural numbers. If X = Z + 1, then the numbers of primes among X + 1, X + 2,....,X + 29, X + 30 is : **[MAT, 2018]**

(A) 30
(B) 2
(C) Cannot be determined
(D) None of the above

**58.** If N = 1 + 11 + 111 + 1111 + .... + 111111111, then what is the sum of the digit's of N ?

(A) 45 (B) 18
(C) 36 (D) 5

## Number of Trailing Zeroes

**59.** How many zeroes are there in the end of $\underline{|10}$ ? **[CAT, 2008]**

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

**60.** Find the number of zeroes in the end of 1400 ! **[CAT]**

(A) 336 (B) 347
(C) 348 (D) 349

**61.** Find the number of zeroes in the product $5 \times 10 \times 25 \times 40 \times 50 \times 55 \times 65 \times 125 \times 80$.
**[CAT]**

(A) 8 (B) 9
(C) 12 (D) 13

## Language Based problems (2 Digit No. & 3 digit No.)

**62.** The cost of 72 books is ₹ $x96.7y$. What will be the cost of each book, when the positive integers $x$ and $y$ are not known ?
**[CAT, 2005]**

(A) ₹ 3.23 (B) ₹ 5.11
(C) ₹ 5.51 (D) ₹ 7.22

**63.** If $3x + y + 4 = 2xy$ where, $x$ and $y$ are natural numbers, then the ratio of sum of all possible values of $x$ and sum of all possible values of $y$ will be :
**[UPSC (CSAT), 2010]**

(A) $\frac{2}{3}$ (B) $\frac{15}{19}$

(C) $\frac{17}{21}$ (D) $\frac{7}{9}$

**64.** If the digits $x$, $y$ and $z$ represent a number in the direction from left to right, then find the number.

(A) $100x + 10y + z$
(B) $x + 10y + 100z$
(C) $xyz$
(D) $10x + y + 100z$

**65.** If $x$ and $y$ both are odd numbers, then which of the following will be an even number ?

(A) $x + y$ (B) $xy$
(C) $x + y + 1$ (D) $xy + 2$

**66.** If $x$ and $y$ are two numbers such that $xy = 0$, then :

(A) $x = 0$ and $y \neq 0$
(B) $x = 0$ or $y = 0$ or both
(C) $x \neq 0$ and $y = 0$
(D) $x \neq 0$ and $y \neq 0$

**67.** A four-digit number is formed by the repetition of 2 digits, *e.g.*,–4040, 2525 etc. The number formed in this way will exactly divisible by :

(A) By 7
(B) By 11
(C) By 13
(D) By the smallest prime number of three-digits

**68.** Divide 26 into two parts so that the product is maximum. **[CAT]**

(A) 14, 12 (B) 15, 11
(C) 16, 10 (D) 13, 13

**69.** XYZ is a three-digit number such that when we calculate the difference between two three-digit numbers XYZ and YXZ, then the result is exactly 90. Find the number of possible values of X and Y.
**[CAT]**

(A) 6 (B) 7
(C) 8 (D) 9

**70.** The square root of a two-digit number gives a prime number. The sum of two digits of such a number is :
**[MPPSC, 2017]**

(A) 8 (B) 13
(C) 10 (D) 15

**71.** An office has odd number of cabins. In each cabin, there are fans and bulbs fitted. The number of bulbs in each cabin is twice the number of fans in the cabin. All the cabins have the same number of bulbs. The total number of bulbs and fans in all the cabins together is equal to 30. How many cabins are there in the office ? **[MPPSC, 2017]**

(A) 3 (B) 5
(C) 7 (D) 9

**72.** The sum of five consecutive numbers is greater than 665 but less than 675. The sum of even numbers in the set of five numbers is :
**[MPPSC, 2017]**

(A) 406 (B) 404
(C) 402 (D) 400

**73.** A sequence of three numbers is generated such that the next number in the sequence is square of the previous number. The sum of all these three numbers in the sequence has a magnitude between 50 and 99. What is the magnitude of the ratio between the first and the second digit of the sum ?
**[MPPSC, 2017]**

(A) 2 (B) 0.5
(C) 3 (D) 0.33

**74.** If a number when added to itself 13 times, gives 112, then the number will be :
**[MPPSC, 2016]**

(A) 8 (B) 9
(C) 10 (D) 11

**Direction (Q. No. 75 and 76)**

Following numbers are given below, answer the questions given below according to them.

738, 429, 615, 732, 894

**75.** Which of the following will be second digit of third number from top, if the first digit of each number is changed from its next maximum digit and arranged in decreasing order ?
**[MPPSC, 2016]**

(A) 2 (B) 3
(C) 5 (D) 7

**76.** After reversing the position of digits of each number. What will be the last digit

of second highest number from them ?

**[MPPSC, 2016]**

(A) 1 (B) 2

(C) 4 (D) 7

**77.** There are ducks and rabbits in a cage. If total heads are 28 in number and total feet are 72 in number, then what is the number of ducks and rabbits in cage ?

**[MPPSC, 2016]**

(A) 16, 12 (B) 20, 8

(C) 24, 4 (D) 14, 14

**78.** The following operations are done sequentially on a number as a result same number comes.

First divide by 2, after this take square root and in last do the cube.

What is the number ? **[MPPSC, 2016]**

(A) 64 (B) 27

(C) 8 (D) 216

**79.** A two-digit number is "PQ", whose sum of digits is 11. A new number "QP" can be formed by interchanging the digits of the original number. On subtracting "QP" from "PQ", we get 9. The original number "PQ" is : **[MPPSC, 2015]**

(A) 83 (B) 47

(C) 74 (D) 65

**80.** The sum of four consecutive two-digit odd numbers, when divided by 10, becomes a perfect square number. Which of the following numbers can possibly be one of these four consecutive numbers ?

**[MPPSC, 2012]**

(A) 21 (B) 25

(C) 41 (D) 67

**81.** A number has two digits. If the position of digits are interchanged and the new number is added to the original number then the resulting number will always be divisible by which of the following ?

**[UPPSC, 2012]**

(A) By 8 (B) By 9

(C) By 10 (D) By 11

**82.** Ramesh is asked to divide half of a number by 6 and other half by 4 and then to add the two quantities. Instead of doing so, Ramesh divides the given number by 8, then the answer is 8 short of the correct answer. Find the number :

**[BSSC Inter Level Exam., 2018]**

(A) 94 (B) 92

(C) 96 (D) 102

**83.** The difference between two numbers is 16 and the fifth part of their sum is 12. Find the smaller number.

**[BSSC First Inter Level (Re-Exam.) 2018]**

(A) 36 (B) 30

(C) 22 (D) 18

**84.** There are 50 questions in a competitive exam. 4 marks are awarded for each correct answer and 2 marks are deducted for each incorrect answer. If only 23 answers are correct and rest are incorrect then how many marks will be scored ?

**[BSSC J.E., 2018]**

(A) 92 (B) 54

(C) 34 (D) 38

**85.** The difference of two natural numbers is 4 and the difference of their reciprocals is $\frac{1}{8}$. What is the sum of the numbers ?

**[UPSSSC Revenue Inspector Exam., 2016]**

(A) 6 (B) 12

(C) 18 (D) 24

**86.** The sum of digits of a two-digit number is 8. If 36 is subtracted from the number, digits of the number gets interchanged. What is the number ?

**[UPSSSC Revenue Inspector Exam., 2016]**

(A) 26 (B) 35

(C) 53 (D) 62

**87.** The sum of two numbers is 14 and their difference is 10. Find the product of these two numbers.

**[UPSSSC Lower-III, 2016]**

(A) 18 (B) 20

(C) 24 (D) 22

**88.** The sum of squares of two numbers is 557 and product is 226, the number will be :

**[UPSSSC Lower-II Exam., 2015]**

(A) 7, 6 (B) 27, 23

(C) 17, 14 (D) 19, 14

**89.** The sum of a two-digit number and the number obtained by reversing its digits will always divisible :

**[UPSSSC Chakbandi Lekhpal Exam., 2015]**

(A) By 2 (B) By 3

(C) By 7 (D) By 11

**90.** I am a two-digit number.

The digit in tens place and the digit in units place are consecutive prime numbers.

The sum of digits is multiple of 3 and 4.

The number is :

**[CTET Paper-I (I to V), 2019]**

(A) 23 (B) 35

(C) 13 (D) 57

**91.** In a five-digit number, the digit at tens place is 8, the digit at units place is one-fourth of ten's place digit, the digit at thousand's place is 0, the digit at hundred's place is double the digit at unit's place and the digit at ten thousand's place is triple the digit at unit's place. What is the number ?

**[CTET, 2019]**

(A) 64028 (B) 46028

(C) 60482 (D) 64082

**92.** What number am I ?

I am a two-digit even number.

I am common multiple of 3, 4, 6.

I have total 9 factors. **[CTET, 2019]**

(A) 24 (B) 36

(C) 48 (D) 56

**93.** A number is smaller than half one hundred and lies between 4 tens and 5 tens. Its ones digit is one less than tens digit. If the sum of digits of the number is 7, then the product of the digits is :

**[CTET, 2016]**

(A) 16 (B) 20

(C) 24 (D) 12

**94.** Two whole numbers are given. If three times the larger number is divided by the smaller number, then we get 4 as the quotient and 8 as the remainder. If seven times the smaller number is divided by the larger number, we get 5 as the quotient and 1 as the remainder. The smaller number is : **[RTET, 2017]**

(A) 25 (B) 18

(C) 36 (D) 50

**95.** The train coach manufacturing plant manufactures 7 trains coaches in 45 days. How many days will it take in manufacturing of 7 trains with nine coaches ? **[Nayab Tehsildar Exam.]**

(A) 315 days (B) 405 days

(C) 395 days (D) 365 days

**96.** A man when asked how many buffaloes and hens he have, then he told that he has animals with 120 eyes and 180 legs. How many hens he has ?

**[HSSC Group-D, 2018]**

(A) 15 (B) 60

(C) 30 (D) None of these

**97.** In a cage, there are rabbits and birds. They have 35 heads and 98 feet. The number of rabbits in cage is :

**[HSSC Group-D, 2018]**

(A) 28 (B) 19

(C) 21 (D) 14

**98.** If all the numbers from 501 to 599 are written, then how many times the digit 6 will appear ?

**[Haryana Field Inspector- Store, 2017]**

(A) 11 (B) 12

(C) 20 (D) None of these

**99.** The difference between a two-digit number and the number obtained by interchanging the digits is 36. What will be the difference between the sum and the difference of the digits of the number, if the ratio between the digits of the number is 1 : 2 ?

**[Haryana Conductor Exam., 2016]**

(A) 8 (B) 16

(C) 4 (D) None of these

**100.** 1 is subtracted from a number M. The result is inversely taken to find the value of 'N'. Then, which of the following is true?

(A) $0 \leq M^N \leq 2$ (B) $1 < M^N < 3$

(C) $M^N > 3$ (D) $1 < M^N < 5$

## No. of Factors

**Direction (Q. No. 101 to 103)**

Two different prime numbers A and B are given. Find the number of divisors in the following questions.

**[CAT]**

**101.** A.B

(A) 2 (B) 4

(C) 6 (D) 8

**102.** $A^2.B$

(A) 2 (B) 4

(C) 6 (D) 8

**103.** $A^3.B^2$

(A) 2 (B) 4

(C) 6 (D) 12

**104.** Which of the following numbers has the most number of divisors ?

**[RRB Exam., 2019]**

(A) 172 (B) 200

(C) 156 (D) 240

**105.** How many odd composite factors exist in 1848 ?

**[UPSSSC J.E./Technical, 2016]**

(A) 4 (B) 3

(C) 2 (D) 1

## Miscellaneous

**106.** If $a$, $a + 2$ and $a + 4$ are prime numbers, then the total number of possible solutions for $a$ will be :

**[CAT, 2003 (R)]**

(A) 1 (B) 2

(C) 3 (D) < 3

**107.** $n^3$ is an odd number, which of the following statements is correct ?

**[CAT, 2008]**

I. $n$ is an odd number

II. $n^2$ is an odd number

III. $n^2$ is an even number

(A) Only I (B) Only II

(C) I and II (D) I and III

**108.** $(BE)^2 = MPB$, where B, E, M and P are distinct integers. Find the value of M.

**[CAT, 2008]**

(A) 2 (B) 3

(C) 9 (D) None of these

**109.** Fermat prime are those prime numbers which are represented in the form of $2^k + 1$, where $k$ is an integer and is represented in the power of 2. Which one among the following is not a fermat prime number ?

**[UPSC (CSAT), 2015]**

(A) 3 (B) 5

(C) 17 (D) 31

**110.** Machine A produces 100 parts twice as fast as machine B does. Machine B produces 100 parts in 40 minutes. If each machine produces parts at a constant rate then how many parts will machine A produce in 6 minutes ?

(A) 30 (B) 25

(C) 20 (D) 15

**111.** What will be the common factor of $\{(125)^{125} + (73)^{125}\}$ and $\{(125)^{73} + (73)^{73}\}$ ?

(A) 125 (B) 73

(C) 52 (D) 198

**112.** If $n$ is a natural number and sum of digits of $(10^n - 1)$ is 3087, then what will be the value of $n$ ?

(A) 256 (B) 392

(C) 343 (D) 523

**113.** How many prime numbers are there between 700 and 950 (including both), which are neither divisible by 7 nor by 3 ?

**[SSC CGL, 2017]**

(A) 107 (B) 141

(C) 144 (D) 145

**114.** How many times the keys of a typewriter have to be pressed in order to write numbers from 121 to 1346 ?

**[SSC CGL, 2017]**

(A) 3675 (B) 4018

(C) 4021 (D) 4025

**115.** Which of the following statement is/are true for natural numbers ?

(i) The smallest natural number is known

(ii) The greatest natural number is known

(iii) There is always a natural number between two consecutive natural numbers.

(A) Only (i) (B) (i) and (ii)

(C) Only (ii) (D) None of these

**116.** If $x$ is a rational number and $y$ is an irrational number, then :

(A) Both $(x + y)$ and $xy$ will be rational number.

(B) Both $(x + y)$ and $xy$ will be irrational number

(C) $xy$ is irrational, but $(x + y)$ will be either rational or irrational

(D) $(x + y)$ is irrational but $xy$ will be either rational or irrational.

**117.** A rational number between two rational numbers $a$ and $b$ will be :

(A) $ab$ (B) $\frac{a}{2}$

(C) $\frac{b}{2}$ (D) $\frac{a+b}{2}$

**118.** If the value of $x$ is greater than zero, but less than 1, the greatest number among the following will be :

(A) $\frac{1}{x^2}$ (B) $\frac{1}{x}$

(C) $x^2$ (D) $x$

**119.** If $x \times (|a| \times |b|) = -ab$, then the value of $x$ is :

(A) –1 (B) 0

(C) 1 (D) None of these

**120.** The additive and multiplicative operations of number are :

(A) Neither commutative nor associative

(B) Associative but not commutative

(C) Commutative but not associative

(D) Both commutative and associative

**121.** If $n = 1 + p$ and $p$ be the product of four consecutive integers, then the following is true :

I. $n$ is an odd integer.

II. $n$ is a prime number.

III. $n$ is a perfect square number.

(A) Only I (B) Only II

(C) Both I and II (D) Both I and III

**122.** How many numbers are there between 300 and 500 in which 4 comes only one time ?

(A) 89 (B) 99

(C) 110 (D) 120

**123.** $n\ (n + 1)\ (2n + 1)$ is a number, where $n$ is a positive integer, then which of the following is definitely wrong ?

**[MPPSC, 2012]**

(A) $n(n + 1)\ (2n + 1)$ is always an even number.

(B) $n(n + 1)\ (2n + 1)$ is always divisible by 3.

(C) $n(n + 1)\ (2n + 1)$ is always divisible by sum of squares of first '$n$' integers.

(D) $n(n + 1)\ (2n + 1)$ is never divisible by 237.

(E) None of these.

**124.** How many times will the digit 5 come in counting from 1 to 99 excluding those which are divisible by 3 ?

**[UPPSC, 2017]**

(A) 13 (B) 14

(C) 15 (D) 20

**125.** What is the sum of the predecessor of the greatest 2-digit number and the successor of the greatest 3-digit number ?

**[Bihar Vidhansabha Sahayak Exam., 2018]**

(A) 198 (B) 201

(C) 200 (D) 199

**126.** First even composite number is :

**[BSSC First Inter Level (Re-Exam.) 2018]**

(A) 8 (B) 2

(C) 4 (D) 6

**127.** There are 10 rows and 12 columns of mango trees in a garden. The distance between the two trees is 2 metres and a distance of 1 metre is left from all sides of the boundary of the garden. What will be the length of garden ?

**[BSSC First Inter Level (Re-Exam.) 2018]**

(A) 26 metres (B) 24 metres

(C) 28 metres (D) 22 metres

**128.** Which of the following does not represent zero ?

**[CSBC Bihar Police Exam., 2017]**

(A) $\frac{2}{0}$ (B) $1 \times 0$

(C) $0 \times 0$ (D) $\frac{10 - 10}{2}$

**129.** A machine which cuts a ribbon into pieces of 10 metres takes 6 second to make a single cut. How long will it take to completely cut into pieces a ribbon 3 km long ?

**[UPSSSC Gram Panchayat Adhikari Re-Exam., 2016]**

(A) 174 seconds (B) 180 seconds

(C) 1794 seconds (D) 1800 seconds

**130.** What is the sum of all natural numbers less than or equal to 100, which are multiple of 3 ?

**[UPSSSC Amin Exam., 2016]**

(A) 1683 (B) 3367

(C) 5050 (D) 10100

**131.** A cooler was sold in 5 instalments. Each instalment is double of the previous instalment. If first instalment is ₹ 300, then the cost of cooler is :

**[UPSSSC Amin Exam., 2016]**

(A) 8600 (B) 9000

(C) 9300 (D) 9600

**132.** What is the value of 5 in 357.21 ?

**[UPSSSC Lower-I Exam., 2015]**

(A) 5 tenth

(B) 5 tens

(C) 5 hundred

(D) None of the above

**133.** Which of the following statements is correct ? **[CTET, 2015]**

(A) The product of three odd numbers is an even number.

(B) The difference of an even number and an odd number can be an even number.

(C) Sum of two odd numbers and one even number is a even number.

(D) The sum of three odd numbers is an even number.

**134.** The sum of place values of 5 in 6251, 6521 and 5621 is : **[CTET, 2015]**

(A) 550 (B) 15

(C) 5550 (D) 5050

**135.** Which of the following statements is correct ? **[UPTET, 2020]**

(A) A composite number can be odd.

(B) There is no even prime number.

(C) The sum of two prime numbers is always a prime number.

(D) The smallest prime number is 1.

**136.** The smallest non-negative prime number is :

**[UPTET, 2020]**

(A) 2 (B) 0

(C) 1 (D) 3

**137.** If $x$ and $y$ are non zero real numbers then $x^2 + xy + y^2$ : **[UPTET, 2018]**

(A) Always positive

(B) Always negative

(C) Is zero for some values of $x$ and $y$

(D) Values of $x$ and $y$ can be both positive and negative.

**138.** $\pi$ is a : **[UPTET, 2017]**

(A) Rational Number

(B) Irrational Number

(C) Prime Number

(D) Integer

**139.** If $a$ is greater than $b$ by 2 and $b$ is greater than $c$ by 10 and $a + b + c = 130$, the value of $(b + c) - a$ is : **[HTET, 2019]**

(A) 28 (B) 32

(C) 34 (D) 44

**140.** Number 0.318564318564318564 is :

**[HPTET, 2018]**

(A) Natural number

(B) An integer

(C) A rational number

(D) An irrational number

**141.** The greatest number which on rounding off to nearest thousands will give 5000, is :

**[UTET, 2018]**

(A) 5001 (B) 5499

(C) 5500 (D) 5999

**142.** If $10^n + 34^{n+2} + k$ for all $n \in$ N is divisible by 9, then least positive indivisible value of $k$ is :

**[Delhi Subordinate Services Selection Commission, 2018]**

(A) 5 (B) 3

(C) 7 (D) 1

**143.** For all $n \in$ N, $3 \times 5^{2n+1} + 2^{3n+1}$ is divisible by.....

**[Delhi Subordinate Services Selection Commission, 2018]**

(A) 19 (B) 17

(C) 27 (D) 25

**144.** The sum of the greatest and the smallest numbers of 3 digits is : **[JTET, 2016]**

(A) 1099 (B) 1100

(C) 1999 (D) 1090

**145.** Which of the following is correct ?

**[JTET, 2010]**

(A) The predecessor of the successor of 1000 is 1000.

(B) The predecessor of predecessor of 1000 is 999.

(C) The successor of predecessor of 1000 is 1001.

(D) The successor of predecessor of 1000 is 1002.

**146.** How many lakh equals to 4 crore ?
**[Madhya Pradesh, Stenographer, Data Entry Operator Combined Exam., 2018]**
(A) 0.4 (B) 400
(C) 40 (D) 4

**147.** For what maximum value of $n$, expression $\frac{10200!}{(504)^n}$ will be an integer ?
(A) 1699 (B) 1697
(C) 1696 (D) 1698

**148.** If $x + y + z = 9$ and $y$ and $z$ are positive integers greater than zero, then the maximum value of $x$ can be :
**[Campus Recruitment, 2006]**
(A) 3 (B) 7
(C) 8 (D) Data Insufficient

**149.** $\begin{array}{r} *** \\ \times\ * \\ \hline 8**1 \end{array}$ Find the value of * in the given product.
(A) 1 (B) 8
(C) 9 (D) 7

**150.** Find the value of $x$ in
$\sqrt{x+2\sqrt{x+2\sqrt{x+2\sqrt{3x}}}} = x$
(A) 1 (B) 3
(C) 6 (D) 12

**151.** If $p$, $q$, $r$ are three consecutive natural numbers, then the expression $(q + r - p)(p + r - q)(q + p - r)$ is :
(A) Positive (B) Negative
(C) Non-positive (D) Non-negative

**152.** If $S = \left[1+\left(\frac{-1}{3}\right)\right]\left[1+\left(\frac{-1}{3}\right)^2\right]\left[1+\left(\frac{-1}{3}\right)^4\right]\left[1+\left(\frac{-1}{3}\right)^8\right]$ ..... $n$ term, then S = ?
(A) $4(10^{2n} - 1)$ (B) $\frac{4}{3}(10^n - 1)$
(C) $\frac{2}{3}(10^n - 1)$ (D) None of these

**153.** If $S = \frac{1}{1!+2!} + \frac{1}{2!+3!} + \frac{1}{3!+4!} + .... + \frac{1}{19!+20!}$ then, S = ?
(A) $\frac{1}{2!} - \frac{1}{21!}$ (B) $\frac{1}{2!} - \frac{1}{20!}$
(C) $\frac{1}{20!}$ (D) None of these

**Direction (Q. No. 154 to 156)**
A, B, C, D, E and F are six positive integers, such that :
$B + C + D + E = 4A$
$C + F = 3A$
$C + D + E = 2F$
$F = 2D$
$E + F = 2C + 1$
**[XAT, 2008]**

**154.** If A is a prime number between 12 and 20, then the value of C is :
(A) 13 (B) 17
(C) 23 (D) 19

**155.** The value of F is :
(A) 14 (B) 16
(C) 20 (D) 28

**156.** Which of the following should be true ?
(A) B is the smallest integer and B = 12
(B) D is the smallest integer and D = 14
(C) C is the greatest integer and C = 23
(D) F is the greatest integer and F = 24

**157.** $a$, $b$, $c$ are integers; $(a) \neq (b) \neq (c)$ and $-10 \leq a, b, c \leq 10$ then what will be the maximum possible value of $[abc - (a + b + c)]$ ?
(A) 524 (B) 693
(C) 731 (D) 970

**158.** The sum of (–100) + (–95) + (–90) + .... + 110 + 115 + 120 is : **[XAT, 2017]**
(A) 0 (B) 230
(C) 340 (D) 450

**159.** In a six-digit number, the sixth, that is the rightmost digit is the sum of the first three digits, the fifth digit is the sum of first two digits, the third digit is equal to the first digit, the second digit is twice the first digit and the fourth digit is the sum of fifth and sixth digits. Then, the largest possible value of the fourth digit is :
**[CAT, 2019]**
(A) 5 (B) 7
(C) 6 (D) 8

**160.** In 2011, Plasma–a pharmaceutical company allocated ₹ $4.5 \times 10^7$ for Research and Development. In 2012, the company allocated ₹ 60,000,000 for Research and Development. If each year the funds are evenly divided among $2 \times 10^2$ departments, how much more will each department receive this year than it did last year ?
**[MAT, 2018]**
(A) ₹ $2.0 \times 10^5$ (B) ₹ $7.5 \times 10^5$
(C) ₹ $7.5 \times 10^4$ (D) ₹ $2.5 \times 10^7$

**161.** How can the relationship between $x$ and $y$ be best defined if values of $x$ and $y$ are as follows ? **[MAT, 2005]**

| $x$ | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| $y$ | 0 | 2 | 6 | 12 | 20 |

(A) $y = 2x - 4$ (B) $y = x^2 - 3x + 2$
(C) $y = x^2 - 4x$ (D) $y = x^2 - 4$

**162.** If $x$ and $y$ are natural numbers such that $x + y = 2017$, then what is the value of $(-1)^x + (-1)^y$ ?
**[SSC CGL. TIER-II, 19-02-2018]**
(A) 2 (B) – 2
(C) 0 (D) 1

**163.** If $N = (12345)^2 + 12345 + 12346$, then what is the value of $\sqrt{N}$ ?
**[SSC CGL. TIER-II, 09-03-2018]**
(A) 12346 (B) 12345
(C) 12344 (D) 12347

# Explanatory Solutions

## Remainder Theorem

**1.** (B) Let $n$ be such a number in set S which is defined according to the question *i.e.*, when $n$ is divided by 2, 3, 4, 5, 6 leaves the remainders 1, 2, 3, 4 and 5 respectively.
So, the number $(n + 1)$ will also divisible by 2, 3, 4, 5 and 6, whose value will be in the form of LCM $60x$ of 2, 3, 4, 5 and 6 and value of $n$ will be in the form of $(60x - 1)$, where $x$ is a natural number.
Since, 59 is the only number between 0 and 100 which represents the above condition true.
So, the option (B) will be correct.

**2.** (D) If the group of last three digits of a number is divisible by 8, then the number will also be divisible by 8.
$\because$ The last 3 digits of formed number is 132
$\therefore$ 132 mod 8 = 4
So, remainder = 4

**3.** (A)

| 11 | $x$ | |
|---|---|---|
| 7 | $y \rightarrow 3$ | (Remainder) |
| 5 | $z \rightarrow 2$ | (Remainder) |
| | $1 \rightarrow 1$ | (Remainder) |

So, $z = 5 \times 1 + 1 = 6$
$y = 7z + 2$
$= 7 \times 6 + 2 = 44$
$x = 11y + 3$
$= 11 \times 44 + 3 = 487$

Again,

| | |
|---|---|
| 5 | 487 |
| 7 | 97 → 2 (Remainder) |
| 11 | 13 → 6 (Remainder) |
| | 1 → 2 (Remainder) |

So, received the remainder of second student = 2, 6, 2

Again,

| | |
|---|---|
| 7 | 487 |
| 5 | 69 → 4 (Remainder) |
| 11 | 13 → 4 (Remainder) |
| | 1 → 2 (Remainder) |

So, received the remainder of third student = 4, 4, 2

**4.** (B) $99999111 = 9999 \times 10000 + 9111$

So, remainder = 9111

**5.** (D) $2272 - 875 = 1397$

$\therefore$ 1397 is exactly divisible by 3-digit number N (let)

Now, $1397 = 127 \times 11$ (On factorization)

So, N should be 127

$\Rightarrow$ The sum of digits of number $= 1 + 2 + 7 = 10$

**6.** (A) Let, the number is $(2x + 1)$

$(2x + 1)^2 = 4x^2 + 4x + 1$

$= 4x(x + 1) + 1$

The above number $4x\ (x + 1)$ will exactly divisible by 8 if $x$ is an even number.

Remainder in this condition = 1

**7.** (A) If $a^n$ is divided by $(a + 1)$ then the remainder 1 comes out when $n$ is an even number.

$\therefore$ Remainder of $\dfrac{2^{1000}}{3}$

$= \text{Remainder of } \dfrac{2^{1000}}{(2+1)} = 1$

**8.** (A) When $(a + 1)^n$ is divided by $a$, then we get 1 as a remainder. So,

$= \text{Remainder of } \dfrac{9^{1000}}{8}$

$= \text{Remainder of } \dfrac{(8+1)^{1000}}{8} = 1$

**9.** (D) Remainder on dividing $n$ by 7 = 4

So, $x = 7 \times 1 + 4 = 11$

So, $(3n + 1) = (3 \times 11 + 1) = 34$

According to the question, on dividing 34 by 7,

$7\overline{)34}\,(4$

$-28$

$6 = \text{Remainder}$

**10.** (D) L.C.M. of 4, 5, 6 and $8 = 8 \times 5 \times 3 = 120$

So, the number will be in the form of $120x + 3$ which will be exactly divisible by 9

On putting value of $x = 1, 2, 3, \ldots$

Put $x = 1$

$120x + 3 = (120 \times 1 + 3) = 123$ which is not divisible by 9

put $x = 2$, $120x + 3$

$= (120 \times 2 + 3) = 243$ which is divisible by 9

**11.** (B) Let, quotient = $k$

Number $= 342 \times k + 47$

$= 19 \times 18k + 19 \times 2 + 9$

$= 19(18k + 2) + 9$

So, remainder = 9

**12.** (D) Let, three consecutive positive numbers are $x, x + 1$ and $x + 2$.

So, According to question,

$$\Rightarrow \frac{x(x+1)(x+2)}{x} + \frac{x(x+1)(x+2)}{x+1} + \frac{x(x+1)(x+2)}{x+2} = 74$$

$$x(x+1)^2(x+2)^2 + x^2(x+1)(x+2)^2$$

$$\Rightarrow \frac{x^2(x+1)^2(x+2)}{x(x+1)(x+2)} = 74$$

$$\frac{x(x+1)(x+2)[(x+1)(x+2) + x(x+2) + x(x+1)]}{x(x+1)(x+2)} = 74$$

$$\Rightarrow 3x^2 + 6x + 2 = 74$$

$$x^2 + 2x - 24 = 0$$

On solving the above equation,

$x = 4$

So, three consecutive positive numbers $= 4, 5, 6$

and their sum $= 4 + 5 + 6 = 15$

**13.** (B) L.C.M. of 5, 6, 7, 8 = 840

$840k + 3$

On dividing by 9 = $837k + 3k + 3$

$= 9 \times 93k + 3k + 3$

$k = 2$

Number $= 837k + 3$

$= 837 \times 2 + 3$

$= 1677$

**14.** (A) We can find the unit digit in $12^{13}$ on dividing 13 by 4

$13 \div 4 = 1$

So, remainder in $12^{13} = 12$

$$\frac{12^{13} + 12}{13} = \frac{\text{Remainder } 12 + 12}{13}$$

$$= \frac{24}{13} = 11 \text{ Remainder.}$$

So, on dividing $(12^{13} + 12)$ by 13. 11 will be remainder.

**15.** (A) $10 - 9 = 1$

$9 - 8 = 1$

$8 - 7 = 1$

L.C.M. of 10, 9, 8 = 360

The least number = $360 - 1 = 359$

**16.** (B) According to the question,

$X = 21n + 2$ and $Y = 55m + 4$

So, put the minimum value *i.e.*, 1 of $n$ and $m$

$X = 21 + 2 = 23$; $Y = 55 + 4 = 59$

$\therefore X + Y = 23 + 59 = 82$

**17.** (C) From option

(A) 325461, abc = 325, which is not divisible by 4, so option (A) is incorrect.

(B) 324651, abc = 324, which is divisibly by 4

bcd = 246, which is not divisible by 5, so option (B) is incorrect.

(C) 324561, abc = 324, divisible by 4

bcd = 245, divisible by 5

cde = 456, divisible by 3

def = 561, divisible by 11

So, option (C) is the answer.

**18.** (D) 52) $x$ (1 (Let)

$-52$

$44$

$x = 52 \times 1 + 44$

$x = 96$

According to the question,

13) 96 ( 7

$-91$

5 Remainder

**19.** (A) Let $x$ be the number.

$x = 6p + 5$ ...(1)

$x = 5q + 4$ ...(2)

$x = 4r + 3$ ...(3)

$x = 3s + 2$ ...(4)

$x = 2t + 1$ ...(5)

Now from options, option (A) 59, satisfies all equations.

**20.** (B) Remainder, when 80808 is divided by 108 = 24

Remainder, when 90909 is divided by 109 = 3

Now, 24 ÷ 3 = 8

So, required quotient = 8

**21.** (D) Remainder in 19009 ÷ 11 = 1

Remainder in 9090 ÷ 11 = 4

$\therefore$ Product = 1 × 4 = 4

**22.** (A) First of all, we will find the remainder of $(2222)^{5555}/7$. When 2222 is divided by 7, then it leaves remains 3

So, $(2222)^{5555}/7 \xrightarrow{R} 3^{5555}/7$

$= (3 \times 3^{5554})/7 = [3(3^2)^{2777}]/7$

$= [3.(7+2)^{2777}]/7 \xrightarrow{R} (3 \times 2^{2777})/7$

$= [3 \times 2^2 \times 2^{2775}]/7$

$= [3 \times 2^2 \times (2^3)^{925}]/7$

$= [3 \times 2^3 \times (2^3)^{925}]/7 \xrightarrow{R} 12/7$

Remainder = 5

Similarly, $(5555)^{2222}/7 \xrightarrow{R}$ $(4^{2222})/7 = [2 \times 2^{4443}]/7$

$= [2\times(2^3)^{1481}]/7 = [2 \times (8)^{1481}]/7$

$\xrightarrow{R} [2 \times 1^{1481}] / 7 \longrightarrow$ 2 (Remainder)

So, $(2222)^{5555}/7 + (5555)^{2222}/7$ $\xrightarrow{R} (5 + 2)/7$ Remainder = 0

**23.** (C) $= \dfrac{(127^{97} + 97^{97})}{32}$

$= \dfrac{(128 - 1)^{97} + (96 + 1)^{97}}{32}$

Required remainder = –1 + 1 = 0

**24.** (D) ATQ,

$x$ = HCF of (8110 – 7897), (8536 – 8110) and (8536 – 7897)

= HCF of 213, 426 and 639

= 213

$\therefore$ Required sum of digits of 213

= 2 + 1 + 3 = 6

**25.** (D) Let the numbers be $a$ and $b$ where $a > b$.

$\because \quad a - b = 2001 \quad ...(i)$

$\because$ divident = quotient × divisor + remainder

$\therefore \quad a = 9b + 41$

$\Rightarrow \quad a - 9b = 41$

$\Rightarrow 2001 + b - 9b = 41$ [From equation (i)]

$\Rightarrow \quad 8b = 2001 - 41$

$= 1960$

$\Rightarrow \quad b = \dfrac{1960}{8} = 245$

$\therefore \quad a = 2001 + 245$

$= 2246$

$\therefore$ Required sum of digits = 2 + 2 + 4 + 6 = 14

**26.** (C) $(3)^{61284} = (3^4)^{15321} = (81)^{15321}$

Dividing $(81)^{15321}$ by 5,

Remainder = 1

$\therefore \quad x = 4$

Now,

Dividing $4^1$ by 6, remainder = 4

Dividing $4^2$ by 6, remainder = 4

Dividing $4^3$ by 6, remainder = 4

$\therefore$ Dividing $4^{96}$ by 6, remainder = 4

$\therefore \quad y = 4$

$\therefore$ Required value = $2x - y$

$= 2 \times 1 - 4$

$= -2.$

**27.** (A) LCM of 3, 4 and 6 = 12

Since we divide largest two digit numbers by 3, 4, 6 then it leaves remainder 1, 2, 4 respectively

So, common digit is 2.

[(3 – 1) = 2, 4 – 2 = 2, 6 – 4 = 2]

$\therefore$ Required number (N) = Multiple of 12 – 2 = 96 – 2 = 94

$\therefore$ 94 ÷ 5 gives remainder = 4.

## Divisibility Rules

**28.** (A) Let, $x = k + 4$ is divisible by 7

and $y = k + 2n$ is divisible by 7

$\Rightarrow y - x = 2n - 4$ will also be divisible by 7

$\Rightarrow (2n - 4)$ will be equal to zero or in multiple of 7

So, for the minimum possible value of $n$,

$2n - 4 = 14$

or $\quad n = 9$

**29.** (C) Let, $(2x + 12)$ is exactly divisible by $x$

So, $\dfrac{2x+12}{x}$ = a positive integer

$\Rightarrow \quad 2 + \dfrac{12}{x}$ = a positive integer

This is possible if and only if when $x$ is exactly divisible by 12.

So, the possible value of $x$ will be 1, 2, 3, 4, 6 and 12

$\therefore$ Required answer = 6

**30.** (C) Multiples of 125 –125, 250, 375, 500, 625, 750, 875, 1000, 1125, .....

According to the question,

5-digit numbers will be divisible by 125 when group of their last three digits will be 375 and 875. So, the unit digit should be 5, tens digit should be 7 and hundred digit should be 3 or 7

So possible members will be :

23875, 32875, 28375, 82375

$\Rightarrow$ Required answer = 4

**31.** (C) Total integers from 100 to 200 = 101

$\Rightarrow$ Total even numbers = 51

Even multiple of 7 from 100 to 200 = 7

Even multiples of 9 from 100 to 200 = 6

and 126 is the positive integer which is divisible by both 7 and 9

So, required even numbers will be :

= 51 – 7 – 6 + 1 = 39

**32.** (D) $a = b^2 - b,\ b \geq 4$ (Given)

$\because a^2 - 2a = (b^2 - b)^2 - 2(b^2 - b)$

$= (b^2 - b)(b^2 - b - 2)$

$= b(b - 1)(b - 2)(b + 1)$

or $\quad = (b - 2)(b - 1)\, b\, (b + 1)$

$\therefore$ Put $b \geq 4$

$(a^2 - 2a)$ will be divisible by 15, 20 and 24.

**33.** (C) Following are the two-digit numbers and multiples of 8

16, 24, 32, 40, 48, 56, 64, 72, 80, 88, 96

According to the question,

If the digits of numbers are reversed then 40 and 48 are only two numbers which are divisible by 4 but not 8.

So, Required answer = 2

**34.** (B) Given, $12 \leq n \leq 40$

$\because$ 7 prime numbers between 12 and 40 are : 13, 17, 19, 23, 29, 31, 37.

$\underline{|(n-1)}$ will not be divisible by any of these numbers.

**35.** (A) Let, $\quad x^n - a^n = 106^{90} - 49^{90}$

$\therefore (x^n - a^n)$ will be divisible by both $(x - a)$ and $(x + a)$, if $n$ is a even number.

So, $(106^{90} - 49^{90})$ will be divisible by $(106 - 49 = 57)$ and $(106 + 49 = 155)$

$\because \quad 57 = 19 \times 3$

and $\quad 155 = 31 \times 5$

$\Rightarrow 106^{90} - 49^{90}$ will be divisible by number $19 \times 31$ *i.e.*, 589

**36.** (D) $\because$ *xxyy* is a perfect square, then

Let $\quad xxyy = 11 \times (100x + y)$

$\Rightarrow (100x + y)$ will be a multiple of 11

$\therefore$ Put the values (possible values) of $x$ and $y$,

$x = 7$

$y = 4$, the expression is satisfied

So, 7744 is a perfect square number.

**37.** (A) $\because \quad 80 = 10 \times 8$

$\Rightarrow$ Number 347 XY will be divisible by 10. So, the value of Y should be zero.

Now, the number 347 X 0 will divisible by 8.

So, the last three digits 7 X 0 of the number should be divisible by 8.

So, on putting 2 in place of X, the above number will exactly divisible by 8.

$34720 \div 8 = 4340$

So, $\quad X + Y = 2 + 0 = 2$

**38.** (A) $\frac{1}{x} + \frac{1}{7} + \frac{1}{3} + \frac{1}{2}$

$= \frac{1}{x} + \frac{6 + 14 + 21}{42} = \frac{1}{x} + \frac{41}{42}$

If the value of $x$ is 42, then the resulting number is a natural number which is exactly divisible by 2, 3 and 7.

So, the value of $x$ will be less than 84. Option (A) is correct.

**39.** (D) $99 = 11 \times 9$, where 11 and 9 both are prime numbers.

$\because$ The number is exactly divisible by 9. So, $3 + 4 + 2 + 2 + 2 + 1 + 3 + x + y = 17 + x + y$ will also be exactly divisible by 9

So, the minimum value of $x + y$ should be either 1 or 10.

$x + y = 10 \quad ...(i)$

$x + y = 1 \quad ...(ii)$

Again, the given number is also exactly divisible by 11.

$\therefore (y + 3 + 2 + 2 + 3) - (x + 1 + 2 + 4)$
$= y - x + 3$ will be multiple of either 0 or 11

$y - x + 3 = 0$

$\Rightarrow \quad x - y = 0 \quad ...(iii)$

$y - x + 3 = 11$

$\Rightarrow \quad x - y = -8 \quad ...(iv)$

On solving equations (i) and (iii),

$x = \frac{13}{2}, \quad y = \frac{9}{2}$

On solving equations (i) and (iv),

$x = 1$ and $y = 9$

So, option (D) is correct.

**40.** (D) From question,

Required power $= \frac{80}{7} + \frac{80}{49}$

$= 11 + 1$

(Taking integer values)

$= 12$

**41.** (B) $\because$ Factors of 12 are 3 and 4.

$\therefore$ Total number of 3 digits in 122!

$= \frac{122}{3} + \frac{122}{9} + \frac{122}{27} + \frac{122}{81}$

$= 40 + 13 + 4 + 1$

$= 58$

Total number of 2 digits in 122!

$= \frac{122}{2} + \frac{122}{4} + \frac{122}{8} + \frac{122}{16} + \frac{122}{32} + \frac{122}{64}$

$= 61 + 30 + 15 + 7 + 3 + 1 = 117$

So, total numbers of $2^2 = \frac{117}{2} = 58$

$\because$ We have to choose the minimum value from both, but here both the values are equal *i.e.*, 58

So, required answer = 58

**42.** (B) From question,

$\because$ Number X! is exactly divisible by $11^{51}$

$\therefore$ Value of X should not be greater than $11 \times 51 = 561$

So, highest power of 11 in 561!

$= \frac{561}{11} + \frac{561}{(11)^2} = \frac{561}{11} + \frac{561}{121}$

$= 51 + 4 = 55$

$\because$ Power is 51, so

Let $\quad 561 - 11 \times 3 = 561 - 33$

$= 528$

Now, highest power of 11 in 528!

$= \frac{528}{11} + \frac{528}{121}$

$= 48 + 4 = 52$

Again calculating,

Let, $\quad 528 - 1 = 527$

Now, highest power of 11 in 527!

$= \frac{527}{11} + \frac{527}{121}$

$= 47 + 4 = 51$

It is clear that the required number will be X = 527 and sum of its digit will be 5 + 2 + 7 *i.e.*, 14

**43.** (D) For divisible by 9, sum of digits of the number should be divisible by 9.

*i.e.*,

$\frac{5 + 4 + 3 + 2 + 1 + A}{9} \Rightarrow \frac{15 + A}{9}$

$\Rightarrow 6 + A = 9$

$\Rightarrow A = 9 - 6$

$\Rightarrow A = 3$

**44.** (A) A number will be divisible by 9, when the sum of digits of the number is divisible by 9.

So, in number 417Z8 $(4 + 1 + 7 + Z + 8) = (20 + Z)$

It is clear that, Number divisible by 9 greater than 20 = 27,

$\therefore \quad (20 + Z) = 27$

$\Rightarrow \quad Z = (27 - 20) = 7$

**45.** (B) According to the question, 444 is the smallest natural number which is divisible by both 3 and 4.

**46.** (D) $\because$ The smallest number divisible by 3, 4, 5, 6 and 8

= L.C.M. of (3, 4, 5, 6, 8)

= 120

So, the perfect square number near 120, which is divisible by above numbers.

$= 120 \times 30$

$= 3600$

**47.** (B) $2^{10} - 1$

$\because \quad 2^n - 1$ is alway divisible by 3, if '*n*' is an even number

Here, $n = 10$, which is an even number

$\therefore \quad 2^{10} - 1$ is divisible by 3

**48.** (C) $15 = 5 \times 3$, so we can make a pair of 5 and 3 each time but we will count only one.

$87! = \frac{87}{5} + \left[\frac{87}{5^2}\right] \Rightarrow 17 + 3 = 5, 20$ (we will get 20 fives)

$87! = \left[\frac{87}{3}\right] + \left[\frac{87}{3^2}\right] + \left[\frac{87}{3^3}\right] + \left[\frac{87}{3^4}\right]$

$= 29 + .....$

[3 will get more than 20 times]

Therefore, 15 will divide 87!, 20 times, since restriction on power is because of number 5's not because of number 3's.

**49.** (B) $7! = 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$

$7! = 2^4 \times 3^2 \times 5 \times 7$

$\therefore$ Least perfect square, divisible by 7!

$= 2^4 \times 3^2 \times 5^2 \times 7^2$

$= 176400$

**50.** (B) $500 = 5 \times 5 \times 5 \times 2 \times 2$

If $(a+b)^{a+b}$ is divisible by 500 then $(a+b)$ should be divisible by 10

Minimum possible value of $(a+b) = 10$

So, minimum possible value of $ab$

$= 9 \times 1 = 9$

## Finding Unit Digit

**51.** (C) If $n$ is a natural number.

*i.e.* $n = 1, 2, 3$ .....

From option (A),

$(3 \times 2)^n = 3^n \times 2^n$

Let $n = 1$, then, $3^1 \times 2^1$

$= 3 \times 2 = 6$

$n = 2$, then, $3^2 \times 2^2 = 9 \times 4 = 36$

So, zero will not come in unit's place

From option (B),

$(3 \times 5)^n = 3^n \times 5^n$

Let $n = 1$, then $3^1 \times 5^1$

$= 3 \times 5 = 15$

$n = 2$, then $3^2 \times 5^2 = 9 \times 25 = 225$

So, zero will not come in place of unit.

From option (C),

$(2 \times 5)^n = 2^n \times 5^n$

Let $n = 1$, then $2^1 \times 5^1$

$= 2 \times 5 = 10$

$n = 2$, then $2^2 \times 5^2 = 4 \times 25 = 100$

It is clear that 0 will the unit digit in $(2 \times 5)^n$

**52.** (D) The unit digit in $3^{99}$,

We get the remainder 3 on dividing the power 99 by 4

So, unit digit in $3^{99}$ = unit digit in $3^3$

$= 7$

The unit digit in $3^{50}$,

Now, we get the remainder 2 on dividing the power 50 by 4

So, unit digit in $3^{50}$ = unit digit in $3^2$

$= 9$

Now, we will get the answer on subtraction the unit digits of $3^{99}$ and $3^{50}$

$= 7 - 9$

$= 8$

[$\because$ Taking carry, 7 will be 17]

So, 8 will be the unit digit in $3^{99} - 3^{50}$

**53.** (D) Unit's digit of $433 \times 456$ = unit digit of $(3 \times 6) = 8$

Unit's digit of $8 \times 43N = N + 2$

Clearly, $N + 2 = 8$

$N = 8 - 2 = 6$

($\because$ Unit's digit of $8 \times 6 = 8$)

**54.** (D) Unit's digit in $(633)^{24}$

= Unit's digit in $(633)^4$

= Unit's digit in $3^4 = 1$

Unit's digit in $(277)^{38}$

= Unit's digit in $[(277)^4]^9 \times (277)^2$

= Unit's digit in $(7)^2 = 9$

Unit's digit in $(266)^{54}$

= Unit's digit in $[(266)^4]^3 \times (266)^2$

= Unit's digit in $(6 \times 6^2) = 6$

$\therefore$ Required unit's digit

$= 10 + 1 - 9 + 6$

[$\because$ we will have to add 10 because unit digit cannot be negative]

$= 17 - 9 = 8$

**55.** (C) Unit's digit in $(164)^{169}$

= Unit's digit of $164 = 4$

[$\because$ Remainder of $169 \div 2 = 1$]

Unit's digit in $(333)^{337}$ = Unit's digit of $333 = 3$

[$\because$ Remainder of $337 \div 4 = 1$]

Unit's digit in $(727)^{726}$ = Unit's digit of $(727)^2 = 9$

[$\because$ Remainder of $726 \div 4 = 2$]

$\therefore$ Required unit's digit

$= 10 + 4 + 3 - 9$

[$\because$ we will have to add 10 because unit digit cannot be negative]

$= 8$

## Finding Last two digits

**56.** (A) Number = 1230 12300 123000 1230000 _ _ _ _ _ clear that,

Place of 1 = 1, 5, 10, 16 ..... (Series of 1)

Place of 2 = 2, 6, 11, 17 ..... (Series of 2)

Place of 3 = 3, 7, 12, 18 ..... (Series of 3)

The difference of these numbers is in A.P. which is as follows :

4, 5, 6, 7, 8 .....

So, 17th 1 will come at 185 place

17th 2 will come at 186 place

17th 3 will come at 187 place

and after this 17 zeroes will come

So, 3 zeroes will come from 188 to 200

$\therefore$ It is clear that, the last two digits of this 200 digit number will be zero.

## Total number of digits

**57.** (D) Product of first 31 natural number

$= 1 \times 2 \times 3 \times ... \times 31 = 31!$

$z = 31!$

$x = 31! + 1$

$x + 1 = 31! + 2$ which is divisible by 2 because 31! is divisible by 2

$x + 2 = 31! + 3$ which is divisible by 3 because 31! is divisible by 3

:

:

$x + 30 = 31! + 31$ which is divisible 31 because 31! is divisible by 31.

**58.** (A) $N = 1 + 11 + 111 + 1111 + ..... + 111111111$

$\therefore$ Sum of digits of $N = 1 + 2 + 3 + .... + 9$

$= \frac{9 \times 10}{2} = 45$

$\left[\because \text{sum of first } n \text{ natural numbers} = 1 + 2 + 3 + .... + n = \frac{n(n+1)}{2}\right]$

## Number of Trailing Zeroes

**59.** (A) Number of zeroes in the end of $\lfloor 10$

$= \frac{10}{5} + \frac{10}{5^2} + ....$ whole value

$= 2 + 0$

$= 2$

**60.** (D) From question,

Number of required zeroes

$= \frac{1400}{5} + \frac{1400}{5^2} + \frac{1400}{5^3} + \frac{1400}{5^4}$

$= \frac{1400}{5} + \frac{1400}{25} + \frac{1400}{125} + \frac{1400}{625}$

$= 280 + 56 + 11 + 2$

(Taking only integer values)

$= 349$

**61.** (B) Rewriting the given product using prime factorization,

$= 5^{13} \times 2^9 \times 11 \times 13$

$= (5 \times 2)^9 \times 5^4 \times 11 \times 13$

$= 10^9 \times 5^4 \times 11 \times 13$

The number of zeroes in the product depends on the number of 10's in the factorization.

$\therefore$ Required number of zeroes = 9

## Language Based problems ( 2 Digit No. & 3 digit No.)

**62.** (C) From option (C),

$72 \times 5.51 = 396.72$

So, Required answer = ₹ 5.51

**63.** (D) $3x + y + 4 = 2xy$

$\Rightarrow \quad 3x + 4 = (2x - 1)y$

$\Rightarrow \quad y = \dfrac{3x+4}{2x-1}$

For different values of $x$,

If $x = 6$, then $y = 2$

and $x = 1$, then $y = 7$

So, we will get only two possible values of $x$ and $y$.

$\Rightarrow$ Required ratio $= \dfrac{6+1}{2+7} = \dfrac{7}{9}$

**64.** (A) $100x + 10y + z$

**65.** (A) $x + y$ is an even number

**66.** (B) $x = 0$ or $y = 0$ or both

**67.** (D)

$$\begin{array}{r|l} 101 & 2525 \ (25 \\ -202 & \\ \hline 505 & \\ -505 & \\ \hline \times & \end{array} \qquad \begin{array}{r|l} 101 & 4040 \ (40 \\ -404 & \\ \hline \times & \end{array}$$

So, 101 is the smallest 3 digit prime number.

**68.** (D) From question, values of both parts of the number should be equal for the maximum value of the product

$13 \times 13 = 169$, $14 \times 12 = 168$

$15 \times 11 = 165$, $16 \times 10 = 160$

So, the required two parts = 13, 13

**69.** (C) From question,

$$\begin{array}{r} XYZ \\ -\ YXZ \\ \hline 90 \end{array}$$

$\because$ It is clear that difference between the values of X and Y must be 1.

So, the possible value will be following :

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| X : | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Y : | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

*i.e.*, Number of total possible values = 8

**70.** (B) Two-digit number whose square root is a prime number = 49
because square root of 49 is 7 which is a prime number.
Sum of its digits = 4 + 9 = 13

**71.** (B) Let, number of cabins in office = $n$
and number of fans = $x$
then number of bulbs = $2x$
According to the question,

$n\,(x + 2x) = 30$

$n.3x = 30$

when $x = 1$

put $n = 10$ (Number of rooms which is even)

$\therefore \quad x = 2$

then $n.3 \times 2 = 30$

$n = 5$, which is odd

**72.** (C) Let, numbers are $x$, $(x + 1)$, $(x + 2)$, $(x + 3)$ and $(x + 4)$ respectively.

According to the question,

$665 < x + (x + 1) + (x + 2) + (x + 3) + (x + 4) < 675$

$665 < 5x + 10 < 675$

$665 - 10 < 5x + 10 - 10 < 675 - 10$

$655 < 5x < 665$

$131 < x < 133$

$\Rightarrow \quad x = 132$

So, the even numbers are 132, 134 and 136

Their sum = (132 + 134 + 136)

= 402

**73.** (C) Let the sequence of numbers is $x$, $x^2$, $x^4$ respectively.

According to the question,

$50 < x + x^2 + x^4 > 99$

Put $x = 1$,

$50 < 1 + (1)^2 + (1)^4 > 99$

$50 < 3 < 99$

Put $x = 2$,

$50 < 2 + (2)^2 + (2)^4 > 99$

$50 < 2 + 4 + 16 > 99$

$50 < 22 > 99$

Put $x = 3$,

$50 < 3 + (3)^2 + (3)^4 > 99$

$50 < 3 + 9 + 81 > 99$

$\Rightarrow \quad 50 < 93 > 99$

So, $x = 3$

So, $x = 3$ satisfies the equation.

Sum = $x + x^2 + x^4 = 3 + 9 + 81 = 93$

Required ratio = 9 : 3 = 3

**74.** (A) Let, number = $x$

According to the question,

$x + 13x = 112$

$\Rightarrow \quad 14x = 112$

$x = \dfrac{112}{14} = 8$

(**Note :** The process of repeated addition is known as multiplication)

**75.** (B) Numbers on interchanging the digits according to the question = 837, 924, 516, 372, 984

Descending order of numbers = 984, 924, 837, 516, 372

It is clear that second digit of third number (837) from top is 3.

**76.** (D) On reversing the each digit of numbers,

738 $\rightarrow$ 837

429 $\rightarrow$ 924

156 $\rightarrow$ 651

273 $\rightarrow$ 372

894 $\rightarrow$ 498

Second largest number will be 837 and its last digit will be 7.

**77.** (B) Let the number of ducks be $x$ and number of rabbits be $y$ in the cage.

According to the question,

$x + y = 28$ ..... (i)

$2x + 4y = 72$ ..... (ii)

On solving equations (i) and (ii),

$x = 20$ and $y = 8$

So, number of ducks = 20

and number of rabbits = 8

**78.** (C) By using option (C), remainder on dividing 8 by 2 = 4

On taking root of 4 = $\sqrt{4} = 2$

Now, on cubing $2 = (2)^3 = 8$

So, again the same number has obtained.

**79.** (D) Given,

Sum of digits of number PQ = 11

The original number,

PQ = 10 P + Q ... (i)

New number on interchanging the digits, QP = 10 Q + P ....(ii)

According to the question

PQ – QP = 9

From equation (i) and (ii)

$10P + Q - (10Q + P) = 9$

$9P - 9Q = 9$

$P - Q = 1$ ... (iii)

$P + Q = 11$ ... (iv)

On solving equations (iii) and (iv),

P = 6 and Q = 5

So, number PQ = 65

**80.** (C) We know that the sum of four consecutive two-digit odd numbers should be 160 or 250, then we will get a perfect square number on dividing it by 10.

So, $\dfrac{(37+39+41+43)}{10} = \dfrac{160}{10}$

= 16

So, 16 is a perfect square number.

So, number 41 from the given options is correct.

**81.** (D) Let tens digit = $x$

Unit digit = $y$

Number = $10x + y$

The new number by changing the place of digits and adding then

$= 10y + x$

$= 10x + y + 10y + x$

$= 11x + 11y = 11(x + y)$

$\therefore$ This number will always be divisible by 11.

**82.** (C) Let, number $= x$

According to the question,

$$\therefore \quad \frac{x}{2 \times 6} + \frac{x}{8} - 8 = \frac{x}{8}$$

$$\Rightarrow \quad \frac{x}{12} = 8$$

$\Rightarrow x = 12 \times 8 = 96$

**83.** (C) Let, the number be $x$ and $y$ respectively.

According to the question,

$$x - y = 16 \qquad ....(i)$$

$$(x + y) \times \frac{1}{5} = 12$$

$$\Rightarrow \quad x + y = 60 \qquad ....(ii)$$

On adding equations (i) and (ii)

$$2x = 76$$

$$\Rightarrow \quad x = \frac{76}{2} = 38$$

Put the value of $x$ in equation (i)

$$38 - y = 16$$

$$\Rightarrow \quad y = (38 - 16) = 22$$

So, smaller number = 22

**84.** (D) Marks obtained for 23 correct answers $= 23 \times 4 = 92$

Marks deducted for remaining 27 wrong answers

$27 \times 2 = 540$

Required marks $= (92 - 54) = 38$

**85.** (B) Let $a$ and $b$ are natural numbers

$$b - a = 4 \qquad \ldots(1)$$

(Let $b$ is larger)

From question,

$$\frac{1}{a} - \frac{1}{b} = \frac{1}{8}$$

$$\frac{b - a}{ab} = \frac{1}{8}$$

$$8(b - a) = ab \qquad \ldots(2)$$

Put the value of equation (1) in equation (2),

$$ab = 32 \qquad \ldots(3)$$

By formula,

$$(a + b)^2 = (a - b)^2 + 4ab$$

$$= (-4)^2 + 4 \times 32$$

$$(a + b)^2 = 144$$

$$(a + b) = 12 \qquad \ldots(4)$$

So, sum of numbers

$$a + b = 12$$

**86.** (D) **Note**—Questions with change of digits of the numbers can be solved very easily with the help of given options.

From the question,

Taking option (D)

Sum of digits of 62, $6 + 2 = 8$, First condition has been satisfied.

On subtracting $36 = 62 - 36$

$= 26$, Second condition fulfilled

So, answer is (D)

**87.** (C) Let numbers are $a$ and $b$

According to the question,

$$a + b = 14 \qquad ...(1)$$

$$a - b = 10 \qquad ...(2)$$

On solving equations (i) and (ii)

$$a = 12$$

and $\quad b = 2$

Product $\quad a \times b = 2 \times 12 = 24$

**88.** (D) Let the numbers are $x$ and $y$

According to the question,

$$x^2 + y^2 = 557$$

$$xy = 266$$

$$(x + y)^2 = x^2 + y^2 + 2xy$$

$$= 557 + 2 \times 266$$

$$= 557 + 532$$

$$= 1089$$

$$x + y = 33 \qquad \ldots(1)$$

$$(x - y)^2 = x^2 + y^2 - 2xy$$

$$= 557 - 532$$

$$= 25$$

$$x - y = 5 \qquad \ldots(2)$$

From equations (1) and (2)

$$x + y = 33$$

$$x - y = 5$$

On solving,

$$x = 19$$

$$y = 14$$

So, numbers are 19 and 14.

**89.** (D) Sum of a two digit number and the number formed by reversing its digits is always divisible by 11. Example :

$$\left.\begin{aligned} 45 + 54 &= 99 \\ 63 + 36 &= 99 \\ 23 + 32 &= 55 \\ 21 + 12 &= 33 \end{aligned}\right\} \text{all are divisible by 11.}$$

**90.** (D) Since, number 57 follows the given conditions. So required number = 57

**91.** (C) In number 60482,

* Digit at tens place = 8
* Digit at ones place = 2 or $8 \times \frac{1}{4}$

= one fourth of the digit at tens place

* Digit at thousands place = 0
* Digit at hundreds place = 4 or $2 \times 2$

= twice the digit at ones place

* Digit at ten thousands place = 6 or $3 \times 2$

= thrice the digit at ones place

So, the number 60482 follows all the conditions given in the question.

**92.** (B) Required number = 36

Even number = 36; common multiple of 3, 4, $6 = 2 \times 2 \times 3 \times 3 = 36$

Total factors = 9 (1, 2, 3, 4, 6, 9, 12, 18, 36)

**93.** (D) Sum of digits of numbers = 7(given)

$\therefore$ Required number = 43

($\because$ Ones digit is one less than tens digit and number lies between 40 and 50)

So, the product of digits

$= 4 \times 3 = 12$

**94.** (B) Let $a$ and $b$ are two whole numbers, where $a > b$

From question,

$$3a = 4b + 3$$

$$\Rightarrow \quad 3a - 4b = 3 \qquad ...(1)$$

and $\quad 5a + 1 = 7b$

$$\Rightarrow \quad 5a - 7b = -1 \qquad ...(2)$$

On solving equations (1) and (2)

$$a = 25; \; b = 18$$

So, smaller number = 18

**95.** (B) Number of coaches manufactured in 45 days = 7 coaches

No. of days in manufacturing 1 coach

$$= \frac{45}{7}$$

Number of days in manufacturing 63 coaches $= \frac{45}{7} \times 63 = 405$ days

**96.** (C) Number of hens

$$= \text{Number of eys} - \frac{\text{Number of feet}}{2}$$

$$= 120 - \frac{180}{2}$$

$$= 120 - 90 = 30$$

**97.** (D) Number of rabbits $= \frac{L}{2} - H$

$$= \frac{98}{2} - 35$$

$$= 49 - 35 = 14$$

**98.** (C) Numbers having 6 as a digit from 501 to 599 are following :

506, 516, 526, 536, 546, 556,

560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 576, 586, 596

So, digit 6 will appear 20 times.

**99.** (A) Let, the tens digit of a number be $x$, then unit digit of the number will be $2x$.

So, number = $10 \times x + 2x = 12x$

Number obtained by interchanging the digits = $10 \times 2x + x = 21x$

According to the question,

$$21x - 12x = 36$$

$$\Rightarrow \quad 9x = 36$$

$$\therefore \quad x = \frac{36}{9}$$

$$x = 4$$

Unit digit = 8, Tens digit = 4

Number = 84

Sum of digits of number = 8 + 4 = 12

Difference between digits of number = 8 – 4 = 4

Difference between the sum and the difference = 12 – 4 = 8

Required difference = 8

**100.** (A) Let number = M

According to the question

$$N = \frac{1}{M - 1}$$

If we put the value of M equals to 5 then $N = \frac{1}{4}$ which is less than 2. If we increase the value of M then, the value of $M^N$ will always come less than 2.

If we put the value less than 5 for M then the possible values of $M^N$ will be $\frac{1}{4^3}, \frac{1}{3^2}, \frac{1}{2^1}$. So, it will also be less than 2 or equal to 2

So, the value of $M^N$ will also less than 2.

So, option (A) is correct.

## No. of Factors

**101.** (B) Number of divisors = (Power of first variable + 1) (Power of second variable + 1)

= (1 + 1) (1 + 1)

= 2 × 2 = 4

**102.** (C) Again, by formula,

Number of divisors = (2 + 1)(1 + 1)

= 3 × 2 = 6

**103.** (D) By formula,

Number of divisors = (3 + 1)(2 + 1)

= 4 × 3 = 12

**104.** (D) (A)

| | |
|---|---|
| 2 | 172 |
| 2 | 86 |
| 43 | 43 |
| | 1 |

$\Rightarrow 2^2 \times 43^1$

(B)

| | |
|---|---|
| 2 | 200 |
| 2 | 100 |
| 2 | 50 |
| 5 | 25 |
| 5 | 5 |
| | 1 |

$\Rightarrow 2^3 \times 5^2$

(C)

| | |
|---|---|
| 2 | 156 |
| 2 | 78 |
| 3 | 39 |
| 13 | 13 |
| | 1 |

$\Rightarrow 2^2 \times 3 \times 13$

(D)

| | |
|---|---|
| 2 | 240 |
| 2 | 120 |
| 2 | 60 |
| 2 | 30 |
| 3 | 15 |
| 5 | 5 |
| | 1 |

$\Rightarrow 2^4 \times 3^1 \times 5^1$

So, 240 has most number of divisors.

**105.** (B) $1848 = 2 \times 2 \times 2 \times 3 \times 7 \times 11$

So, there will be 3(3, 7, 11) odd composite factors of 1848.

## Miscellaneous

**106.** (A) We know that prime numbers greater than 3 are represented in the form of $6n \pm 1$

According to the question,

Only one set is formed on putting $a = 3$, *i.e.*, 3, 5, 7 is possible.

So, Required answer = 1

**107.** (C) $\because n^3$ is an odd number

$\therefore n$ is also an odd number

$\Rightarrow n^2$ will also an odd number

So, Statements I and II are true.

**108.** (B) $(BE)^2 = MPB$

$\because$ The square of a two-digit number is a 3-digit number.

$\therefore$ The maximum value of BE will be 31 [$(32)^2 = 1024$, where we get a 4-digit number]

$\Rightarrow \quad BE \le 31$

So, value of B can be 0, 1, 2 or 3 but 0 or 1 will come on squarring B

According to the question,

$(BE)^2 = MPB$

$\Rightarrow$ Zero will come in place of unit and tens place in finding the value of $(10)^2, (20)^2, (30)^2$, which is opposite to the condition.

So, value of B will be 1

$\Rightarrow \quad (1E)^2 = MP1$

Now, since unit digit in R.H.S. is 1

$\therefore$ The value of E will be either 1 or 9

So, the two-digit number will be either 11 or 19

$\because (11)^2 = 121$, which is opposite to condition

$\therefore (19)^2 = 361$, condition is fulfilled

$\therefore$ Value of M will be 3

**109.** (D) $3 = 2^1 + 1; \; 5 = 2^2 + 1$

$17 = 2^4 + 1; \; 31 = 30 + 1 \neq 2^k + 1$

$\therefore$ Required answer = 31

**110.** (A) $\because$ Production of Machine B in 40 minutes = 100 parts

According to the question,

Machine A is twice capable of Machine B

So, Machine A will produce 100 parts = In 20 minutes

$\therefore$ Number of parts produced by Machine A in 6 minutes

$$= \frac{100}{20} \times 6 = 30 \text{ parts}$$

**111.** (D) $\because (x + y)$ is a factor of $(x^n + y^n)$

$\therefore (125 + 73)$ *i.e.*, 198 is a factor of $\{(125)^{125} + (73)^{125}\}$

Similarly (125 + 73) *i.e.*, 198 is a factor of $\{(125)^{73} + (73)^{73}\}$

So, the common factor of both expressions = 198

**112.** (C) Let, there are $x$ digits in $10^n$. So, $x$ will repeat 9 times in expression $(10^n - 1)$

$$\therefore \quad 9x = 3087$$

$$\Rightarrow \quad x = \frac{3087}{9} = 343$$

In this way, 343 will come 9 times in $(10^n - 1)$.

**113.** (D) Total numbers from 700 to 950 = 251

Total numbers divisible by 3

$$= \frac{\text{The greates number} - \text{The least number}}{3} + 1$$

$$= \frac{948 - 702}{3} + 1$$

$$= 82 + 1 = 83$$

Total numbers divisible by 7

$$= \frac{945 - 707}{7} + 1$$

$$= \frac{238}{7} + 1 = 35$$

Total numbers divisible by 21

$$= \frac{945 - 714}{21} + 1$$

$$= \frac{231}{21} + 1 = 12$$

So, Total required numbers

$$= 251 - (83 + 35 - 12)$$
$$= 145$$

**114.** (D) $\because$ Total 3-digit numbers from 121 to 999

$= 999 - 121 + 1 = 879$

and total 4-digit numbers from 1000 to 1346

$$= 1346 - 1000 + 1 = 347$$

$\therefore$ Required value

$$= 879 \times 3 + 347 \times 4$$
$$= 2637 + 1388 = 4025$$

**115.** (A) Only (i)

**116.** (D) $(x + y)$ will be an irrational number and $xy$ will be either rational or irrational.

**117.** (D) $\frac{a+b}{2}$ is a rational number between rational numbers $a$ and $b$.

**118.** (A) From question,

$$0 < x < 1$$
$$\Rightarrow \quad x^2 < x < 1$$
$$\Rightarrow \quad \frac{1}{x^2} > \frac{1}{x} > 1 > x > x^2$$

$\therefore \frac{1}{x^2}$ will be the largest number.

**119.** (A) $\because \quad |a| \times |b| = |ab|$

$$x = \frac{-ab}{|ab|}$$
$$= \frac{-ab}{ab} = -1$$

**120.** (D) Both commutative and associative.

**121.** (D) $\because$ Two integers are even from 4 consecutive integers. So, the product P of four numbers will be an even number. The sum of product P and 1 will be an add integer.

So, $n$ is an odd integer.

$\therefore \quad n = 1 + (1 \times 2 \times 3 \times 4)$
$= 1 + 24 = 25 = (5)^2$
$n = 1 + (2 \times 3 \times 4 \times 5)$
$= 1 + 120 = 121 = (11)^2$

$\therefore$ $n$ is a perfect square number.

So, $n$ is an odd integer and a perfect square number.

**122.** (B) Numbers between 300 to 399 in which 4 comes only one time = 19

Number between 400 to 500 in which 4 comes only one time = 80

So, total such numbers = 19 + 80 = 99

**123.** (E) By options,

(A) On putting $n$ = 1, 2, 3,....in $n(n + 1)(2n + 1)$, we get 6, 30, 84,.....So, $n(n + 1)(2n + 1)$ is always an even number.

(B) $n(n + 1)(2n + 1)$ will always be divisible by 3.

(C) Sum of squares of first '$n$' integers $= \frac{1}{6} n(n + 1)(2n + 1)$. So, $n(n + 1)(2n + 1)$ is divisible by sum of squares of first '$n$' integers.

(D) $n = 237$

Then, $237 \times 238 \times 475 = 26792850$, which is divisible by 237

So, none of the option is correct.

**124.** (B) Numbers divisible by 3 from 1 to 99, having 5 as a digit, are following :

15, 45, 51, 54, 57, 75

Excluding those numbers having 5 as a digit counting from 1 to 99 = 5, 25, 35, 50, 52, 53, 55, 56, 58, 59, 65, 85, 95

**125.** (D) The greatest number of two digits = 99

$\therefore$ Its predecessor = (99 – 1) = 98

The smallest number of three digits

$$= 100$$

$\therefore$ Its successor = (100 + 1) = 101

Required number

$$= (98 + 101) = 199$$

**126.** (C) First even composite number = 4

**127.** (B) Distance between 12 mango trees

$= 11 \times 2 = 22$ metres

$\therefore$ Length of garden

$= (22 + 2)$ metre = 24 metre

**128.** (A) $\frac{2}{0}$ = Infinite

**129.** (C) A ribbon is 3 km long. Machine cuts the ribbon in pieces of 10 m.

Number of cut pieces of ribbon by machine $= \frac{3 \text{ km}}{10 \text{ km}}$

$$= \frac{3000}{10} = 300 \text{ pieces}$$

299 cut should be marked to cut 300 pieces.

Time taken in making 1 cut = 6 sec.

Time taken in making 299 cuts

$$= 299 \times 6$$
$$= 1794 \text{ seconds}$$

**130.** (A) Multiple of 3

3, 6, 9, 12, 15, 18 … 99

It is clear that it is a arithmetic series

$$\text{Sum} = \frac{\text{Number of terms}}{2} \times (\text{First term} + \text{last term})$$
$$= \frac{33}{2} \times (3 + 99)$$
$$\left(\because \text{Number of terms} = \frac{99}{3} = 33\right)$$
$$= 33 \times 51 = 1683$$

**131.** (C) 300 + 600 + 1200 + 2400 + 4800 = 9300

**132.** (B) 3 5 7 2 1

$1 \times 10^{-2}$
$2 \times 10^{-1}$
$7 \times 1$
$5 \times 10$
$3 \times 100$

So, the value of 5 is $5 \times 10$ *i.e.*, 5 tens.

**133.** (C) The sum of two odd numbers and an even number will always an even number.

Example : 37 + 41 + 44 = 122

**134.** (C) Place value of 5 in 6251 = 50

Place value of 5 in 6521 = 500

Place value of 5 in 5621 = 5000

$\therefore$ Required sum = 5000 + 500 + 50
= 5550

**135.** (A) The number having at least one factor other than 1 and itself are called composite numbers.

Example : 4, 6, 8, 9, 10, 12, 14, 15, 16.....

**Note :** Composite numbers can be both even or odd. So, option (A) is true.

Option (B) is false, because 2 is the only even prime number.

Sum of two prime numbers is always a prime number given in option (C) is completely false.

because (2 + 3) = 5 (Prime number)

(3 + 5) = 8 (Composite number)

( 5 + 7) = 12 (Composite number)

So, option (C) is completely incorrect.

The smallest prime number is 1, given in option (D) is completely incorrect, because the smallest prime number is 2

**Note–**1 is neither a prime number nor a composite number.

**136.** (A) The smallest non-negative prime integer = 2

**137.** (A) Is always positive.

**138.** (B) $\pi$ is a irrational number.

**139.** (C) From question,

$$a - b = 2 \quad ...(1)$$

$$b - c = 10 \quad ...(2)$$

$$a + b + c = 130 \quad ...(3)$$

Adding equations (1) and (2)

$$a - c = 12 \quad ...(4)$$

Put the values of $b$ and $c$ in equation (3) from equations (1) and (4),

$a + a - 2 + a - 12 = 130$

$3a = 144$ or $a = 48$

Again, by equation (3)

$$a + b + c = 130$$

$\Rightarrow a + b + c - 2a = 130 - 2a$

$\Rightarrow b + c - a = 130 - 2 \times 48$

(Put the value of $a$)

$\Rightarrow b + c - a = 34$

**140.** (C) The given number is a rational number.

**141.** (B) Value of 5499, rounding off to nearest thousand will be 5000.

So, option (B) is correct.

**142.** (C) $10^n + 34^{n+2} + k$

when $n = 1$

$= 10 + 34^3 + k$

$= 10 + 39304 + k$

$= (39314 + k)$, which is divisible by 9

$\therefore 3 + 9 + 3 + 1 + 4 + k$

$= (20 + k)$, which is divisible by 9

$\therefore k = 7$

**143.** (B) $3 \times 5^{2n+1} + 2^{3n+1}$

$= 3 \times 5^{2+1} + 2^{3+1}$ [when $n = 1$]

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

$= 3 \times 125 + 16$

$= 375 + 16$

$= 391$, which is divisible by 17.

**144.** (A) The greatest number of three digits

$= 999$

The smallest number of three digits

$= 100$

$\therefore$ Required sum $= 999 + 100$

$= 1099$

**145.** (A) Successor of 1000

$= 1000 + 1 = 1001$

Now, Predecessor of 1001

$= 1001 - 1 = 1000$

So, option (A) is correct.

**146.** (B) 4 crore = 4,0000000

$= 4{,}00 \times 10{,}0000$

= 400 Lakh

**147.** (D) Prime factors of 504 is required for $\frac{10200!}{504^n}$ be an integer

$504 = 3^2 \times 7 \times 8 = 2^3 \times 3^2 \times 7$

We have to find the number of 7's, number of $2^3$'s and number of $3^2$'s which are in 10200!

To find the number $2^3$'s, we find the number of 2's

$$\left[\frac{10200}{2}\right] + \left[\frac{10200}{4}\right] + \left[\frac{10200}{8}\right] + \left[\frac{10200}{16}\right] + \left[\frac{10200}{32}\right] + \left[\frac{10200}{64}\right] + \left[\frac{10200}{128}\right] + \left[\frac{10200}{256}\right] + \left[\frac{10200}{512}\right] + \left[\frac{10200}{1024}\right] + \left[\frac{10200}{2048}\right] + \left[\frac{10200}{4016}\right] + \left[\frac{10200}{8192}\right]$$

where 7 is the maximum integer function

$= 5100 + 2550 + 1275 + 637 + 318 + 159 + 79 + 39 + 19 + 9 + 4 + 2 + 1$

Number of 2's = 10192

$\therefore$ Number of $2^3$'s = 3397

Similarly, we find the number of 3's

$$= \left[\frac{10200}{3}\right] + \left[\frac{10200}{9}\right] + \left[\frac{10200}{27}\right] + \left[\frac{10200}{81}\right] + \left[\frac{10200}{243}\right] + \left[\frac{10200}{729}\right] + \left[\frac{10200}{2187}\right] + \left[\frac{10200}{6561}\right]$$

$= 3400 + 1133 + 377 + 125 + 41 + 13 + 4 + 1$

Number of 3's = 5094

$\therefore$ Number of $3^2$'s = 2547

Similarly, we calculate number of 7's

$$\left[\frac{10200}{7}\right] + \left[\frac{10200}{49}\right] + \left[\frac{10200}{243}\right] + \left[\frac{10200}{2401}\right]$$

$= 1457 + 208 + 29 + 4 = 1698$

So, Number of $2^3$'s = 3397

Number of $3^2$'s = 2547

Number of 7's = 1698

So, $n = 1698$

**148.** (B) The minimum value of $y$ and $z$ can be 1.

So, the maximum value of $x$ will be 7.

**149.** (C) We know that, $1 \times 1 = 1$

$9 \times 9 = 81$

So, the value of * will be either 1 or 9

If * = 1

then, $111 \times 1 \neq 8111$

If * = 9

then $999 \times 9 = 8991$

So, * = 9

**150.** (B) For positive integer value of $x$

In $\sqrt{3x}$, $x = 3$ or 12

If $x = 12$, $\sqrt{x + 2\sqrt{3x}}$

$= \sqrt{12 + 12} = \sqrt{24}$

$\sqrt{24}$, which is a irrational number.

If $x = 3$, $\sqrt{3 + 2\sqrt{3 + 2\sqrt{3 + 2\sqrt{3 \times 3}}}}$

$= \sqrt{3 + 2\sqrt{3 + 2 \times 3}}$

$= \sqrt{3 + 6} = 3$

So, $x = 3$

**151.** (D) Let, $p = 1$, $q = 2$, $r = 3$

then the value of expression = 0

If $p = 2$, $q = 3$, $r = 4$

then the value of expression will be positive.

So, we can calculate that the value of expression will be non-negative.

**152.** (D) For $n = 1$, $S = \frac{2}{3}$

For $n = 2$, $S = \frac{20}{27}$

For $n = 3$, $S = \frac{1640}{2187}$

All the given options are different from the above number. So option (D) is correct.

**153.** (A) $m^{\text{th}}$ term $= \frac{1}{m! + (m+1)!}$

$$= \frac{1}{m!(m+2)!}$$

$$= \frac{1}{(m+1)!} - \frac{1}{(m+2)!}$$

$$S = \frac{1}{2!} - \frac{1}{3!} + \frac{1}{3!} - \frac{1}{4!} + ..... + \frac{1}{20!} - \frac{1}{21!}$$

$$S = \frac{1}{2!} - \frac{1}{21!}$$

**For the solution of Q. Nos. 154 to 156**

From equations,

F should be even. C should be odd (Since C + F = 3A and A is a odd prime number A = 13 or 17 or 19) D + E is even number, since (C + D + E + 2F).

Therefore, D and E both should be even or odd, because F is even then E should be odd.

(Since E + F = 2C + 1). In the way D and E both should be odd.

This way, A → odd

F → even

C → odd

D, E → odd

B → odd

Let, A = 17

C + F = 3A = 51

From here, C = 23, F = 28

then, D = 14; C + D + E = 2F

E = 2 × 28 – 23 – 14

E = 19

∵ B + C + D + E = 4A

∴ B = 12

E + F = 2C + 1

19 + 28 = 2 × 23 + 1

47 = 47

So, it is satisfied.

So, on taking A = 13 or 19, all the given equations are not satisfied.

So, A = 17, C = 23, F = 28, D = 14, E = 19 and B = 12

**154.** (C) Value of C = 23.

**155.** (D) Value of F = 28.

**156.** (A) B = 12, which is smallest integer.

**157.** (C) For the maximum value of *abc, a* and *b* should be negative

So, $a = -10, b = -9, c = 8$

$abc = (-10) \times (-9) \times 8$

$= 720$

$abc - (a + b + c)$

$= 720 - (-10 - 9 + 8)$

$= 731$

**158.** (D) Number of terms

$$= \frac{\text{Difference of first and last number}}{\text{Common difference}} + 1$$

$$= \frac{220}{5} + 1 = 45$$

$$\text{Sum} = \frac{45}{2}[-100 + 120] = 450$$

**159.** (B) Assume the six digit number is *pqrstu*

$u = p + q + r, t = p + q, r = p, q = 2p, s = t + u$

So, $s = 2p + 2q + r = 2p + 4p + p = 7p$

$p$ cannot be 0 as the number is a six-digit number. $p$ cannot be 1 as $s$ would become a two-digit number.

Therefore, $p = 1$ and $s = 7$.

Thus The correct answer is 7.

**160.** (C) Fund allotted in 2011 = ₹ $4.5 \times 10^7$

No. of department = $2 \times 10^2$

Fund to each department in 2011

$$= \frac{4.5 \times 10^7}{2 \times 10^2}$$

$$= \frac{4.5 \times 10^5 \times 10^2}{2 \times 10^2}$$

$= ₹\ 22.5 \times 10^4$ ....(i)

Fund allotted in 2012 = 60,000,000

$= 6 \times 10^7$

Fund to each department in 2012

$$= \frac{6 \times 10^2 \times 10^5}{2 \times 10^2}$$

$= ₹\ 30 \times 10^4$ ....(ii)

Extra amount that each department will receive in 2012

$= ₹\ (30 \times 10^4 - 22.5 \times 10^4)$

$= ₹\ 7.5 \times 10^4$

**161.** (B) From option (A).

$y = 2x - 4$ does not satisfy the pair of values in the table.

$y = x^2 - 3x + 2 = (x - 1)(x - 2)$ satisfies the values.

Hence, we get $y = 0, 2, 6, 12, 20$, on putting $x = 2, 3, 4, 5, 6$ respectively.

**162.** (C) We know that, an even number + an odd number = odd number

$\therefore \quad x + y = 2017$

$\Rightarrow$ If $x$ = even number, then $y$ = odd number and if $x$ = odd number, then $y$ = even number

$\therefore \quad (-1)^x + (-1)^y = 1 - 1$

or $-1 + 1 = 0$

**163.** (A) Given that,

$N = (12345)^2 + 12345 + 12346$

$= (12345)^2 + 12345 + 12345 + 1$

$= (12345)^2 + 2 \times 12345 + (1)^2$

$= (12345 + 1)^2$

$[\because a^2 + 2ab + b^2 = (a + b)^2]$

$= (12346)^2$

$\therefore \quad \sqrt{N} = 12346$

❑❑