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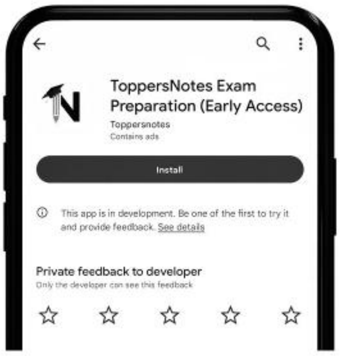

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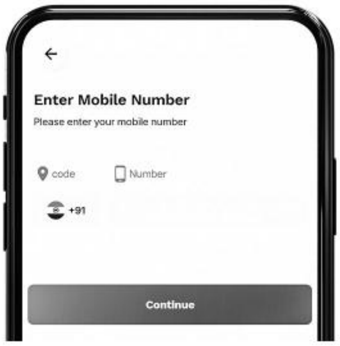

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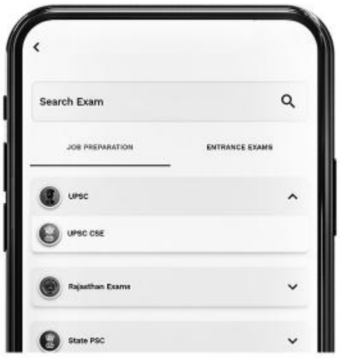

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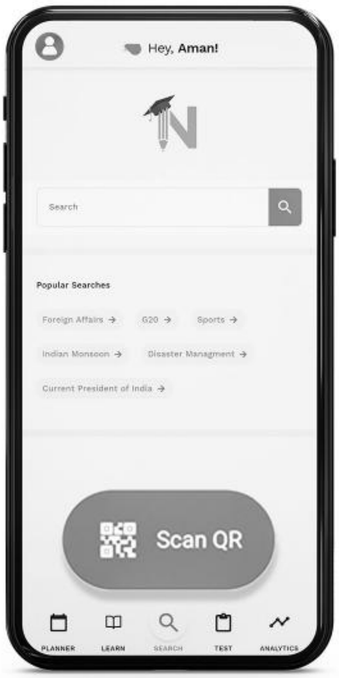

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Simplification

- In simplification, we represent the given data in a simple form, such as the data is done in fraction, in decimal, in division, in power and by solving or changing the mathematical operation.
- If different types of operations are given on some number, then how can we solve it so that the answer to the question is correct, for that there is a rule which we call the rule of VBODMAS.
- Which operation we should do first, it decides the rule of VBODMAS.

V → Vinculum
B → Bracket[{()}]
O → OF
D → Divide (/)
M → Multiplication (×)
A → (+) Addition
S → Subtraction (–)

- The first of all these mathematical operations is V which means Vinculum (line bracket). If there is a line bracket in the question, then first we will solve it and then (BODMAS) Rule will work in it.
- B (Bracket) in the second place means brackets which can be –
  1. Small bracket ( )
  2. Middle/curly bracket { }
  3. Big bracket/ [ ]
- First the small brackets, then the curly bracket, and then the big brackets are solved.
- In the third place is "O" which is formed from "of" or "order", which means "multiply" or "of".
- In the fourth place is "D" which means "Division", in the given expression do the first division in different actions if given.
- There is “M” in the fifth place which means “Multiplication”, in the given expression after “Division” we will do “Multiplication”.
- Sixth position is held by “A” which is related to “Addition”. Addition action takes place after division and multiplication.
- There is "S" in the seventh place which is made of "Subtraction".

Q. Simplify –

$$\left[3\frac{1}{4}\div\left\{1\frac{1}{4}-\frac{1}{2}\left(2\frac{1}{2}-\overline{\frac{1}{4}-\frac{1}{6}}\right)\right\}\right]\div\left(\frac{1}{2}\text{of}\,4\frac{1}{3}\right)$$

Sol: Step 1 – Convert the mixed fraction into simple fraction

$$\left[\frac{13}{4}\div\left\{\frac{5}{4}-\frac{1}{2}\left(\frac{5}{2}-\overline{\frac{1}{4}-\frac{1}{6}}\right)\right\}\right]\div\left(\frac{1}{2}\text{of}\,\frac{13}{3}\right)$$

Now, according to VBODMAS –

Step 2 – $\left[\frac{13}{4} \div \left\{\frac{5}{4} - \frac{1}{2}\left(\frac{5}{2} - \frac{3-2}{12}\right)\right\}\right] \div \left(\frac{1}{2} \text{of} \frac{13}{3}\right)$

Step 3 – $\left[\frac{13}{4} \div \left\{\frac{5}{4} - \frac{1}{2}\left(\frac{5}{2} - \frac{1}{12}\right)\right\}\right] \div \frac{13}{6}$

Step 4 – $\left[\frac{13}{4} \div \left\{\frac{5}{4} - \frac{1}{2} \times \left(\frac{30-1}{12}\right)\right\}\right] \div \frac{13}{6}$

Step 5 – $\left[\frac{13}{4} \div \left\{\frac{5}{4} - \frac{1}{2} \times \frac{29}{12}\right\}\right] \div \frac{13}{6}$

Step 6 – $\left[\frac{13}{4} \div \left\{\frac{30-29}{24}\right\}\right] \div \frac{13}{6}$

Step 7 – $\left[\frac{13}{4} \div \frac{1}{24}\right] \div \frac{13}{6}$

Step 8 – $\left[\frac{13}{4} \times 24\right] \div \frac{13}{6}$

Step 9 – $13 \times 6 \times \frac{6}{13}$

= 36 Ans.

Algebraic Formulas –

1. $(a + b)^2 = a^2 + 2ab + b^2$
2. $(a - b)^2 = a^2 - 2ab + b^2$
3. $(a + b)^2 + (a - b)^2 = 2(a^2 + b^2)$
4. $(a^2 - b^2) = (a + b)(a - b)$
5. $a^2 + b^2 + c^2 = (a + b + c)^2 - 2(ab + bc + ca)$
6. $a^2 + \frac{1}{a^2} = \left(a + \frac{1}{a}\right)^2 - 2$
7. $a^2 + b^2 + c^2 - ab - bc - ca = \frac{1}{2}\left[(a-b)^2 + (b+c)^2 + (c-a)^2\right]$
8. $a^3 + b^3 = (a + b)^3 - 3ab(a + b) = (a + b)(a^2 - ab + b^2)$
9. $a^3 - b^3 = (a - b)^3 + 3ab(a - b) = (a - b)(a^2 + ab + b^2)$
10. $a^3 + b^3 + c^3 - 3abc = (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ca)$

    $= \frac{1}{2}(a+b+c)\left\{(a-b)^2 + (b-c)^2 + (c-a)^2\right\}$

    If $a + b + c = 0$, then

    $a^3 + b^3 + c^3 = 3abc$

11. $a^3 + \frac{1}{a^3} = \left(a + \frac{1}{a}\right)^3 - 3\left(a + \frac{1}{a}\right)$

12. $a^3 - \frac{1}{a^3} = \left(a - \frac{1}{a}\right)^3 + 3\left(a - \frac{1}{a}\right)$

Square and Square Root Table

Square	Square Root	Square	Square Root
$1^2 = 1$	$\sqrt{1} = 1$	$16^2 = 256$	$\sqrt{256} = 16$
$2^2 = 4$	$\sqrt{4} = 2$	$17^2 = 289$	$\sqrt{289} = 17$
$3^2 = 9$	$\sqrt{9} = 3$	$18^2 = 324$	$\sqrt{324} = 18$
$4^2 = 16$	$\sqrt{16} = 4$	$19^2 = 361$	$\sqrt{361} = 19$
$5^2 = 25$	$\sqrt{25} = 5$	$20^2 = 400$	$\sqrt{400} = 20$
$6^2 = 36$	$\sqrt{36} = 6$	$21^2 = 441$	$\sqrt{441} = 21$
$7^2 = 49$	$\sqrt{49} = 7$	$22^2 = 484$	$\sqrt{484} = 22$
$8^2 = 64$	$\sqrt{64} = 8$	$23^2 = 529$	$\sqrt{529} = 23$
$9^2 = 81$	$\sqrt{81} = 9$	$24^2 = 576$	$\sqrt{576} = 24$
$10^2 = 100$	$\sqrt{100} = 10$	$25^2 = 625$	$\sqrt{625} = 25$
$11^2 = 121$	$\sqrt{121} = 11$	$26^2 = 676$	$\sqrt{676} = 26$
$12^2 = 144$	$\sqrt{144} = 12$	$27^2 = 729$	$\sqrt{729} = 27$
$13^2 = 169$	$\sqrt{169} = 13$	$28^2 = 784$	$\sqrt{784} = 28$
$14^2 = 196$	$\sqrt{196} = 14$	$29^2 = 841$	$\sqrt{841} = 29$
$15^2 = 225$	$\sqrt{225} = 15$	$30^2 = 900$	$\sqrt{900} = 30$

Cube and Cube Root Table

Cube	Cube Root	Cube	Cube Root
$1^3 = 1$	$\sqrt[3]{1} = 1$	$16^3 = 4096$	$\sqrt[3]{4096} = 16$
$2^3 = 8$	$\sqrt[3]{8} = 2$	$17^3 = 4913$	$\sqrt[3]{4913} = 17$
$3^3 = 27$	$\sqrt[3]{27} = 3$	$18^3 = 5832$	$\sqrt[3]{5832} = 18$
$4^3 = 64$	$\sqrt[3]{64} = 4$	$19^3 = 6859$	$\sqrt[3]{6859} = 19$
$5^3 = 125$	$\sqrt[3]{125} = 5$	$20^3 = 8000$	$\sqrt[3]{8000} = 20$
$6^3 = 216$	$\sqrt[3]{216} = 6$	$21^3 = 9261$	$\sqrt[3]{9261} = 21$
$7^3 = 343$	$\sqrt[3]{343} = 7$	$22^3 = 10648$	$\sqrt[3]{10648} = 22$
$8^3 = 512$	$\sqrt[3]{512} = 8$	$23^3 = 12167$	$\sqrt[3]{12167} = 23$
$9^3 = 729$	$\sqrt[3]{729} = 9$	$24^3 = 13824$	$\sqrt[3]{13824} = 24$

$10^3 = 1000$	$\sqrt[3]{1000} = 10$	$25^3 = 15625$	$\sqrt[3]{15625} = 25$
$11^3 = 1331$	$\sqrt[3]{1331} = 11$	$26^3 = 17576$	$\sqrt[3]{17576} = 26$
$12^3 = 1728$	$\sqrt[3]{1728} = 12$	$27^3 = 19683$	$\sqrt[3]{19683} = 27$
$13^3 = 2197$	$\sqrt[3]{2197} = 13$	$28^3 = 21952$	$\sqrt[3]{21952} = 28$
$14^3 = 2744$	$\sqrt[3]{2744} = 14$	$29^3 = 24389$	$\sqrt[3]{24389} = 29$
$15^3 = 3375$	$\sqrt[3]{3375} = 15$	$30^3 = 27000$	$\sqrt[3]{27000} = 30$

Arithmetic Progression

The series in which each term can be found by adding or subtracting with its preceding term is called the arithmetic progression.

E.g. 2, 5, 8, 11, …….

n^{th} term of an Arithmetic Progression

$T_n = a + (n - 1)\,d$

Where, a = First term

d = Common difference (2^{nd} term – 1^{st} term)

n = Number of all terms.

Addition of n^{th} terms of an Arithmetic Progression –

$$S_n = \frac{n}{2}\left[2a + (n-1)d\right]$$

If the first and last term is known –

$$S_n = \frac{n}{2}\left[a + \ell\right]$$

Where, $\ell =$ Last term

Arithmetic progression between the two variables

$A = \frac{a+b}{2}$ [The arithmetic progression of a & b is A]

Geometric Progression

If the ratio of each term of the series to its preceding term is a certain variable, then it is called a geometric series. This fixed variable is called the common ratio.

n^{th} term of Geometric Series –

$T_n = a.r^{n-1}$

Where, a = First term r = Common ratio n = Number of terms

Addition of n^{th} terms of Geometric Series –

$$S_n = a\left(\frac{1-r^n}{1-r}\right); \text{ When } r < 1$$

$$S_n = a\left(\frac{r^n - 1}{r-1}\right); \text{ when } r > 1$$

1. Geometric series between two variables $G=\sqrt{ab}$
2. If the arithmetic mean and geometric mean between two positive quantities a and b are A and G, then A > G, $\frac{a+b}{2}>\sqrt{ab}$

Harmonic Progression

If the reciprocals of the terms of a series are written in the same order and it is in arithmetic progression, then this is known as harmonic series.

n^{th} term of a Harmonic Progression –

$$T_n=\frac{1}{a+(n-1)d}$$

Harmonic series (H) = $\frac{2ab}{a+b}$

Relation between Arithmetic Mean, Geometric Mean and Harmonic Mean

Let A, G and H be the arithmetic mean, geometric mean and harmonic mean between two quantities a and b respectively, then

$\boxed{G^2=AH}$ and $\boxed{A>G>H}$

Examples

Ex.1 The value of 24 × 2 ÷ 12 + 12 ÷ 6 of 2 ÷ (15 ÷ 8 × 4) of (28 ÷ 7 of 5) is –

(a) $4\frac{32}{75}$ (b) $4\frac{8}{75}$ (c) $4\frac{2}{3}$ (d) $4\frac{1}{6}$

Sol: (d)

24 × 2 ÷ 12 + 12 ÷ 6 of 2 ÷ (15 ÷ 8 × 4) of (28 ÷ 7 of 5)

= 24 × (2/12) + 12 ÷ 12 ÷ [(15/8) × 4] of (28 ÷ 35)

= 4 +1 ÷ (15/2) of 4/5

= 4 +1 ÷ 6

= 4 + 1/6

= $4\frac{1}{6}$ Ans.

Ex.2 Simplify –

$$\left[3\frac{1}{4}\div\left\{1\frac{1}{4}-\frac{1}{2}\left(2\frac{1}{2}-\frac{1}{4}-\frac{1}{6}\right)\right\}\right]\div\left(\frac{1}{2}\text{ of }4\frac{1}{3}\right)$$

Sol: According to question –

$$=\left[3\frac{1}{4}\div\left\{1\frac{1}{4}-\frac{1}{2}\left(2\frac{1}{2}-\frac{1}{4}-\frac{1}{6}\right)\right\}\right]\div\left(\frac{1}{2}\text{ of }4\frac{1}{3}\right)$$

$$=\left[\frac{13}{4}\div\left\{\frac{5}{4}-\frac{1}{2}\left(\frac{5}{2}-\frac{1}{4}-\frac{1}{6}\right)\right\}\right]\div\left(\frac{1}{2}\times\frac{13}{3}\right)$$

$$= \left[\frac{13}{4} \div \left\{\frac{5}{4} - \frac{1}{2}\left(\frac{30-3-2}{12}\right)\right\}\right] \div \frac{13}{6}$$

$$= \left[\frac{13}{4} \div \left\{\frac{5}{4} - \frac{1}{2} \times \frac{25}{12}\right\}\right] \div \frac{13}{6}$$

$$= \left[\frac{13}{4} \div \left\{\frac{5}{4} - \frac{25}{24}\right\}\right] \div \frac{13}{6}$$

$$= \left[\frac{13}{4} \div \left\{\frac{30-25}{24}\right\}\right] \div \frac{13}{6}$$

$$= \left[\frac{13}{4} \div \frac{5}{24}\right] \div \frac{13}{6}$$

$$= \frac{13}{4} \times \frac{24}{5} \times \frac{6}{13}$$

$$= \frac{36}{5} = 7\frac{1}{5}$$

Ex.3 Evaluate –

$$2\frac{3}{4} \div 1\frac{5}{6} \div \frac{7}{8} \times \left(\frac{1}{3} + \frac{1}{4}\right) + \frac{5}{7} \div \frac{3}{4} \text{ of } \frac{3}{7}$$

(a) $\frac{56}{77}$ (b) $\frac{49}{80}$ (c) $\frac{2}{3}$ (d) $3\frac{2}{9}$

Sol: According to question –

$$\left(\frac{2\frac{3}{4}}{1\frac{5}{6}}\right) \div \frac{7}{8} \times \left(\frac{1}{3} + \frac{1}{4}\right) + \frac{5}{7} + \frac{3}{4} \text{ of } \frac{3}{7}$$

$$= \frac{\frac{11}{4}}{\frac{11}{6}} \div \frac{7}{8} \times \frac{7}{12} + \frac{5}{7} \div \left(\frac{3}{4} \times \frac{3}{7}\right)$$

$$= \frac{3}{2} \times \frac{8}{7} \times \frac{7}{12} + \frac{5}{7} \times \frac{28}{9}$$

$$= 1 + \frac{20}{9}$$

$$= \frac{29}{9} = 3\frac{2}{9} \text{ Ans.}$$

Ex.4 If $(102)^2 = 10404$ then the value of $\sqrt{104.04} + \sqrt{1.0404} + \sqrt{0.010404}$ is equals to?

(a) 0.306 (b) 0.0306 (c) 11.122 (d) 11.322

Sol: (d)

According to question –

$$= \sqrt{104.04} + \sqrt{1.0404} + \sqrt{0.010404}$$

$= \sqrt{\frac{10404}{100}} + \sqrt{\frac{10404}{10000}} + \sqrt{\frac{10404}{1000000}}$

$= \frac{102}{10} + \frac{102}{100} + \frac{102}{1000}$

= 10.2 + 1.02 + 0.102 = 11.322

Ex.5 If a = 64 & b = 289 then find the value of $\left(\sqrt{\sqrt{a}+\sqrt{b}} - \sqrt{\sqrt{\sqrt{b}-\sqrt{a}}}\right)^{\frac{1}{2}}$

(a) $2^{1/2}$ (b) 2 (c) 4 (d) -2

Sol: (a)

a = 64, b = 289

$= \left(\sqrt{\sqrt{a}+\sqrt{b}} - \sqrt{\sqrt{b}-\sqrt{a}}\right)^{\frac{1}{2}}$

$= \left(\sqrt{\sqrt{64}+\sqrt{289}} - \sqrt{\sqrt{289}-\sqrt{64}}\right)^{\frac{1}{2}}$

$= \left(\sqrt{8+17} - \sqrt{17-8}\right)^{\frac{1}{2}}$

$= \left(\sqrt{25} - \sqrt{9}\right)^{\frac{1}{2}}$

$= (5-3)^{\frac{1}{2}}$ $= (2)^{\frac{1}{2}} = \boxed{\sqrt{2}}$

Ex.6 The cube root of 175616 is 56 then find the value of

$\sqrt[3]{175.616} + \sqrt[3]{0.175616} + \sqrt[3]{0.000175616}$?

(a) 0.168 (b) 62.16 (c) 6.216 (d) 6.116

Sol: (c)

According to question –

$= \sqrt[3]{175.616} + \sqrt[3]{0.175616} + \sqrt[3]{0.000175616}$

$\Rightarrow \sqrt[3]{\frac{175616}{1000}} + \sqrt[3]{\frac{175616}{1000000}} + \sqrt[3]{\frac{175616}{1000000000}}$

$\Rightarrow \frac{56}{10} + \frac{56}{100} + \frac{56}{1000}$

$\Rightarrow$ 5.6 + 0.56 + 0.056 = 6.216

Ex.7 What is the smallest number to be added to 710 so that the sum becomes a perfect cube?

(a) 29 (b) 19 (c) 11 (d) 21

Sol: (b)

Clearly, $\sqrt[3]{729} = 9$

$\therefore$ 19 must be added to 710 to get a perfect cube.

Ex.8 Find the value of the following –

$$4-\cfrac{5}{1+\cfrac{1}{3+\cfrac{1}{2+\cfrac{1}{4}}}} \text{ is}$$

(a) $\frac{1}{8}$ (b) $\frac{1}{64}$ (c) $\frac{1}{16}$ (d) $\frac{1}{32}$

Sol: (a)

Expression

$$4-\cfrac{5}{1+\cfrac{1}{3+\cfrac{1}{\cfrac{8+1}{4}}}}$$

$$= 4-\cfrac{5}{1+\cfrac{1}{3+\cfrac{4}{9}}}$$

$$= 4-\cfrac{5}{1+\cfrac{1}{\cfrac{27+4}{9}}}$$

$$= 4-\cfrac{5}{1+\cfrac{9}{31}}$$

$$= 4-\cfrac{5}{\cfrac{31+9}{31}}$$

$$= 4-\frac{5\times31}{40}=\frac{160-155}{40}$$

$$= \frac{5}{40}=\frac{1}{8}$$

Ex.9 If $2=x+\cfrac{1}{1+\cfrac{1}{3+\cfrac{1}{4}}}$ then find the value of x ?

(a) $\frac{18}{17}$ (b) $\frac{21}{17}$ (c) $\frac{13}{17}$ (d) $\frac{12}{17}$

Sol: (b)

According to question –

If $2=x+\cfrac{1}{1+\cfrac{1}{3+\cfrac{1}{4}}}$

$$\Rightarrow 2=x+\cfrac{1}{1+\cfrac{4}{12+1}}$$

$\Rightarrow 2 = x + \dfrac{1}{1+\dfrac{4}{13}}$ $\Rightarrow 2 = x + \dfrac{13}{17}$

$\Rightarrow x = 2 - \dfrac{13}{17}$ $\Rightarrow x = \dfrac{34-13}{17}$

$\Rightarrow x = \dfrac{21}{17}$

Ex.10 $999\dfrac{998}{999} \times 999$ equals to ?

(a) 998999 (b) 999899 (c) 989999 (d) 999989

Sol: (a)

$= 999\dfrac{998}{999} \times 999$

$= \left(999 + \dfrac{998}{999}\right) \times 999$

$= 999^2 + 998$

$= (1000-1)^2 + 998$

$= 1000000 - 2000 + 1 + 998$

$= 998999$

Ex.11 Find the value of $\dfrac{(0.03)^2 - (0.01)^2}{0.03 - 0.01}$?

(a) 0.02 (b) 0.004 (c) 0.4 (d) 0.04

Sol: (d)

According to question –

$\dfrac{(0.03)^2 - (0.01)^2}{0.03 - 0.01}$

$= \dfrac{(0.03+0.01)(0.03-0.01)}{(0.03-0.01)}$

[$\because a^2 - b^2 = (a + b)(a - b)$]

$= (0.03 + 0.01)$

$= 0.04$

Ex.12 $\left(\sqrt{2} + \dfrac{1}{\sqrt{2}}\right)^2$ equals to ?

(a) $2\dfrac{1}{2}$ (b) $3\dfrac{1}{2}$ (c) $4\dfrac{1}{2}$ (d) $5\dfrac{1}{2}$

Sol: (c)

According to question –

$$=\left(\sqrt{2}+\frac{1}{\sqrt{2}}\right)^2\left[\because (a+b)^2=a^2+b^2+2ab\right]$$

$$=\left(\sqrt{2}\right)^2+\left(\frac{1}{\sqrt{2}}\right)^2+2\times\sqrt{2}\times\frac{1}{\sqrt{2}}$$

$$=2+\frac{1}{2}+2=\frac{4+1+4}{2}$$

$$=\frac{9}{2}=4\frac{1}{2}$$

Ex.13 Find the value of $\frac{0.051\times0.051\times0.051+0.041\times0.041\times0.041}{0.051\times0.051-0.051\times0.041+0.041\times0.041}$?

(a) 0.92 (b) 0.092 (c) 0.0092 (d) 0.00092

Sol: (b)

According to question –

$$\frac{0.051\times0.051\times0.051+0.041\times0.041\times0.041}{0.051\times0.051-0.051\times0.041+0.041\times0.041}$$

We know that,

$a^3 + b^3 = (a + b)(a^2 + b^2 – ab)$

$$=\frac{(0.051)^3+(0.041)^3}{(0.051)^2+(0.041)^2-0.051\times0.041}$$

$$=\frac{[0.051+0.041]\left[(0.051)^2+(0.041)^2-0.051\times0.041\right]}{\left[(0.051)^2+(0.041)^2-0.051\times0.041\right]}$$

= 0.051 + 0.041 = 0.092 Ans.

Ex.14 Find the sum of all the multiples of 3 less than 50 ?

(a) 400 (b) 408 (c) 404 (d) 412

Sol: (b)

3 + 6 + 9 .... + 48

Here, a = 3, d = 3, n = $\frac{48}{3}$ = 16

$S_n = \frac{n}{2}$ [2a + (n-1) d]

$$=\frac{16}{2}\left[2\times3+(16-1)3\right]$$

= 8 [6+45]

= 8 × 51 = 408 Ans.

Ex.5 How many terms are there in the following arithmetic series?

7, 13, 19, ... , 205

Sol: a = 7, d = 13 - 7 = 6, T_n = 205

$T_n = a + (n - 1)d$

$\Rightarrow 205 = 7 + (n - 1) 6$

$\Rightarrow 205 - 7 = (n - 1) 6$

$\Rightarrow 198 = (n - 1)6$

$\Rightarrow n - 1 = 33$

$\Rightarrow n = 33 + 1$

$\Rightarrow n = 34$

There are 34 terms in this series.

Ex.16 If the sum of two numbers is 22, and the sum of their squares is 404, then find the product of those numbers?

(a) 40 (b) 44 (c) 80 (d) 89

Sol: (a)

According to question –

$x + y = 22$ .... (i)

$x^2 + y^2 = 404$ .... (ii)

$\Rightarrow (x + y)^2 = x^2 + y^2 + 2xy$

$\Rightarrow (22)^2 = 404 + 2xy$

$\Rightarrow 484 = 404 + 2xy$

$\Rightarrow 2xy = 80$

$\Rightarrow xy = 40$ Ans.

Ex.17 When a two digit number is multiplied by the sum of its digits, the product is 424. When the number obtained by interchanging its digits is multiplied by the sum of the digits, the result is 280. What is the sum of the digits of the number?

(a) 7 (b) 9 (c) 6 (d) 8

Sol: (d)

Let the unit digit number be x and the tenth digit number be y, then the number =10y + x

According to question –

$(10y + x) \times (x + y) = 424$ ----(1)

$(10x + y) \times (x + y) = 280$ ----(2)

On dividing the equation (1) & (2) –

$\Rightarrow (10y + x)/ (10x + y) = 424/280$

$\Rightarrow (10y + x)/ (10x + y) = 53/35$

$(10y + x)/ (10x + y) = (50 + 3)/ (30 + 5)$

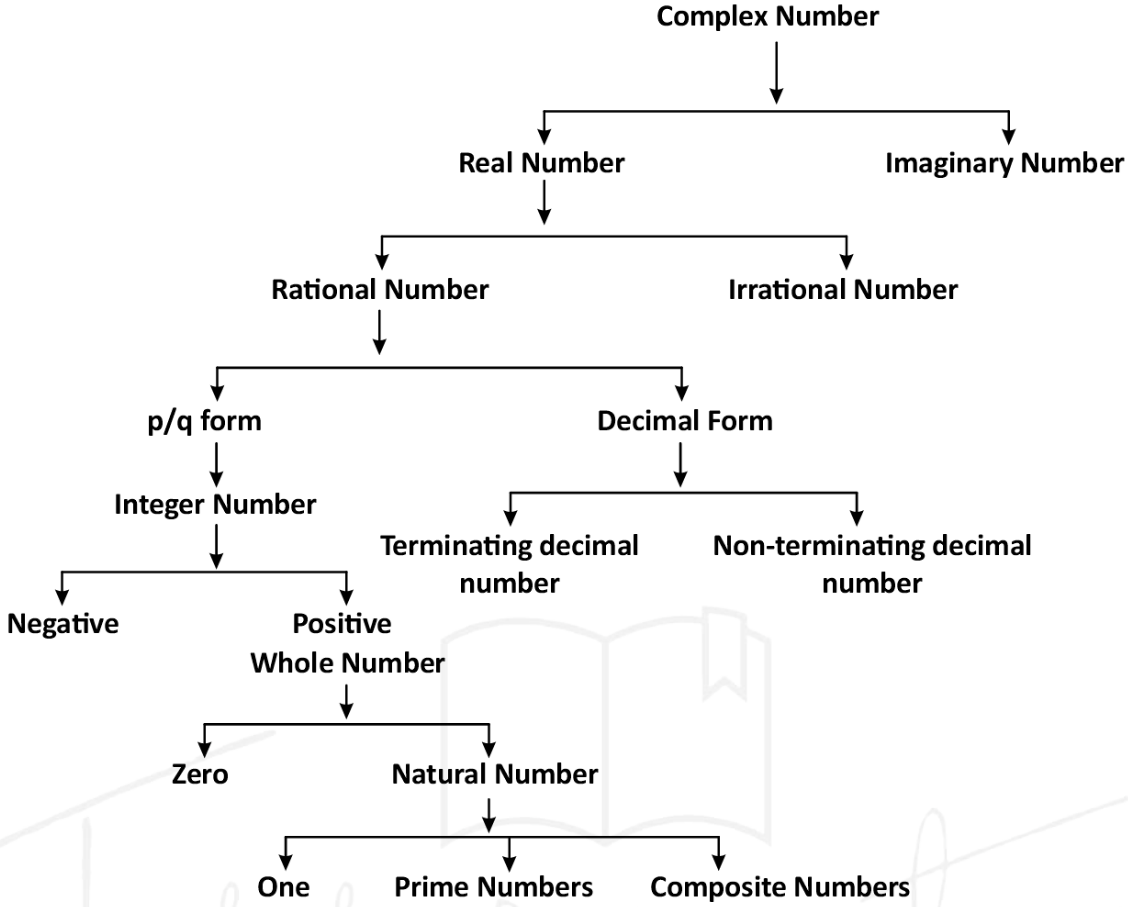
(After solving in detail we can find the value of x and y)

$\therefore$ x = 3 and y = 5

So, we can say that the digit of the number is 5 and 3**.**

Hence, sum of the digits = 5+ 3 = 8

Number System



Complex Number (Z)

Z = Real numbers + Imaginary numbers

Z = a + ib

Where, a = Real numbers.
b = Imaginary numbers.

Real Numbers

Rational and irrational numbers together are called real numbers. These can be represented on the number line.

Imaginary Numbers

Numbers that can not be represented on the number line.

Integer Numbers

A set of numbers which includes whole numbers as well as negative numbers, is called integer numbers, it is denoted by I.

I = {–4, –3, –2, –1, 0, 1, 2, 3, 4,…..}

Natural Numbers

The numbers which are used to count things are called natural numbers.

N = {1, 2, 3, 4, 5, ……}

Whole Numbers

When 0 is also included in the family of natural numbers, then they are called whole numbers.

W = {0, 1, 2, 3, 4, 5, …..}

The product of four consecutive natural numbers is always exactly divisible by 24.

Even Numbers

Numbers which are completely divisible by 2 are called even numbers.

n^{th} term = 2n

Sum of first n even natural numbers = n(n+1)

Sum of square of first n even natural numbers = $\frac{2n(n+1)(2n+1)}{3}$

$$\left\{ n = \frac{\text{Last term}}{2} \right\}$$

Odd Numbers

The numbers which are not divisible by 2 are odd numbers.

Sum of first n odd numbers = n^2

$$\left\{ n = \frac{\text{Last term} + 1}{2} \right\}$$

Natural Numbers

Sum of first n natural numbers $= \frac{n(n+1)}{2}$

Sum of square of first n natural numbers $= \frac{n(n+1)(2n+1)}{6}$

Sum of cube of first n natural numbers = $\left[\frac{n(n+1)}{2} \right]^2$

The difference of the squares of two consecutive natural numbers is equal to their sum.

Example - $11^2 = 121$

$12^2 = 144$

$11 + 12 \rightarrow 23$ Difference 144 – 121 = 23

Prime Numbers – Which have only two forms - 1 × numbers

E.g. - {2, 3, 5, 7, 11, 13, 17, 19……..}

Where, 1 isn't a Prime Number.

- The digit 2 is only even prime number.
- 3, 5, 7 is the only pair of consecutive odd prime numbers.
- Total prime numbers between 1 to 25 = 9
- Total prime numbers between 25 to 50 = 6
- There are total of 15 prime numbers between 1-50.
- There are total of 10 prime numbers between 51 – 100.
  So there are total 25 prime numbers from 1-100.
- Total prime numbers from 1 to 200 = 46
- Total prime numbers from 1 to 300 = 62
- Total prime numbers from 1 to 400 = 78
- Total prime numbers from 1 to 500 = 95

Co-prime Numbers

Numbers whose HCF is only 1.

E.g. - (4,9), (15, 22), (39, 40)

HCF = 1

Perfect Number

A number whose sum of its factors is equal to that number (except the number itself in the factors)

E.g. - 6 → 1, 2, 3 → Here 1 + 2 + 3 → 6

28 → 1, 2, 4, 7, 14 → 1 + 2 + 4 + 7 + 14 → 28

Rational Numbers

Numbers that can be written in the form of P/Q, but where Q must not be zero and P and Q must be integers.

E.g. - 2/3, 4/5, $\frac{10}{-11}, \frac{7}{8}$

Irrational Numbers

These cannot be displayed in P/Q form.

E.g. - $\sqrt{2}, \sqrt{3}, \sqrt{11}, \sqrt{19}, \sqrt{26}$...

Perfect square numbers

↓

Unit Digit which can be of square	Which can't be square
0	2 ——
1	3 ——
4	7 ——
5 or 25	8 ——
6	
9	

- The last two digits of the square of any number will be the same as the last two digits of the square of numbers 1-24.

Note: Therefore, everyone must remember the squares of 1-25.

Convert to Binary and Decimal –

1. Convert Decimal Number to Binary Number

To find the binary number equivalent to a decimal number, we continuously divide the given decimal number by 2 until we get 1 as the final quotient.

E.g.

2	89	2 × 44 = 88 ; 89 – 88 = 1
2	44	2 × 22 = 44; 44 – 44 = 0
2	22	2 × 11 = 22 ; 22 – 22 = 0
2	11	2 × 5 = 10 ; 11 – 10 = 1
2	5	2 × 2 = 4 ; 5 – 4 = 1
2	2	2 × 1 = 2 ; 2 – 2 = 0
	1	Final quotient

Hence, binary number equivalent to 89 = $(1011001)_2$

2. **Convert Binary to Decimal Nubmer**

In binary system the value of 1 when it moves one place to its left every time it doubles itself and wherever 0 comes its value is 0.

E.g.

1	0	1	1	0	0	1
2^6	2^5	2^4	2^3	2^2	2^1	2^0

Now

$(1011001)_2 = 1 \times 2^6 + 0 \times 2^5 + 1 \times 2^4 \times 1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

$= 64 + 0 + 16 + 8 + 8 + 0 + 1 \quad \{2^0 = 1\}$

$= 89$

Finding the Number of Divisors or Number of Factors

First we will do the prime factorization of the number and write it as Power and multiply by adding

One to each power, then the number of divisors will be obtained.

E.g. By how many total numbers can 2280 be completely divided?

Sol. $2280 = 2^3 \times 3^1 \times 5^1 \times 19^1$

Number of divisors $= (3 + 1)(1 + 1)(1 + 1)(1 + 1)$

$= 4 \times 2 \times 2 \times 2 = 32$