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GENERAL APTITUDE

PART-A

COMPREHENSIVE THEORY, PRACTICE & PYQ BOOK

USEFUL FOR PART-A

- Life Sciences
- Physical Sciences
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- Earth Sciences

Kailash Choudhary

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P R E F A C E

This book with the title **“General Aptitude - Comprehensive Theory and Practice”** focused on important topics according to new trends of various competitive exams such as CSIR - NET, GATE, SET, and DBT exams.

The aptitude section has a major role to play in CSIR NET, GATE, SET, DBT irrespective of your subject stream. General Aptitude covers around 10-15 percent of the entire exam paper and it can make or mar a candidate in these exams. Hence, this becomes more pertinent from the exam’s point of view and can’t be neglected. If you've got these competitive examinations around the corner, this is the book for you.

General Aptitude - Comprehensive Theory and Practice, have been divided into nineteen chapters covering all aspects of aptitude and reasoning, which are generally asked in most competitive exams followed by model questions and previous year questions. The book explains the fundamentals of general aptitude with simplified theory, short tricks, and a multitude of examples and quick exercises. A large number of well-graded examination questions from CSIR NET exams have been solved in the given chapters.

It is one of the best reference guides that will help you get your elementary mathematics right. It is beneficial for all science streams - Mathematical Sciences, Physical Sciences, Chemical Sciences, Life Sciences, Earth Sciences, and Engineering Science.

The book has practice model questions that the candidate can work on in order to boost preparation for the examination.

Kailash Choudhary

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CHAPTER 1

NUMBER SYSTEM

-: GENERAL APTITUDE :-

A number is an arithmetical value, expressed by a symbol or word, representing a particular quantity or amount and used in counting and making calculations.

1.1 Different Types of Numbers:

1.1.1 Natural Numbers

The counting numbers are called natural numbers. Natural numbers do not include 0 or any negative numbers.
Example: 1, 2, 3, 4… are all-natural numbers.

1.1.2 Whole Numbers

All counting numbers and 0 (zero) together form the set of whole numbers. They do not include negative numbers.
Example: 0, 1, 2, 3, 4… are whole numbers.

1.1.3 Integers

All counting numbers including 0 and the negatives of the counting numbers form the set of integers.
Example: -3, -2, -1, 0, 1, 2, 3… are all integers.
Set of positive integers = {1, 2, 3, 4, 5, 6…}
Set of negative integers = {-1, -2, -3, -4, -5, -6…}
Set of non-negative integers = {0, 1, 2, 3, 4, 5, 6…}

1.1.4 Even Numbers and Odd Numbers

An integer which is exactly divisible by 2 is called an even number. While an integer which cannot be exactly divisible by 2 is called an odd number.
Example: -6, -4, -2, 0, 2, 4, 6, 8, 10… are all **even numbers**.
Zero is considered an even number.
While an integer which cannot be exactly divisible by 2 is called an odd number.
Example: -5, -3, -1, 1, 3, 5, 7, 9, 11… are all **odd numbers**.

1.1.5 Prime Numbers

A natural number other than 1 is a **prime number** if it is divisible by 1 and itself only.
Example: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43 and 47 are the prime numbers less than 50.

Test to find whether a given number is a prime:
Step 1:
Select a least positive integer n such that n^2> given number

Step 2:
Test the divisibility of a given number by every prime number less than n.

Step 3:
The given number is prime only if it is not divisible by any of these primes.

Example: Check whether 571 is a prime number
Since $(23)^2 = 529 < 571$ and $(24)^2 = 576 > 571$
So, n = 24
Prime numbers less than 24 are 2, 3, 5, 7, 11, 13, 17, 19, 23.
Since 571 is not divisible by any of these primes, therefore 571 is a prime number.

Example: Check whether 923 is a prime number.
Since $30^2 = 900 < 923$ and $31^2 = 961 > 923$
So, n = 31
Prime numbers less than 31 are 2, 3, 5, 7, 11, 13, 17, 19, 23, 29
Since 923 is divisible by 13, 923 is not a prime number

1.1.6 Composite Numbers

Natural numbers greater than 1 which are not prime are known as **composite numbers**.
Example: 9 can be divided by 3 (as well as 1 and 9), so 9 is a composite number similarly 12 can be divided by 2, 3, 4 and 6, so it is also a composite number.

Note:
1. The number 1 is neither a prime number nor a composite number.
2. The number 2 is the only even number which is prime

1.1.7 Rational Numbers

A rational number is a number that can be represented as a ratio or fraction in which both the numerator and the denominator are whole numbers.
The number 18 can be said to a rational number because it can be written as the fraction $\frac{18}{1}$.
Likewise, ¾ is also a rational number because it can be written as a fraction.
Every whole number is a rational number, because any whole number can be written as a fraction.

1.1.8 Irrational Numbers

Any number that is not rational is considered as an irrational number. An irrational number can be written as a decimal, but not as a fraction.
An irrational number has endless non-repeating digits to the right of the decimal point.

Some important examples of irrational numbers include:
π = 3.141592…
$\sqrt{2}$ = 1.414213…
Although irrational numbers are not often used in daily life, they do exist on the number line. In fact, between 0 and 1 on the number line, there are an infinite number of irrational numbers

1.1.9 Decimal Numbers
Not every number we face is a whole number. Our decimal system allows us a flexibility in writing the numbers of different values and sizes, using a symbol called the decimal point.
Example: 32.567, 12.87 23.64
As we move right from the decimal point, each place value is divided by 10. While on moving to the left side from the decimal point each place value is multiplied by 10.

1.1.10 Perfect Number:
A perfect number is a natural number, which when you add up all of the factors less than that number will give you that number.
Example: The factors of 28 are 1, 2, 4, 7, and 14.
1 + 2 + 4 + 7 + 14 = 28.
Thus, 28 is a perfect number.

1.1.11 Perfect Square:
A perfect square is a number that can be written as the product of two equal factors.
Example: 25, 36, 49, 64… are all perfect squares.
Important properties of perfect squares:
(a) No perfect square ends with 2, 3, 7, 8.
(b) No perfect square ends with an odd number of zeros.
(c) Perfect squares can be recognized by the fact that all of their prime factors have even multiplicities.

1.1.12 Fractions:
A fraction is used to represent a part of a whole or any number of equal parts. A fraction (examples: 5/11 and 3/7) consists of an integer numerator, displayed above a line, and a non-zero integer denominator, displayed below that line.

Proper Fraction:
A fraction whose numerator is less than the denominator. The value of such fractions is usually less than 1.
Example $\frac{1}{4}, \frac{2}{7}, \frac{17}{20}$.

Improper Fraction:
A fraction whose numerator is equal to or greater than the denominator.
The value of such fractions is usually more than 1.
Example. $\frac{5}{3}, \frac{10}{7}, \frac{40}{19}$.

Mixed Fraction:
An improper fraction (fractions having denominator smaller than numerator) can be expressed as a whole number and a proper fraction. Such fractions are then called mixed fraction.

Steps involved in conversion of improper fraction to mixed fraction
Step 1: Divide the numerator by the denominator.
Step 2: Write down the Quotient (whole number) of the division followed by the fraction having the remainder above the denominator.
Example $5\frac{1}{4}, 3\frac{7}{8}, 22\frac{3}{17}$.

Factorization:
The prime numbers that divide an integer exactly are termed as the prime factors of that Integer.
The factorization of a positive integer is the process of listing of the integer's prime factors, together with their multiplicities.
Example 1: Prime factors of 420 $= 2 \times 2 \times 3 \times 5 \times 7$
$= 2^2 \times 3^1 \times 5^1 \times 7^1$
Where, 2, 3, 5 and 7 are factors having multiplicities 2, 1, 1 and 1 respectively.
Example2: Prime factorization of 900 = 2^2 x 3^2 x 5^2 in which multiplicities of the factors 2, 3, 5 are 2, 2, 2 respectively, which are all even. Thus 900 is a perfect square.
IV. Perfect square (unit digit- 0, 1, 4, 5, 6, 9)

Unit's digit	0	1	4	5	6	9
Ten's digit	0	even	even	2	odd	even

1.2 Factors and Multiples:

If a number, say, 'x' exactly divides another number 'y', we can say that 'x' is a factor of 'y'. Further, 'y' is called a multiple of 'x'.
For example, 4 is a common factor of 8 and 12.

Example 1: If A and B are two natural numbers such that A *x* B = 84, which of the following cannot be the value of A + B?
(1) 21 (2) 25
(3) 45 (4) 85
Explanation:
Checking only the given answer options,
12 x 7 = 84, 12+7 = 21
21 x 4 = 84, 21+4 = 25
84 x 1 = 84, 84+1 = 85
42 x 2 = 84, 42+2 = 44
Since A and B are natural numbers and we can get 44 by addition of a particular set of values, there can be no way of getting 45 by using natural number for A and B.
Therefore, 45 is the number which cannot be obtained in the above question i.e. option (3)
Answer (3)

1.2.1 GCD - Greatest Common Divisor (Highest Common Factor (HCF)):
The GCD or HCF of two or more than two numbers is the greatest number that divides each one of them exactly.
For example, 6 is the highest common factor of 12, 18 and 24.

Method for finding the GCD of two or more numbers:

Step 1: Express each one of the given numbers as the product of prime factors.

Step 2: Choose common factors.

Step 3: Find the product of these common factors. This is the required H.C.F. of given numbers.

Example: Find the GCD of 360 and 240?

Prime factors of 360 = $2 \times 2 \times 2 \times 3 \times 3 \times 5 = 2^3 3^2 5^1$

Prime factors of 240 = $2 \times 2 \times 2 \times 2 \times 3 \times 5 = 2^4 3^1 5^1$

Prime factors common to 360 and 240= $2 \times 2 \times 2 \times 3 \times 5 = 120$.

So, the GCD/HCF of 360 and 240 is 120.

1.2.2 Least Common Multiple (LCM):

The LCM of two or more given numbers is the smallest number which is exactly divisible by each one of them.

Method of finding LCM of two or more numbers:

Step 1: Resolve each given number into prime factors.

Step 2: Take out all factors with highest powers that occur in given numbers.

Step 3: Find the product of these factors. This product will be the L.C.M.

Example 1: Find LCM of 360 and 240

Prime factors of 360 = $2 \times 2 \times 2 \times 3 \times 3 \times 5 = 2^3 3^2 5^1$.

Prime factors of 240 = $2 \times 2 \times 2 \times 2 \times 3 \times 5 = 2^4 3^1 5^1$.

Product of highest powers of all prime factors of 360 and 240 = $2^4 \times 3^2 \times 5^1 = 720$.

Thus, the LCM of 360 and 240 is 720.

Important Properties of GCD and LCM

i. Product of two numbers = LCM of the numbers × HCF of the numbers

ii. HCF or GCD of given numbers always divides their LCM

iii. HCF or GCD of given fractions = $\frac{GCD\ of\ Numerators}{LCM\ of\ Denominator}$

iv. LCM of given fractions = $\frac{LCM\ of\ Numerators}{GCD\ of\ Denominator}$

Example 2: The GCD of two numbers is 2 and their LCM is 42. If one of the numbers is 6, find the other number?

(1) 12 (2) 13

(3) 14 (4) 16

Explanation:

Let another number be *y*.

We know that, Product of two numbers = Product of their GCD and LCM

i.e. $6 \times y = 2 \times 42$

i.e. $y = \frac{(2 \times 42)}{6}$

i.e. $y = 14$

Answer (3)

Example 3: Find the H.C.F of 108, 360 and 600.

(1) 12 (2) 13

(3) 14 (4) 15

Explanation:

Upon prime factorization of the given numbers,

$108 = 2^2 \times 3^3$,

$360 = (2^3 \times 3^2 \times 5)$

$600 = (2^3 \times 5^2 \times 3)$

Taking out the common factors, we can say,

H.C.F $= (2^2 \times 3)$

$= (4 \times 3)$

$= 12$

Answer (1)

1.3 'BODMAS' Rule:

This rule depicts the correct sequence in which the operations are to be executed, so as to find out the value of the given expression.

Here B - Bracket,
O - of,
D - Division,
M - Multiplication,
A - Addition and
S – Subtraction

Thus, in simplifying an expression, first of all the brackets must be removed, strictly in the order (), {} and ||.

After removing the brackets, we must use the following operations strictly in the order:

(i) Division (ii) Multiplication (iii) Addition (iv) Subtraction.

Example 4: What will be the value of $(48 - 12) \div 4 + 6 \div 2 \times 3$?

(1) 18 (2) 9/4

(3) 24 (4) 4.5

Explanation:

$(48 - 12) \div 4 + 6 \div 2 \times 3$

$= 36 \div 4 + 6 \div 2 \times 3$ (Solving Bracket)

$= 9 + 3 \times 3$ (Solving Division)

$= 9 + 9$ (Solving Multiplication)

$= 18$ (Solving Addition)

Answer (1)

1.4 Test for Divisibility:

- A number is **divisible by 2** if its last digit is 0 or divisible by 2 (i.e. 0,2,4,6 or 8).
  Example – 48, 786, 987654 are divisible by 2
- A number is **divisible by 3** if the sum of its digits is divisible by 3.
  Example: 534: 5+3+4=12 and 1+2=3 so 534 is divisible by 3.
- A number is **divisible by 4** if the last two digits of the number are divisible by 4 or both are 0.
  Example – 4224 is divisible by 4 since 24 (last two digits are divisible by 4)
- A number is **divisible by 5** if the last digit is 5 or 0.
  Example – 555, 8870, 745 are divisible by 5
- A number is **divisible by 6** if the number is divisible by both 2 and 3.

Example –36, 90, 216 are divisible by 2 since they are even and also by 3 (applying divisibility test for 3), therefore this numbers should be divisible by 6.

- A number is **divisible by 7** if the number follows the given condition –
  Double the last digit and subtract it from the remaining leading truncated number. If the result is divisible by 7, then so was the original number.
  Example – Whether 357 is divisible by 7 or not can be checked by taking the unit digit 7, double it to 14, and then subtract it from 35, then 35 – 14 = 21, which is divisible by 7. Therefore, 357 is divisible by 7.
- A number is **divisible by 8** if the number formed by the last three digits is divisible by 8.
  Example – 376, 67192, 1225448 are divisible by 8.
- A number is **divisible by 9** if the sum of the digits is divisible by 9.
  Example – 459, 1242, 6732 are divisible by since their addition is divisible by 9.
- A number is **divisible by 10** if it ends in a 0.
  Example – 340, 5670, 10000 are divisible by 10.
- A number is **divisible by 11** if the difference of the sum of the digits in the even and odd positions gives us a number which is either 0 or divisible by 11.
  Example – 572 is divisible by 11,
  Sum of digits in the even positions (i.e.2nd position) = 7
  Sum of digits in the odd positions (i.e.1st and 3rd position) = 5 + 2 = 7
  Difference = 7 -7 = 0, which is divisible by 11.
  There is an **alternative method for testing the divisibility by 11**.
  Subtract the last digit from the remaining leading truncated number. If the result is divisible by 11, then so was the first number. Apply this rule over and over again as necessary.
  Example – 19151→ 1915-1 =1914 →191-4=187 →18-7=11,
  so yes, 19151 is divisible by 11
- A number is divisible by 12 if the number is divisible by 2, 3 and 4 as well.
  Example – 108 is divisible by 2(since its even), divisible by 3(since addition of the digits is 9), divisible by 4(since 08 is divisible by 4) and therefore divisible by 12.
- A number is divisible by 13 if it follows the following condition- Add four times the last digit to the remaining leading truncated number. If the result is divisible by 13, then so was the first number. Apply this rule over and over again as necessary.
  Example–50661-->5066+4=5070-->507+0=507--> 50+28=78 and 78 is 6×13, so 50661 is divisible by 13.

Example 5: The number 333,333,333,333 is divisible by

(1) 9 and 11 (2) 3 and 11
(3) 3 and 9 (4) 3, 9 and 11

Explanation:
The addition of the digits in the number is 36 which is divisible by 3 as well as 9 therefore the number must be divisible by both 3 and 9.
Let us check the divisibility test for 11,
So, the addition of the digits at even places will be
3 +3 +3 +3 +3 +3 = 18,
While the addition of the digits at odd places will be 3 +3 +3 +3 +3 +3 = 18
So, 18-18 = 0, therefore according to the divisibility test of 11, the number should be divisible by 11 as well.
Answer (4)

1.5 Modulus of a Real Number:

Modulus of a real number x is defined as:

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

Thus, |5| = 5 and |-5| = -(-5) = 5.

1.6 Laws of Exponents:

$\boldsymbol{X^a}$: When '*X*' is a natural number, then $\boldsymbol{X^a}$ stands for the product of '*a*' factors each equal to '*X*'.

- $\left(\frac{x}{y}\right)^a = \frac{x^a}{y^a}$
- $x^0 = 1$
- $x^{-a} = \frac{1}{x^a}$
- $x^{\frac{1}{a}} = \sqrt[a]{x}$
- For any natural numbers a, b, c, d, $a^b > a^c > a^d$, if and only if $b > c > d$.
- For three positive real numbers 'a', 'b', 'c' with the same positive valued exponent x, $a^x > b^x > c^x$ if and only if $a > b > c$.

1.7 Properties of Exponents:

- $x^a \times x^b = x^{a+b}$
- $\frac{x^a}{x^b} = x^{a-b}$
- $(x^a)^b = x^{ab}$
- $(xy)^a = x^a . y^a$.

Example 6
$(32)^{2.6}$ x $(32)^{?} = 32^8$
(1) 2.9 (2) 2.75
(3) 4.5 (4) 5.4

Explanation:
$(32)^{2.6}$ x $(32)^{?} = 32^8$
$(32)^{?} = \frac{32^8}{32^{2.6}}$
$(32)^{?} = 32^{8-2.6}$ (since the numbers (roots) of the power are same)
$(32)^{?} = 32^{5.4}$
Answer (4)

Some Important Expansion Formulae:
i) $(x + y)(x - y) = (x^2 - y^2)$
ii) $(x + y)^2 = (x^2 + y^2 + 2xy)$

iii) $(x - y)^2 = (x^2 + y^2 - 2xy)$
iv) $(x + y + z)^2 = x^2 + y^2 + z^2 + 2(xy + yz + zx)$
v) $(x^3 + y^3) = (x + y)(x^2 - xy + y^2)$
vi) $(x^3 - y^3) = (x - y)(x^2 + xy + y^2)$
vii) $(x^3 + y^3 + z^3 - 3xyz) = (x + y + z)(x^2 + y^2 + z^2 - xy - yz - xz)$
viii) When $x + y + z = 0$, then $x^3 + y^3 + z^3 = 3xyz$.

1.8 Quadratic Equation

A quadratic equation is an equation of the form $f(x) = ax^2 + bx + c$, where a, b, c are all real and a≠0, and x is an unknown variable.
The values of x satisfying $f(x) = 0$ are called its roots.

- In $ax^2 + bx + c = 0$, the expression $D = b^2 - 4ac$ is called discriminant.
- Let α, β be the roots of the equation, $ax^2 + bx + c = 0$. Then
  Sum of roots$= \alpha + \beta = \frac{-b}{a}$
  Product of roots$= \alpha\beta = \frac{c}{a}$
- When the roots of quadratic equation are given, the quadratic equation is given by
  $x^2 -$(Sum of roots) x + Product of roots$= 0$

Nature of the roots of $ax^2 + bx + c = 0$
Let $D = b^2 - 4ac$ be the discriminant of the given equation and the nature of two roots depends on this discriminant as follows:

1. Real and equal if $D = 0$
2. Real, unequal and rational, when $D > 0$ and D is a perfect square.
3. Real, unequal and irrational, when $D > 0$ but D is not a perfect square
4. Imaginary, if $D < 0$

Example 7: While solving a problem that reduces to a quadratic equation one student makes a mistake only in the constant term of the equation and obtains 8 and 2 for the roots. Another student makes a mistake only in the coefficient of the first-degree term and finds -9 and -1 for the roots. The correct equation was:
(1) $x^2 - 10x + 9 = 0$ (2) $x^2 + 10x + 9 = 0$
(3) $x^2 - 10x + 16 = 0$ (4) $x^2 - 8x - 9 = 0$
Explanation:
For a general quadratic equation, $px^2 + qx + r = 0$,
Sum of roots = $-\frac{q}{p}$,
Product of roots = $\frac{r}{p}$
Here $x^2 + ax + b = 0$
So, p = 1, q = a, r = b.
Thus, sum of roots = -a
Product of roots = b
First student took the wrong value of b, but the correct value of a. Therefore, the sum of roots is correct.
Thus, sum of the roots (-a) = 8 + 2 = 10
So, -a = 10
a = -10
Another student took a wrong value of a, but correct value of b.
Therefore, the products of roots are correct.
Thus, product of roots (b) = -9 x -1 = 9
b = 9
Thus, the correct values of a and b are -10 and 9
Therefore, the correct equation becomes $x^2 - 10x + 9 = 0$
Answer (1)

1.9 Power Cycle of Number:

When we multiply any two numbers having more than one digit, the last digit of the product is the result of the last digit of the product of the last digit of the two numbers.
For example, 332 × 332 =110224, the last digit of this product can be simply obtained by multiplying 2 × 2 = 4 and taking the last digit of that product, i.e., 4 itself.
The last digit of a number x^y forms an order which depends on the unit (last) digit of the number (x) and the power of the number i.e. (y).
This order which is followed by a particular number is the power cycle of that number.
Example – The power cycle of 3:
3^1 = **3**, 3^5 = 24**3**, 3^9 = 1968**3**,
3^2 = **9**, 3^6 = 72**9**, 3^{10} =5904**9**,
3^3 = 2**7**, 3^7 = 218**7**, 3^{11} = 17714**7**,
3^4 = 8**1**, 3^8 = 656**1,** 3^{12} = 53144**1**

Notice that the unit digit gets repeated after every 4th power of 3.
Therefore, it is said that 3 has a power cycle of 3, 9, 7, 1 with frequency 4.

All the numbers having 3 at their unit place will have the power cycle and its frequency is the same as 3.
The power cycle of the digits from 0-9 is given below:

Last Digit	Power Cycle	Frequency
0	0	1
1	1	1
2	2, 4, 8, 6	4
3	3, 9, 7, 1	4
4	4, 6	2
5	5	1
6	6	1
7	7, 9, 3, 1	4
8	8, 4, 2, 6	4
9	9, 1	2

Power cycle of any given number can be estimated by knowing the power cycle of these 9 digits.

Example 8: What is the last digit of 38^{38}?
(1) 2 (2) 4
(3) 6 (4) 8

Explanation:
The unit place digit of 38 is 8. From the above table we know that power cycle of 8 is {8, 4, 2, 6} with the frequency of 4.
That is, $8^1 = 8$,
$8^2 = 64$,
$8^3 = 512$,
$8^4 = 4096$ and so on.
Since the power of 38 is 38, we can directly divide 38 by 4 and get remainder as 2 which means the last digit of the number we get after raising the power to 38 is same as the last digit of power 2 and i.e.4
Answer (2)

Example 9: What is the last digit of 63^{121}?
(1) 1 (2) 3
(3) 7 (4) 9
Explanation:
To obtain the last digit of 63^2, 63^3… multiply the last digits i.e., 3×3, 9×3, 7×3 etc.
Hence, the last digit is given by,
For 63^1, Last digit = 3, i.e.3
For 63^2, Last digit = 3 × 3 = 9, i.e., 9
For 63^3, Last digit = 9 × 3 = 27, i.e., 7
For 63^4, Last digit = 7 × 3 = 21, i.e., 1.
For 63^5, Last digit = 1 × 3 = 3, i.e., 3
For 63^6, Last digit = 3 × 3 = 9, i.e., 9
For 63^7, Last digit = 9 × 3 = 27, i.e., 7
For 63^8, Last digit = 7 × 3 = 21, i.e., 1.
Clearly, we can observe that the unit digit gets repeated after every 4th power of 3.
Hence, we can say that 3 has a power cycle of 3, 9, 7, 1, with frequency 4.
Therefore, for powers, 1, 5, 9, 13… the last digit will be 3.
For powers, 2, 6, 10, 14…., the last digit will be 9.
For powers, 3, 7, 11, 15…., the last digit will be 7.
For powers, 4, 8, 12, 16…., the last digit will be 1.
In the question, the power is 121.
We have to check, in which series does 121 come.
121 is a number that gives a remainder 1 when divided by 4.
Therefore, 121 is in the series 1, 5, 9, 13, …
Hence, the last digit is 3.
Answer (2)

Example 10: When 2^{33} is divided by 10, the remainder will be
(1) 2 (2) 3
(3) 4 (4) 8
Explanation:
We know that, $2^1 = 2$, $2^2 = 4$, $2^3 = 8$, $2^4 = 16$, $2^5 = 32$….
2 have a power cycle {2, 4, 8, 6} with the frequency of 4. So, dividing 33 by 4 we get 1 as remainder.
So, $2^1 = 2$ should be present on unit place.
The number present on unit place is the remainder when any number is divided by 10.
Answer (1)

1.10 Addition of the Sequences

Arithmetic Sequence
In an arithmetic sequence, when each term of a sequence differs from its preceding term by a constant value, the value is called the common difference of that sequence.
The general form of an arithmetic sequence is a, a+d, a+2d, a+3d and so on.
Three numbers x, y and z are in A.P. if $2y = x + z$
The nth term of an Arithmetic Sequence is can be found by
$t_n = a + (n-1)\, d$
Sum of n terms of an Arithmetic sequence is given by
$S_n = \frac{n}{2}$(first term + last term)
$= \frac{n}{2}[2a + (n-1)\, d]$
Where, a = first term of the sequence,
d = common difference of the sequence = $T_n - T_{n-1}$
Sum of first n consecutive natural numbers
$= (1 + 2 + 3 + \ldots + n) = \frac{n\,(n+1)}{2}$
Sum of first n consecutive square numbers
$= (1^2 + 2^2 + 3^2 + \ldots + n^2) = \frac{n(n+1)\,(2n+1)}{6}$
Sum of first n consecutive cubic numbers
$= (1^3 + 2^3 + 3^3 + \ldots + n^3) = \frac{(n\,(n+1))2}{4}$

1.11 Geometric Sequence

In a geometric sequence, the ratio of a term with its preceding term tends to be constant.
The general form of a G.P. is a, ar, ar^2, ar^3 and so on.
Three numbers a, b, c are in G.P. if $b^2 = ac$
The nth term of a geometric series is $t_n = ar^{n-1}$
Sum of n terms of a Geometric sequence

$$S_n = \frac{a(r^n - 1)}{r - 1}, \quad r > 1$$

Where, a is the first term, r is the common ratio
Sum of terms of an infinite geometric progression,

$$S_\infty = \frac{a}{1 - r}, r < 1.$$

Example 11: Which term of the series 2, 5, 8, 11, 14…. is 266?
(1) 66th (2) 89th
(3) 90th (4) 92th
Explanation:
Looking at the sequence, we can find that,
1st term is 2 i.e. 3 x 1 – 1
2nd term is 5 i.e. 3 x 2 – 1
3rd term is 8 i.e. 3 x 3 – 1
So, 266 is $\frac{266+1}{3}$ i.e. 89th term
Or
Use this formula, $t_n = a + (n-1)\, d$
Where a=2, t_n=266, d=3
266=2+(n-1)3
266-2=3n-3
264+3=3n
267=3n
n=89
Answer (2)

1.12 CSIR NET Solved Problems:

(CSIR NET/JRF DEC 2012)

1. Which of the following numbers is the largest?

$2^{3^4}, 2^{4^3}, 3^{2^4}, 3^{4^2}, 4^{2^3}, 4^{3^2}$

(1) 2^{3^4} (2) 3^{4^2}

(3) 4^{3^2} (4) 4^{2^3}

Explanation:

Consider the given options:

$2^{3^4} = 2^{81}$,

$3^{4^2} = 3^{16}$,

$4^{3^2} = 4^9$,

$4^{2^3} = 4^8$

We can clearly say that $4^8 < 4^9$. So, option 3 can be eliminated from the above-considered options.

To compare the remaining 3 numbers, 2^{81}, 3^{16}, 4^9 we need to make base or power of each number the same. So we can try to make the bases same.

$2^{81} = 2 \times 2^{80} = 2 \times (2^2)^{80} = 2 \times 4^{40}$

Thus, our remaining three numbers become 2×4^{40}, 3^{16}, 4^9.

Notice that the base and power of 4^{40} is greater than 3^{16} and 4^9, 4^{40} is greater than both the other numbers. Then surely, 2 times 4^{40} is also greater than both the other numbers.

Hence, 2^{81} is the largest.

Answer (1)

(CSIR NET/JRF DEC 2012)

2. Which of the following curve just touches the x-axis?

(1) $y = x^2 - x + 1$ (2) $y = x^2 - 2x + 2$

(3) $y = x^2 - 10x + 25$ (4) $y = x^2 - 7x + 12$

Explanation:

Clearly $x^2 - 10x + 25 = 0$

$(x - 5)^2 = 0$

x = 5, 5, real and equal roots.

Answer (3)

(DECEMBER 2012)

3. Consider the following equation:

$x^2 + 4y^2 + 9z^2 = 14x + 28y + 42z + 147$

Where, *x, y* and *z* are real numbers. Then the value of $x+2y+3z$ is

(1) 7 (2) 14

(3) 21 (4) not unique

Explanation:

$x^2+4y^2+9z^2 = 14x + 28y + 42z - 147$

$x^2+4y^2+9z^2-14x-28y-42z+ 147=0$

$x^2+4y^2 +9z^2-14x-28y-42z+49 +49 +49=0$

$x^2-14x+49 +4y^2-28y + 49+ 9 z^2-42z+49=0$

$(x^2-14x+49) + (4y^2-28y+49) + (9z^2-42z+49)=0$

$(x-7)^2 +(2y-7)^2 \ (3z-7)^2 = 0$

Thus, each term must be separately zero.

$(x-7)^2=0$

Take square root on both sides,

$(x-7)=0$

x = 7

$(2y-7)^2=0$

Take square root on both sides.

$(2y-7)=0$

y = 7/2

As, $(3z-7)^2$

Z = 7/3

$x+2y+3z=7+2\left(\frac{7}{2}\right)+3\left(\frac{7}{3}\right) = 7+7+7=21$

Then, the value of x + 2y + 3z is 21

Answer (3)

(CSIR NET/JRF DEC 2012)

4. Consider the following equation:

$x^2 + 4y^2 + 9z^2 = 14x + 28y + 42z - 147$

Where x, y and z are real numbers.

Then the value of x + 2y + 3z is

(1) 7 (2) 14

(3) 21 (4) not unique

Explanation:

Given:

$x^2 + 4y^2 + 9z^2 = 14x + 28y + 42z - 147$

Grouping like terms together as below:

$(x^2 - 14x) + ((2y)^2 - 28y) + ((3z)^2 - 42z) + 147 = 0$

Making perfect squares by adding adequate numbers in each grouping as below:

$(x^2 - 14x + 49) + ((2y)^2 - 28y + 49) + ((3z)^2 - 42z + 49) = 0$

$(x - 7)^2 + (2y - 7)^2 + (3z - 7)^2 = 0$.

The left-hand side in above equation is the sum of 3 non-negative numbers because every square number is positive.

For the sum of three non-negative numbers to be zero, they all should be zero.

So: $(x - 7)^2 = 0$, $(2y - 7)^2 = 0$, $(3z - 7)^2 = 0$.

$(x - 7) = 0$, $(2y - 7) = 0$, $(3z - 7) = 0$.

$x = 7$, $y = 7/2$, $z = 7/3$.

Thus, $x + 2y + 3z = 7 + (2\times7/2) + (3\times7/3) = 7 + 7 + 7 = 21$.

Answer (3)

(CSIR NET/JRF JUNE 2013)

5. n is a natural number. If n^5 is odd, which of the following is true?

A. n is odd

B. n^3 is odd

C. n^4 is even

(1) A only (2) B only

(3) C only (4) A and B only

Explanation:

Consider any small natural number say 5, such that its fifth power is odd.

$5^5 = 3125$, odd

$5^4 = 625$, odd

$5^3 = 125$, odd

Clearly, only A and B are correct. Hence, option (4).

Answer (4)

(CSIR NET/JRF JUNE 13)

6. What is the last digit of 7^{73}?

(1) 7 (2) 9

(3) 3 (4) 1

Explanation:
To obtain the last digit of 7^2, 7^3, …, multiply the last digits i.e., 7×7, 9×7, 3×7 etc.
So, the last digit is given by as below:
For 7^1, Last digit = 7, i.e., 7
For 7^2, Last digit = 7 × 7 = 49, i.e., 9
For 7^3, Last digit = 9 × 7 = 63, i.e., 3
For 7^4, Last digit = 3 × 7 = 21, i.e., 1.
For 7^5, Last digit = 1 × 7 = 7, i.e., 7
For 7^6, Last digit = 7 × 7 = 49, i.e., 9
For 7^7, Last digit = 9 × 7 = 63, i.e., 3
For 7^8, Last digit = 3 × 7 = 21, i.e., 1.
Note that {7, 9, 3, 1} is the cycle of last digits which gets repeated.
So, for powers, 1, 5, 9, 13… the last digit will be 7 itself.
For powers, 2, 6, 10, 14… the last digit will be 9.
For powers, 3, 7, 11, 15… the last digit will be 3.
For powers, 4, 8, 12, 16… the last digit will be 1.
In the question, the power is given as 73.
73 when divided by 4, gives a remainder 1.
So, 73 should be in the series 1, 5, 9, 13…
Thus, the last digit is 7.
Answer (1)

(CSIR NET/JRF JUNE 2013)

7. Suppose you expand the product $(x_1 + y_1)(x_2 + y_2)…(x_{20} + y_{20})$. How many terms will have only one x and rest y's?
(1) 1 (2) 5
(3) 10 (4) 20
Explanation:
Here,
$(x_1 + y_1)$ ----- 1 term
$(x_1 + y_1)(x_2 + y_2) = (x_1 x_2 + x_1 y_2 + x_2 y_1 + y_1 y_2)$ ----- 2 terms
Continuing like this, we can find that if 20 factors are there in the product, there will be 20 terms in the expression with only 1 x and rest all y's.
Answer (4)

(CSIR NET/JRF JUNE 2013)

8. In solving a quadratic equation of the form $x^2 + ax + b = 0$, one student took the wrong value of a and got the roots as 6 and 2; while another student took the wrong value of b and got the roots as 6 and 1.
What are the correct values of a and b, respectively?
(1) 7 and 12 (2) 3 and 4
(3) -7 and 12 (4) 8 and 12
Explanation:
For a general quadratic equation: $mx^2 + nx + p = 0$,
Sum of roots = -n/m, Product of roots = p/m
Given: $x^2 + ax + b = 0$
So, m = 1, n = a, p = b.
Therefore, sum of roots = -a
Product of roots = b
Given: First student took the wrong value of a, but the correct value of b.
So, the product of roots is correct.
Therefore, product of roots (b) = 6 × 2 = 12.
Given: Another student took the wrong value of b, but correct value of a.
So, the sum of roots is correct.
Therefore, sum of roots (-a) = 6 + 1 = 7
-a = 7
a = -7
So, the correct values of a and b are -7 and 12.
Answer (3)

(CSIR NET/JRF JUNE 2013)

9. Choose the largest number:
(1) 2^{500} (2) 3^{400}
(3) 4^{300} (4) 5^{200}
Explanation:
If we have to compare these numbers, then we should either make the base same, or the power same.
Here in the base, the numbers are 2, 3, 4 and 5. It is difficult to make the base same here.
Therefore, we can try making the exponent same.
$2^{500} = (2^5)^{100} = 32^{100}$,
$3^{400} = (3^4)^{100} = 81^{100}$,
$4^{300} = (4^3)^{100} = 64^{100}$,
$5^{200} = (5^2)^{100} = 25^{100}$.
Now the exponents are all the same.
Therefore, the number with largest base is the largest number.
Hence, $81^{100} = 3^{400}$ is the largest number.
Answer (2)

(CSIR NET/JRF JUNE 2013)

10. Define
$a \otimes b$ = LCM (a, b) + GCD (a, b) and $a \oplus b = a^b + b^a$.
What is the value of $(1 \oplus 2) \otimes (3 \oplus 4)$?
Here LCM = least common multiple and GCD = greatest common divisor.
(1) 145 (2) 286
(3) 436 (4) 572
Explanation:
Given: $a \oplus b = a^b + b^a$
So, $1 \oplus 2 = 1^2 + 2^1 = 1 + 2 = 3$,
$3 \oplus 4 = 3^4 + 4^3 = 81 + 64 = 145$
Therefore, $(1 \oplus 2) \otimes (3 \oplus 4) = 3 \otimes 145$
It is said that $a \otimes b$ = LCM (a, b) + GCD (a, b)
So, $(1 \oplus 2) \otimes (3 \oplus 4)$ = LCM (3,145) + GCD (3,145)
= 435 + 1 = 436.
Answer (3)

(CSIR NET/JRF JUNE 2013)

11. How many pairs of positive integers have GCD 20 and LCM 600? (GCD = greatest common divisor, LCM = least common multiple)
(1) 4 (2) 0
(3) 1 (4) 7
Explanation:
Note:
For any two number (p and q):
GCD (p, q) × LCM (p, q) = p × q
Given: GCD = 20 & LCM = 600
$20 \times 600 = p \times q$

i.e. $p \times q = 12000$.
Since p and q have GCD 20, both p and q are multiples of 20.
i.e., $p = 20x$, $q = 20y$,
where x and y are relatively prime numbers.
So, $20x \times 20y = 12000$
$400x \times y = 12000$
$x \times y = 30$.
So, possible combinations of x and y are

x	1	2	3	5
y	30	15	10	6

Thus, possible pairs of such positive integers with GCD 20 and LCM 600 are as below:
$20 \times 1, 20 \times 30 = 20, 600$
$20 \times 2, 20 \times 15 = 40, 300$
$20 \times 3, 20 \times 10 = 60, 200$
$20 \times 5, 20 \times 6 = 100, 120$
Thus, there are 4 pairs.
Answer (1)

(CSIR NET/JRF DEC 2013)

12. If a_i, b_i and c_i are distinct, how many terms will the expansion of the product $(a_1 + a_2 + a_3)(b_1 + b_2 + b_3 + b_4)(c_1 + c_2 + c_3 + c_4 + c_5)$ contain?
(1) 12 (2) 30
(3) 23 (4) 60
Explanation:
$(a_1 + a_2 + a_3)(b_1 + b_2 + b_3 + b_4)(c_1 + c_2 + c_3 + c_4 + c_5)$
Let x, y, z be the number of a_i, b_i, c_i terms respectively.
Principle of Counting: If a_i, b_i, c_i are distinct, the number of terms in the product = $x \times y \times z$
So, the total number of terms = $3 \times 4 \times 5 = 60$.
Answer (4)

(CSIR NET/JRF DEC 2013)

13. $4^0+4^2+1/4^2+4^{1/2}+1/4^{1/2}$ equals
(1) 4^0 (2) $4^{2\frac{1}{2}} + 4^{-2\frac{1}{2}}$
(3) $19\frac{9}{16}$ (4) $22\frac{9}{16}$
Explanation:
We know that:
$4^0 = 1$, $4^2 = 16$,
$1/4^2 = 1/16$, $4^{1/2} = \sqrt{4} = 2$, $1/4^{1/2} = 1/\sqrt{4} = 1/2$
So, $4^0+4^2+1/4^2+4^{1/2}+1/4^{1/2}$
$= 1+16+ 1/16+2+ 1/2$
$= 19 + 1/16 + ½ = 19 + 9/16$.
Answer (3)

(CSIR NET/JRF DEC 2013)

14. Every time a ball falls to ground, it bounces back to half the height it fell from. A ball is dropped from a height of 1024 cm. The maximum height from the ground to which it can rise after the tenth bounce is
(1) 102.4 cm (2) 1.24 cm
(3) 1 cm (4) 2 cm
Explanation:
Given:
Ball bounces back to half the height $(1/2 \times 1024)$, it was dropped from initially.
After the second bounce, it bounces back to half the height $(1/2 \times (1/2 \times 1024))$, after the first bounce.
This sequence continues in the same manner.
We need to find the height of the ball after the 10th bounce.
Given: Initial height = 1024 cm
Height after 1st bounce = $1/2 \times 1024$
Height after 2nd bounce= $1/2 \times (1/2 \times 1024) = (1/2)2 \times 1024$
Height after 3rd bounce = $1/2 \times (1/2 \times 1/2 \times 1024) = (1/2)3 \times 1024$
Similarly, height after 10th bounce = $(1/2)^{10} \times 1024 = 1/1024 \times 1024 = 1$ cm.
Answer (3)

(CSIR NET/JRF DEC 2013)

15. $(25 \div 5 + 3 – 2 \times 4) + (16 \times 4 - 3) =$
(1) 61 (2) 22
(3) 41/24 (4) 1
Explanation:
Using BODMAS rule:
$(25 \div 5 + 3 – 2 \times 4) + (16 \times 4 – 3)$
$= ((25 \div 5) + 3 – (2 \times 4)) + ((16 \times 4) – 3)$
$= ((5 + 3) – 8) + ((16 \times 4) – 3) = (8 - 8) + (64 – 3) = 61$.
Answer (1)

(CSIR NET/JRF DEC 2013)

16. For real numbers x and y, $x^2 + (y - 4)^2 = 0$. Then the value of x + y is:
(1) 0 (2) 2
(3) √2 (4) 4
Explanation:
Given: $x^2 + (y – 4)^2 = 0$.
Here x^2 and $(y – 4)^2$ are non-negative real numbers and we know that the sum of non-negative real numbers is 0 only when both the numbers are 0.
So: $x^2 = 0$ and $(y – 4)^2 = 0$.
$x = 0$, $y – 4 = 0$, i.e. $y = 4$
Therefore: $x + y = 0 + 4 = 4$
Answer (4)

(CSIR NET/JRF DEC 2013)

17. If $a + b + c + d + e = 10$ (all positive numbers), then the maximum value of $a \times b \times c \times d \times e$ is
(1) 12 (2) 32
(3) 48 (4) 72
Explanation:
Maximum of {*a, b, c, d, e*} is minimum for {2, 2, 2, 2, 2}.
That is, $a \times b \times c \times d \times e = 2 \times 2 \times 2 \times 2 \times 2 = 32$.
Answer (2)

(CSIR NET/JRF JUNE 2014)

18. How many digits are there in $2^{17} \times 3^2 \times 5^{14} \times 7$?
(1) 14 (2) 15
(3) 16 (4) 17
Explanation:
First, we can simplify the expression by finding the powers of 10 in the product.
For that, we can club the powers of 2 and 5.
$2^{17} \times 3^2 \times 5^{14} \times 7$
$= 2^3 \times 2^{14} \times 5^{14} \times 3^2 \times 7$

$= (2 \times 5)^{14} \times 2^3 \times 3^2 \times 7$
$= 10^{14} \times 8 \times 9 \times 7$
$= 504 \times 10^{14}$
i.e., 504 followed by 14 zeros.
i.e., 14 + 3= 17 digits
Answer (4)

(CSIR NET/JRF JUNE 2014)

19. The following sum is:
1 + 1 - 2 + 3 - 4 + 5 - 6 …. - 20 =?
(1) 10 (2) -10
(3) -11 (4) -9
Explanation:
In the above given problem, there are 21 numbers.
Leaving the first number 1, we can pair all other numbers.
1 + (1 - 2) + (3 – 4) + (5 – 6) …. + (19 - 20)
= 1 + (-1) + (-1) …. + (-1)
= 1 - 10 (since there will be 10 terms of -1)
= -9.
Answer (4)

(CSIR NET/JRF JUNE 2014)

20. You are given 100 verbs using which you have to form sentences containing at least one verb, without repeating the verbs, under the condition that the number of verbs (from this set of 100) in any two sentences should not be equal. The maximum number of sentences you can form is
(1) 10 (2) 13
(3) 14 (4) 100
Explanation:
Given: 100 verbs and we are required to form sentences using these 100 verbs using two conditions.
Condition 1:
The number of verbs in any two sentences should not be equal.
i.e., if we use only one verb in one sentence, then we cannot construct another sentence with only one verb.
If we form a sentence with only two verbs, then we cannot construct another sentence with only two verbs and so on.
Condition 2:
If we use a verb in one sentence, we are not allowed to use the same verb in any other sentence.
Let n be the maximum number of sentences we can form satisfying these conditions.
By condition 1:
1st sentence has 1 verb in it.
2nd sentence has 2 verbs in it.
3rd sentence has 3 verbs in it.
…
nth sentence has n verbs in it.
So, by the above two conditions, only the number of verbs we use matter and the actual verbs we use does not matter.
i.e., Maximize n: 1 + 2 + 3 + … + n ≤ 100.
Now, we know that the Sum of first n natural numbers = $\frac{n(n+1)}{2}$.
By trial and error, putting the 4 options, find the maximum value of n for which, $\frac{n(n+1)}{2} \leq 100$.
Putting n = 13, we get $\frac{13 \times 14}{2} \leq 100$
91 ≤ 100
Thus, n = 13 is the maximum value of n which satisfies the inequality.
Answer (2)

(CSIR NET/JRF JUNE 2014)

21. Suppose $x \Delta y = (x-y)^2$
$x \circ y = (x+y)^2$
$x * y = (x \times y)^{-1}$
$x. y = x \times y$
+, - and × have their usual meanings.
What is the value of {(197 o 315) - (197 Δ 315)} ? (197 x 315)?
(1) 1018 (2) 512
(3) 2 (4) 4
Explanation:
Consider 197 and 315 as x and y respectively.
Then, the given expression becomes as below:
{(xoy) – (xΔy)}. (x*y)
Applying the given definitions, we get:
{(xoy) – (xΔy)}. (x*y) = {(x + y)2– (x – y)2} × (x × y)-1
= {x2 + y2 + 2xy – x2 – y2 + 2xy} × 1/xy
= 4xy/xy = 4.
Answer (4)

(CSIR NET/JRF JUNE 2014)

22. If A × B = 24, B × C = 32, C × D = 48, then A×D
(1) cannot be found (2) is a perfect square
(3) is a perfect cube (4) is odd
Explanation:
A × B = 24 -------- (1)
B × C = 32 -------- (2)
C × D = 48 -------- (3)
Equation (1) divided by equation (2) gives as below:
A/C = 3/4------ (4)
Equation (3) multiplied by equation (4) gives as below:
A × D = 48×3/4 = 36
$= 6^2$, a perfect square.
Alternate method: $(A \times D) = \frac{(A \times B) \times (C \times D)}{(B \times C)}$
$= \frac{24 \times 48}{32}$
$= 36 = 6^2$, a perfect square.
Answer (2)

(CSIR NET/JRF JUNE 2014)

23. Suppose n is a positive integer. Then $(n^2 + n)(2n + 1)$
(1) may not be divisible by 2
(2) is always divisible by 2 but may not be divisible by 3
(3) is always divisible by 3 but may not be divisible by 6
(4) is always divisible by 6
Explanation:
Given: $(n^2 + n)(2n + 1) = n(n+1)(2n+1)$
Note:
Sum of squares of first n natural numbers = (n(n+1)(2n+1))/6

Sum of squares of first n natural numbers is always a natural number.
(n(n+1) (2n+1))/6 is a natural number.
For (n(n+1) (2n+1))/6 to be a natural number, n(n+1) (2n+1) should be a multiple of 6.
Option (4): n(n+1) (2n+1) is divisible by 6.
Answer (4)

(CSIR NET/JRF JUNE 2014)

24. Consider the set of numbers $\{17^1, 17^2, \ldots, 17^{300}\}$. How many of these numbers end with the digit 3?
(1) 60 (2) 75
(3) 100 (4) 150
Explanation:
To obtain the last digit of 17^2, 17^3,…, Multiply the last digits as below:
i.e., 7×7, (since 7x7 in 49)
9×7, (since 9x7 in 63)
3×7 and so on.
So, for 17^1, Last digit = 7
17^2, Last digit = 7×7 = 49, i.e., 9
17^3, Last digit = 9×7 = 63, i.e., 3
17^4, Last digit = 3×7 = 21, i.e., 1
17^5, Last digit = 1×7 = 7, i.e., 7
17^6, Last digit = 7×7 = 49, i.e., 9
17^7, Last digit = 9×7 = 63, i.e., 3
17^8, Last digit = 3×7 = 21, i.e., 1.
So, {7, 9, 3, 1} is the cycle of last digits which gets repeated as above.
The digit 3 appears once in each cycle of length 4.
In 300, there are 300/4 = 75 cycles of length 4.
So, in the given set, there are 75 numbers with the last digit 3.
Answer (2)

(CSIR NET DEC 2014)

25. What is the 94th term of the following sequence? 1, 1, 2, 2, 2, 2, 3, 3, 3, 3, 3, 3, 4, 4, 4, 4, 4, 4, 4, 4, ….?
(1) 8 (2) 9
(3) 10 (4) 11
Explanation:
In the given sequence notice that in the nth set, there are 2n elements and all the elements are n.
Thus, our question can be reformulated as
Minimize n for which 2 + 4 + 6 +…. + 2n ≥ 94
2(1+2+3+…. + n) ≥ 94
(1+2+3+…. + n) ≥ 47.
Now, the Sum of the first 'n' consecutive natural numbers = (n(n+1))/2.
Thus, Minimize n for which (n(n+1))/2 ≥ 47.
Now, if we take n =9, the value of (n(n+1))/2 becomes (9 x 10)/2 = 45, which contradicts our equation (n(n+1))/2 ≥ 47
Therefore, taking next value for n i.e. n = 10,
That is (10 ×11)/2 = 55 ≥ 47.
Thus, 94 occurs in the 10th set, and so the 94th term is 10.
Answer (3)

(CSIR NET/JRF DEC 2014)

26. Which of the following numbers is a perfect square?
(1) 1022121 (2) 2042122
(3) 3063126 (4) 4083128
Explanation:
We know that a perfect square does not end with 2, 3, 7 or 8.
Thus, we can say that (2) and (4) cannot be the correct options.
For the remaining options that are (1) and (3).
Now, we also know that Perfect squares have all of their prime factors with even multiplicities.
Doing the prime factorization of options (1) and (3).
3063126 = 2 × 3 × 11 × 46411, in which the factors 2, 3, 11, 46411 all have multiplicities 1, which is odd.
Thus, 3063126 should not be a perfect square.
$1022121 = 3^2 \times 337^2 = (3 \times 337)^2$, which is clearly a perfect square.
Answer (1)

(CSIR NET/JRF DEC 2014)

27. The equation $m^2 - 33n + 1 = 0$, where m & n are integers has
(1) no solution
(2) exactly one solution
(3) exactly two solutions
(4) infinitely many solutions
Explanation:
Given: $m^2 - 33n + 1 = 0$.
$m^2 = 33n - 1$
$m = \sqrt{(33n-1)}$
There is no such integer 'n' which satisfies the equation.
Hence, there is no solution to the given equation.
Answer (1)

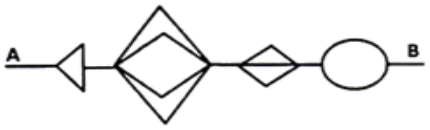
(CSIR NET/JRF DEC 2014)

28. We define a function *f* (N) = sum of digits of N, expressed as a decimal number.
E.g. *f* (137) = 1 + 3 + 7 = 11:
Evaluate $f(2^7 3^5 5^6)$.
(1) 10 (2) 18
(3) 28 (4) 11
Explanation:
We require finding the value of expression $(2^7 3^5 5^6)$ and then finding its sum of digits.
First, we can simplify the expression by applying laws of exponents in the product.
For that, we can club all the powers of 2 and 5.
Hence,
$2^7 3^5 5^6 = 2 \times 3^5 \times 2^6 \times 5^6$
$= 2 \times 3^5 \times (2 \times 5)^6$
$= 2 \times 3^5 \times 10^6$ $= 2 \times 243 \times 10^6$
$= 486 \times 10^6$ $= 486000000$.
Thus, $f(2^7 3^5 5^6)$= sum of digits of 486000000
= 4 + 8 + 6 + 0 = 18
Answer (2)

(CSIR NET/JRF DEC 2014)

29. A mouse has to go from a point A to B without retracing any part of the path, and never moving backwards. What

is the total number of distinct paths that the mouse may take to go from A to B?



(1) 11 (2) 48
(3) 72 (4) 24

Explanation:

If we analyse the given figure, between points A and B, there are four junctions with 2,4,3,2 paths respectively.
For the first two paths, there are four paths each and for each of the four paths, there are three paths each and for each of the three paths, there are two paths each.
So, by the fundamental principle of counting,
Therefore, the total number of distinct paths from A to B
= 2 × 4 × 3 × 2 = 48.

Answer (2)

(CSIR NET/JRF DEC 2014)

30. The sum of first n natural numbers with one of them missed is 42. What is the number that was missed?
(1) 1 (2) 2
(3) 3 (4) 4

Explanation:

Let us consider that x be the missed number.
Since x is a positive number, the sum of the first 'n' natural numbers including x should be greater than 42.
Note: Sum of first 'n' natural numbers $\frac{n\times(n+1)}{2}$
If we take the sum for first 9 natural numbers= $\frac{(9\times 10)}{2} = 45$, (Nearest sum to 45, since sum of first 8 natural numbers would be 36 and that of first 10 would be 55)
Thus, 45 – x = 42
x = 3.

Answer (3)

(CSIR NET/JRF DEC 2014)

31. If N, E and T are distinct positive integers such that N × E × T = 2013, then which of the following is the maximum possible sum of N, E and T?
(1) 39 (2) 2015
(3) 675 (4) 671

Explanation:

By prime factorization:
2013 = 3 × 671
So, 2013 = 1 × 3 × 671 is the only possible way in which 2013 can be expressed as the product of three distinct positive integers.
Hence the sum = 1 + 3 + 671 = 675
Here 2013 = 2013 × 1 × 1 is not possible because the number 1 is repeated and hence not distinct positive integers.
Therefore, 675 is the maximum possible sum.

Answer (3)

(CSIR NET/JRF DEC 2014)

32. If n is a positive integer, then n(n + 1) (n + 2)(n + 3)(n + 4)(n + 5)(n + 6) is divisible by
(1) 3 but not 7 (2) 3 and 7
(3) 7 but not 3 (4) neither 3 nor 7

Explanation:

It is fact that in every three consecutive integers, there should be a multiple of 3 and in every seven consecutive integers, there should be a multiple of 7.
Now, n, n+1…, n+6 are 7 consecutive numbers.
So, there will be a multiple of 3 and 7 in these numbers.
Therefore, n (n + 1) (n + 2) (n + 3) (n + 4) (n + 5) (n + 6), having consecutive integers is divisible by 3 and 7.

Answer (2)

(CSIR NET/JRF DEC 2014)

33. The least significant bit of an 8-bit binary number is zero. A binary number whose value is 8 times the previous number has
(1) 12 bits ending with three zeros
(2) 11 bits ending with four zeros
(3) 11 bits ending with three zeros
(4) 12 bits ending with four zeros

Explanation:

Least Significant bit is the last bit of a binary number.
Let us take a typical 8-bit binary number, for example 10000010.
Now, the least significant bit here is zero.
We have to determine the binary number whose value is 8 times the above number.
Note: Rules of binary addition:
0+0 =0, 1+1 =10,
Note: In any number system, for any number x,
x + x = 2x,
2x + 2x = 4x,
4x + 4x = 8x, i.e. 8 times the number x.
So, to find 8 times the number 10000010, we should perform 3 cycles of the above-mentioned binary addition.

```
              10000010 +
              10000010
2 times?     100000100

              100000100 +
              100000100
4 times ?    1000001000

              1000001000 +
              1000001000
8 times?     10000010000
```

Therefore, 11 bits ending with four zeros.

Answer (2)

(CSIR NET/JRF DEC 2014)

34. Binomial theorem in algebra gives
$(1 + x)^n = a0 + a_1x + a_2x^2 + \ldots + a_nx^n$,
where $a_0, a_1 \ldots, a_n$ are constants depending on n. What is the sum of $a_0 + a_1 + a_2 + \ldots + a_n$?
(1) 2^n (2) n
(3) n^2 (4) $n^2 + n$

Explanation:

$(1 + x)^n = a_0 + a_1x + a_2x^2 + ...+ a_nx^n$

Let's take a condition where x = 1 in the LHS and RHS of this equation.

$(1+1)^n = a_0 + a_1 + a_2 + ... + a_n$

$2^n = a_0 + a_1 + a_2 + ... + a_n$

$a_0 + a_1 + a_2 + ... + a_n = 2^n$.

Answer (1)

(JUNE 2015)

35. If:

$$\begin{array}{r} 2\,a \\ \times\ b\,2 \\ \hline c\,6 \\ 8\,4 \\ \hline 8\,d\,6 \end{array}$$

Here a, b, c and d are digits.

Then a + b =

(1) 4 (2) 9

(3) 11 (4) 16

Explanation:

As when we multiply 2 from a we get either 6 or 16 so, 2 × a = 6, a = 3 or 2 × a = 16, a = 8

If a = 3 then. When b is multiplied by a we gets a unit digit as 4 so value of b must be 8 i.e.

3 × 8 = 24 we get unit digit as 4 if we place value of a and b and multiply the numbers i.e.

23 ×82 we get 4 digit number so we have to check for a = 8

When we place a =8 we gets b=3 hence this satisfies the condition so a+b =8+3= 11

Answer (3)

(JUNE 2015)

36. Let *m* and *n* be two positive integers such that *m + n + mn* = 118. Then the value of m + n is:

(1) not uniquely determined (2) 18

(3) 3. 20 (4) 22

Explanation:

mn+m+n=118

mn+m+n+1=119

(m+1)(n+1)=119=7∗17

mn+m+n=118

mn+m+n+1=119

(m+1)(n+1)=119=7∗17

Now, since m, n are positive integers, we must have either m+1=7 and n+1=17 , or vice versa. So the sum is always 22.

Answer (4)

(DECEMBER 2016)

37. The dimensions of a floor are 18 X 24. What is the smallest number of identical squares tiles that will pave the entire floor without the need to break any tile? :

(1) 6 (2) 24

(2) 3. 8 (4) 12

If you get such kind of questions, here is one short cut.

Find the Least Common Multiple (L.C.M) of the given dimensions.

L.C.M of 18 and 24 = 72.

Area of the given figure=24x18= 432.

To get the number of tiles which have equal sides = $(L.C.M)^2$ / (Area)= (72x72)/432 = 12tiles

Answer (4)

(DECEMBER 2016)

38. To determine the number of parrots in a sparse population, an ecologist captures 30 parrots and puts rings around their necks and releases them. After a week he captures 40 parrots and finds that 8 of them have rings on their necks. What approximately is the parrot population? :

(1) 70 (2) 150

(3) 160 (4) 100

Explanation:

Let x be the total population of the parrot30 parrot out of x have rings, so the ratio of the parrot with ring = $\frac{30}{x}$

After a week he captures 40 parrots and finds that 8 of them have rings. This means , 8 parrot out of 40 parrot have rings ,so the ratio of parrot with rings to considered parrot population = $\frac{8}{40}$.

Since the 40 parrot were captured randomly this both ratio are equal

$$\frac{30}{x} = \frac{8}{40}$$

So x = 150

Answer (2)

(CSIR NET/JRF JUNE 2016)

39. N is a four-digit number. If the leftmost digit is removed, the resulting three-digit number is $1/9^{th}$ of N. How many such N are possible?

(1) 10 (2) 9

(3) 8 (4) 7

Explanation:

Let N = abcd be the four-digit number

Given: If the leftmost digit is removed, the resulting three-digit number is $1/9^{th}$ of N

i.e. 1/9 x N = bcd …… (1)

Put according to place value in above (1)

1/9(1000 a + 100b + 10c + d) = 100b + 10c + d

On solving above, we get:

125a = 100b + 10c + d

125 a = bcd

A	Bcd	N = abcd
1	125	1125
2	250	2250
3	375	3375
4	500	4500
5	625	5625
6	750	6750
7	875	6750
8	1000	Not acceptable

So, there is total 7 numbers

Answer (4)

(CSIR NET/JRF JUNE 2016)

40. Choose the four-digit number, in which the product of the first & fourth digits is 40 and the product of the middle digits is 28. The thousands digit is as much less than the unit digit as the hundreds digit is less than the tens digit:
(1) 5478 (2) 8745
(3) 5748 (4) 8475
Explanation:
Assume that pqrs is the required 4-digit number.
This means that p represents thousand-digit, q represents hundred-digit, r represents ten digit and s represents unit digit.
Given: product of the first & fourth digits is 40
i.e. p x s = 40 …… (1)
Given: product of the middle digits is 28
i.e. q x r = 28 …… (2)
Given: The thousands digit is as much less than the unit digit as the hundreds digit is less than the tens digit
i.e. s – p = r – q ……. (3)
By observation of (1), (2) and (3) only value which satisfies the given condition is 5478.
Answer (1)

(CSIR NET JUNE 2017)

41. If the product of three consecutive positive integers is equal to their sum, then what would be the sum of their squares?
(1) 9 (2) 14
(3) 16 (4) 24
Explanation:
Let's consider 3 consecutive positive integers = (n-1), n and (n+1)
Given: the product of three consecutive positive integers is equal to their sum
(n-1) x n x (n+1) = (n-1) + n + (n+1)
(n-1) (n+1) x n = 3n
$(n^2 – 1) = 3$
$n^2 = 4$
So, n = 2
So, numbers are: (n-1), n and (n+1) = 1, 2 and 3
We need to find: sum of their squares
$(1)^2 + (2)^2 + (3)^2$
= 1 + 4 + 9 = 14
Answer (2)

(CSIR NET JUNE 2017)

42. Which is the odd one out divisibility test?
154, 286, 363, 474, 572, 682
(1) 474 (2) 572
(3) 682 (4) 154
Explanation:
In this all the numbers except 474 are divisible by 11. So, 474 is the odd one out.
Answer: (1)

(CSIR NET JUNE 2017)

43. N is a two-digit number such that the product of its digits when added to their sum equals N. The unit digit of N would be:
(1) 1 (2) 7
(3) 8 (4) 9
Explanation:
Let two-digit number be x and y; where x = ten's place and y = unit's place
Given: N is a two-digit number such that the product of its digits when added to their sum equals N
i.e. Product of digits + Sum of digits = Number
xy + x + y = 10 x + y
xy = 10x – x = 9x
y = 9
So, number at unit digit = 9
Answer (4)

(CSIR NET JUNE 2017)

44. If P + 1/Q = 1 and Q + 1/R = 1, then what is PQR?
(1) -1 (2) 2
(3) -2 (4) cannot be calculated
Explanation:
Given: P + 1/Q = 1 & Q + 1/R = 1

$$P + \frac{1}{Q} = 1$$

$P = 1 - \frac{1}{Q}$
$P = \frac{Q-1}{Q}$ …… (1)
Q + 1/R = 1
$\frac{1}{R} = 1 – Q$
$R = \frac{1}{1-Q}$ …… (2)
We have to find the value of PQR:
Replacing the value of P and R in PQR with (1) and (2)
$PQR = \frac{Q-1}{Q} \times Q \times \frac{1}{1-Q}$
$= \frac{(Q-1)Q}{(1-Q)Q} = \frac{(Q-1)}{(1-Q)} = \frac{-1(-Q+1)}{(1-Q)} = -1$
Answer (1)

(CSIR NET/JRF JUNE 2017)

45. What is the reminder when 3^{256} is divided by 5?
(1) 1 (2) 2
(3) 3 (4) 4
Explanation:
For such type of questions, we don't need to determine the exact value of 3^{256} because that will be time consuming.
We have to find the reminder when 3^{256} is divided by 5.
So simpler steps will be to determine the last digit of value of 3^{256}.
$3^1=3$
$3^2=9$
$3^3=27$, last digit is 7
$3^4=81$, last digit is 1
$3^5=243$
…
So therefore, each 4th power of 3 ends with a unit digit of 1. So therefore, 3^{256} ends with a unit digit of one.
And when dividing such a number by five (e.g. 11, 21, 31), the remainder is always 1.
Answer (1)

(CSIR NET/JRF JUNE 2017)

46. A, B and C are three distinct digits. If they are added as below,

$$\begin{array}{cccc} & A & B & C \\ + & A & B & C \\ + & A & B & C \\ \hline & C & C & C \end{array}$$

Find out the value of A, B and C?

(1) A = 3, B = 4, C = 5 (2) A = 2, B = 3, C = 1

(3) A = 5, B = 1, C = 3 (4) A = 1, B = 8, C = 5

Explanation:

In such type of questions, take the value from option and replace them in questions.

If we consider that Option (4) is correct, then putting A = 1, B = 8 and C = 5, it satisfies the answer.

Answer (4)

(CSIR NET DEC 2017)

47. The sum of two numbers is equal to sum of square of 11 and cube of 9. The larger number is $(5)^2$ less than square of 25. What is the value of the sum of twice of 24 percent of the smaller number and half of the larger number?

(1) 415 (2) 400

(3) 410 (4) 420

Explanation:

Let the two number be a and b (consider a > b)

Given: "The sum of two numbers is equal to sum of square of 11 and cube of 9"

i.e. $a + b = 11^2 + 9^3 = 121 + 729 = 850$

So, $a + b = 850$ …. (1)

Given: The larger number is $(5)^2$ less than square of 25

$a = (25)^2 - (5)^2$

$a = 625 – 25 = 600$

So, b = 250 (From equation (1))

To find: "Value of the sum of twice of 24 percent of the smaller number and half of the larger number"

$2 \times (\frac{24}{100} \times b) + \frac{a}{2} = 2 \times (\frac{24}{100} \times 250) + \frac{600}{2} = 420$

Answer (4)

(CSIR NET JUNE 2018)

48. A long-distance runner finds a water station after completing $\frac{1}{7}th$ of the total distance. After covering another $\frac{1}{6}th$ of the total distance he gets medical-aid. Another runner joins him 4 km after the medical-aid station. The second runner stops 4 km before the completion of run, covering $\frac{1}{2}$ of the total distance. What is the total distance?

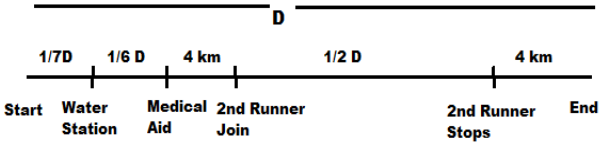
(1) 21 km (2) 30 km

(3) 42 km (4) 50 km

Explanation:

Let total distance be D

We can represent all the information provided as below figure:



So total Distance D will be equal to sum of all above information.

D = 1/7 D + 1/6 D + 4 + ½ D + 4 OR D = 42 km

Answer (3)

(CSIR NET JUNE 2018)

49. A fuel station sold diesel costing Rs 15000 to 150 persons on a day. If the lower limit of sale to a person is Rs. 50, what is the maximum amount in rupees for which one person could have purchased diesel on that day?

(1) 7450 (2) 7500

(3) 7550 (4) 7600

Explanation:

Given:

Diesel sold on particular day: Rs 15000

Total person purchased diesel: 150

Minimum Limit for sale to single person: Rs 50

We have to find the maximum amount in rupees, one person would have purchased diesel on that day.

In order to find maximum amount for 1 person, 149 person should purchase on lower limit i.e. 50 Rs

So, Amount spend by 149 persons in purchasing diesel of Rs 50 each = 149 x 50 = Rs 7450

Remaining amount = Total Amount – Amount spent by 149 persons= 15000 – 7450 = Rs 7550

Answer (3)

(CSIR NET JUNE 2018)

50. In a 100 m race A beats B by 10 m. B beats C by 5m. By how many meters does A beat C?

(1) 15.0 m (2) 10.5 m

(3) 5.5 m (4) 14.5 m

Explanation:

Given:

In 100m race; when A runs 100, B ran 90

So, ratio of A and B; A: B = 100:90

Given:

B beats C by 5 m i.e. when B runs 100, C ran 95

So, ratio of B and C; B:C = 100:95

$\frac{A}{C} = \frac{A}{B} \times \frac{B}{C}$

So: $\frac{A}{C} = \frac{100}{90} \times \frac{100}{95} = \frac{200}{171}$

It means that when A runs 200 m, then C will complete 171m

Or when A runs 100 m, C will complete 85.5 m.

So, difference = 100-85.5 = 14.5m

Answer (4)

(CSIR NET JUNE 2018)

51. What is the last digit of $(2017)^{2017}$?

(1) 1 (2) 3

(3) 7 (4) 9

Explanation:

$(2017)^{2017}$ can also be written as $(2017)^{2016} \times 2017 = (2017^4)^{504} \times 2017$

$= (...1)^{504} \times 2017 = ...7$ at the unit place.

(Because $7^4 = 2041$)

Answer (3)

(CSIR NET JUNE 2018)

52. How much gold and copper (in g), respectively, are required to make a 120 g bar of 22 carat gold?
(1) 90 and 30 (2) 100 and 20
(3) 110 and 10 (4) 120 and 0
Explanation:
We know that 22 carat gold denotes the purity of gold in the final product, i.e. 91.6 grams of pure gold in 100-gram alloy.
According to this for 120 g bar of 22 carat, the amount of gold required = (91.6 x 120) /100 = 109.02
Remaining amount of copper in grams = (8.4 x120) / 100 = 10.08
Approximately, 110 g gold and 10 g copper
Answer (3)

(CSIR NET JUNE 2018)

53. Nine-eleventh of the members of a parliamentary committee are men. Of the men, two-thirds are from the Rajya Sabha. Further, 7/11 of the total committee members are from the Rajya Sabha.
What fraction of the total number are women from the Rajya Sabha?
(1) 1/11 (2) 6/11
(3) 2/11 (4) 3/11
Explanation:
Given: 7/11 of the total committee members are from the Rajya Sabha.
So total committee members fraction in Lok Sabha = 1 – 7/11 = 4/11
Given: 9/11 of the members of a parliamentary committee are men
So, total women in a parliamentary committee = 1 – 9/11 = 2/11
Given: Of the men, 2/3 are from the Rajya Sabha
So total fraction of men in Lok Sabha = 1 – 2/3 = 1/3
So total male from Lok Sabha = 9/11 x 1/3 = 9/33 = 3/11
Women from Lok Sabha = Total Fraction of Lok Sabha – Men from Lok Sabha
= 4/11 – 3/11 = 1/11
Answer (1)

(CSIR NET JUNE 2018)

54. Mohan lent Geeta as much money as she already had. She then spent *Rs.*10. Next day, he again lent as much money as Geeta now had, and she spent *Rs.*10 again. On the third day, Mohan again lent as much money as Geeta now had, and she again spent *Rs.*10. If Geeta was left with no money. at the end of the third day, how much money did she have initially?
(1) Rs.11.25 (2) Rs.10
(3) Rs. 7.75 (4) Rs. 8.75
Explanation:
Let Geeta have x Rs.
First Day:
Mohan lent Geeta as much money as she already had i.e. x Rs
So now Geeta have: x + x = 2x Rs
Money spent by Geeta = Rs 10
So now Geeta have: 2x – 10 Rs
Second Day:
Mohan again lent as much money as Geeta now had i.e. 2x – 10 Rs
So now Geeta have: 2 (2x - 10) = 4x – 20 Rs
Money spent by Geeta = Rs 10
So now Geeta have: (4x – 20) – 10 = 4x – 30 Rs
Third Day:
Mohan again lent as much money as Geeta now had i.e. 4x – 30 Rs
So now Geeta have: 2 (4x - 30) = 8x – 60 Rs
Money spent by Geeta = Rs 10
So now Geeta have: (8x – 60) – 10 = 8x – 70 Rs
It's given that at end of 3rd day; Geeta was left with no money
So: 8x – 70 = 0
X = 70/8 = 8.75 Rs
So initially Geeta have 8.75 Rs
Answer (4)

(CSIR NET JUNE 2018)

55. Consider a number 54 expressed in a base different from ten. What is the base of this number system if its equivalent value in the decimal system is 49?
(1) 1 (2) 3
(3) 6 (4) 9
Explanation:
54 $\overrightarrow{What\ Base?}$ 49
Analyse all options provided:
Option 1: 5 x 1 + 4 = 9 ≠ 49 (Wrong)
Option 2: 5 x 3 + 4 = 19 ≠ 49 (Wrong)
Option 3: 5 x 6 + 4 = 34 ≠ 49 (Wrong)
Option 4: 5 x 9 + 4 = 49 = 49 (Correct)
Answer (4)

(CSIR NET/JRF DEC 2018)

56. Two solutions X and Y containing ingredients A, B and C in proportions a: b:c and c: b: a, respectively, are mixed. For the resultant mixture to have A, B and C in equal proportion, it is necessary that:
(1) b = $\frac{c-a}{2}$ (2) c = $\frac{a+b}{2}$
(3) c = $\frac{a-b}{2}$ (4) b = $\frac{c+a}{2}$
Explanation:
Let the ingredient of A in X is *ax*, of B in X is *bx* and that of C in X is *cx*.
Then the ingredient of A in Y is *cx*, of B in Y is *bx* and that of C in Y is *ax* according to the given information.
Now X and Y are mixed.
So, ingredient of A in mixture is *(a + c) x*.
Similarly, ingredient of B in the mixture is *(2 b) x* and of C in the mixture is *(a + c) x*.
Since they are in equal proportion in the mixture, we have *2 b x = (a + c) x*. This gives *b = (a + c) / 2*
Answer: (4)

(CSIR NET/JRF DEC 2018)

57. In an examination 100 questions of 1 mark each are given. After the examination, 20 questions are deleted from evaluation, leaving 80 questions with a total of 100 marks. Student A had answered 4 of the deleted questions correctly and got 40 marks, whereas student B had answered 1O of the deleted questions correctly and got 35 marks. In this situation:
(1) A and B were equally benefited.
(2) A and B lost equally.
(3) B lost more than A.
(4) A lost more than B.
Explanation:
Here, we need to find Score of A and B when questions were not deleted from evaluation
Given:
Questions not deleted: *80*
Questions deleted: *20*
Old marks per question: *1*
New marks per question: *100/80 = 5/4 = 1.25*
Student A: "*Student A had answered 4 of the deleted questions correctly and got 40 marks*"
Correct question by A after deleted questions
= 40/1.25 = 32
(i.e. Total Correct Answer = Total Marks / Mark of each correct answer)
Deleted correct questions of A = 4
So, total correct question answered by A = 32 + 4 = 36
Thus, if questions were not deleted then A would have got: 36 x 1 = 36 Marks
(Since each correct question was of 1 mark)
Student B: "*Student B had answered 1O of the deleted questions correctly and got 35 marks*"
Correct question by B after deleted questions
= 35/1.25 = 28
(i.e. Total Correct Answer = Total Marks / Mark of each correct answer)
Deleted correct questions of B = 10
So, total correct question answered by B = 28 + 10 = 38
Thus, if questions were not deleted then B would have got: 38 x 1 = 38 Marks
(Since each correct question was of 1 mark)
Clearly B lost more than A due to deleted questions.
Answer: (3)

(CSIR NET/JRF DEC 2018)

58. If D = ABC + BCA + CAB
where A, B and C are decimal digits, then D is divisible by:
(1) 37 and 29 (2) 37 but not 29
(3) 29 but not 37 (4) Neither 29 nor 37
Explanation:
Given:
D = ABC + BCA + CAB
Or D = (100A + 10B + C) + (100B + 10C + A) + (100C + 10A + B)
Or D = 111A + 111B + 111C = 111(A + B + C)
This means that D is always multiple of 111.
We know that 111 is divisible by 37 and not by 29.
Answer: (2)

(CSIR NET/JRF DEC 2018)

59. At a birthday party, every child gets 2 chocolates, every mother gets 1 chocolate, while no father gets a chocolate. In total 69 persons get 70 chocolates. If the number of children is half of the number of mothers and fathers put together, then how many fathers are there?
(1) 22 (2) 23
(3) 24 (4) 69
Explanation:
Let's assume: Child = C , Mother = M and Father = F
Given:
Total Chocolates = 70
"*Every child gets 2 chocolates; every mother gets 1 chocolate*"
i.e. 2 C + 1 M = 70 …. (1)
Total Person = 69
i.e. C + M + F = 69 …. (2)
"*the number of children is half of the number of mothers and fathers put together*"
i.e. C = ½ (M + F)
or 2C = M + F …. (3)
We have to determine total number of Fathers i.e. F
Solving (2) and (3): C + M + F = 69 and 2C = M + F
Putting value of M + F in (2)
C + 2C = 69 or 3C = 69
So, C = 23
Replacing value of C in (1)
2C + 1M = 70 or 2(23) + 1M = 70 or 46 + M = 70 or M = 70 – 46 = 24
So, M = 24
Putting value of C and M in equation (2):
C + M + F = 69 or 23 + 24 + F = 69
Or F = 69 – 23 – 24 = 22
So total Fathers = 22
Answer: (1)

(CSIR NET/JRF DEC 2018)

60. Marks (out of 30) of seven students in an examination are 4, 15, 6, 7, 5, a and b, where a (> 0) is a multiple of 4 and b is a prime.
What is the maximum possible value of the difference between the maximum and minimum marks?
(1)25 (2) 26
(3) 27 (4) 29
Explanation:
"We have to find the maximum possible value of the difference between the maximum and minimum marks"
Given: *a multiple of 4*
So max value of a can be 28
Given: *b is a prime*
Prime Number: A prime number is a whole number greater than 1 whose only factors are 1 and itself. The first few prime numbers are 2, 3, 5, 7, 11, 13, 17, 19, 23 and 29
So minimum value of b can be 2.

So now all the numbers are: 4, 15, 6, 7, 5, 28 and 2
Difference between maximum and minimum number
= 28 – 2 = 26
Answer: (2)

(CSIR NET/JRF JUNE 2019)

61. The number of digits you have to type to write all the page numbers of a book starting from 1 (first page) is 2019. What is the number of pages in that book?
(1) 609 (2) 610
(3) 709 (4) 710
Explanation:
In the range of numbers from 1 to 9 pages, we have 9 numbers and 9 digits. … (1)
From 10 to 99 pages, we have 90 numbers and 180 digits. ....(2)
From 100 to 709 pages we have 610 numbers and 1830 digits...(3)
Total of (1) + (2) + (3) = 2019
Hence number of pages in the book = 709
Answer: (3)

(CSIR NET/JRF JUNE 2019)

62. Which one of the following numbers is a prime number?
(1) 183 (2) 121
(3) 157 (4) 1020
Explanation:
183 is divisible by 3
121 is divisible by 11
10201 is divisible by 101.
Only 157 cannot be divided by any other number other than 1 or itself.
Answer: (3)

(CSIR NET/JRF JUNE 2019)

63. In a city, each person has at least one hair on his/her head. At least two persons in this city are guaranteed to have exactly the same number of hair on their heads if the population of the city:
(1) Is greater than the maximum possible number of hair on the head.
(2) Is less than the maximum possible number of hair on the head.
(3) Has at least one pair of identical twins
(4) Is genetically homogeneous
Explanation:
For a guaranteed two people having same number of hair on their head, the population has to be greater than the maximum possible number.
Answer: (1)

(CSIR NET/JRF JUNE 2019)

64. The value of a physical quantity is measured to be 3.4587 $\pm$ 0.0022. Which one of the following is the appropriate representation of the result taking the errors in account?
(1) 3.4567 (2) 3.457
(3) 3.46 (4) 3.5
Explanation:
After adding and subtracting 0.0022 the values will be 3.4609 and 3.4565
So, if we round the value to two decimal 3.4565 will be 3.46
Answer: (3)

(CSIR NET/JRF JUNE 2019)

65. Which of the following is the largest?
(1) 2^{50} (2) 3^{40}
(3) 4^{30} (4) 5^{20}
Explanation:
In such types of questions, make power of each option similar so as to evaluate which number is largest.
On analysing all options, we can see that 10 can be the common power for all options.
Option (1): 2^{50}
It can be written as: $2^{10} \times 2^{10} \times 2^{10} \times 2^{10} \times 2^{10}$
or $(2 \times 2 \times 2 \times 2 \times 2)^{10}$ or $(32)^{10}$ …. (1)
Option (2): 3^{40}
It can be written as: $3^{10} \times 3^{10} \times 3^{10} \times 3^{10}$
or $(3 \times 3 \times 3 \times 3)^{10}$ or $(81)^{10}$ …. (2)
Option (3): 4^{30}
It can be written as: $4^{10} \times 4^{10} \times 4^{10}$
or $(4 \times 4 \times 4)^{10}$ or $(64)^{10}$ … (3)
Option (4): 5^{20}
It can be written as: $5^{10} \times 5^{10}$ or $(5 \times 5)^{10}$
or $(25)^{10}$ …. (4)
So, it's clear from above: $(81)^{10}$ or option 2 is largest.
Answer: (2)

(CSIR NET/JRF DEC 2019)

66. Which of the following 7-digit numbers CANNOT be a perfect square?
A=45xyz26, B=2xyz175, C=xyz3310
(1) Only A (2) Only B
(3) Only C (4) All three
Explanation:
As we know the rules of perfect squares.
No perfect square ends with an odd number of zeros.
Perfect squares (unit digit- 0, 1, 4, 5, 6, 9)

Unit's digit	0	1	4	5	6	9
Ten's digit	0	Even	even	2	odd	even

Through these rules we can easily discard the options.
As in A ten's digit should be odd, in B ten's digit should be 2 and in C there should be even number of zeros
So, A, B and C all are not perfect squares.
Answer: (4)

(CSIR NET/JRF DEC 2019)

67. Given that K! =1×2×3×…. ×K, which is the largest among the following numbers?
(1) $(2!)^{1/2}$ (2) $(3!)^{1/3}$
(3) $(4!)^{1/4}$ (4) (3!)/2
Explanation:
Elimination by analysing options
$(2!)^{1/2} = (2)^{1/2} = 1.414\ldots < 3$
$(3!)^{1/3} = (6)^{1/3} < 3$ ($(27)^{1/3} = 3$)
$(4!)^{1/4} = (24)^{1/4} < 3$ ($(81)^{1/4} = 3$)
(3!)/2= 3
3 is largest, so(3!)/2 is largest.
Answer: (4)

(CSIR NET/JRF DEC 2019)

68. The difference between the squares of two consecutive integers is 408235. The sum of the numbers is?
(1)16324 (2)27061
(3)180235 (4)408235
Explanation:
Let the two consecutive integers be x and y
Given: The difference between the squares of two consecutive integers is 408235.
So,
$x^2-y^2=408235$
(x-y) (x+y) =408235
{as difference between two consecutive integers is 1 i.e. (x-y) =1}
Then,
x+y=408235
Sum of two consecutive integers will be 408235
Answer: (4)

(CSIR NET/JRF DEC 2019)

69. The difference between the squares of two consecutive integers is 408235.
The sum of the numbers is?
(1) 16324 (2)27061
(3)180235 (4)408235
Explanation:
Let the two consecutive integers be x and y
Given: The difference between the squares of two consecutive integers is 408235.
So,
$x^2-y^2=408235$
(x-y) (x+y) =408235
{as difference between two consecutive integers is 1 i.e. (x-y) =1}
Then,
x+y=408235
Sum of two consecutive integers will be 408235
Answer: (4)

(CSIR NET/JRF DEC 2019)

70. The difference, the sum and the product of two integers are in the proportion 1: 3: 10. The two integers are:
(1) 3, 9 (2) 2, 5
(3) 5, 10 (4) 3, 10
Explanation:
Given difference sum & product of two integers are in proportion 1:3:10
Let x & y be that two integers
$\Longrightarrow x-y=3(x+y)=10xy$ ……(*)
From options
Option (1) $\Longrightarrow$if $x=3, y=9$ Then (*) is not satisfied
Similarly, (2) & (4) are also incorrect.
So, correct option is (3)
Answer: (3)

(CSIR NET/JRF NOV 2020)

71. Find the value of $f(0)$
$if\ f(x+2)=(x+1)^{34}-(x+1)^{33}+5$
(1) 5 (2) 7
(3) 6 (4) 72
Explanation:
$f(x+2)=(x+1)^{34}-(x+1)^{33}+5$
$\Rightarrow f(10)=f(-2+2)$
$=(-2+1)^{34}-(-2+1)^{33}+5$
$=(-1)^{34}-(-1)^{33}+5$
$=\ 1\ -(-1)+5$
$=\ 1+1+5=7$
Answer: (2)

(CSIR NET/JRF DEC 2019)

72. Two varieties A and B of rice cost Rs. 30 and Rs. 90 per kg whereas two varieties C and D of pulses, Rs 100 and Rs 120 per kg, respectively. If at least one kg each of A and B and at least half a kg each of C and D have to be purchased, then the minimum and maximum costs of a total of 5 kg of these provision are, respectively
(1) Rs 150 and Rs 600 (2) Rs 260 and Rs 530
(3) Rs 290 and Rs 470 (4) Rs. 370 and Rs 460
Explanation:
For minimum cost:
Price to A = 30
Price to B = 90
Price to C = 100
Price to D = 120
We have to purchase at least one kg each of A & B and at least half a kg each of C & D
For minimum Cost: In this case: We purchase that product more which have less price
$\Rightarrow 1\ kg$ of A+1kg of B+½ kg C + ½ kg of C + 2 kg of C = 5kg
Price of 5 Kg product = 30+90+90+60+30+30 = 290
For maximum cost: In this case we purchase that product more which have high price
⇒1 Kg (A) + 1 Kg (B) + ½ Kg (C) +1/2 Kg (D) +2 Kg (D) = 5 Kg
Price of 5 kg product = 30+90+30+60+120+120=470
Answer-(3)

(CSIR NET/ JRF JUNE 2021)

73. Which of the following values is same as $2^{2^{2^2}}$?
(1) 2^6 (2) 2^8
(3) 2^{16} (4) 2^{222}
Explanation:
Here we need to use a simple concept of exponent.
$$2^{2^{2^2}}=2^{2^4}=2^{16}$$
Answer-(3)

(CSIR NET/ JRF JUNE 2021)

74. $81^{1/3}\times 81^{1/9}\times 81^{1/27}\times 81^{1/81}\times$ …… up to infinite term will be equal to
(1) 3 (2) 9
(3) 27 (4) 81
Explanation:
$81^{1/3}\times 81^{1/9}\times 81^{1/27}\times 81^{1/81}\times$ ……
$=(9^2)^{\frac{1}{3}}\times(9^2)^{\frac{1}{9}}\times(9^2)^{\frac{1}{27}}\times(9^2)^{\frac{1}{81}}\times$ ….
$=(9^2)^{\frac{1}{3}+\frac{1}{9}+\frac{1}{27}+\cdots}=(9^2)^{\frac{\frac{1}{3}}{1-\frac{1}{3}}}=9$
Answer-(2)

(CSIR NET/ JRF JUNE 2021)

75. If we replace the mathematical operations in the expression (11+4-2) ÷ 24×6 as given in the table.

Operation	+	-	×	÷
Replaced by	-	×	÷	+

Then its new value is

(1) 23/6 (2) 1

(3) 18 (4) 7

Explanation:

(11+4-2) ÷ 24×6

= (11-4 ×2)+24 ÷ 6

=(11-8)+4

= 3+4

=7

Answer-(4)

(CSIR NET/ JRF JUNE 2021)

76. The square of a two digit number, with non-zero digits, is the number itself preceded by the digit C. Then C is

(1) 1 (2) 2

(3) 4 (4) 6

Explanation:

Think of an example:

$(25)^2 = 625$

So here the two digit number 25 has a square which is end up in 25 and started with 6.

Answer-(4)

(CSIR NET/ JRF JUNE 2021)

77. How many integers in the set {1,2,3,.....,100} have exactly 3 divisors?

(1) 4 (2) 12

(3) 5 (4) 9

Explanation:

The numbers which can be expressed as a square of a prime will have exactly 3 divisors. Like for 3^2, it has 3 divisors 1, 3,3^2.

So starting from 2^2 to 10^2, there will be 9 numbers.

Answer-(4)

(JUNE 2022)

78. When 100 balls were equally distributed among students in a class (having strength between 10 and 60), 7 balls remained undistributed. The number of balls that would remain if there were 125 balls to begin with is:

(1) Indeterminable (2) 1

(3) 5 (4) 9

Explanation:

Total balls are 100

Balls that are equally divided among students = 100-7=93

Let the number of students be a.

As, the value of 'a' can lie between 10 to 60.

So, possible value of a is 31. ie. factor of 93.

When 125 balls are equally distributed among 31 students then only 1 ball remain undistributed.

Answer- (2)

(JUNE 2022)

79. Which of the following is the most precisely reported value of a speed measurement?:

(1) 125 km/s (2) 12.5 × 10 km/s

(3) 125.00 km/s (4) 1.250 × 10^2km/s

Explanation:

As the value is measured upto 2 place of decimal hence, it is most precise among all the given options.

Answer-(3)

(JUNE 2022)

80. If $2^a \times 5^b = 500$, and a and b are integers, then a + b is :

(1) 5 (2) 6

(3) 7 (4) Indeterminable

Explanation:

As, $2^a \times 5^b = 500$, 500 - 2×2×5×5×5

$2^a \times 5^b = 2^2 \times 5^3$

a= 2, b = 3

a+b = 5

Answer-(1)

(JUNE 2022)

81. Suppose A=1, B=2, C=3, D-4,..., X=24, Y=25, Z=26.

$$\frac{(A-M)(D-M)(C-M)\ldots(S-M)}{(M-Z)(M-Y)(M-X)\ldots(M-T)}$$

Has a value of

(1) 0, (2) –1

(3) 25/26 (4) 1

Explanation:

As,

$$\frac{(A-M)(D-M)(C-M)\ldots(S-M)}{(M-Z)(M-Y)(M-X)\ldots(M-T)}$$

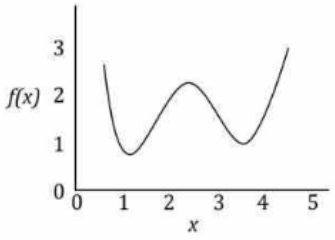
So in the numerator for (M-M)= 0

Hence result will be 0.

Answer-(1)

(JUNE 2022)

82. How many real roots does the continuous function f of a variable x shown below have in the interval 0.5 < x < 4.5?



(1) Two positive

(2) One positive and two negative

(3) Two positive and one negative

(4) None

Explanation:

As there is three times increment and two times decrement. So, Three positive and two negative

Answer-(4)

(LS JUNE 2023 I)

83. If 6 students occupy a bench, one bench will be left completely unoccupied. If 5 students occupy each bench, instead, one student will not find a seat. The number of students is

(1) 30 (2) 31
(3) 36 (4) 42

Explanation:

Let the number of benches be n so,
Number of students =6n-1=5n+1
6n-6=5n+1
n=7
So, no. of students =67-1
=36

Answer (3)

(MS-JUNE 2023)

84. The difference of the squares of two distinct two-digit numbers with one being obtained by reversing the digits of the other is always divisible by

(1) 4 (2) 6
(3) 10 (4) 11

Explanation:

Let's consider two distinct two-digit numbers: AB and BA, where A and B represent the digits.
The number AB can be written as 10A + B, and the number BA can be written as 10B + A.
The square of AB is (10A + B)2, which simplifies to (100A2 + 20AB +B2).
The square of BA is (10B+A)2, which simplifies to(100B2 + 20BA +A2).
The difference between the squares is given by (100A2 + 20AB +B2) - (100B2 + 20BA +A2).
By simplifying the expression, we get 99(A2-B2) + 20(AB - BA).
We can factor out common terms from the expression: (A - B)(99(A + B) + 20(B - A)).
Simplifying further, we get (A - B)(119A - 79B).
Since (119A - 79B) is always a multiple of 11, the entire expression (A - B)(119A - 79B) is divisible by 11.
Therefore, the difference of the squares of two distinct two-digit numbers with one being obtained by reversing the digits of the other is always divisible by 11.

Answer: (4)

(PS-JUNE 2023-II)

85. Three consecuticve integers a, b, c, add to 15. Then the value of a-22+b-22+c-22 would be

(1) 25 (2) 27
(3) 29 (4) 31

Explanation:

Let us choose 3 consecuticve integers whose sum is 15 that is 4, 5, 6.
Here we assume a = 4, b = 5, c = 6
Now (a-2)2 + (b-2)2+ (c-2)2
= (4-2)2 + (5-2)2+ (6-2)2
= (2)2 + (3)2+ (4)2
= 4 + 9+ 16 = 29

Answer: (3)

(LS JUNE 2023 II)

86. If the sum of the two-digit numbers formed from the digits a and b is a perfect square, the sum of the digits is

(1) 7 (2) 9
(3) 10 (4) 11

Explanation:

Let tow digit number be 10a+b and 10b+a
So, 10a+b+10b+a= Perfect square
11a+11b= Prefect square
11a+b= Prefect square
a+b= Prefect square
As a+b will be a non-decimal number so, the perfect square
Number will divisible by 11.
So, 112=121
Hence a+b=11×1111
a+b=11

Answer (4)

(PS-JUNE 2023-II)

87. What is the largest number of father-son pairs that can exist in a group of four men?

(1) 3 (2) 2
(3) 4 (4) 6

Explanation:

4 Mens are there name as **A, B, C, D**
One person should be in the upper position (that person is a father)**,** if **A** is a father then possible pairs of Father-sons are **AB, AC, AD.**

Answer: (1)

(CS-JUNE 2023)

88. Suppose a, b, c, d and e are five positive integers such that the values of a+b, b+c, c+d, d+e and e+7 are the same. Which of the following values is always same as a?

(1) c+e (2) c+d+7
(3) d+e-7 (4) b+c+d3

Explanation:

We are given that the values of a+b, b+c, c+d, d+e, and e+7 are the same. Let's assume this common value is represented by x.From this, we can derive the following equations:

a + b = x ...(1)
b + c = x ...(2)
c + d = x ...(3)
d + e = x ...(4)
e + 7 = x ...(5)

Now, let's rearrange equation (2) to isolate the value of c:
c = x - b
Substituting this value of c into equation (4), we have: d + e = x - b ...(6)
Rearranging equation (6) to isolate the value of b, we get:
b = x - d - e
Substituting this value of b into equation (1), we have:a + (x - d - e) = x
a - d - e = 0
a = d + e ...(7)
Comparing equation (7) with the given options:

- c + e: This is not always the same as a.
- c + d + 7: This is not always the same as a.

- d + e - 7: This is always the same as a, as shown in equation (7).
- b + c + d: This is not always the same as a.

Therefore, the correct answer is option 3. d + e - 7 is always the same as a.

Answer: (2)

(LS JUNE 2023 I)

89. If the difference between the two-digit numbers made from digits a and b is 27, the difference between a and b is

(1) 2 (2) 1

(3) 4 (4) 3

Explanation:

Let two digit number be 10a+b

So, 10a+b-10b+a=27

9a-9b=27

9a-b=27

a-b=3

Answer: (4)

(LS JUNE 2023 I)

90. The possible number of integers between 1000 and 10000 containing two 2's, one 0 and one 3 (for example, 2023 is such an integer) is

(1) 6 (2) 9

(3) 12 (4) 24

Explanation:

We have to make 4 digit number form digits (2,2,0,3).

So, we can use only 3 digits at 1st place. So we have 3 options to fill

3			
1	2	3	4

We have 3 options for 2nd place

3	3		
1	2	3	4

We have remaining 2 options and 1 option for 3rd and 4th place

3	3	2	1
1	2	3	4

As digit 2 is repeated twice

So, number of such 4 digit number possible =3×3×2×12!=9

Answer: (2)

(LS DEC 2023 I)

91. The number 68132 - 31932 is divisible by

(1) both 362 and 1000 (2) 362 but not 1000

(3) 1000 but not 362 (4) neither 362 nor 1000

Explanation:

To determine whether $68132 - 31932$ is divisible by 362 and 1000, let's first calculate the difference:

$$68132 - 31932 = 36200$$

Now, let's check if 36200 is divisible by 362 and 1000:

To check if it's divisible by 362, we divide 36200 by 362:

$$\frac{36200}{362} = 100$$

Since the result is an integer, 36200 is divisible by 362.

To check if it's divisible by 1000, we observe that 36200 is not a multiple of 1000

So, the answer is 2. 362 but not 1000

Answer (2)

(LS DEC 2023 I)

92. If $ab = 5, bc = 7$ and $ca = 11$, which of the following identities is valid?

(1) $7a = 11b = 5c$

(2) $\sqrt{35}\, a = \sqrt{55}\, b = \sqrt{77}\, c$

(3) $\sqrt{7}/5a = \sqrt{5}/11\, b = \sqrt{11}/7\, c$

(4) $\sqrt{5}/11a = \sqrt{11}/7\, b = \sqrt{7}/5\, c$

Explanation:

$$\frac{\text{ab} \times \text{ca}}{\text{bc}} = \frac{5 \times 11}{7} = \frac{55}{7}$$

$$\Rightarrow \text{a}^2 = \frac{55}{7}$$

$$\Rightarrow \text{a} = \frac{\sqrt{55}}{\sqrt{7}}$$

So, b= $\frac{\sqrt{35}}{\sqrt{11}}$ and c= $\frac{\sqrt{77}}{\sqrt{5}}$

Which is satisfied by option 1. 7a=11b=5c

Answer (1)

(LS DEC 2023 I)

93. The sum of squares of four integers

(1) can never be divisible by 13

(2) can never be divisible by 15

(3) can be divisible by 17

(4) can never be divisible by 19

Explanation:

As each number can divide the sum of squares of four integers, as

For example:

$0^2 = 0$, which is congruent to 0 modulo 17.

$17^2 = 289$, and when divided by 17, the remainder is 0.

$34^2 = 1156$, and when divided by 17, the remainder is 0

These examples illustrate that there are integers whose squares are congruent to 0 modulo 17. Now, when we sum the squares of four such integers, the total sum will also be congruent to 0 modulo 17. Therefore, the sum of squares of four integers can indeed be divisible by 17.

So Is for, 13, 15 & 19

Hence the correct answer is 3. Can be divisible by 17

Answer (3)

(LS DEC 2023 I)

94. In the following finite sequence of integers, how many 9s are divisible by the integers immediately preceding them?

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

(1) 3 (2) 4

(3) 5 (4) 6

Explanation:

To find how many 9s are divisible by the integers immediately preceding them, we need to check each occurrence of 9 in the sequence and verify if it is divisible by the preceding integer.

Looking at the sequence:

- The first occurrence of 9 is preceded by 4, and 9 is not divisible by 4.
- The second occurrence of 9 is preceded by 5, and 9 is not divisible by 5.
- The third occurrence of 9 is preceded by 5, and 9 is not divisible by 5.
- The fourth occurrence of 9 is preceded by 9, and 9 is divisible by 9.
- The fifth occurrence of 9 is preceded by 9, and 9 is divisible by 9.
- The sixth occurrence of 9 is preceded by 9, and 9 is divisible by 9.
- The seventh occurrence of 9 is preceded by 5, and 9 is not divisible by 5.
- The eight occurrence of 9 is preceded by 3, and 9 is divisible by 3.
- The ninth occurrence of 9 is preceded by 9, and 9 is divisible by 9.
- The tenth occurrence of 9 is preceded by 8, and 9 is not divisible by 8.
- The eleventh occurrence of 9 is preceded by 3, and 9 is divisible by 3.
- The twelfth occurrence of 9 is preceded by 1, and 9 is divisible by 1.

So, there are 6 occurrences of 12 that are divisible by the integers immediately preceding them.

The correct answer is: 4. 6

Answer (4)

(LS DEC 2023 I)

95. Symbols $\ominus \otimes \oslash$ represent mathematical operations (out of $+, -, \div, \times$) which respect the relations

$$8 \oslash 5 \ominus 9 = 53$$
$$9 \ominus 3 \otimes 2 = 25$$

What is the value of $2 \otimes 13 \oslash 7$?

(1) -4 (2) 8

(3) -89 (4) 19

Explanation:

Symbols $\ominus \otimes, \oslash$ represent mathematical operations (out of $+, -, \div, \times$) which respect the relations

$$8 \oslash 5 \ominus 9 = 53$$
$$9 \ominus 3 \otimes 2 = 25$$

Suggests, $\ominus \otimes, \oslash$ are respectively $\times, -, +$

Hence, $2 \otimes 13 \oslash 7 = 2 - 13 + 7 = -4$

Answer (1)

(LS-DEC 2023 II)

96. Let $2^a 3^b 5^c = 1200$ where a, b, c are integers. Then $a + 2b + 3c$ is

(1) 7 (2) 8

(3) 11 (4) 12

Explanation:

To find the values of a, b, and c such that $2^a \cdot 3^b \cdot 5^c = 1200$, we first express 1200 as a product of its prime factors:

$$1200 = 2^4 \cdot 3 \cdot 5^2$$

Comparing this with $2^a \cdot 3^b \cdot 5^c$, we get:

$$a = 4,\ b = 1,\ c = 2$$

Now, we can calculate $+2b + 3c$:

$$a + 2b + 3c = 4 + 2 \cdot 1 + 3 \cdot 2 = 4 + 2 + 6 = 12$$

Answer (4)

(LS-DEC 2023 II)

97. In the following finite sequence of integers, how many terms are divisible by their immediate next terms?

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

(1) 7 (2) 4

(3) 5 (4) 6

Explanation:

To determine the terms in the sequence that are divisible by their immediate next terms, we need to check each term and see if it is divisible by the term immediately following it.

Sequence: 8, 3, 4, 9, 3, 5, 9, 5, 9, 9, 9, 4, 5, 6, 3, 3, 5, 7, 2, 3, 9, 9

Terms divisible by their immediate next terms:

- 9 (divisible by 3)
- 9 (divisible by 9)
- 9 (divisible by 9)
- 6 (divisible by 3)
- 3 (divisible by 3)
- 9 (divisible by 9)

Total: 6 terms

So, the correct answer is option 4. There are 6 terms in the sequence that are divisible by their immediate next terms.

Answer (4)

(MS DEC 2023)

98. Rounding off 4.58500001 to the second decimal place will give

(1) 4.6 (2) 4.58

(3) 4.59 (4) 4.585

Explanation:

To round off 4.58500001 to the second decimal place, you look at the third decimal digit, which is 5. Since 5 is greater than or equal to 5, you round the second decimal digit up by 1. Therefore, the correct answer is: 3. 4.59

Answer (3)

(MS DEC 2023)

99. Which of the following powers of 3 is the largest factor of $1 \times 2 \times 3 \times 4 \times \ldots \times 30$?

(1) 3^{10} (2) 3^{13}

(3) 3^{14} (4) 3^{15}

Explanation:

To find the largest power of 3 that divides $1 \times 2 \times 3 \times 4 \times \ldots \times 30$, we need to determine the highest power of 3 that exists within the prime factorization of this expression.

First, let's find out how many multiples of 3 are there from 1 to 30. We can use the formula:

Number of multiples of 3 from 1 to $30 = \left\lfloor \frac{30}{3} \right\rfloor = 10$

So, there are 10 multiples of 3 within the numbers from 1 to 30.

Next, let's consider the multiples of 3 that are also multiples of $3^2 = 9$. We can use the formula:

Number of multiples of 9 from 1 to $30 = \left\lfloor \frac{30}{9} \right\rfloor = 3$

So, there are 3 multiples of 9 within the numbers from 1 to 30.

Finally, let's consider the multiples of 3 that are also multiples of $3^3 = 27$. We can use the formula:

Number of multiples of 27 from 1 to $30 = \left\lfloor \frac{30}{27} \right\rfloor = 1$

So, there is 1 multiple of 27 within the numbers from 1 to 30.

Now, to find the highest power of 3 that divides $1 \times 2 \times 3 \times 4 \times \ldots \times 30$, we add up these counts:

$$10 + 3 + 1 = 14$$

So, the highest power of 3 that divides $1 \times 2 \times 3 \times 4 \times \ldots \times 30$ is 3^{14}.

Therefore, the correct answer is option $3: 3^{14}$.

Answer (3)

(MS DEC 2023)

100. Which of the integers 10, 11, 12 and 13 can be written as the sum of squares of four integers (allowing repetition)?

(1) Only 10 (2) Only 10 and 11

(3) Only 10,11 and 12 (4) All

Explanation:

All of them can be expressed as the sum of squares of four integers.

As, $10 = 1^2 + 3^2 + 0^2 + 0^2$

$11 = 1^2 + 1^2 + 3^2 + 0^2$

$12 = 2^2 + 2^2 + 2^2 + 0^2$

$13 = 2^2 + 3^2 + 0^2 + 0^2$

Hence our answer is 4. All

Answer (4)

(MS DEC 2023)

101. From a two-digit number, the sum of its digits is subtracted. The resulting number is

(1) always divisible by 6 (2) always divisible by 9

(3) never divisible by 4 (4) never divisible by 5

Explanation:

Let's denote the two-digit number as AB, where A is the tens digit and B is the units digit.

The value of the two-digit number is $10A + B$, and the sum of its digits is $A + B$.

When we subtract the sum of the digits from the number itself, we get:

$$10A + B - (A + B) = 10A + B - A - B = 9A$$

Since $9\,\mathrm{A}$ is a multiple of 9 for any value of A, the resulting number is always divisible by 9 .

Therefore, the correct answer is option 2: always divisible by 9.

Answer (2)

(MS DEC 2023)

102. In the following finite sequence of integers, how many terms are divisible by their immediately preceding terms?

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

(1) 3 (2) 4

(3) 5 (4) 6

Explanation:

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

The terms which are divisible by preceding terms are

(1) 3 is divisible by 3

(2) 3 is divisible by 3

(3) 3 is divisible by 3

(4) 3 is divisible by 3

(5) 3 is divisible by 3

Answer (3)

(PS-DEC 2023)

103. The sum of the two positive integers is 14. Then their product CANNOT be divisible by

(1) 12 (2) 13

(3) 14 (4) 49

Explanation:

Let's consider the possible pairs of positive integers whose sum is 14:

(1) $(1,13)$ (2) $(2,12)$

(3) $(3,11)$ (4) $(4,10)$

(5) $(5,9)$ (6) (6, 8)

(7) $(7,7)$

Now, let's check the products of these pairs and see which one is not divisible by the given numbers:

1. $1 \times 13 = 13$ (Not divisible by 12,14, or 49)
2. $2 \times 12 = 24$ (Not divisible by 13,14, or 49)
3. $3 \times 11 = 33$ (Not divisible by 12,14, or 49)
4. $4 \times 10 = 40$ (Not divisible by 13,14, or 49)
5. $5 \times 9 = 45$ (Not divisible by 13,14, or 49)
6. $6 + 8 = 14, 6 \times 8 = 48$ (Not divisible by 13,14, or 49)
7. $7 + 7 = 14, 7 \times 7 = 49$ (Not divisible by 14)

Hence the correct answer is (3) 14

Answer (3)

(CS-DEC 2023)

104. In the following finite sequence of integers, how many 9s are divisible by their immediate next terms?

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

(1) 2 (2) 4

(3) 5 (4) 6

Explanation:

To find the number of 9s that are divisible by their immediate next terms in the given sequence, let's examine each pair of consecutive terms and count how many times the first term is divisible by the second term:

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

Pairs where the first term is divisible by the second term:

1. 9 (divisible by) 3
2. 9 (divisible by) 9
3. 9 (divisible by) 9
4. 9 (divisible by) 9
5. 9 (divisible by) 3
6. 9 (divisible by) 1

So, there are 6 instances where a 9 is divisible by its immediate next term.

Therefore, the correct answer is option 4:6

Answer (6)

(CS-DEC 2023)

105. If $9X^2 + 16Y^2 + 24$ is a perfect square, X and Y being integers, then the smallest possible non-negative value of $X + Y$ is

(1) 0 (2) 1

(3) 2 (4) 3

Explanation:

Now, let's try to express this as a difference of squares: $a^2 - b^2 = (a + b)(a - b)$.

$9X^2 + 16Y^2 + 9 \times 24 = (3X)^2 + (4Y)^2 + (3 \times 2\sqrt{6})^2$

This expression resembles the difference of squares if we let $a = 3X, b = 4Y$, and $c = 3 \times 2\sqrt{6}$.

So, $9X^2 + 16Y^2 + 24$ can be expressed as:

$$(3X + 4Y + 3 \times 2\sqrt{6})(3X - 4Y + 3 \times 2\sqrt{6})$$

For this expression to be a perfect square, both factors must be equal. However, the square root term $3 \times 2\sqrt{6}$ doesn't easily allow for integer solutions.

So, let's minimize X and Y to simplify the expression:

If we take $X = 0$ and $Y = 0$, then $3X + 4Y = 0$, and the expression simplifies to $3 \times 2\sqrt{6}$

Therefore, the smallest possible non-negative value of $X + Y$ is 0 .

Hence, the correct answer is option 1: 0.

Answer (1)

(CS-DEC 2023)

106. Which among the following integers can never be written as the sum of squares of three integers?

(1) 6 (2) 7

(3) 8 (4) 9

Explanation:

The integer that can never be written as the sum of squares of three integers is any integer of the form $4^n(8m + 7)$, where n and m are non-negative integers.

Let's analyse the given options:

$6 = 2^2 + 1^2 + 1^2$

$7 =$ Can't be expressed

$8 = 2^2 + 2^2 + 0^2$

$9 = 3^2 + 0^2 + 0^2$

So, (2) 7 is the answer.

Answer (2)

(LS JULY 2024 I)

107. Consider the first few consecutive natural numbers. The ratio of the sum of their squares to their sum can NEVER be

(1) 67 (2) 75

(3) 91 (4) 100

Explanation:

We need to determine which ratio of the sum of squares to the sum of the first n natural numbers is never possible.

Step 1: Formulating the Ratio

For the first n natural numbers:

- Sum of squares: $S_2 = 1^2 + 2^2 + 3^2 + \ldots + n^2 = \frac{n(n+1)(2n+1)}{6}$
- Sum of numbers: $S_1 = 1 + 2 + 3 + \ldots + n = \frac{n(n+1)}{2}$
- Ratio: $R = \frac{S_2}{S_1} = \frac{\frac{n(n+1)(2n+1)}{6}}{\frac{n(n+1)}{2}} = \frac{(2n+1)}{3}$

Step 2: Checking the Given Options

From our formula: $R = \frac{(2n+1)}{3}$

This means R must be of the form $\frac{(2n+1)}{3}$, where $2n + 1$ is an odd number and divisible by 3.

Let's check:

- 67: $3 \times 67 = 201$ (odd, divisible by 3) (Possible)
- 75: $3 \times 75 = 225$ (odd, divisible by 3) (Possible)
- 91: $3 \times 91 = 273$ (odd, divisible by 3) (Possible)
- 100: $3 \times 100 = 300$ (not odd, not valid) (Impossible)

Correct answer: Option 4 (100).

Answer (4)

(LS JULY 2024 I)

108. For any four consecutive decimal digits, the largest value of the product of the sum of any two and the sum of the other two is

(1) an even number and a perfect square

(2) an even number, but not a perfect square

(3) an odd number and a perfect square

(4) an odd number, but not a perfect square

Explanation:

For any four consecutive decimal digits, the largest value of the product of the sum of any two and the sum of the other two is:

Let's consider four consecutive decimal digits: 1, 2, 3, and 4.

The possible sums of any two digits are:

- 1 + 2 = 3
- 1 + 3 = 4
- 1 + 4 = 5
- 2 + 3 = 5
- 2 + 4 = 6
- 3 + 4 = 7

Now, we need to find the product of the sum of any two and the sum of the other two.

Let's consider all possible combinations:

- $(1 + 2) \times (3 + 4) = 3 \times 7 = 21$
- $(1 + 3) \times (2 + 4) = 4 \times 6 = 24$
- $(1 + 4) \times (2 + 3) = 5 \times 5 = 25$

Among these, the largest value is 25, which is an odd number and a perfect square.

Therefore, the correct answer is an odd number and a perfect square.

Answer (3)

(LS JULY 2024 II)

109. The difference between a three-digit number (with non-repeating digits) and the same number in the reverse order is always divisible by?

(1) 33 (2) 22

(3) 13 (4) 31

Explanation: Let the three-digit number be $100a + 10b + c$, where a, b, c are the digits of the number.

The reverse of this number would be $100c + 10b + a$.
The difference between the number and its reverse is:
$$(100a + 10b + c) - (100c + 10b + a) = 99a - 99c.$$
$$99(a - c).$$
The difference is always $99(a - c)$, and 99 can be factored as:
$$99 = 3 \times 33.$$
This means the difference is always divisible by 33.
Final Answer: Option 1: 33.
Answer (1)

(PS JULY 2024)

110. If 32XY6 is divisible by 9, X and Y being even decimal digits, then X =
(1) 2 (2) 4
(3) 6 (4) 8
Explanation:
Note - A number is divisible by **9** if the **sum of its digits** is a multiple of **9** (i.e., 9, 18, 27, etc.).
Solution
The sum of the digits of **32XY6** is:
$$3 + 2 + X + Y + 6 = 11 + X + Y$$
Since the number is divisible by **9**, 11 + X + Y must be a multiple of **9**.
The smallest multiple of **9** greater than 11 is 18, and the next one is **27**.
Finding X and Y (Even Digits):
We need to check valid even-digit pairs for **X** and **Y**.
- If **X = 8** and **Y = 8**, then:$11 + 8 + 8 = 27$Since **27** is a multiple of **9**, this is a valid pair.

Thus, the correct value of **X** is **8**.
Final Answer: The correct option is **(4) 8**.
Answer (4)

(CS July-2024)

111. If A, B and C are decimal digits and ABC + BCA + CAB + 6(A + B + C) is a perfect square, then A + B + C =
(1) 13 (2) 17
(3) 19 (4) 23
Explanation:
We are given the equation:
$ABC + BCA + CAB + 6(A + B + C) =$ perfect square
where A, B, and C are decimal digits (i.e., 0 to 9).
Step 1: Expressing the Numbers
- AB, BCA, and CAB are three-digit numbers represented as:

$$ABC = 100A + 10B + C$$
$$BCA = 100B + 10C + A$$
$$CAB = 100C + 10A + B$$

Summing them:
$$ABC + BCA + CAB$$
$$= (100A + 10B + C) + (100B + 10C + A) + (100C + 10A + B)$$
$$= (100A + A + 10A) + (100B + B + 10B) + (100C + C + 10C)$$
$$= 111A + 111B + 111C$$
$$= 111(A + B + C)$$
Now, adding the remaining term:
$$111(A + B + C) + 6(A + B + C)$$
$$= (111 + 6)(A + B + C)$$
$= 117S$ (where $S = A + B + C$)
Step 2: Checking for Perfect Squares
For $117S$ to be a perfect square, S must be chosen such that **117S is a perfect square**.
Prime Factorization of 117 : $117 = 3^2 \times 13$
- For $117S$ to be a perfect square, **S must contain factors that make the product a square number**.
- **Since 117 contains 3^2 and 13, S must include a factor of 13 to balance it.**
- The smallest possible sum of digits that is **a multiple of 13** is:

$$S = 13$$

Step 3: Verifying the Answer
If $S = 13$, then: $117 \times 13 = 1521 = 39^2$
Since 1521 is a perfect square, the correct value of $A + B + C$ is: option (1): 13
Answer (1)

(EARTH SCIENCE JULY 2024)

112. The addition of a three-digit number and the number with the same digits in reverse order, is 1089. The middle digit of that number must be
(1) 9 (2) 8
(3) 0 (4) 4
Explanation:
Let's define the three-digit number as XYZ, where:
- X is the hundreds digit, Y is the tens digit, Z is the units digit.

The number can be expressed as: $100X + 10Y + Z$
Its reverse is: $100Z + 10Y + X$
According to the problem, their sum is 1089:
$$(100X + 10Y + Z) + (100Z + 10Y + X) = 1089$$
$$100X + 10Y + Z + 100Z + 10Y + X = 1089$$
$$101X + 20Y + 101Z = 1089$$
$$101(X + Z) + 20Y = 1089$$
Since 101(X + Z) must be close to 1089, let's check values:
- 1089 ÷ 101 = 10.79, so X + Z = 10 seems reasonable.
- This gives: $101(10) + 20Y = 10891010 + 20Y = 108920Y = 79$

Since 79 is not divisible by 20, let's try X + Z = 9 instead:
$$101(9) + 20Y = 1089$$
$$909 + 20Y = 1089$$
$$20Y = 180$$
$$Y = 9$$
Step 3: Verify the solution
If Y = 9 and X + Z = 9, possible numbers are:
- 192 (reverse: 291) → 192 + 291 = 483 (incorrect)
- 283 (reverse: 382) → 283 + 382 = 665 (incorrect)
- 495 (reverse: 594) → 495 + 594 = 1089 (correct!)

Thus, the middle digit is 9.
Final Answer: 1. 9
Answer (1)

(EARTH SCIENCE JULY 2024)

113. Which of the following can be a perfect square if X and Y are decimal digits?

(1) 93XY215 (2) 7XY0625
(3) 613XY45 (4) XY21375

Explanation:

Its last digit must be one of 0, 1, 4, 5, 6, or 9.

- If it ends in 5, it must end in 25.
- If it ends in 6, it must have an even digit before it.
- If it ends in 00, it must be divisible by 400.

Option (a) 93XY215

- Ends in 215, which does not follow the rule for a perfect square.
- Not a perfect square.

Option (b) 7XY0625

- Ends in 0625, which is a common ending for a perfect square, like $25^2 = 625$, $75^2 = 5625$, etc.
- 0625 is a valid ending for a perfect square.

$25^2 = 625$

Option (c) 613XY45

- Ends in 45, which is not a valid ending for a perfect square.
- Not a perfect square.

Option (d) XY21375

- Ends in 375, which is not a valid ending for a perfect square.
- Not a perfect square.

Since 7XY0625 follows this pattern, it can be a perfect square.

Final Answer:

Answer (2)

(LS MARCH 2025 I)

114. $\sqrt{0.99 \times 0.99 \times 0.99}$ is closest to
(1) 0.99×0.33 (2) 0.33×0.33×0.33
(3) 0.99×0.99×0.99 (4) 0.33

Explanation:

Note that $0.99 \times 0.99 \times 0.99 \approx 1$. So, its square root should also be close to 1.

Among the options, (3) $0.99 \times 0.99 \times 0.99$ is closest to 1.

Answer (3)

(LS MARCH 2025 I)

115. The sum of the digits of a four-digit number 'abcd' is subtracted from the number. Then the result of this will be always divisible by
(1) 9 (2) 11
(3) 13 (4) 14

Explanation:

We are given a four-digit number represented as "abcd", where:

$$N = 1000a + 100b + 10c + d$$

We subtract the sum of its digits from the number:

$$N - (a + b + c + d)$$

Rewriting:

$$(1000a + 100b + 10c + d) - (a + b + c + d)$$
$$= 1000a + 100b + 10c + d - a - b - c - d$$
$$= (1000a - a) + (100b - b) + (10c - c) + (d - d)$$
$$= 999a + 99b + 9c$$
$$= 9(111a + 11b + c)$$

The result is always a multiple of 9 since we factored out 9.

The correct answer is: option 1: 9.

Answer (1)

(LS MARCH 2025 I)

116. The geometric mean of squares of two positive integers is 10. The smallest possible sum of these two integers is
(1) 7 (2) 8
(3) 11 (4) 10

Explanation:

We are given that the geometric mean of the squares of two positive integers is 10. We need to find the smallest possible sum of these two integers.

The geometric mean of two numbers a^2 and b^2 is given by: $\sqrt{a^2 \cdot b^2} = 10$

$\therefore a \cdot b = 10$

where a and b are positive integers.

We need to find integer pairs (a, b) such that: $a \cdot b = 10$ and minimize: $a + b$

The factor pairs of 10 are: $(1,10), (2,5)$

Now, calculate their sums:

- $1 + 10 = 11$
- $2 + 5 = 7$

The smallest sum is 7.

Final Answer: Option 1: 7

Answer (1)

(LS MARCH 2025 II)

117. $(2025)^{2025} - (2025)^{2024}$ is NOT divisible by
(1) 8 (2) 13
(3) 23 (4) 33

Explanation:

We are given the expression: $(2025)^{2025} - (2025)^{2024}$

Factor out the common term:

$(2025)^{2024} \times (2025 - 1)$

$(2025)^{2024} \times 2024$

We factorize 2024 to check its divisibility:

$$2024 = 2^3 \times 11 \times 23$$

Since the expression is already divisible by $2^3 = 8$, 11, and 23, it is NOT divisible by any factor that is not present in 2024.

The given options are 8, 13, 23, 33.

- 8 is a factor (divisible).
- 13 is not a factor (not divisible).
- 23 is a factor (divisible).
- 33 (3×11) contains 11, which is a factor.

The expression is NOT divisible by 13.

Answer: 13 (Option 2)

Answer (2)

(LS MARCH 2025 II)

118. Any 9 papers printed on both sides are drawn from a book. The sum of their page numbers CAN NEVER be _____.
(1) 199 (2) 219
(3) 235 (4) 256

Explanation:

In a book where pages are printed on both sides, each sheet of paper contains two consecutive pages (one on the front, one on the back).

These pages are always an odd number on one side and the next even number on the other.

Example: A sheet might have pages $(1,2)$, $(3,4)$, $(5,6)$, ... and so on.

For any sheet with two consecutive pages n and $n+1$, the sum is:

$$n + (n+1) = 2n + 1$$

This means that the sum of the page numbers on any single sheet is always an odd number.

Since each sheet contributes an odd sum, and we have 9 such sheets, the total sum is:

Sum $=$ (odd) + (odd) + (odd)+...(9 times)

The sum of an odd number of odd numbers is always odd.

As we have established that the sum must be odd, the only impossible option is 256, because it is even.

The sum of the page numbers can never be 256.

Correct answer: Option 4 (256).

Answer (4)

(LS MARCH 2025 II)

119. Three positive integers a, b, c, have a sum of 15. Then the minimum value of $(a-2)^2 + (b-2)^2 + (c-2)^2$ would be.

(1) 25 (2) 27

(3) 29 (4) 31

Explanation:

We need to minimize the expression:

$$(a-2)^2 + (b-2)^2 + (c-2)^2$$

given that $a+b+c = 15$ and a, b, c are positive integers.

Define new variables: $x = a-2, y = b-2, z = c-2$

Since $a, b, c \geq 1$, we have:

$$x + 2 + y + 2 + z + 2 = 15$$

$$x + y + z = 9$$

We need to minimize:

$$x^2 + y^2 + z^2$$

The sum $x + y + z = 9$ should be distributed as evenly as possible to minimize the sum of squares.

A nearly equal distribution is: $x = 3, y = 3, z = 3$

Compute the Minimum Value

$3^2 + 3^2 + 3^2 = 9 + 9 + 9 = 27$

The minimum value is 27, which matches option (2).

Answer (2)

[PS MARCH 2025]

120. The square of the geometric mean of two positive integers is 30. The smallest possible sum of the two integers is

(1) 10 (2) 11

(3) 13 (4) 17

Explanation:

We are given that the square of the geometric mean of two positive integers is 30. We need to find the smallest possible sum of these two integers.

The geometric mean (GM) of two numbers a and b is given by:

$$GM = \sqrt{a \times b}$$

According to the problem:

$$(GM)^2 = 30$$

$$a \times b = 30$$

We need integer values of a and b such that their product is 30:

$$(a, b) = (1,30), (2,15), (3,10), (5,6)$$

Find the smallest sum

- $1 + 30 = 31$
- $2 + 15 = 17$
- $3 + 10 = 13$
- $5 + 6 = 11$ (smallest)

Thus, the smallest possible sum is 11.

Final Answer: (2) 11

Answer (2)

[PS MARCH 2025]

121. The value of $\left(1-\frac{1}{2025}\right)\left(1-\frac{1}{2024}\right)\left(1-\frac{2}{2023}\right)....\left(1-\frac{1}{2001}\right)$ is

(1) $\left(1-\frac{1}{79}\right)$ (2) $\left(1-\frac{1}{80}\right)$

(3) $\left(1-\frac{1}{81}\right)$ (4) $\left(1-\frac{1}{82}\right)$

Explanation:

We need to evaluate the following expression:

$$\left(1-\frac{1}{2025}\right) \times \left(1-\frac{1}{2024}\right) \times \left(1-\frac{1}{2023}\right) \times \cdots \times \left(1-\frac{1}{2001}\right)$$

Each term can be rewritten as:

$$1 - \frac{1}{n} = \frac{n-1}{n}$$

So, the given expression becomes:

$$\frac{2024}{2025} \times \frac{2023}{2024} \times \frac{2022}{2023} \times \cdots \times \frac{2000}{2001}$$

Notice that every numerator cancels with the denominator of the next fraction:

After cancellation, we are left with: $\frac{2000}{2025}$

$$\frac{2000}{2025} = \frac{80}{81} = 1 - \frac{1}{81}$$

Final Answer: (3) $\left(1-\frac{1}{81}\right)$

Answer (3)

(LS/ES JULY 2025)

122. $\sqrt[3]{0.99}$ is closest to

(1) 0.33 (2) 0.14

(3) 0.99 (4) 0.45

Explanation:

$$\sqrt[3]{0.99}$$

Since $0.99 \approx 1$

$$\sqrt[3]{1} = 1$$

Closest value = 0.99

Answer (3)

(LS/ES JULY 2025)

123. A pilgrim starts walking for a journey of 115 km. On the first day he covers 7 km, the next day 9 km, and likewise

keeps adding 2 km everyday till he reaches 15 km per day which he maintains for the rest of the journey. How many days in all will he take to complete the journey?

(1) 7 (2) 8

(3) 9 (4) 10

Explanation:

Daily distances form AP until 15 km:

7, 9, 11, 13, 15

Distance in first 5 days:

$$S = \frac{n}{2}(a + l)$$

$= \frac{5}{2}(7 + 15)$

$= \frac{5}{2} \times 22 = 55$ km

Remaining distance:

$$115 - 55 = 60 \text{ km}$$

Distance per day afterwards = 15 km

$$\frac{60}{15} = 4 \text{ days}$$

Total days:

$$5 + 4 = 9$$

Answer (3)

(LS/ES JULY 2025)

124. What is the remainder when $2023^{2024} + 2025^{2024}$ is divided by 2024?

(1) 0 (2) 2

(3) 223 (4) 2023

Explanation:

$$2023 \equiv -1 \pmod{2024}$$
$$2023^{2024} = (-1)^{2024} = 1$$
$$2025 \equiv 1 \pmod{2024}$$
$$2025^{2024} = 1^{2024} = 1$$

$\therefore 2023^{2024} + 2025^{2024} \equiv 1 + 1 = 2 \pmod{2024}$

Answer (2)

(LS/ES JULY 2025)

125. The sixth largest three-digit odd number among those with all digits distinct is |

(1) 989 (2) 987

(3) 973 (4) 971

Explanation:

Largest distinct-three-digit odd numbers:

$$987, 985, 983, 981, 975, 973$$

6th largest = 973.

Answer (3)

(LS/ES JULY 2025)

126. Which of the following is true?

(1) $\pi^{\pi^{\pi}} < e^{e^{e}} < 3^{3^{3}}$ (2) $\pi^{\pi^{\pi}} < 3^{3^{3}} < e^{e^{e}}$

(3) $3^{3^{3}} < e^{e^{e}} < \pi^{\pi^{\pi}}$ (4) $e^{e^{e}} < 3^{3^{3}} < \pi^{\pi^{\pi}}$

Explanation:

We have $e \approx 2.7, \pi \approx 3.14$

$\therefore e < 3 < \pi$

Note that for $0 < x < y$, we have $x^x < y^y$.

Using this result, we have,

$\therefore e^e < 3^3 < \pi^\pi$

$\therefore e^{e^e} < 3^{3^3} < \pi^{\pi^\pi}$

Answer (4)

(PS/CS/MS JULY 2025)

127. What will be the digit at the unit's place of $1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 + 7^3 + 8^3 + 9^3$?

(1) 0 (2) 5

(3) 7 (4) 9

Explanation:

We only need the unit digit (last digit), so focus on the unit digits of cubes from 1 to 9.

$1^3 \rightarrow 1$

$2^3 \rightarrow 8$

$3^3 \rightarrow 27 \rightarrow 7$

$4^3 \rightarrow 64 \rightarrow 4$

$5^3 \rightarrow 125 \rightarrow 5$

$6^3 \rightarrow 216 \rightarrow 6$

$7^3 \rightarrow 343 \rightarrow 3$

$8^3 \rightarrow 512 \rightarrow 2$

$9^3 \rightarrow 729 \rightarrow 9$

Now add only the unit digits:

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

= 45

Unit digit of 45 is 5.

Therefore, unit digit of given sum is 5.

Answer (2)

(LS/ES DEC 2025)

128. An auditorium has 8 seats in the first row, with every row to follow having 4 more seats than its preceding row. The total capacity is 416. What is the minimum number of rows needed to seat 150 people?

(1) 8 (2) 5

(3) 3 (4) 2

Explanation:

Total capacity $= 416$

First find total rows:

$$S_n = \frac{n}{2}(2 \times 8 + (n-1) \times 4)$$

$\therefore 416 = \frac{n}{2}(4n + 12)$

$\therefore 104 = \frac{n}{2}(n + 3)$

$\therefore 208 = n^2 + 3n$

$\therefore n^2 + 3n - 208 = 0$

$\therefore (n + 16)(n - 13) = 0$

$\therefore n = 13$

Last row $= 8 + 12 \times 4 = 56$

Row $12 = 52$,

Row $11 = 48$

Row $11 + 12 + 13 = 48 + 52 + 56 = 156 > 150$

That gives 3 rows.

Answer (3)

(PS/CS/MS DEC 2025)

129. The value of $1 + \left(\frac{1}{2^1} + \frac{1}{3}\right) + \left(\frac{1}{2^2} + \frac{1}{5} + \frac{1}{6} + \frac{1}{7}\right) + \cdots + \left(\frac{1}{2^9} + \cdots + \frac{1}{1023}\right)$ lies between

(1) 2 and 10 (2) 11 and 20

(3) 21 and 30 (4) 31 and 40

Explanation: (1)

The expression is

$$1+\left(\frac{1}{2^1}+\frac{1}{3}\right)+\left(\frac{1}{2^2}+\frac{1}{5}+\frac{1}{6}+\frac{1}{7}\right)+\cdots+\left(\frac{1}{2^9}+\cdots+\frac{1}{1023}\right)$$

Notice the pattern:

- The powers of 2 are
$$\frac{1}{2^1}+\frac{1}{2^2}+\cdots+\frac{1}{2^9}$$
- The remaining terms form
$$\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\cdots+\frac{1}{1023}$$

So, the whole expression becomes

$$1+\left(\frac{1}{2}+\frac{1}{4}+\cdots+\frac{1}{2^9}\right)+\left(\frac{1}{3}+\frac{1}{4}+\cdots+\frac{1}{1023}\right)$$

Step 1: Geometric series

$$\frac{1}{2}+\frac{1}{4}+\cdots+\frac{1}{2^9}=\sum_{k=1}^{9}\frac{1}{2^k}$$

This is a geometric series:

$$=\frac{\frac{1}{2}\left(1-\left(\frac{1}{2}\right)^9\right)}{1-\frac{1}{2}}=1-\frac{1}{2^9}=1-\frac{1}{512}\approx 0.998$$

Thus,

$$1+\left(1-\frac{1}{512}\right)=2-\frac{1}{512}\approx 2$$

Step 2: Harmonic part

$$\frac{1}{3}+\frac{1}{4}+\cdots+\frac{1}{1023}=H_{1023}-1-\frac{1}{2}$$

Using approximation:

$$H_n\approx \ln n+\gamma$$

where $\gamma\approx 0.577$.

So,

$$H_{1023}\approx \ln(1023)+0.577$$
$$\ln(1023)\approx 6.93$$

Hence,

$$H_{1023}\approx 6.93+0.577\approx 7.5$$

Now subtract:

$$7.5-1.5=6$$

Step 3: Final value

$$\approx 2+6=8$$

Therefore, the value lies between

2 and 10

Correct answer: 1. 2 and 10

Practice Problems

1. If $-7 \le x \le 7$ and $0 \le y \le 12$, the greatest possible value of y - x is
(1) -19 (2) -17
(3) 17 (4) 19

2. If a + b + c + d + e = 10 (all positive numbers), then the maximum value of $a \times b \times c \times d \times e$ is
(1) 12 (2) 48
(3) 32 (4) 72

3. Evaluate the value of x for which the following equation is satisfied.
$6^{3.2} \times 36^{1.6} \times 7^{6.4} \times 42^{2.6} = 42^x$
(1) 8.6 (2) 9
(3) 10.2 (4) 12

4. The difference of the squares of two consecutive odd integers is divisible by which of the following integers?
(1) 3 (2) 6
(3) 7 (4) 8

5. 64 x 5^5 x 4^3 x 256 =?
(1) 2^{12} x 10^5 (2) 2^{21}
(3) 2^{15} x 10^5 (4) 2^{20}

6. You are given 120 adjectives using which you have to form sentences containing at least one adjective, without repeating the adjectives, following the condition that the number of adjectives (from this set) should not be equal in any two sentences. Now, the maximum number of sentences you can form is:
(1) 10 (2) 13
(3) 15 (4) 100

7. What is the last digit of 131^{21}?
(1) 1 (2) 3
(3) 7 (4) 9

8. While solving a quadratic equation of the form $x^2 + px + q = 0$, one student took the wrong value of p and got the root as 2 and 6; while another student took the wrong value of q and got the roots as 2 and -9. What are the correct values of p and q, respectively?
(1) 7 and 12 (2) -3 and -4
(3) -8 and 16 (4) 8 and 16

9. The sum of three prime numbers is 100. If one of them exceeds another by 36, then one of the numbers is
(1) 7 (2) 29
(3) 41 (4) 67

10. Four metal rods of lengths 78 cm, 104 cm, 117 cm and 169 cm are to be cut into parts of equal length. Each part must be as long as possible. What is the maximum number of pieces that can be cut?
(1) 27 (2) 36
(3) 43 (4) 480

11. Three times the first of three consecutive odd integers are 3 more than twice the third. The third integer is:
(1) 9 (2) 11
(3) 13 (4) 15

12. The product of two numbers is 120 and the sum of their squares is 289. The sum of the number is:
(1) 20 (2) 23
(3) 27 (4) 169

13. A girl wrote all the numbers from 100 to 200. Then she started counting the number of one's that has been used while writing all these numbers. What is the number that she got?
(1) 111 (2) 119
(3) 120 (4) 121

14. The LCM of two numbers is 280 and their ratio is 7:8. The two numbers are
(1) 70, 80 (2) 35, 40
(3) 42, 48 (4) 28, 32

15. If n is a positive integer, which one of the following numbers must have a remainder of 3 when divided by any of the numbers 4, 5 and 6?
(1) 12n+3 (2) 24n+3
(3) 90n+2 (4) 120n+3

16. Find the remainder when 2^{31} is divided by 5.
(1) 4 (2) 5
(3) 3 (4) 7

17. A number when divided by a divisor leaves a remainder of 24. When twice the original number is divided by the same divisor, the remainder is 11. What is the value of the divisor?
(1) 13 (2) 59
(3) 35 (4) 37

18. *f (a, b, c) = a + b+ c*, *g (a, b, c) = a x b x c,* where *a, b* and *c* are different integers. Then how many such integer triplets a, b, c is there for which *f (a, b, c) = g (a, b, c)*?
(1) 0 (2) only 1
(3) 2 (4) More than 2

19. The sum of n terms of the series 4+44+444+… is
(1) (4/81) [10^{n+1} -9n-1] (2) (4/81) [10^{n-1} -9n-1]
(3) (4/81) [10^{n+1} -9n-10] (4) (4/81) [10^{n} -9n-10]

20. A number is as much greater than 75 as it is smaller than 117. The number is:
(1) 91 (2) 93
(3) 89 (4) 96

21. The number of 3-digit numbers such that the digit 1 is never to the immediate right of 2 is
(1) 781 (2) 791
(3) 881 (4) 891

22. In a sequence of 12 consecutive odd numbers, the sum of the first 5 numbers is 425. What is the sum of the last 5 numbers in the sequence?
(1) 505 (2) 495
(3) 490 (4) 500

23. How many multiples of 3 are there between the integers 18 and 108, both inclusive?
(1) 29 (2) 30
(3) 31 (4) 32

ANSWER KEY									
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
4	3	2	4	3	3	2	2	4	2
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
4	2	3	2	4	3	4	4	3	4
21	**22**	**23**							
3	2	3							

1.14 Solution to Practice Problems

1. Solution:
y-x gives greatest value when the value of y is maximum and value of x is minimum. From -7 to 7 minimum value of x is -7 and from 0 to 12 maximum value of y is 12.
Therefore, y-x=12-(-7) =12+7
Greatest value is 19.
Answer: (4)

2. Solution:
In three dimensions, if we have a maximum for width + length + height and we are trying to make the cuboid box with large volume, the best choice is a cube with all sides are equal.
The same work for 5 positive numbers with a given sum:
The greatest product is obtained when all numbers are equal:
So, with a=b=c=d=e; a+b+c+d+e=10;
5a=10;
a=2;
then, $a \times b \times c \times d \times e = 2^5 = 32$
Answer: (3)

3. Solution:
$6^{3.2} \times (6^2)^{1.6} \times 7^{6.4} \times (6 \times 7)^{2.6} = 42^x$
$6^{3.2+2.6+3.2} \times 7^{6.4+2.6} = 42^x$
$6^9 \times 7^9 = 42^x$
$42^9 = 42^x$
x=9
Answer: (2)

4. Solution:
Let the two consecutive odd integers be (2x + 1) and (2x + 3)
Then,
$(2x + 3)^2 - (2x + 1)^2$
= (2x + 3 + 2x + 1) (2x + 3 - 2x - 1)
= (4x + 4) (2)
= 8 (x + 1), which is always divisible by 8
Answer:(4)

5. Solution:
Factors of $64 = 2^6$
Factors of $256=2^8$
Factors of $4^3=64=2^6$
Multiplication of 2 and 5 make 10, we have five five's
And 20 two's. If we multiply five two's with five five's they make 10^5. And rest 15 two's make 2^{15}.
Therefore, answer is: $2^{15} \times 10^5$
Answer: (3)

6. Solution:
Given:Maximize n: 1 + 2 + 3 + … + n ≤ 120.
Now, we know that the Sum of first n natural numbers = $\frac{(n(n+1))}{2}$
By trial and error, putting the 4 options, find the maximum value of n for which, $\frac{(n(n+1))}{2} \leq 120$.
Putting n = 15, we get $\frac{(15 \times 16)}{2} \leq 120$
120 ≤ 120
Thus, n = 15 is the maximum value of n which satisfies the inequality.
Answer: (3)

7. **Solution:**
The last digit of 131^{21} is 3
Answer: (2)